

JPL Hardware Requirements
Certification Review (HRCR)-
Flight Spare (FS)
Photometer Medium Wavelength (PMW)
Bolometer Detector Assembly (BDA)
10209800-2 S/N 019

SPIRE Element
Herschel Space Observatory Project

September 16, 2005

Change Log

Issue	Date	Section	Changes
1.0	16 Sept 05		Initial version (HRCR review)
1.1	20 Sept 05		PDF for RAL review
		9	Included signed ETAS for SN011 testing
		10	Updated performance data to v6
		14	Added Backshort / Frontshort data
		14	Added Feedhorn data
		14	Added 300mK filter EIDP

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M. Herman 15 May 2003 memo (fasteners for vibe. tests)	
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HR-SP-JPL-ECR-003 (300mK filter clamp fixing holes)	
HR-SP-JPL-ECR-005v2 (Kapton Cable routing design error)	
HR-SP-JPL-ECR-007 (Spectrometer BDA envelope height)	
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	
Electronic	
Environmental Requirements Verification Matrix	9
Performance Data Matrix	10
Qualification Status	11
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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-32977

Assembly/Subsystem		PEM		Phone		Section		Date		
SPIRE		Martin Herman		(818) 354-8541		385		16 September, 2005		
Drawing/ Part No.	Dwg. Rev.	Nomenclature		Serial No.	Model	Type	Final IR No.	Mass (grams) As Meas. / Req.		
10209800-2	B	Bolometer Detector Assembly		019	FS	PMW	926215	605 g / 632 g		
Check applicable answer and give necessary explanation in remarks column		Y	N	N / A	Remarks		Data Attachments (Package Sec. #)	Signature Approval & Date		
1. Are all drawings and specifications complete, approved, released and frozen?		X			See Issues (section 3). See section 10 for detector performance matrix.		14. Latest Top Assembly Drawings <input checked="" type="checkbox"/> Attached <input type="checkbox"/> None (Sec. 4)	Cog E		
2. Do the released drawings and specifications reflect all approved changes?		X					15. List of open ECRs <input checked="" type="checkbox"/> Attached <input type="checkbox"/> None (Sec. 5)		PEM	
3. Is hardware identical to other hardware delivered? If no, provide difference list.		X					16. Waivers <input checked="" type="checkbox"/> Attached <input type="checkbox"/> None (Sec. 6)		QA Engineer	
4. Does the hardware meet the requirement of its functional requirements, specifications, waivers and/or ICDs? If no, provide difference list.		X					17. Open MRBs <input type="checkbox"/> Attached <input checked="" type="checkbox"/> None (N/A)		Environments/Reliability	
5. Have all IR discrepancies and MRBs been dispositioned and agreed to by Engineering/ QA ?		X					18. Open P/FRs on this H/W <input type="checkbox"/> Attached <input checked="" type="checkbox"/> None (Sec. 7)		Mission Assurance Mgr.	
6. Is complete as-built list information included in the build book?		X					19. Open P/FRs on similar H/W <input type="checkbox"/> Attached <input checked="" type="checkbox"/> None (Sec. 7)		Project	
7. Have all required environmental tests & analyses been completed?		X					20. Handling Documents <input checked="" type="checkbox"/> Attached <input type="checkbox"/> None (Sec. 8)		PI	
8. Is all required assembly and/or subsystem level functional testing complete?		X					21. Shortage List <input type="checkbox"/> Attached <input checked="" type="checkbox"/> None (N/A)			
9. Have all piece parts, processes and materials been approved by JPL?		X					22. Requirements Verification Matrix <input checked="" type="checkbox"/> Attached <input type="checkbox"/> None (Sec. 9)			
10. Does this hardware meet all contamination control requirements?		X					23. Qualification Status <input checked="" type="checkbox"/> Attached <input type="checkbox"/> None (Sec. 11)			
11. Are all required shipping containers, shipping procedures, and special handling procedures ready?		X					24. Connector Mate / Demate Log <input checked="" type="checkbox"/> Attached <input type="checkbox"/> None (Sec. 12)			
12. Is additional work required to bring this hardware to flight readiness?			X				25. Operation Log <input checked="" type="checkbox"/> Attached <input type="checkbox"/> None (Sec. 12)			
13. Is this hardware acceptable for flight ?		X					26. ICDs <input checked="" type="checkbox"/> Attached <input type="checkbox"/> None (Sec. 13)			



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

IR Number
926215

Action
 BROWSE

Status
 "IRDis
 and/or
 IR
 Closed"
[IR Instructions](#)

REFERS TO:

Part Number	Dash Number	Revision	Latest Rev	Serial Number	Quantity
10209800-2	(with part number)	B	B	019	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:

	Initiated by VALENZUELA, LORRAINE V.	Signed by COGE	Signed by QAE	Closed by VALENZUELA, LORRAINE V.
Number of Files Attached 0	Date 16-MAY-2005	Date	Date	Date 16-MAY-2005

Reserved by	Reserved on	Reason
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Issues

FS PMW BDA 10209800-2 S/N 019

Environmental Test:

- **This BDA utilized a Kevlar suspension sub-assembly that had previously been used on PMW BDA SN011, which was discovered to be noisy. The bolometer detector sub-assembly is a new unit. The suspension was given a full level (protoflight) vibration test within the SN011 BDA assembly, and only a Flight Acceptance level vibration test was performed on the SN019 BDA. See section 9 for details. The BDA suspension has also experienced more thermal cycles and bakeouts than is typical see section 12 for details.**
- 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-005 (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).

Configuration:

Several ECRs related to the BDA hardware have been incorporated into released drawings.

- 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 to -2 (PMW) and -3 (PSW) BDAs. This drawing revision also incorporated JPL ECR 1026751.
- The maximum height of 300 mK stage for spectrometer BDAs exceeds the 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. *This do not apply directly to the PMW BDA type, but since it affects the same drawings it is 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 to -2 (PMW) and -3 (PSW) BDAs.

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

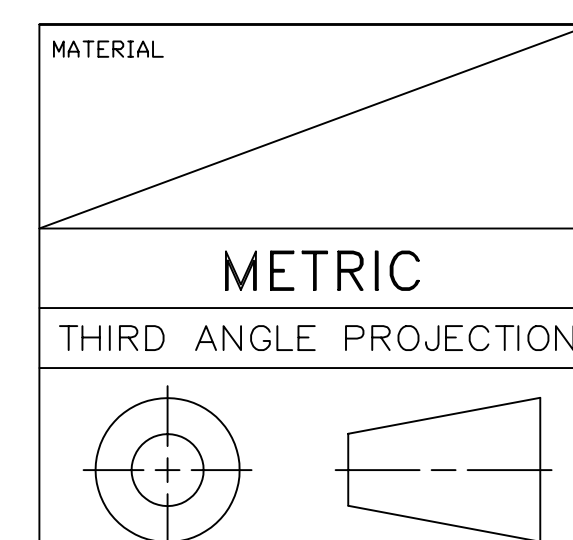
14. ALTERNATE OR EQUIVALENT ITEMS MAY BE USED FOR THIS ITEM WITH PRIOR ENGINEERING APPROVAL.
13. SEAL SHIPPING CONTAINER USING ITEMS 28, LID, 30, SCREWS, 31, O-RING, AND ITEM 32, PLUG. TORQUE ITEM 30, SCREWS TO 1.9 N*MM PLUS RUNNING TORQUE PER JPL SPEC ES517040. TORQUE ITEM 32, PLUG TO 7.3 N*MM PLUS 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*MM PER JPL SPEC ES517040. SECURE ITEM 33, ACCELEROMETER, TO ITEM 39, UNION NUT AND TORQUE TO 1.7-2.2 N*MM 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*MM 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*MM PER JPL SPEC ES517040. CONNECT ITEM 34, CABLE, TO ITEM 33, ACCELEROMETER.

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.).

NOTES: UNLESS OTHERWISE SPECIFIED

LTR	ZONE	DESCRIPTION	REV	ENGR	DATE
A		INITIAL RELEASE			
B		ADDED ITEM 51, ADDED VIEW SH4, MOVED VIEW FROM SH2 TO SH4			

QTY	REF	DES	CAGE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL OR NOTE	ZONE
1	1			10209903-1	RING, SPACER			
4	4			NA0070-016004	SCREW, MACHINE FLUSH HEAD	NA0070	A-286 CRES	
1	1			10209805-2	CAN, LIGHT			
6	6			NA0068A016012	SCREW, MACHINE PAN HEAD	NA0068	A-286 CRES	
AR	AR	AR	AR	AR	EPOXY INK, BLACK			
2	2	2	2	2	2	2	2	46
				ST12259-020	WASHER, COUNTERSUNK, LUBRICATED	ST12259	A-286 CRES	
1				10209807-1	SEAL, LIGHT			
1				10209847-1	SIMULATOR, THERMAL STRAP			
1				10209744-1	MASS SIMULATOR, ACCELEROMETER			
1				10217688-1	CAN, LIGHT, STM			
1				10217680-1	DUMMY BOLOMETER			
	1			40	OE328 92313A829	SET SCREW, 10-32 UNF X 1/2"	MCMMASTER CARR	
	1			39	OE328 90977A021	UNION NUT, 10-32 UNF	MCMMASTER CARR	
1	1			38	OE328 92313A824	SET SCREW, 10-32 UNF X 3/16"	MCMMASTER CARR	
				37		ACCELEROMETER, THREE AXIS		
	1			36		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	32
				32	SE027 2 P50N	PLUG, O-RING	PARKER FLUID CONNECTORS	
1	1	1	1	1	1	1	1	31
				31	OE328 9262K331	O-RING, 114.5mm ID X 3mm WIDTH	MCMMASTER CARR	
8	8	8	8	8	8	8	8	30
4	4	4	4	4	4	4	4	29
				29	MS5197-50	SCREW, #8-32 UNC X 1.25"	MS5197	
1	1	1	1	1	1	1	1	28
1	1	1	1	1	1	1	1	27
4	4	4	4	4	4	4	4	26
				26	OE328 9217K32	MOUNT, NATURAL RUBBER, SANDWICH, M4 X 0.7	MCMMASTER CARR	
AR	AR	AR	AR	AR	AR	AR	AR	25
4				24	EC 2216 A/B	EPOXY		
				24	NA0069-016010	SCREW, CAP, SOCKET HEAD, FULL THREAD, 1100 MPa	NA0069	A-286 CRES
				23	NA0068A016010	SCREW, MACHINE PAN HEAD	NA0068	A-286 CRES
6	2	4	4	2	2	2	2	22
				22	NA0069-020010	SCREW, CAP, SOCKET HEAD, FULL THREAD, 1100 MPa	NA0069	A-286 CRES
20	20			21	B0187-010-S	BELLEVILLE SPRING WASHER		
4	4	4	4	6	6	6	6	19
4	4			18	934-A2 M1.6 X 0.35	NUT	DIN 934	A-286 CRES
				18	NA0069-016004	SCREW, CAP, SOCKET HEAD, FULL THREAD, 1100 MPa	NA0069	A-286 CRES
				17	NA0069-040008	SCREW, CAP, SOCKET HEAD, FULL THREAD, 1100 MPa	NA0069	A-286 CRES
				16	S/SW FILTER	S/SW FILTER		
				15	S/LW FILTER	S/LW FILTER		
				14	P/SW FILTER	P/SW FILTER		
				13	P/MW FILTER	P/MW FILTER		
				12	P/LW FILTER	P/LW FILTER		
1				11	10209805-1	CAN, LIGHT		
				10	10209746-1	MOUNT, ACCELEROMETER		
				9	10209745-1	MASS SIMULATOR		
				8	10209850-1	DETECTOR ASSEMBLY, SPECTROMETER SHORT WAVE		
				7	10209840-1	DETECTOR ASSEMBLY, SPECTROMETER LONG WAVE		
				6	10209830-1	DETECTOR ASSEMBLY, PHOTOMETER SHORT WAVE		
				5	10209820-1	DETECTOR ASSEMBLY, PHOTOMETER MEDIUM WAVE		
1				4	10209810-2	DETECTOR ASSEMBLY, PHOTOMETER LONG WAVE SIMULATOR		
				3	10209810-1	DETECTOR ASSEMBLY, PHOTOMETER LONG WAVE		
				2	10209860-2	SUSPENSION ASSEMBLY		
1	1	1	1	1	1	1	1	1
				1	10209860-1	SUSPENSION ASSEMBLY		



PARTS LIST

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

ENGR: M. WEILERT 03/11/04

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

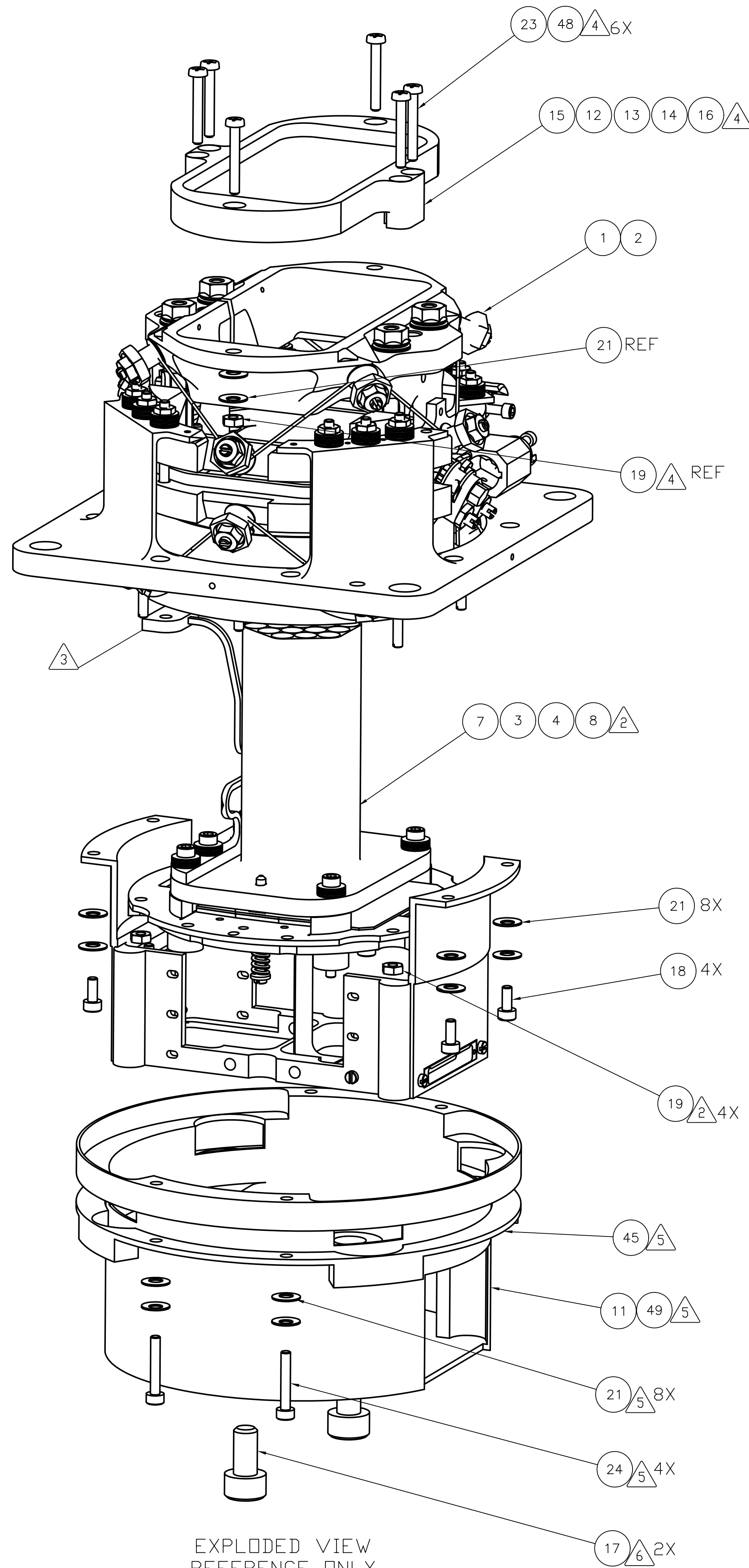
JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CA 91109
RELEASED THROUGH EDMG

BOLOMETER DETECTOR ASSEMBLY

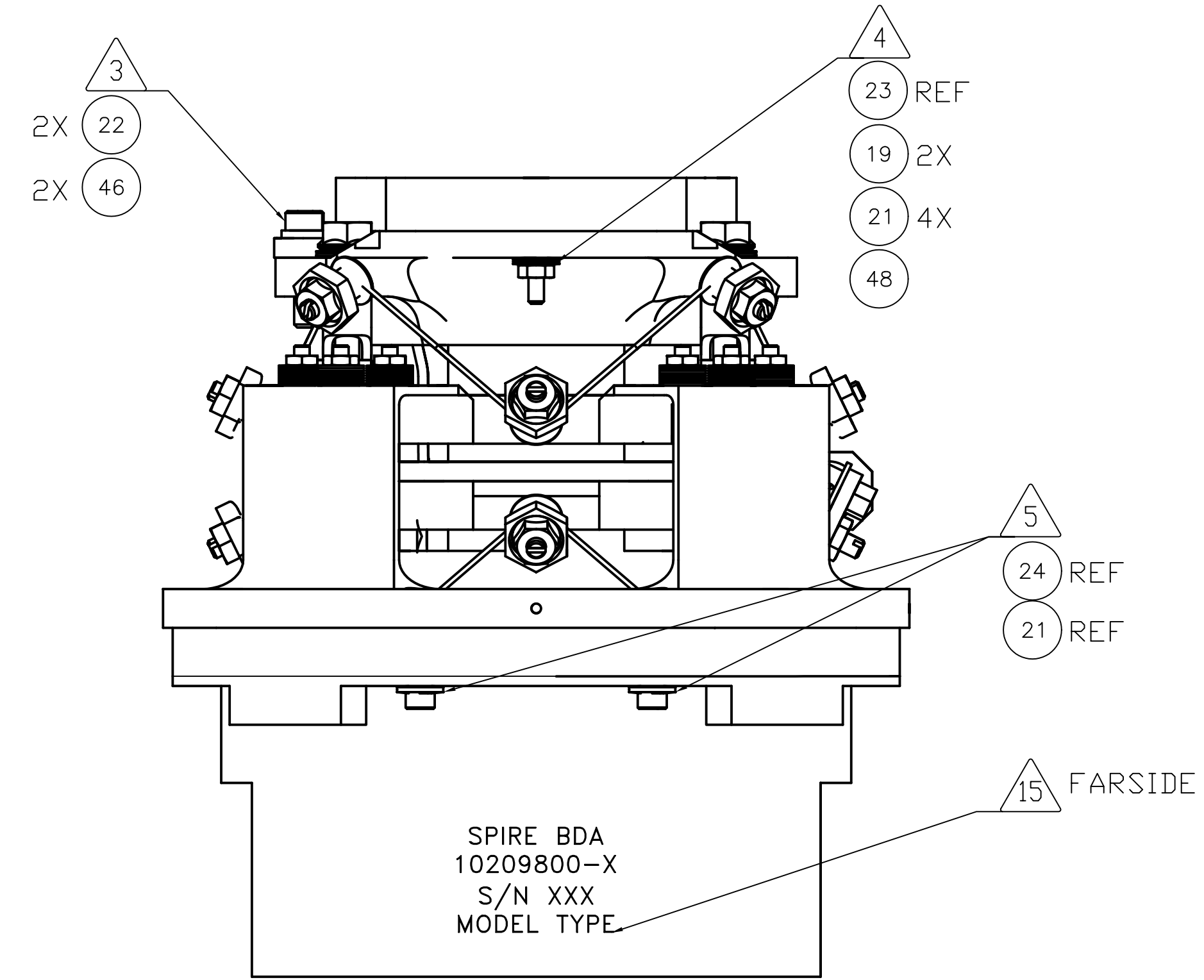
SIZE: A1 CAGE NO: 23835 10209800

SCALE: NONE UNCLASSIFIED SHEET 1 OF 4

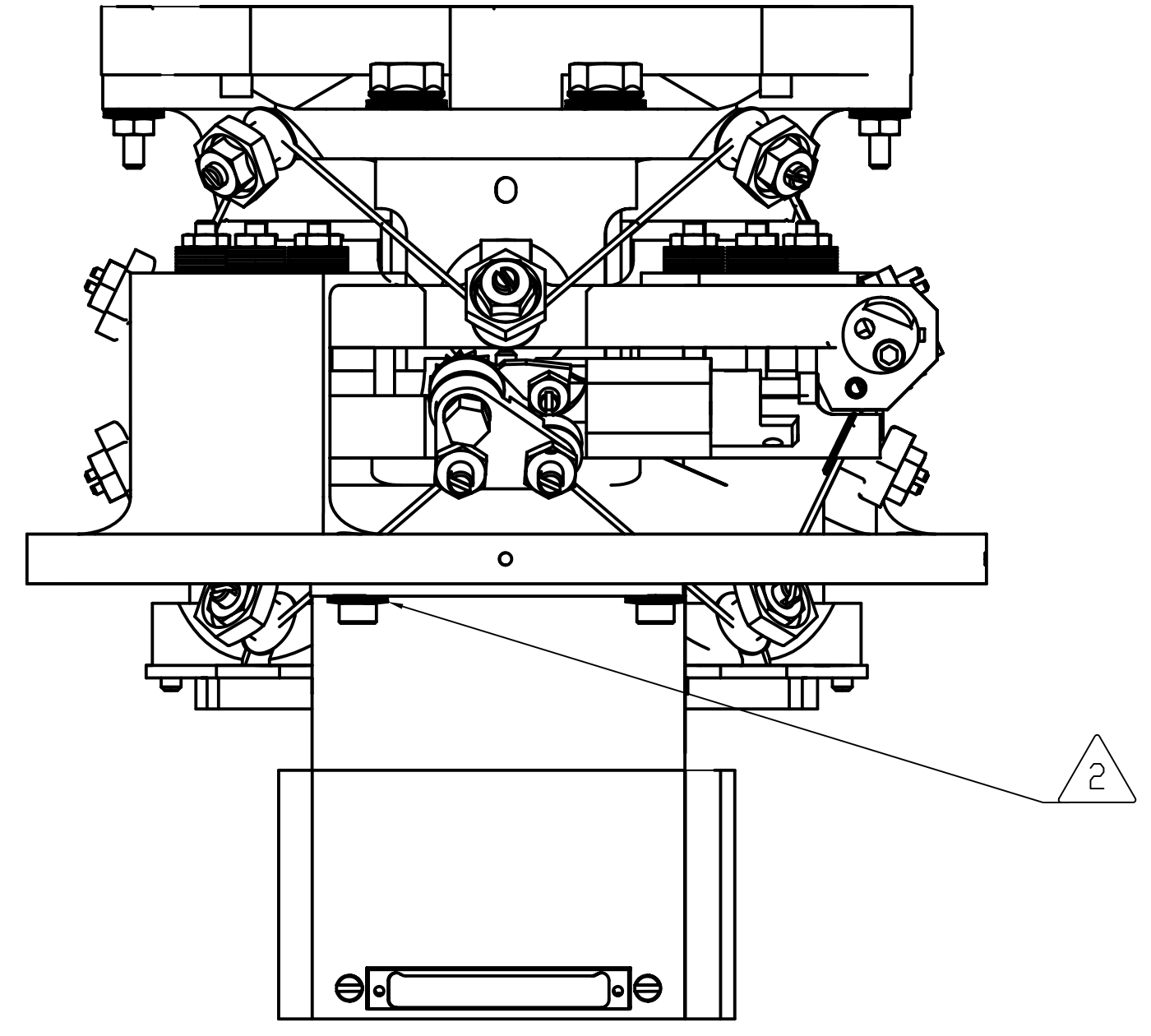
10209800
A1
B
A
B
C
D
E
F
G
H



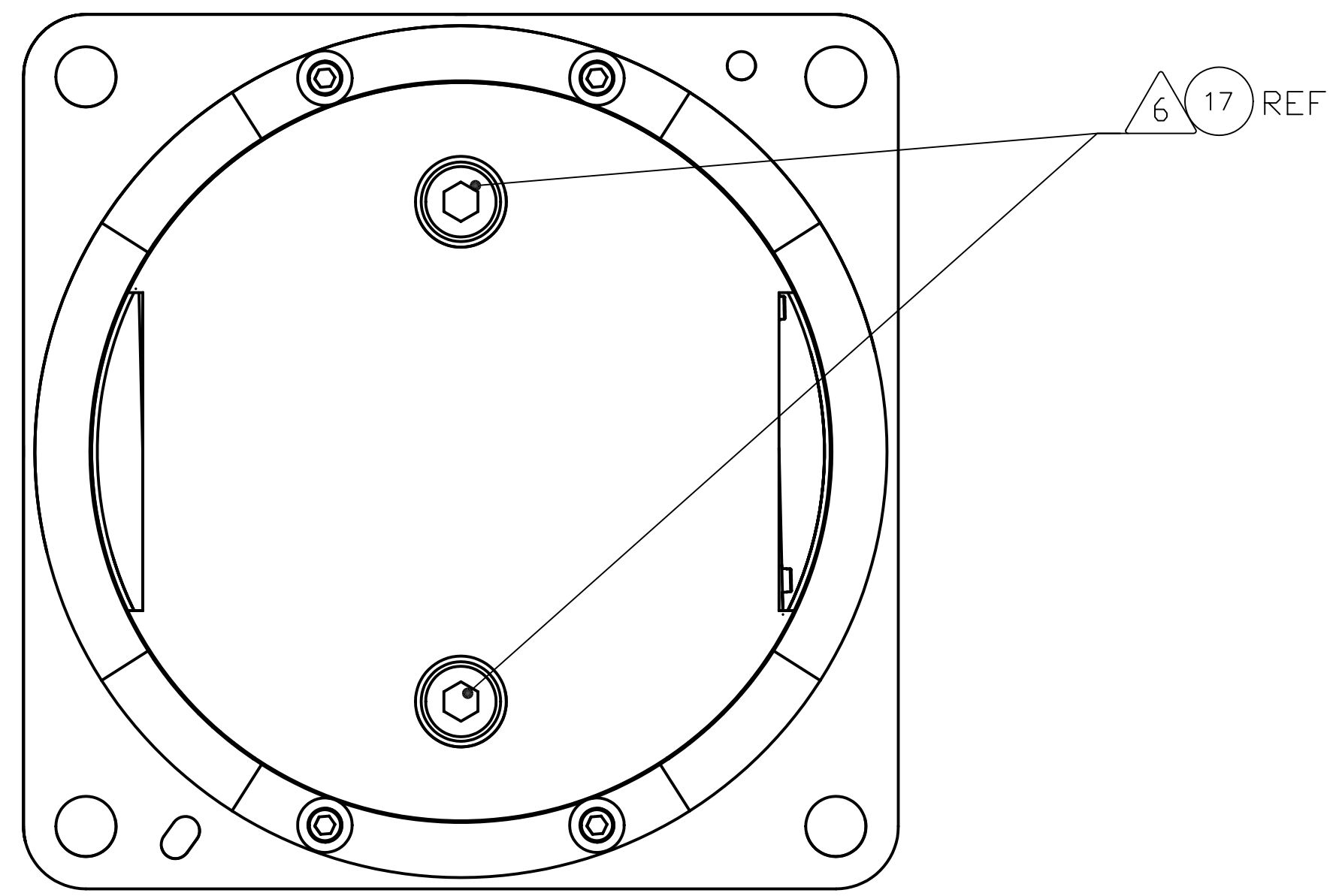
EXPLODED VIEW
 REFERENCE ONLY
 -4 CONFIGURATION SHOWN
 -1, -5 CONFIGURATIONS ARE SIMILAR
 -8 CONFIGURATION SIMILAR WITHOUT FILTER



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

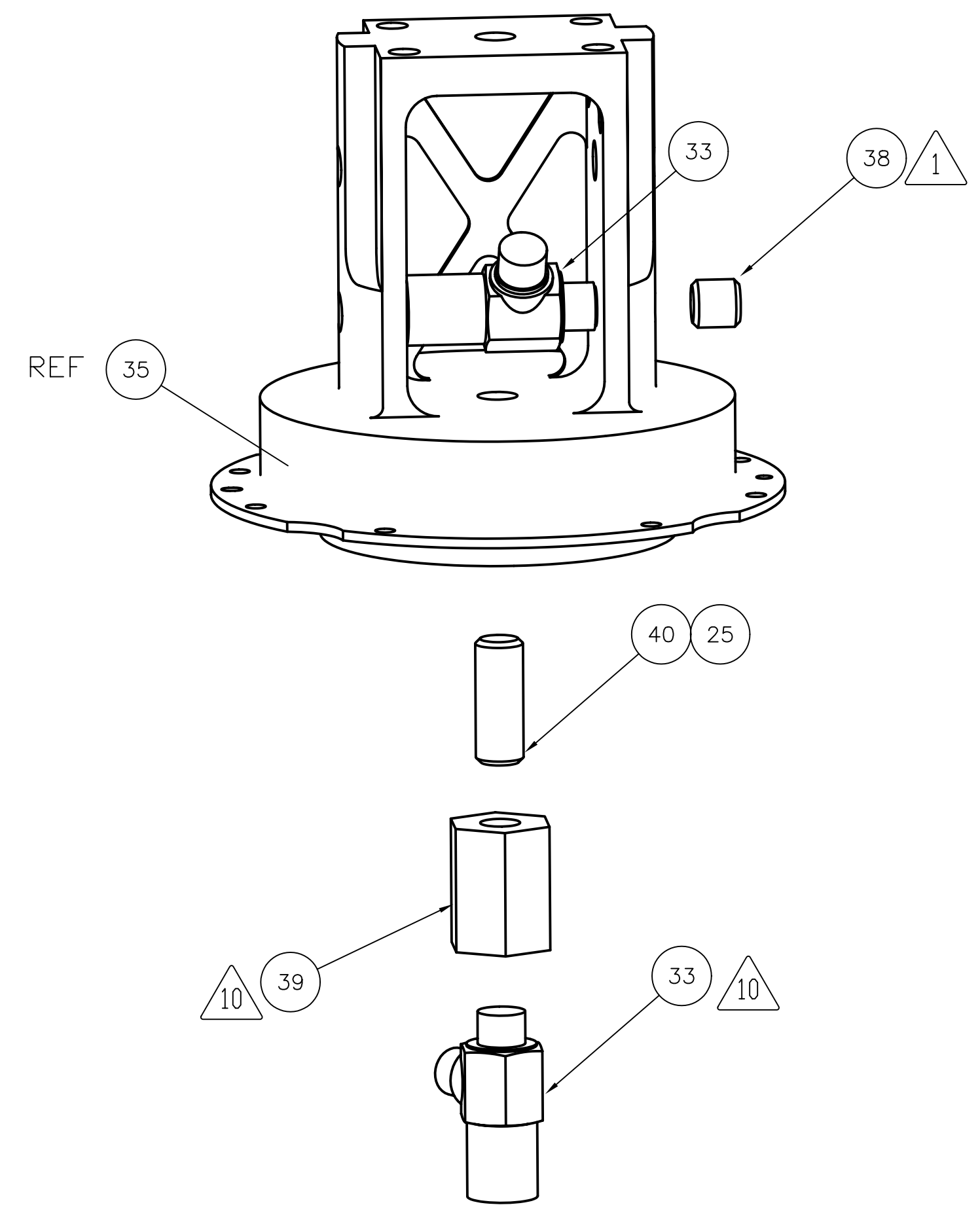
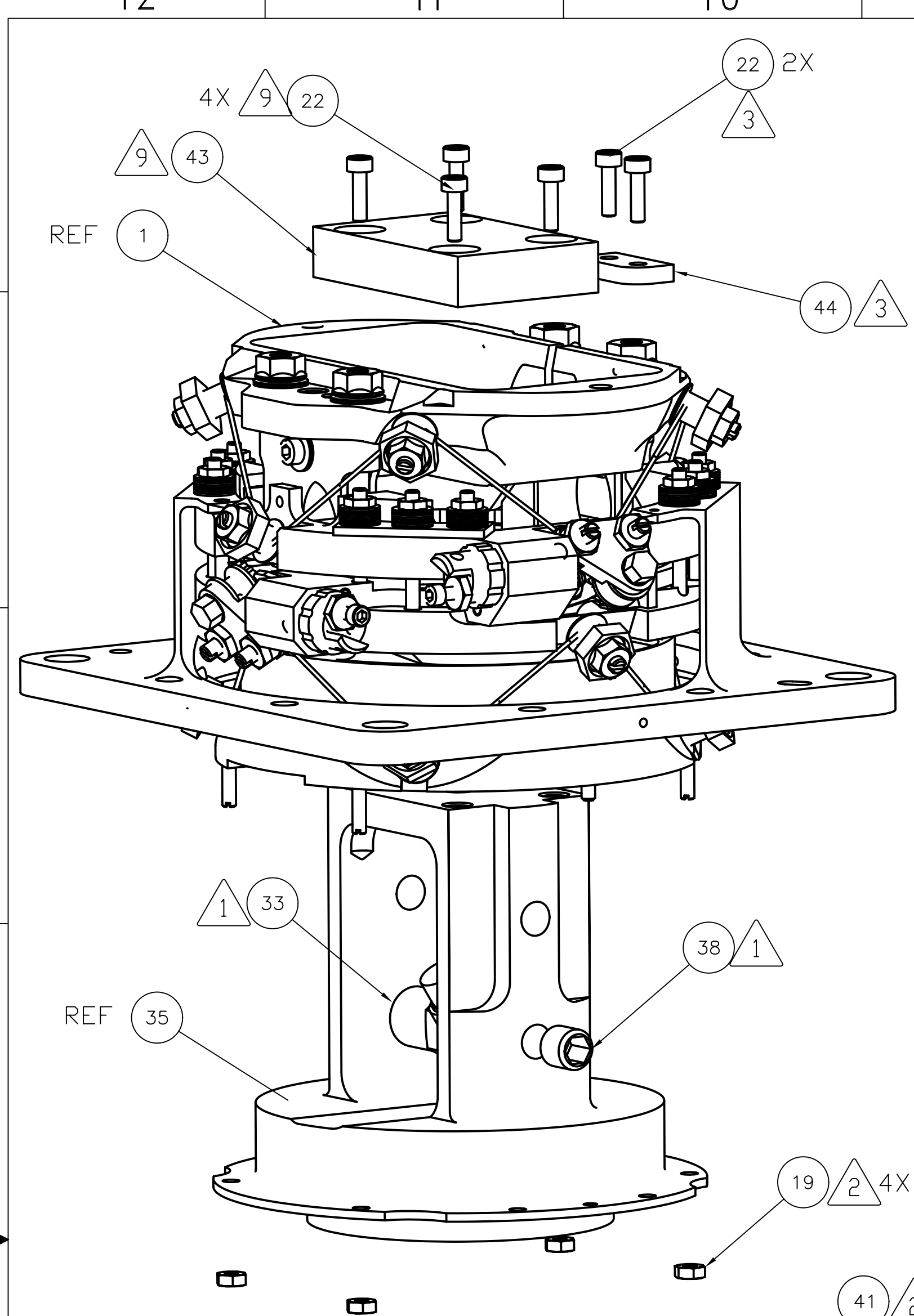


COMPONENTS REMOVED FOR CLARITY
 -4 CONFIGURATION SHOWN
 -1, -2, -3, -5 CONFIGURATIONS ARE SIMILAR
 -8 CONFIGURATION SIMILAR WITHOUT FILTER

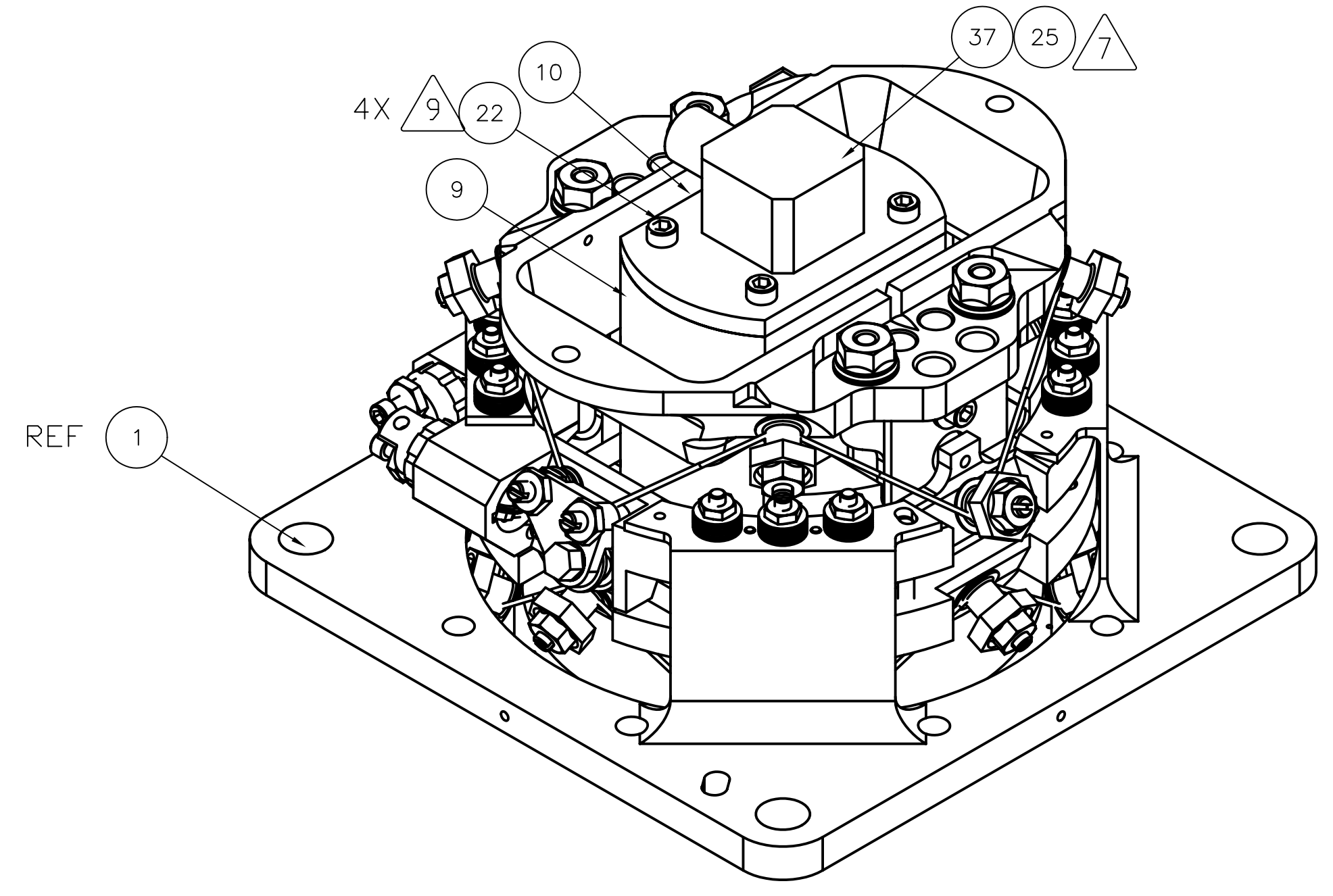


-4 CONFIGURATION SHOWN
 -1 AND -5 CONFIGURATIONS ARE SIMILAR
 -8 CONFIGURATION SIMILAR WITHOUT FILTER

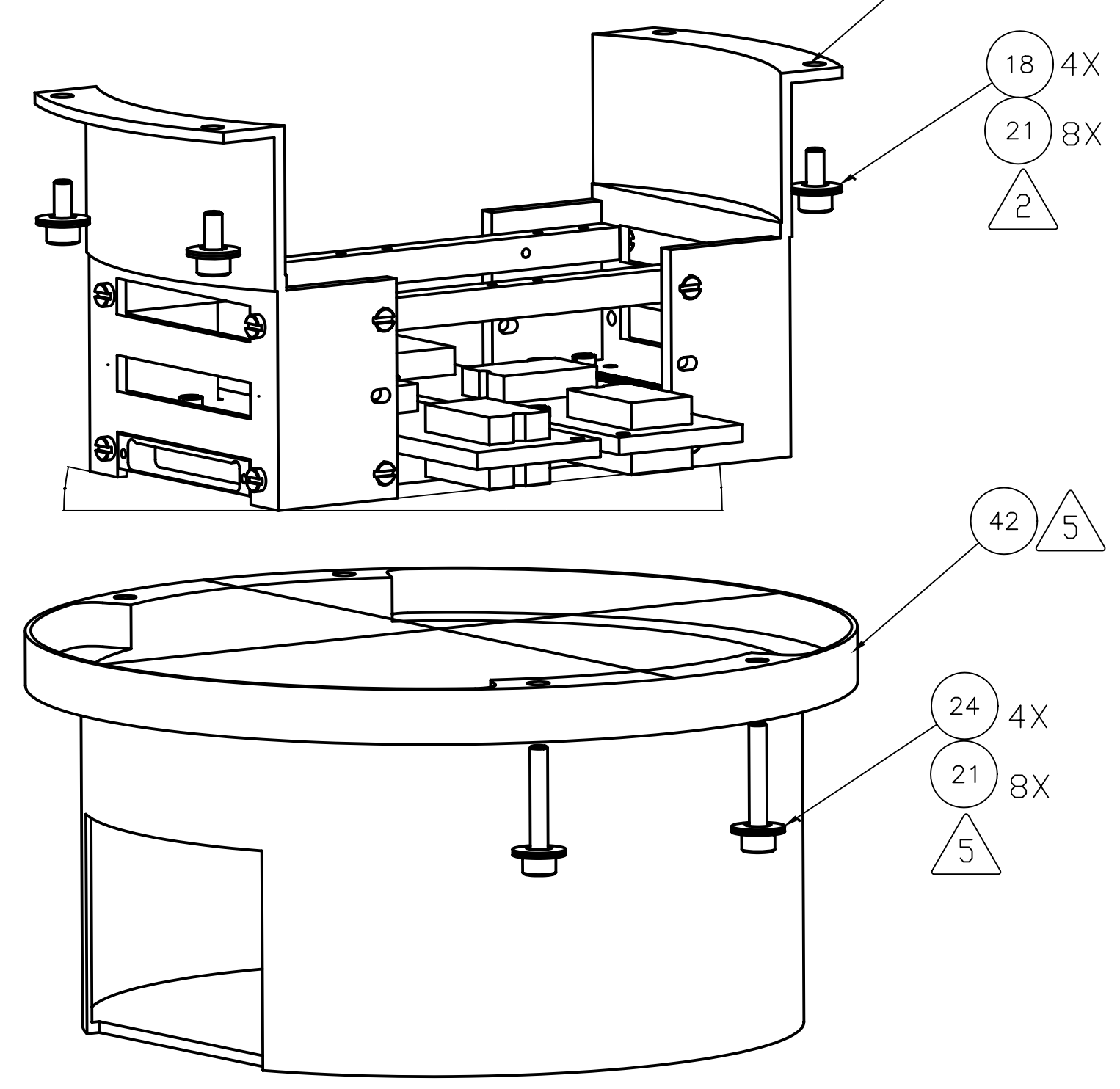
SIZE	CAGE NO	10209800	REV
A1	23835		B
SCALE	UNCLASSIFIED	SHEET 2 OF 4	REV 2/00



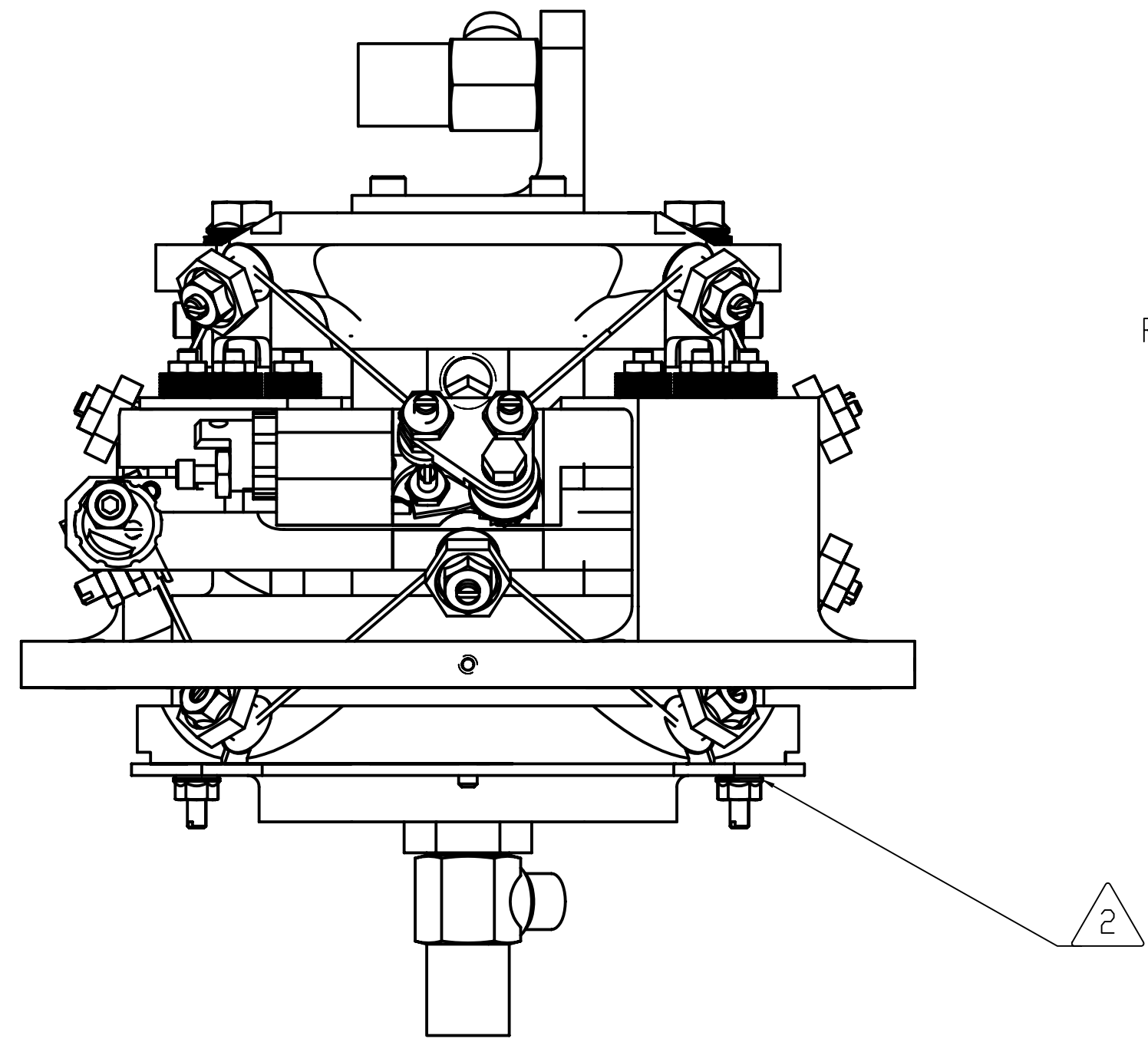
GENERAL VIEW
REFERENCE ONLY
SCALE: NONE
-7 CONFIGURATION,
ONLY ACCELEROMETERS AND
MASS SIMULATOR SHOWN



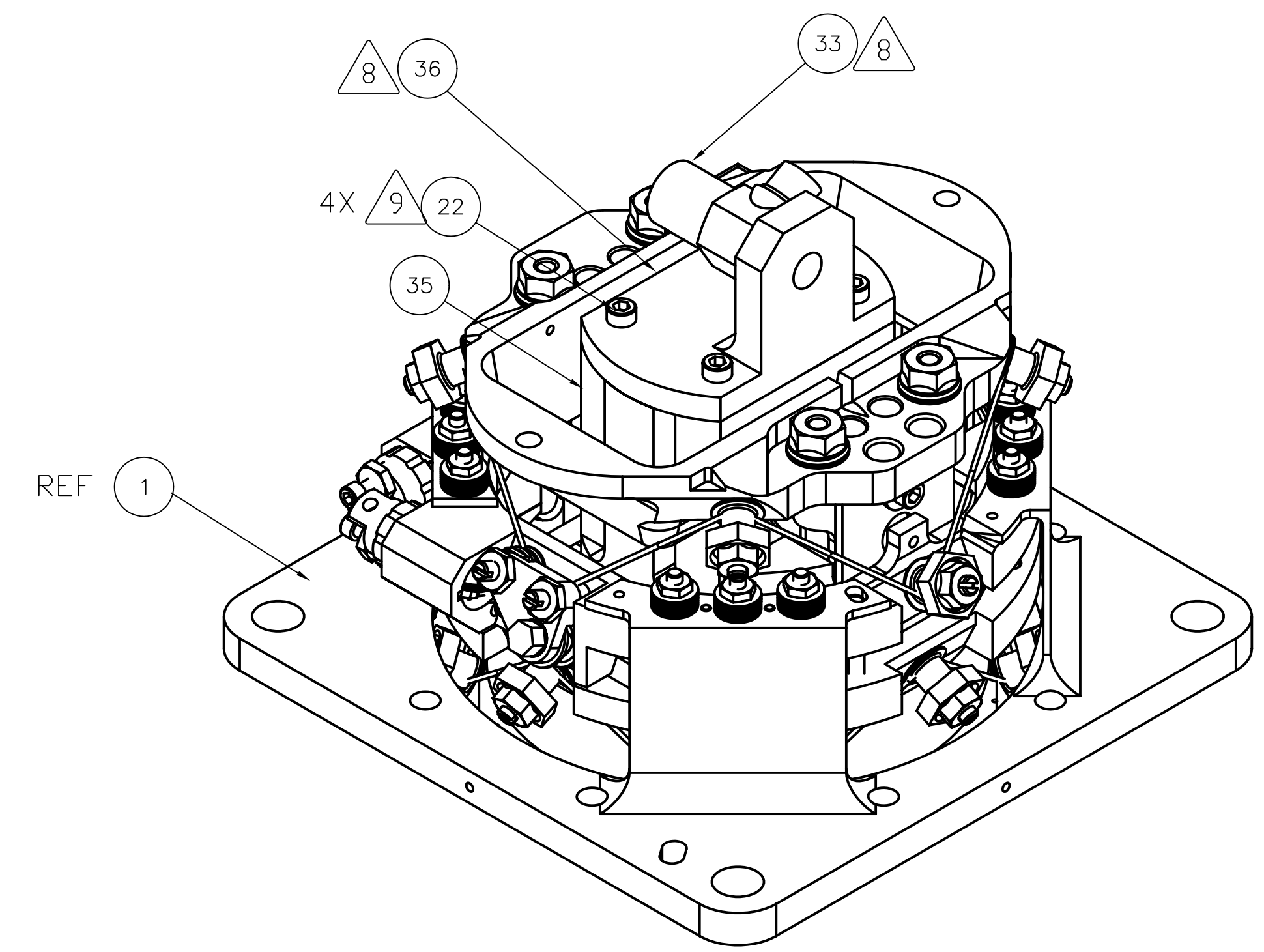
GENERAL VIEW
REFERENCE ONLY
SCALE: NONE
-6 CONFIGURATION



GENERAL VIEW
REFERENCE ONLY
SCALE: NONE
-9 CONFIGURATION,

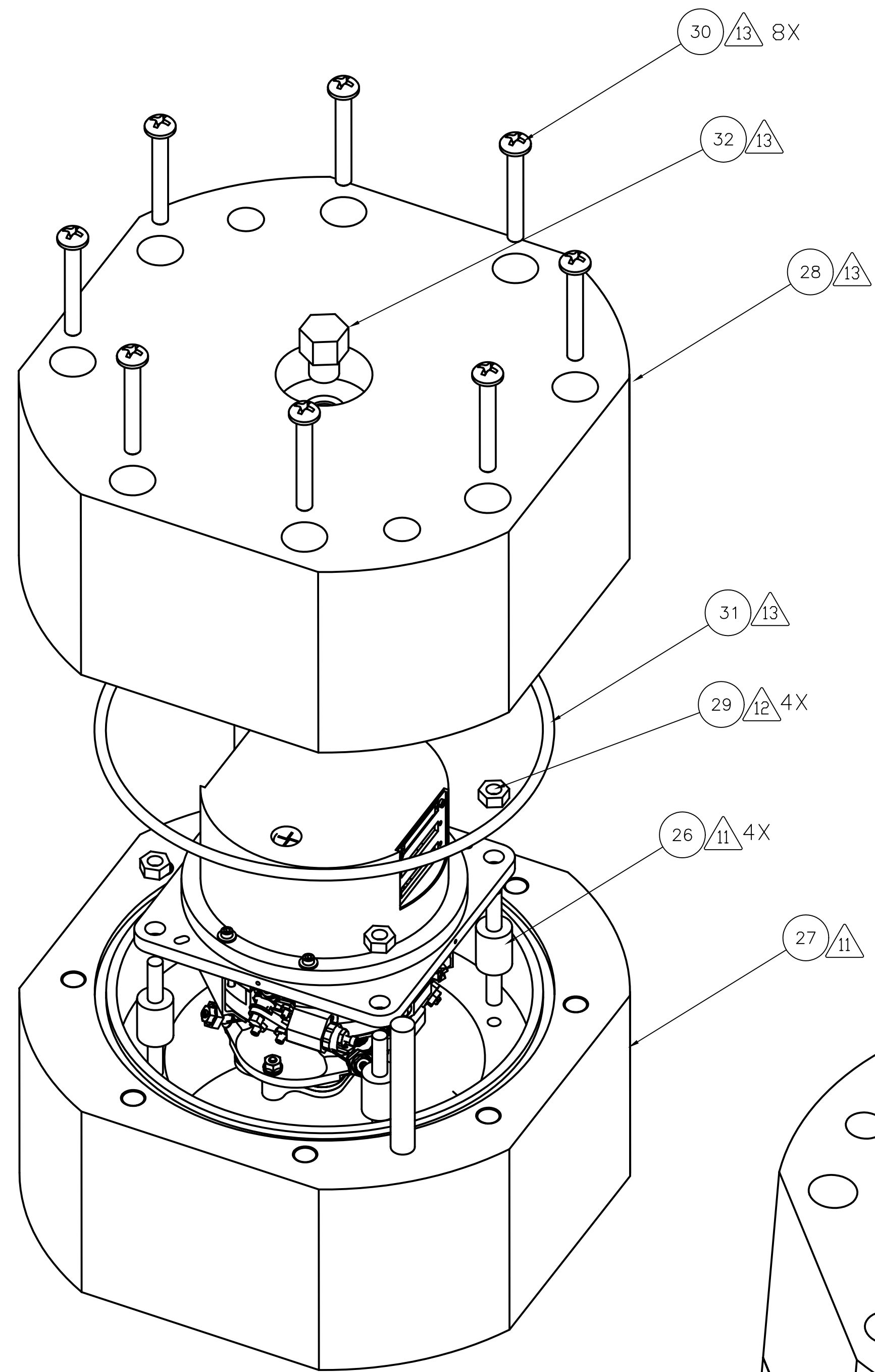


-7 CONFIGURATION

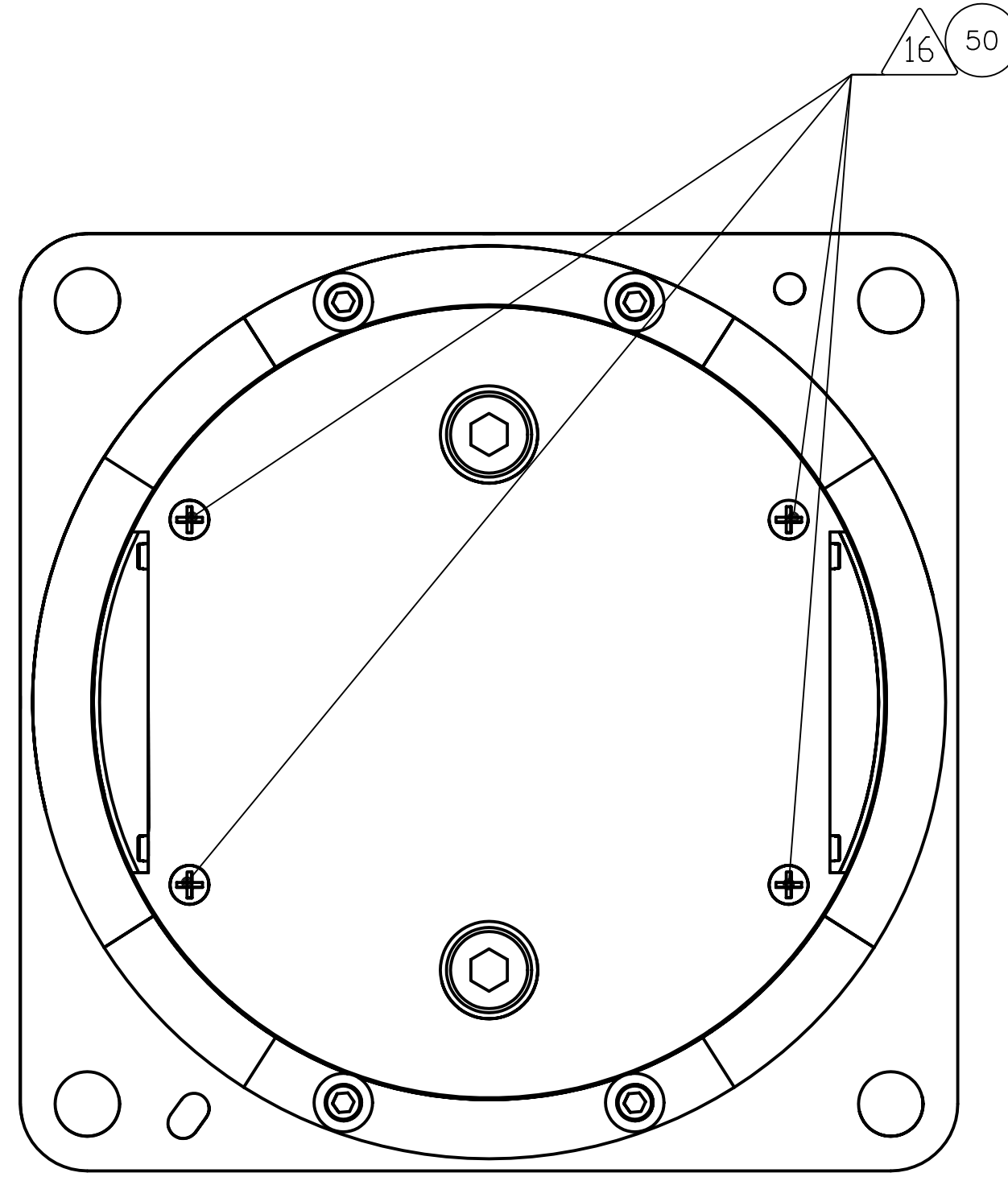


GENERAL VIEW
REFERENCE ONLY
SCALE: NONE
-7 CONFIGURATION

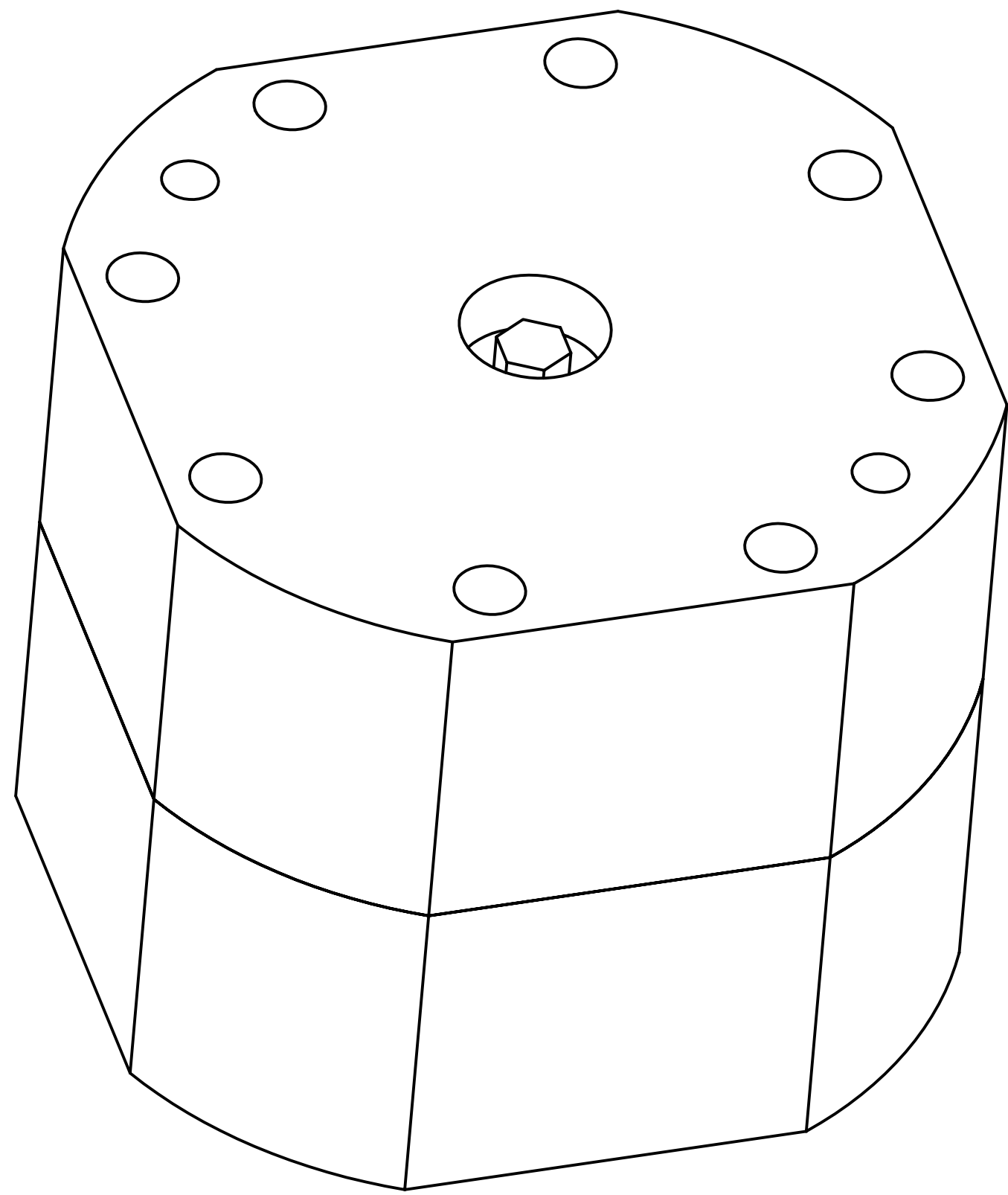
SIZE	CAGE NO	REV
A1	23835	10209800
SCALE: NONE	UNCLASSIFIED	SHEET 3 OF 4



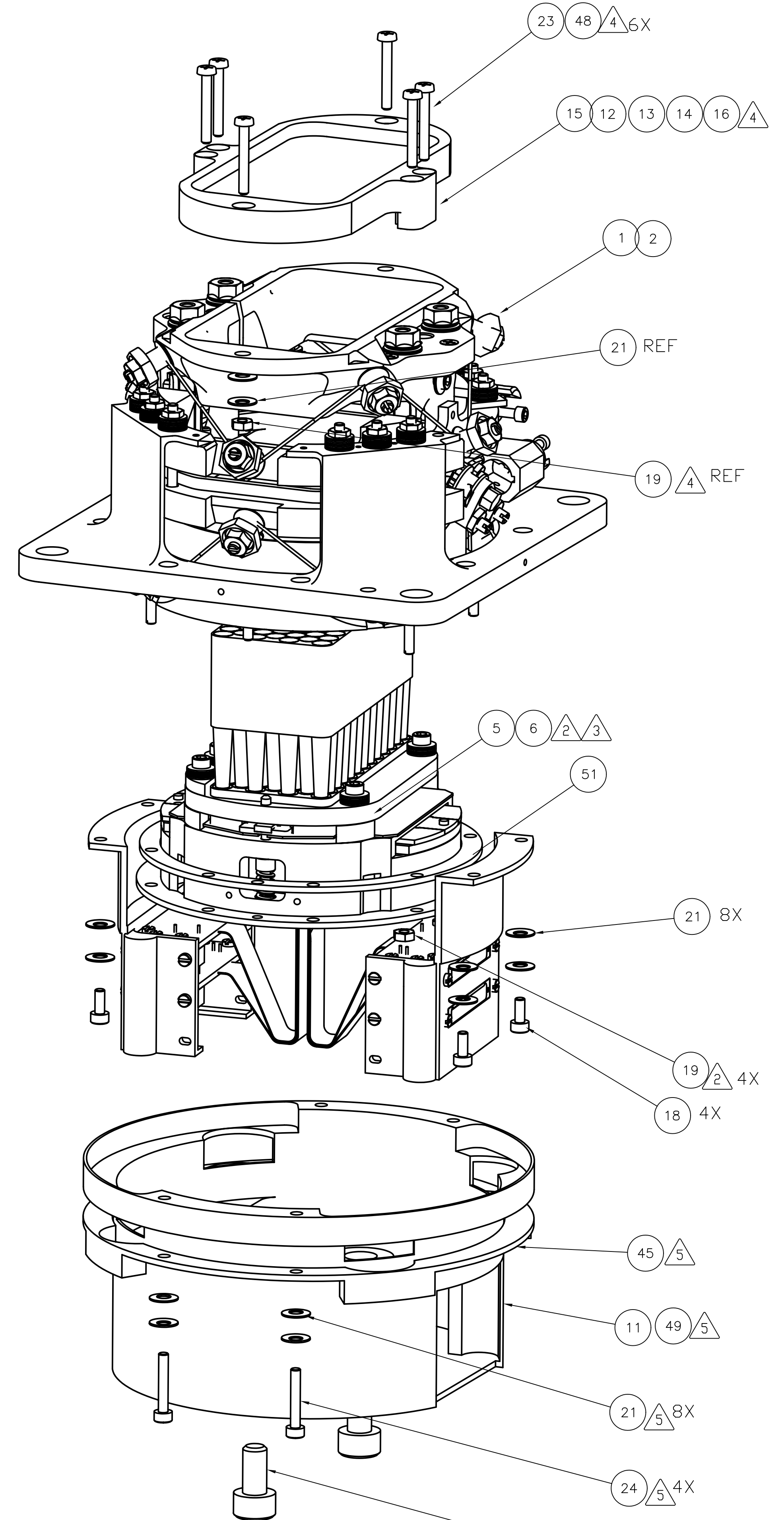
EXPLODED VIEW
 REFERENCE ONLY
 -5 CONFIGURATION
 -1,-2,-3,-4, -8 AND -9 SIMILAR
 -6 AND -7 SIMILAR WITH NO CAN



-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	10209800	REV
A1	23835		B
SCALE	UNCLASSIFIED	SHEET 4 OF 4	REV 2/00

ECR/NCR List
FS PMW BDA 10209800-2 S/N 019

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-005v2 – 300mK Stage Assembly – BDA Kapton cable routing design error.

3. HR-SP-JPL-ECR-007 – Spectrometer BDA Envelope Height (NOTE: does not apply to the PMW BDA type, but affects the same drawings.)

4. HR-SP-JPL-NCR-007 – PMW and PSW focal position shift



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	22 nd 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:

- 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”
- Add missing dimension for length of projecting mounting legs – $2.75 \pm 0.02\text{mm}$ in sector H8
- Add box for total stack thickness and mass per channel in sector A8
- 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°”
- 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: Draft version of new ICD – incomplete – for reference only 300MK_FILTER_ICD_170403_weilert.doc Shown as figure 1.	DISTRIBUTION:	CHANGE APPROVED	 Digitally signed by Eric Clark Date: 2005.07.13 11:17:10 +01'00'
		SIGNATURE:	
		DATE:	



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

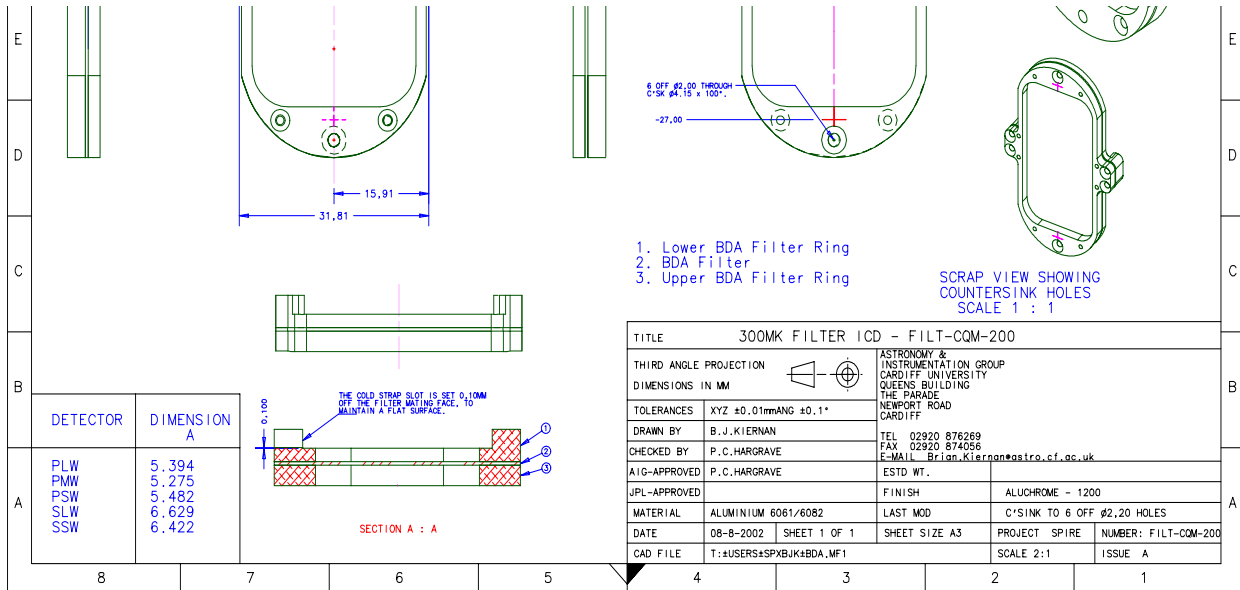


Figure 1 Preliminary draft of new ICD for reference only. Additional proposed changes to this drawing will be implemented by Cardiff, and sent to JPL for approval.

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

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	

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

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
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NCR Title	PMW and PSW focal position shift
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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
	 <small>Digitally signed by Eric Clark Date: 2005.07.18 11:18:22 +01'00'</small>	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)**

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
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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				

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.
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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

- Random Vibration Test Levels are not the same as given in the BDA-SSSD (Issue 3.2), BDA-Des-10
- 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

- The random vibration test levels are as specified by Berend Winter (MSSL) in an email on May 2, 2003, which superseded the BDA-SSSD
- 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				



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 constraints, 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 vibrate 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

RFW/RFD Number:	HR-SP-JPL-RFW-022
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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.
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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 PMW BDA 10209800-2 S/N 019):

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 approved¹ nitrile or polyurethane ESD safe cleanroom gloves only. (See end of document for notes and JPL approved products).

BDA is ESD Sensitive: Handle with approved² wrist straps, ESD-safe gloves and ESD smocks at an approved ESD protected workstation³. All personnel within 1 meter of unprotected ESD sensitive hardware shall be certified for ESD awareness⁴. 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 approved⁵ 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.

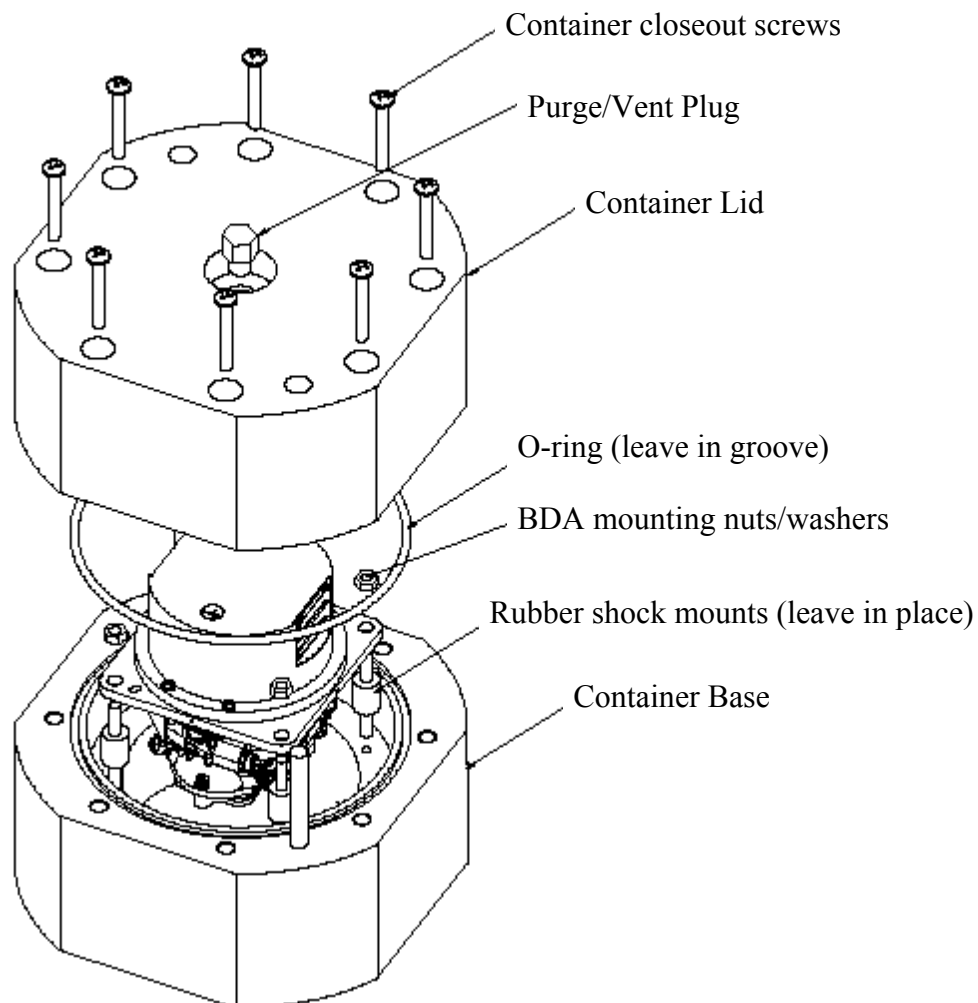
BDA is Temperature Sensitive: The Kevlar tension and creep increases at high temperatures, **DO NOT BAKE OUT AT ABOVE 80°C**.

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: BDA Electronic Handling Procedure, SPIRE P/MW-FS S/N019

Prepared by: Anthony Turner

Document No:

Issue: Draft

Date: 9/15/05

Checked by:

Date:.....

Approved by:.....

Date:.....

Electronic Handling Procedure P/MW-FS S/N019

Ref:

Issue:

Date:

Distribution

Electronic Handling Procedure P/MW-FS S/N019

Ref:

Issue:

Date:

Change Record

Issue

Date

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Glossary

1. Introduction:

This document provides the Electronic Handling Procedure for the Flight Spare-Photometer Medium Wavelength Bolometer Detector Array serial number 019.

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 P/MW-FS S/N019 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 ($\sim 6\text{-}14\text{ M}\Omega$) 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 $\pm 1\text{ V}$, and the maximum AC input voltage is 100mV rms .

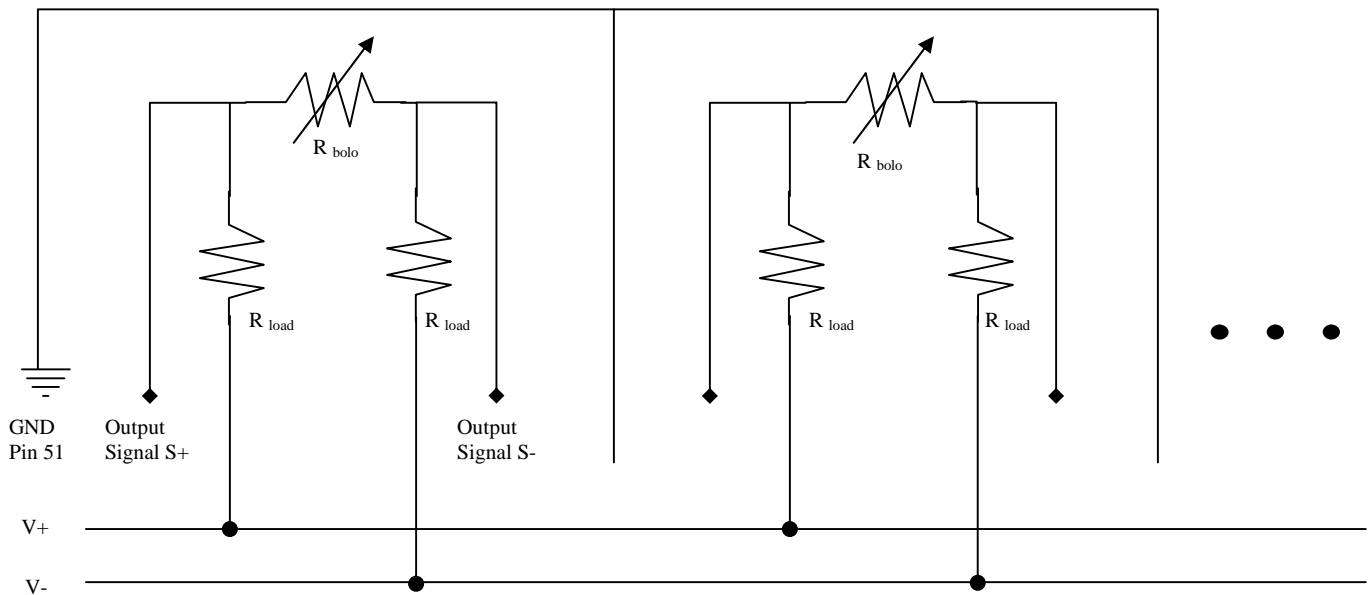


Figure 1: Interface circuit of the Bolometer Detector Array

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	10 μ A	25 μ A

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	<0.5 μ A	1 μ A

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 200 Ω 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 tables 1 through 4. 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 4k Ω range. All measurements are in k Ω unless designated otherwise. Channels that are out of range are re-measured using the 40M Ω range to determine their value. The failure mode of any particular channel is also designated in tables 1 through 4. The designation for the failure modes are open- Channel open at 300mK, short-channel shorted at 300mK, and float- channel floating at 300mK.

Table 1: P/MW-FS S/N019 Room Temperature DC Detector Measurements J01 connector

Connector Label	Signal	Nanonics Pin From	Nanonics Pin To	Detector Label	Resistance (kohms)	Failure Mode
J01	1	1	26	A7	2.663	
	2	2	27	A6	2.675	
	3	3	28	B6	2.722	
	4	4	29	C7	2.731	
	5	5	30	A5	2.713	
	6	6	31	B5	2.797	
	7	7	32	C6	2.819	
	8	8	33	D6	2.855	
	9	9	34	B4	2.804	
	10	10	35	C5	2.822	
	11	11	36	D4	2.869	
	12	12	37	A4	2.847	
	13	13	38	C4	2.905	
	14	14	39	B3	2.947	
	15	15	40	C3	2.983	
	16	16	41	B2	2.978	
	17	17	42	D2	3.197	
	18	18	43	A3	2.97	
	19	19	44	A2	2.998	
	20	20	45	C2	3.123	
	21	21	46	B1	3.088	
	22	22	47	A1	3.11	
	23	23	48	DK1	3.12	
	24	24	49	C1	3.208	
	V+ to V-	25	50		0.467M	
	V- to gnd	50	51		>40M	
	V+ to gnd	25	51		>40M	
	Chassis to gnd				49.3 ohms	

Table 2: P/MW-FS S/N019 Room Temperature DC Detector Measurements J02 connector

Connector Label	Signal	Nanonics Pin From	Nanonics Pin To	Detector Label	Resistance (kohms)	Failure Mode
J02	1	1	26	E7	2.818	
	2	2	27	D7	2.809	
	3	3	28	F7	2.751	
	4	4	29	E8	2.795	
	5	5	30	G8	2.71	
	6	6	31	F8	2.727	
	7	7	32	E9	2.832	
	8	8	33	G9	2.868	
	9	9	34	D9	2.83	
	10	10	35	F9	2.814	
	11	11	36	E10	2.872	
	12	12	37	G10	2.785	
	13	13	38	F10	2.833	
	14	14	39	E11	2.917	
	15	15	40	G11	2.855	
	16	16	41	F11	2.911	
	17	17	42	E12	3.001	
	18	18	43	G12	2.941	
	19	19	44	F12	3.027	
	20	20	45	G13	2.977	
	21	21	46	DK2	3.1	
	22	22	47	SH	1.551	
	23	23	48	SH	1.593	
	24	24	49	R2	5.80M	
	V+ to V-	25	50		0.482M	
	V- to gnd	50	51		>40M	
	V+ to gnd	25	51		>40M	
	Chassis to gnd				49.4 ohms	

Note: Value of R2 resistor when not connected to the overall array circuitry is 7.61Mohms

Table 3: P/MW-FS S/N019 Room Temperature DC Detector Measurements J03 connector

Connector Label	Signal	Nanonics Pin From	Nanonics Pin To	Detector Label	Resistance (kohms)	Failure Mode
J03	1	1	26	A13	3.164	
	2	2	27	T1	3.202	
	3	3	28	B12	3.127	
	4	4	29	C13	3.112	
	5	5	30	A12	3.017	
	6	6	31	D12	3.096	
	7	7	32	C12	3.02	
	8	8	33	B11	2.961	
	9	9	34	A11	2.919	
	10	10	35	E13	3.032	
	11	11	36	D11	2.968	
	12	12	37	C11	2.855	
	13	13	38	B10	2.851	
	14	14	39	A10	2.803	
	15	15	40	D10	2.814	
	16	16	41	B9	2.799	
	17	17	42	C10	2.872	
	18	18	43	C9	2.74	
	19	19	44	A9	2.696	
	20	20	45	B8	2.726	
	21	21	46	A8	2.752	
	22	22	47	D8	2.843	
	23	23	48	C8	2.755	
	24	24	49	B7	2.711	
	V+ to V-	25	50		0.467M	
	V- to gnd	50	51		>40M	
	V+ to gnd	25	51		>40M	
	Chassis to gnd				51.3 ohms	

Table 4: P/MW-FS S/N019 Room Temperature DC Detector Measurements J04 connector

Connector Label	Signal	Nanonics Pin From	Nanonics Pin To	Detector Label	Resistance (kohms)	Failure Mode
J04	1	1	26	R1	5.20M	
	2	2	27	G1	3.139	
	3	3	28	T2	3.214	
	4	4	29	E1	3.148	
	5	5	30	D1	3.159	
	6	6	31	F1	3.062	
	7	7	32	E2	3.314	
	8	8	33	G2	2.904	
	9	9	34	F2	2.946	
	10	10	35	G3	2.875	
	11	11	36	E3	2.936	
	12	12	37	D3	2.959	
	13	13	38	F3	2.838	
	14	14	39	G4	2.799	
	15	15	40	E4	2.84	
	16	16	41	F4	2.792	
	17	17	42	E5	2.862	
	18	18	43	D5	2.858	
	19	19	44	F5	2.877	
	20	20	45	G5	2.726	
	21	21	46	E6	2.765	
	22	22	47	G6	2.758	
	23	23	48	F6	2.739	
	24	24	49	G7	2.724	
	V+ to V-	25	50		0.483M	
	V- to gnd	50	51		>40M	
	V+ to gnd	25	51		>40M	
	Chassis to gnd				51.4 ohms	

Note: Value of R1 resistor when not connected to the overall array circuitry is 6.75Mohms

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 $40\text{M}\Omega$ 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 $\sim 1.5\text{k}\Omega$) should read approximately $3\text{-}6\text{M}\Omega$. Channels with open bolometer channels will give values $8\text{M}\Omega$ or higher. The Data sets for the P/MW-FS S/N019 for the final test through the entire circuit are shown in tables 5 through 8.

Table 5: P/MW-FS S/N019 Load Resistor- Detector DC Continuity Check J01 connector

Connector Label	Signal	Detector Label	Bias V+ (pin 25) To S+ pin	V+ to S+ Resistance (Mohms)	Bias V- (pin 50) To S- pin	V- to S- Resistance (Mohms)
J01	1	A7	1	5.84	26	5.84
	2	A6	2	5.88	27	5.88
	3	B6	3	5.88	28	5.92
	4	C7	4	5.8	29	5.88
	5	A5	5	5.8	30	5.92
	6	B5	6	5.8	31	5.88
	7	C6	7	5.8	32	5.84
	8	D6	8	5.82	33	5.84
	9	B4	9	5.84	34	5.84
	10	C5	10	5.88	35	5.84
	11	D4	11	5.88	36	5.84
	12	A4	12	5.88	37	5.88
	13	C4	13	5.82	38	5.84
	14	B3	14	5.92	39	5.88
	15	C3	15	5.96	40	5.92
	16	B2	16	5.96	41	5.92
	17	D2	17	5.93	42	5.96
	18	A3	18	5.96	43	5.96
	19	A2	19	5.97	44	5.96
	20	C2	20	6	45	6
	21	B1	21	5.98	46	5.99
	22	A1	22	6	47	6
	23	DK1	23	6.04	48	6
	24	C1	24	6.04	49	6.03

Table 6: P/MW-FS S/N019 Load Resistor- Detector DC Continuity Check J02 connector

Connector Label	Signal	Detector Label	Bias V+ (pin 25) To S+ pin	V+ to S+ Resistance (Mohms)	Bias V- (pin 50) To S- pin	V- to S- Resistance (Mohms)
J02	1	E7	1	5.92	26	6.04
	2	D7	2	5.92	27	6.04
	3	F7	3	5.93	28	6.04
	4	E8	4	5.96	29	5.96
	5	G8	5	5.96	30	5.97
	6	F8	6	5.98	31	5.96
	7	E9	7	6	32	6
	8	G9	8	6	33	6
	9	D9	9	6.01	34	6.04
	10	F9	10	6.01	35	6.02
	11	E10	11	6.04	36	6.02
	12	G10	12	6.04	37	6.04
	13	F10	13	6.04	38	6.04
	14	E11	14	6.04	39	6.04
	15	G11	15	6.08	40	6.07
	16	F11	16	6.08	41	6.08
	17	E12	17	6.06	42	6.08
	18	G12	18	6.08	43	6.08
	19	F12	19	6.1	44	6.1
	20	G13	20	6.12	45	6.12
	21	DK2	21	6.12	46	6.12
	22	SH	22	6.1	47	6.12
	23	SH	23	6.12	48	6.14
	24	R2	24	7.51	49	7.56

Table 7: P/MW-FS S/N019 Load Resistor- Detector DC Continuity Check J03 connector

Connector Label	Signal	Detector Label	Bias V+ (pin 25) To S+ pin	V+ to S+ Resistance (Mohms)	Bias V- (pin 50) To S- pin	V- to S- Resistance (Mohms)
J03	1	A13	1	5.4	26	5.44
	2	T1	2	5.44	27	5.44
	3	B12	3	5.44	28	5.44
	4	C13	4	5.44	29	5.44
	5	A12	5	5.44	30	5.44
	6	D12	6	5.44	31	5.44
	7	C12	7	5.44	32	5.44
	8	B11	8	5.52	33	5.44
	9	A11	9	5.48	34	5.44
	10	E13	10	5.46	35	5.45
	11	D11	11	5.48	36	5.48
	12	C11	12	5.48	37	5.48
	13	B10	13	5.48	38	5.48
	14	A10	14	5.48	39	5.48
	15	D10	15	5.52	40	5.48
	16	B9	16	5.56	41	5.52
	17	C10	17	5.5	42	5.48
	18	C9	18	5.52	43	5.51
	19	A9	19	5.52	44	5.52
	20	B8	20	5.53	45	5.52
	21	A8	21	5.52	46	5.52
	22	D8	22	5.49	47	5.52
	23	C8	23	5.52	48	5.52
	24	B7	24	5.52	49	5.52

Table 8: P/MW-FS S/N019 Load Resistor- Detector DC Continuity Check J04 connector

Connector Label	Signal	Detector Label	Bias V+ (pin 25) To S+ pin	V+ to S+ Resistance (Mohms)	Bias V- (pin 50) To S- pin	V- to S- Resistance (Mohms)
J04	1	R1	1	6.76	26	6.8
	2	G1	2	5.6	27	5.6
	3	T2	3	5.52	28	5.5
	4	E1	4	5.56	29	5.56
	5	D1	5	5.6	30	5.58
	6	F1	6	5.6	31	5.58
	7	E2	7	5.6	32	5.6
	8	G2	8	5.6	33	5.6
	9	F2	9	5.6	34	5.6
	10	G3	10	5.6	35	5.56
	11	E3	11	5.6	36	5.6
	12	D3	12	5.6	37	5.6
	13	F3	13	5.63	38	5.61
	14	G4	14	5.62	39	5.6
	15	E4	15	5.62	40	5.62
	16	F4	16	5.64	41	5.62
	17	E5	17	5.6	42	5.64
	18	D5	18	5.62	43	5.64
	19	F5	19	5.64	44	5.64
	20	G5	20	5.66	45	5.64
	21	E6	21	5.6	46	5.6
	22	G6	22	5.66	47	5.64
	23	F6	23	5.64	48	5.64
	24	G7	24	5.68	49	5.68

EIDP Coverage For PMW BDA (SN019)

Unit Identification							
Name	PMW BDA						
Part #	10209800-2						
S/N	#019						
NOTE: The suspension in this BDA was initially shake tested at the usual protoflight levels (as part of SN011 BDA). SN011 BDA was later disassembled due to noisy bolometers. This BDA (SN019) was assembled with the same suspension and then shake tested at flight-acceptance levels. Except as noted results are for SN019.							

Environmental Testing							
	Axes Tested	Temperature	Duration or Number of Cycles	Pass/Fail	Requirement	Source	Waiver #
Random Vibration Test (initial PF test on SN011)	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, HR-SP-JPL-RFW-022
Random Vibration Test (FA test, SN019)	X	100 K	2 min per axis	P			
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]				Minimum Performance	Source	Waiver #
	Pre-full level	Post-full level					
Lowest Resonant Frequency	318 Hz	314 Hz	initial PF test		> 200 Hz (Goal: >250 Hz)	SSSD Sec # 3.1.3	NA
	314 Hz	316 Hz	FA test				
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	28 µm	32 µm	initial PF test	Y	125 µm in X/Y and 500 µm in Z	SSSD Sec # 3.1.1	NA
	24 µm	26 µm	FA test	Y			
Maximum motion due to the 1st thermal cycle	23 µm	17 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	28 µm	9 µm		Y	125 µm in X/Y and 500 µm in Z	SSSD Sec # 3.1.1	NA
Cumulative Maximum motion	71 µm	53 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 Herschel		LOG NO. HS026	
SYSTEM/ASSEMBLY TITLE PXX BDA SN011			DATE ISSUED 06/14/2003
REFERENCE DESIGNATION NUMBER	PART NO. (IF MULTIPLE, ATTACH LIST) 10209800	REV.	SERIAL NO. 011
HARDWARE TYPE <input type="checkbox"/> EM QUAL <input checked="" type="checkbox"/> FLIGHT <input type="checkbox"/> FLIGHT SPARE <input type="checkbox"/> OTHER		PRE-ENVIRONMENTAL INSPECTION REPORT NUMBER (ATTACH IR)	
WIRING HARNESS <input type="checkbox"/> EM QUAL <input type="checkbox"/> FLIGHT <input type="checkbox"/> EM <input type="checkbox"/> SE		PART NO.	REV. SERIAL NO.
TEST DESCRIPTION (CHECK ALL APPLICABLE) <input type="checkbox"/> SINE VIBRATION <input type="checkbox"/> PYROSHOCK <input type="checkbox"/> ACOUSTIC <input type="checkbox"/> EMC <input type="checkbox"/> OTHER _____ <input checked="" type="checkbox"/> RANDOM VIBRATION <input checked="" type="checkbox"/> THERMAL VAC. <input type="checkbox"/> THERMAL ATMOSPHERE		TYPE OF TEST <input type="checkbox"/> QUALIFICATION <input type="checkbox"/> FLIGHT ACCEPTANCE <input checked="" type="checkbox"/> PROTO FLIGHT <input type="checkbox"/> RETEST	
WILL ALL TESTS/LEVELS/DURATIONS REQUIRED BY THE PROJECT DOCUMENTS BE PERFORMED ON THIS UNIT? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) ENTER PROJ. DOC. NO. AND REV. _____			
HAS THE UNIT PASSED ALL PRE-ENVIRONMENTAL FUNCTIONAL TESTS? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION			
HAVE ALL DESIGN ANALYSES BEEN COMPLETED AND REQUIRED CHANGES BEEN IMPLEMENTED? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION			
IS THE TEST ARTICLE IDENTICAL TO OTHER FLIGHT UNITS? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION			
ARE ALL PFRs AGAINST THIS UNIT CLOSED? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION			
HAVE ALL WAIVERS AND ECRs BEEN APPROVED AND ARE THEY INCORPORATED? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION			

TEST AUTHORIZED BY

COGNIZANT ENGINEER <i>[Signature]</i>	DATE 6/21/04	TECHNICAL MGR./INSTR MRG./PI PREP REP <i>[Signature]</i>	DATE 6/24/04	ENVIRONMENTAL REQUIREMENTS ENG. <i>[Signature]</i>	DATE 6-09-04
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SUMMARY SECTION

TEST AGENCY (IF MULTIPLE, ATTACH SUMMARY AND TEST DATES) JPL Building 144	TEST INITIATION DATE 06/14/04	ACCUMULATED OPERATING HOURS PRIOR TO FIRST ENVIRONMENTAL TEST
SERIAL NUMBERS ACTUALLY TESTED	TEST TERMINATION DATE	OPERATING HOURS DURING ENVIRONMENTAL EXPOSURE

TEST DESCRIPTION

VIBRATION AXES: X Y Z SINE VIBRATION <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> RANDOM VIBRATION <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	ACOUSTIC <input type="checkbox"/>	PYROSHOCK SHOCK AXES: X Y Z <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> SHOCKS/AXIS: NO OF CYCLES: 2	<input checked="" type="checkbox"/> THERMAL VACUUM PRESSURE: <1E-5 mbar, 290K to 7K	<input type="checkbox"/> TEMPERATURE ATMOSPHERE NO OF CYCLES: _____	<input type="checkbox"/> OTHER
EMC <input type="checkbox"/> ESD <input type="checkbox"/> COND. SUSC. <input type="checkbox"/> RAD. SUSC.	<input type="checkbox"/> COND. EMIS. <input type="checkbox"/> RAD. EMIS.	<input type="checkbox"/> ISOLATION <input type="checkbox"/> MAGNETICS	TEMP. LEVEL (°C) AND ACCUMULATED DURATION (HRS.) HOT: _____°C, _____h COLD: _____°C, _____h HOT: _____°C, _____h COLD: _____°C, _____h		
WERE THERE ANY PFRs GENERATED DURING ENVIRONMENTAL TESTS? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST)		LIST PFR NOS. / BRIEF EXPLANATION			
ARE THE POST ENVIRONMENTAL DAMAGE INSPECTIONS COMPLETE? <input checked="" type="checkbox"/> YES <input type="checkbox"/> 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? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST)		LIST PFR NOS. / BRIEF EXPLANATION			

<input type="checkbox"/> 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 <i>[Signature]</i>	DATE 9/19/05	TECHNICAL MGR./INSTR MRG./PI PREP REP <i>[Signature]</i>	DATE 9/19/05	ENVIRONMENTAL REQUIREMENTS ENG. <i>[Signature]</i>	DATE 9-16-05



ENVIRONMENTAL TEST AUTHORIZATION AND SUMMARY (ETAS)

OTHER AUTHORIZATION PROVISIONS AND EXPLANATIONS

s 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 TEST AUTHORIZATION AND SUMMARY (ETAS)

ENVIRONMENTAL TEST SUMMARY

HARDWARE	S/N	ETAS	TEST ENVIRONMENT LEVELS & DURATION	DATE TEST PERFORMED	TEST AGENCY	PASS/ FAIL	COMMENTS
BDA (10209800)	11	26	<p>LATERAL 2 minute Random Vibe +3dB/octave 20-100Hz 0.06 g²/Hz 100-138.5 Hz +36dB/octave 138.5-170 Hz 0.7 g²/Hz 170-200 Hz -48dB/octave 200-220 Hz .1 g²/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</p> <p>LONGITUDINAL (not done on this unit) 2 minute Random Vibe +3dB/octave 20-100Hz 0.08g²/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</p> <p>Each axis 1/4 g sine sweep 20-2000 Hz each axis T ~ 100 K</p> <p>2 Thermal cycles from 290K to 7K</p>				

Sine

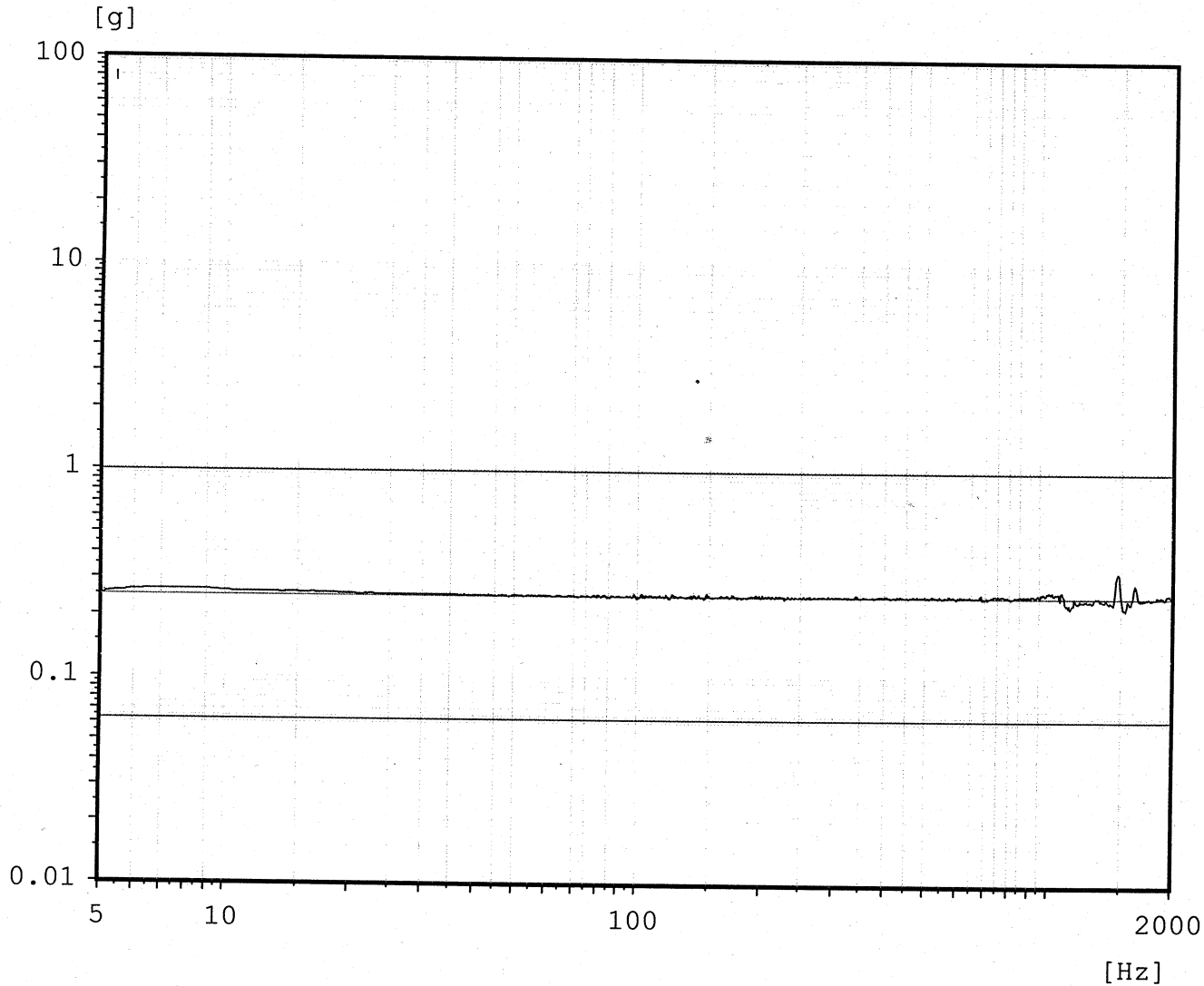
101530, Run 3, X axis

Spire BDA

P/N 10209800-2, S/N : 011

Control channel

**Before Shake, Cold
Initial PF Test**



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: 06-24-04
Time: 11:22:26

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

Sine

101530, Run 3, X axis

Spire BDA

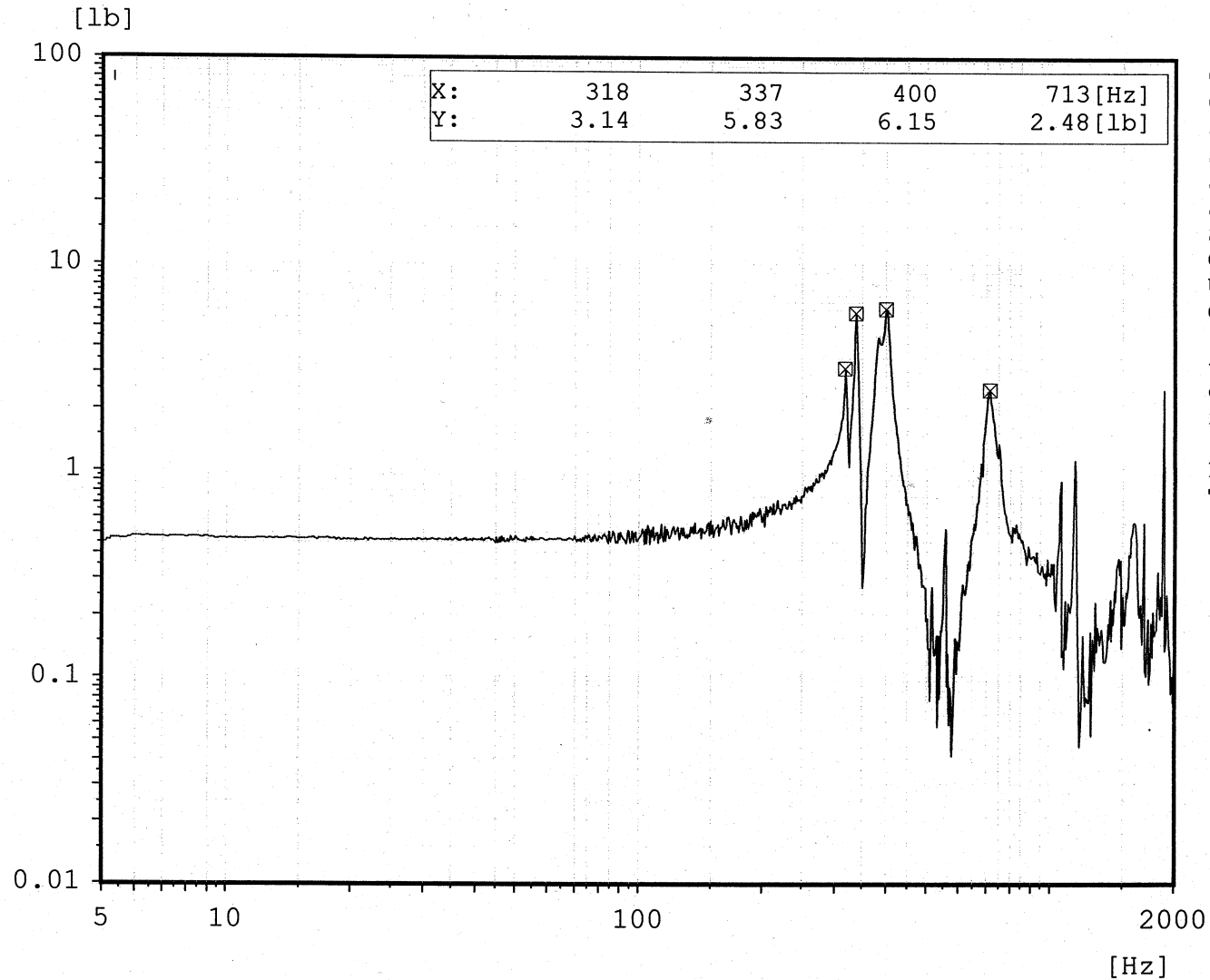
P/N 10209800-2, S/N : 011

Force Sum X

Before Shake, Cold

Initial PF Test

JPL



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: 06-24-04
Time: 11:22:26

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

Sine

101530, Run 3, X axis

Spire BDA

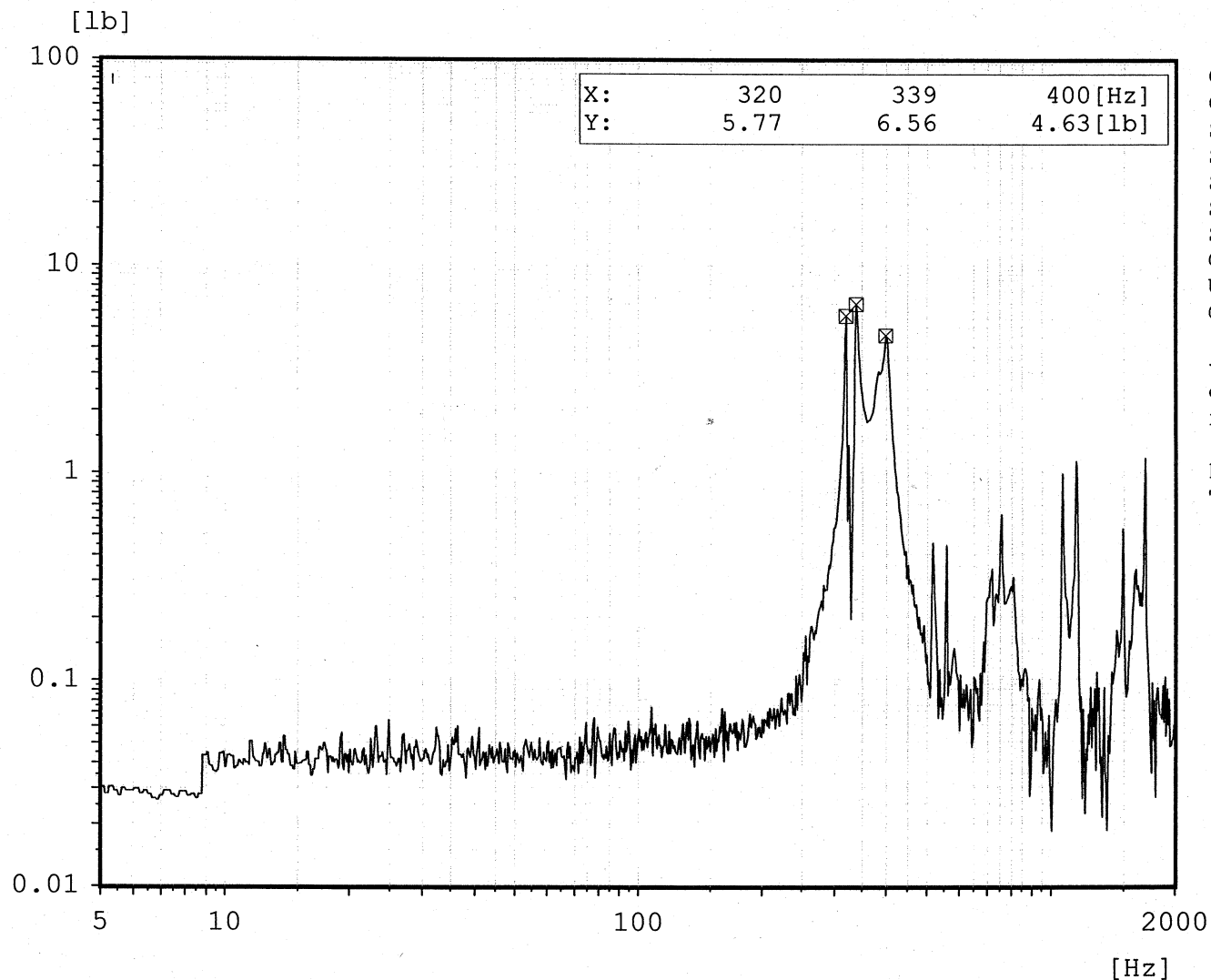
P/N 10209800-2, S/N : 011

Force Sum Y

Before Shake, Cold

Initial PF Test

JPL



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: 06-24-04
Time: 11:22:26

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

Sine

101530, Run 3, X axis

Spire BDA

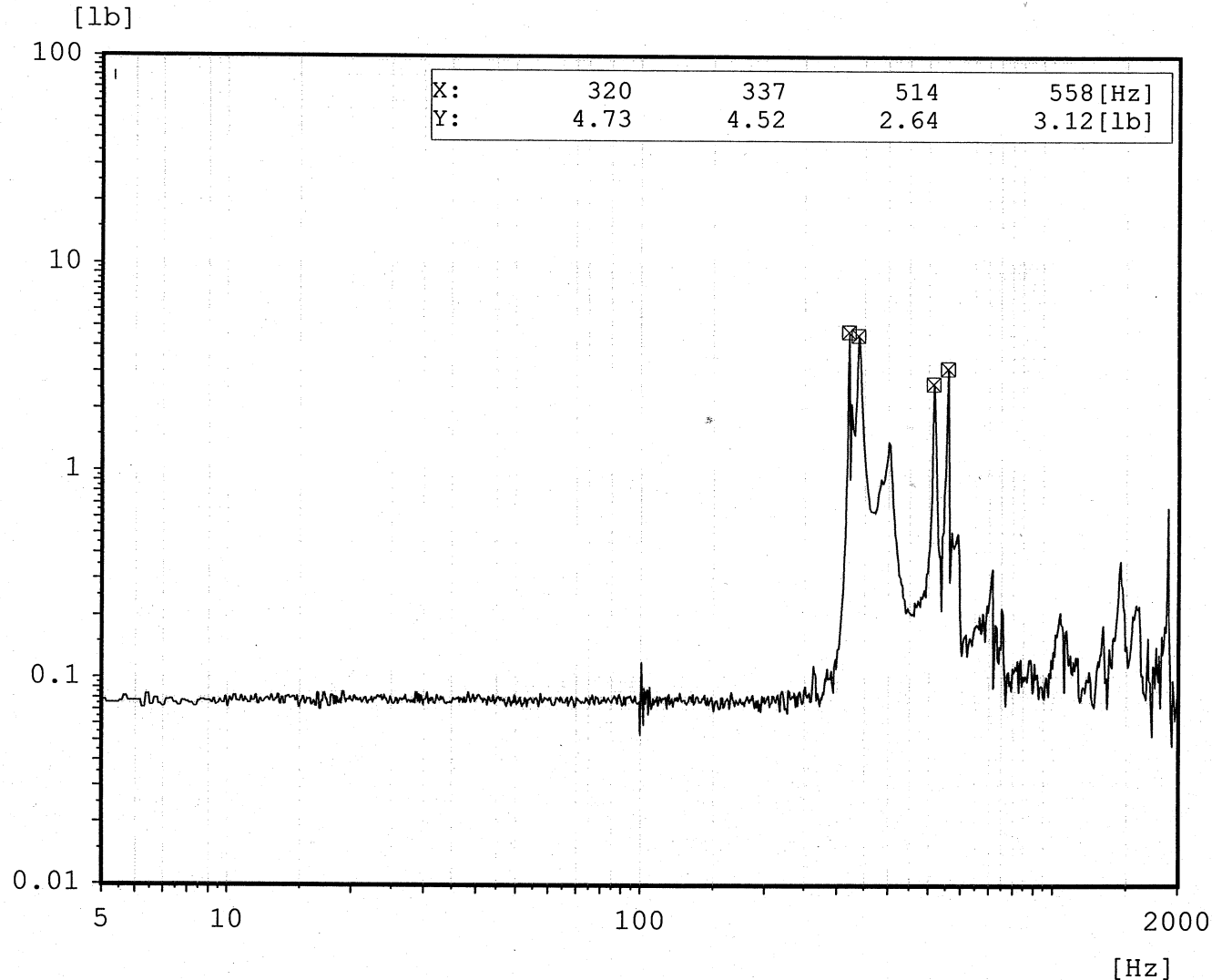
P/N 10209800-2, S/N : 011

Force Sum Z

Before Shake, Cold

Initial PF Test

JPL



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: 06-24-04
Time: 11:22:26

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

Random

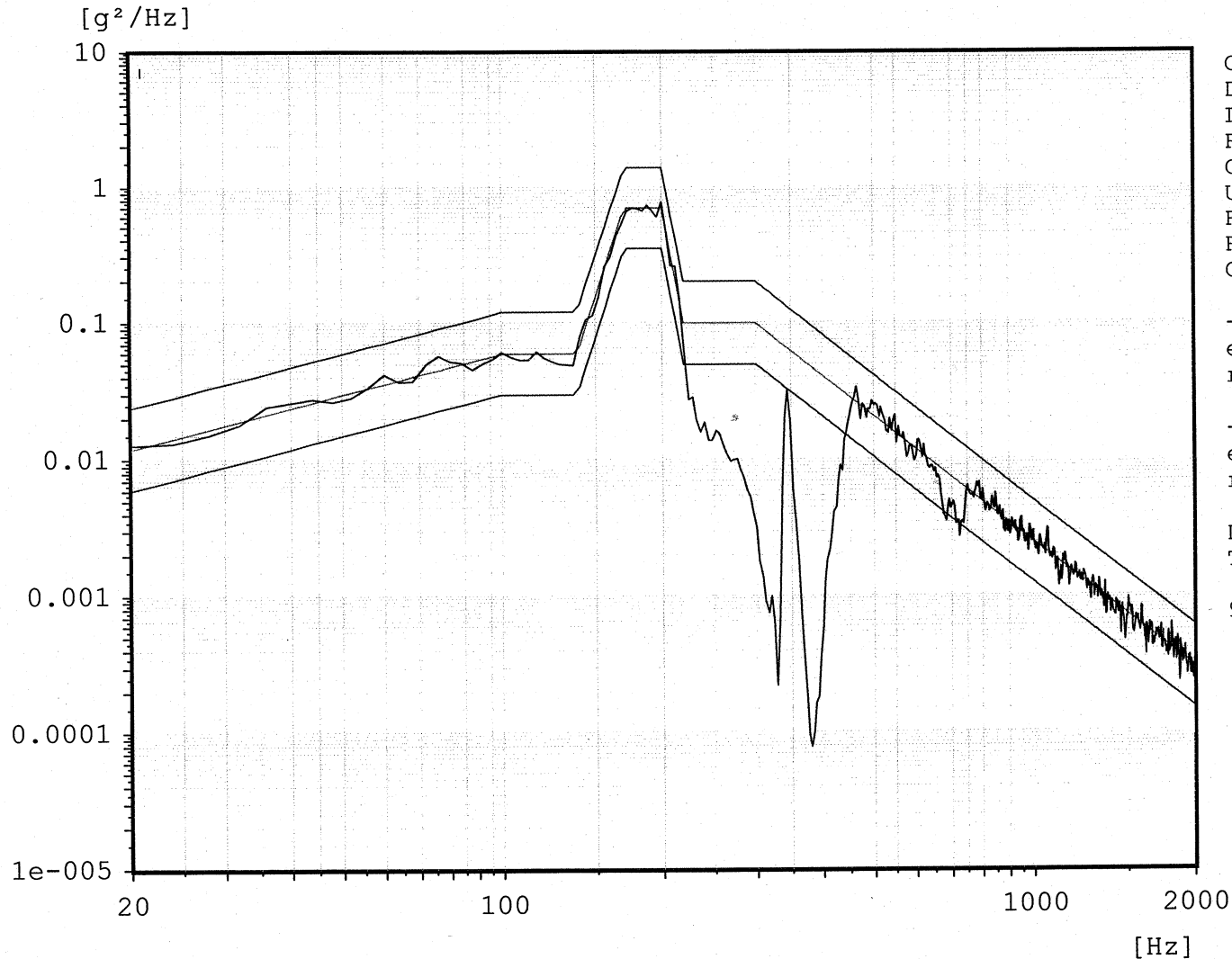
101530, Run 5, X axis

SPIRE BDA

P/N 10209800-2, S/N : 011

Control channel

0dB, Cold
Initial PF Test



Chan.type: X
DOF: 180
Level: 0.0 dB
Resolution: 4 Hz
Contr.strat.: Maximum
Unit: g²/Hz
RMS (act.): 6.894 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: 000:03:27
remaining: 000:00:00

Date: 06-24-04
Time: 11:58:41

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

Random

101530, Run 5, X axis

SPIRE BDA

P/N 10209800-2, S/N : 011

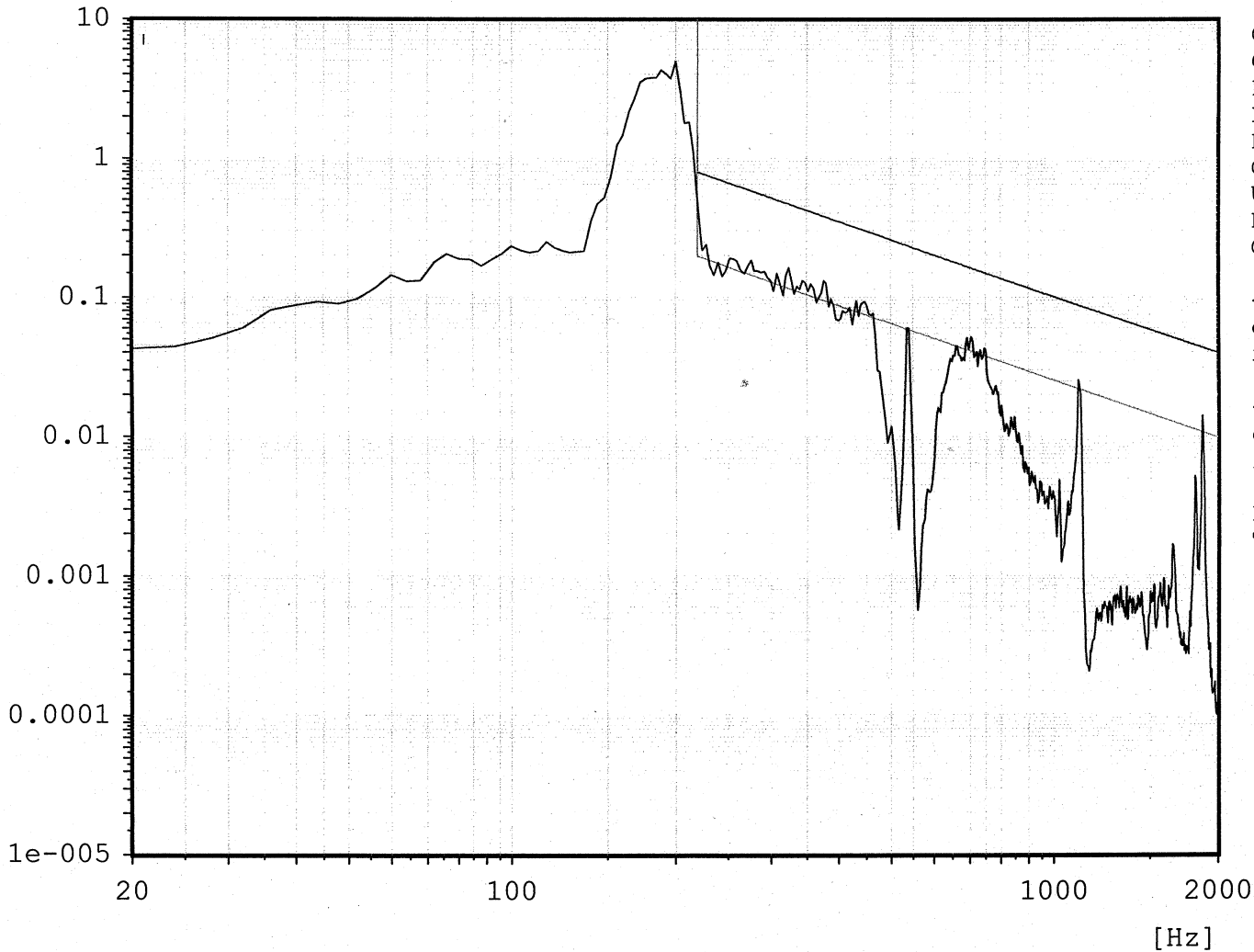
Force Sum X

0dB, Cold

Initial PF Test

JPL

[lb²/Hz]



Chan.no: 6
Chan.type: W
DOF: 90
Level: 0.0 dB
Resolution: 4 Hz
Contr.strat.: Maximum
Unit: lb²/Hz
RMS (act.): 16.16 lb
Contr.strat.: Closed loop

-- Time on act. level --
elapsed: 000:02:00
remaining: 000:00:00

-- Time total --
elapsed: 000:03:27
remaining: 000:00:00

Date: 06-24-04
Time: 11:58:41

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

Random

101530, Run 5, X axis

SPIRE BDA

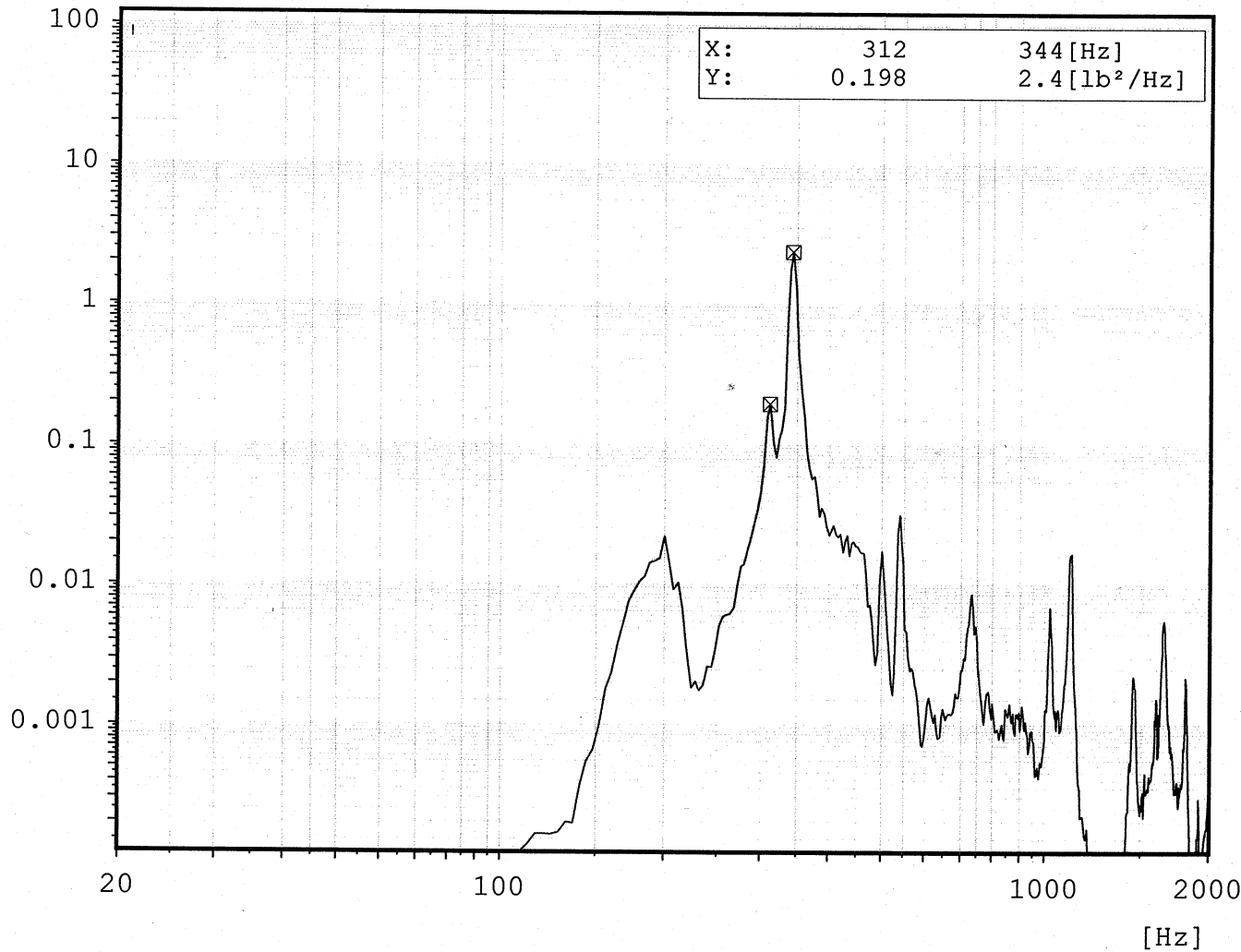
P/N 10209800-2, S/N : 011

Force Sum Y

0dB, Cold
Initial PF Test

JPL

[lb²/Hz]



Chan.no: 7
Chan.type: W
DOF: 90
Level: 0.0 dB
Resolution: 4 Hz
Contr.strat.: Maximum
Unit: lb²/Hz
RMS (act.): 6.314 lb
Contr.strat.: Closed loop

-- Time on act. level --
elapsed: 000:02:00
remaining: 000:00:00

-- Time total --
elapsed: 000:03:27
remaining: 000:00:00

Date: 06-24-04
Time: 11:58:41

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

Random

101530, Run 5, X axis

SPIRE BDA

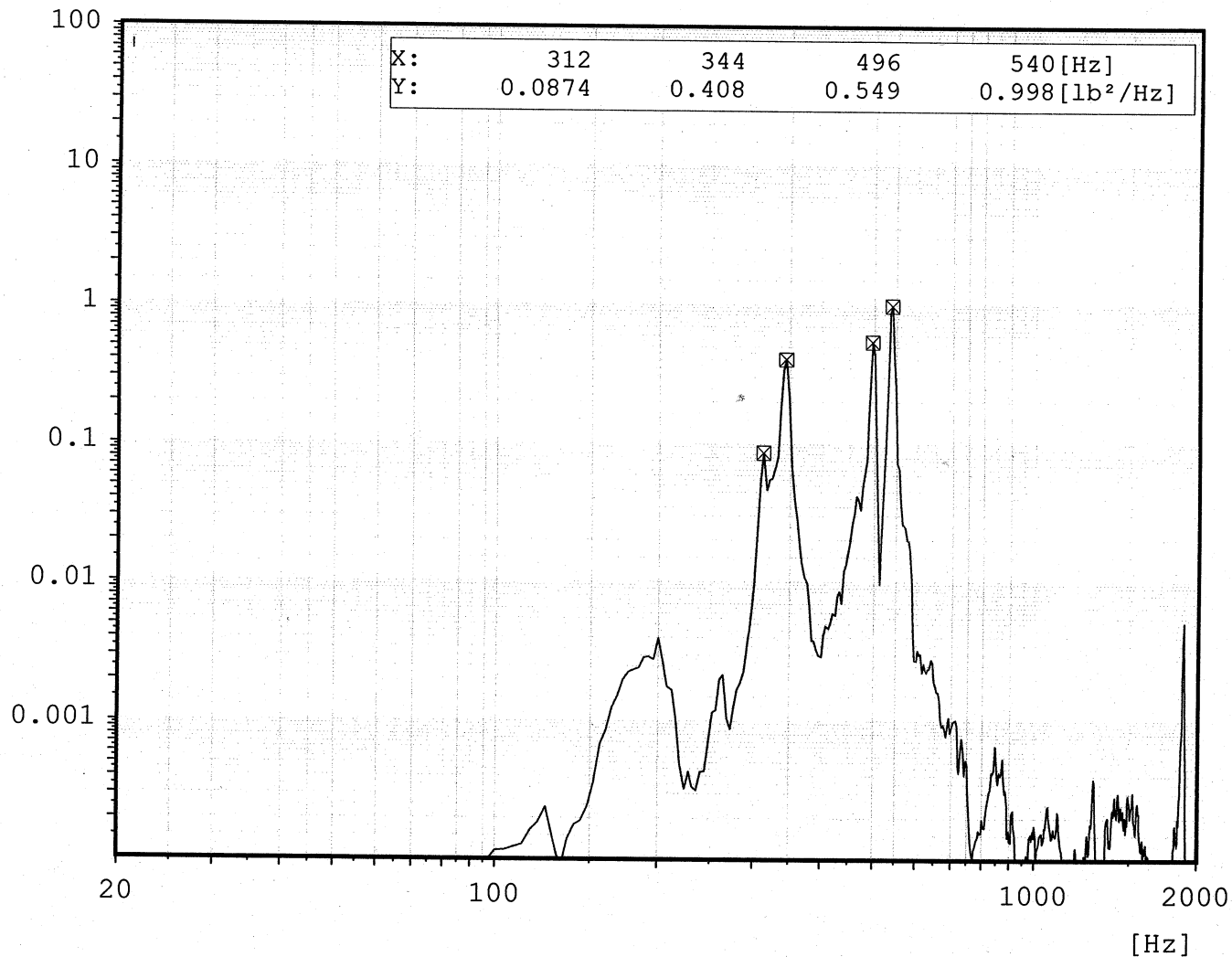
P/N 10209800-2, S/N : 011

Force Sum Z

0dB, Cold
Initial PF Test



[lb²/Hz]



Chan.no: 8
Chan.type: W
DOF: 90
Level: 0.0 dB
Resolution: 4 Hz
Contr.strat.: Maximum
Unit: lb²/Hz
RMS (act.): 5.569 lb
Contr.strat.: Closed loop

-- Time on act. level --
elapsed: 000:02:00
remaining: 000:00:00

-- Time total --
elapsed: 000:03:27
remaining: 000:00:00

Date: 06-24-04
Time: 11:58:41

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

Sine

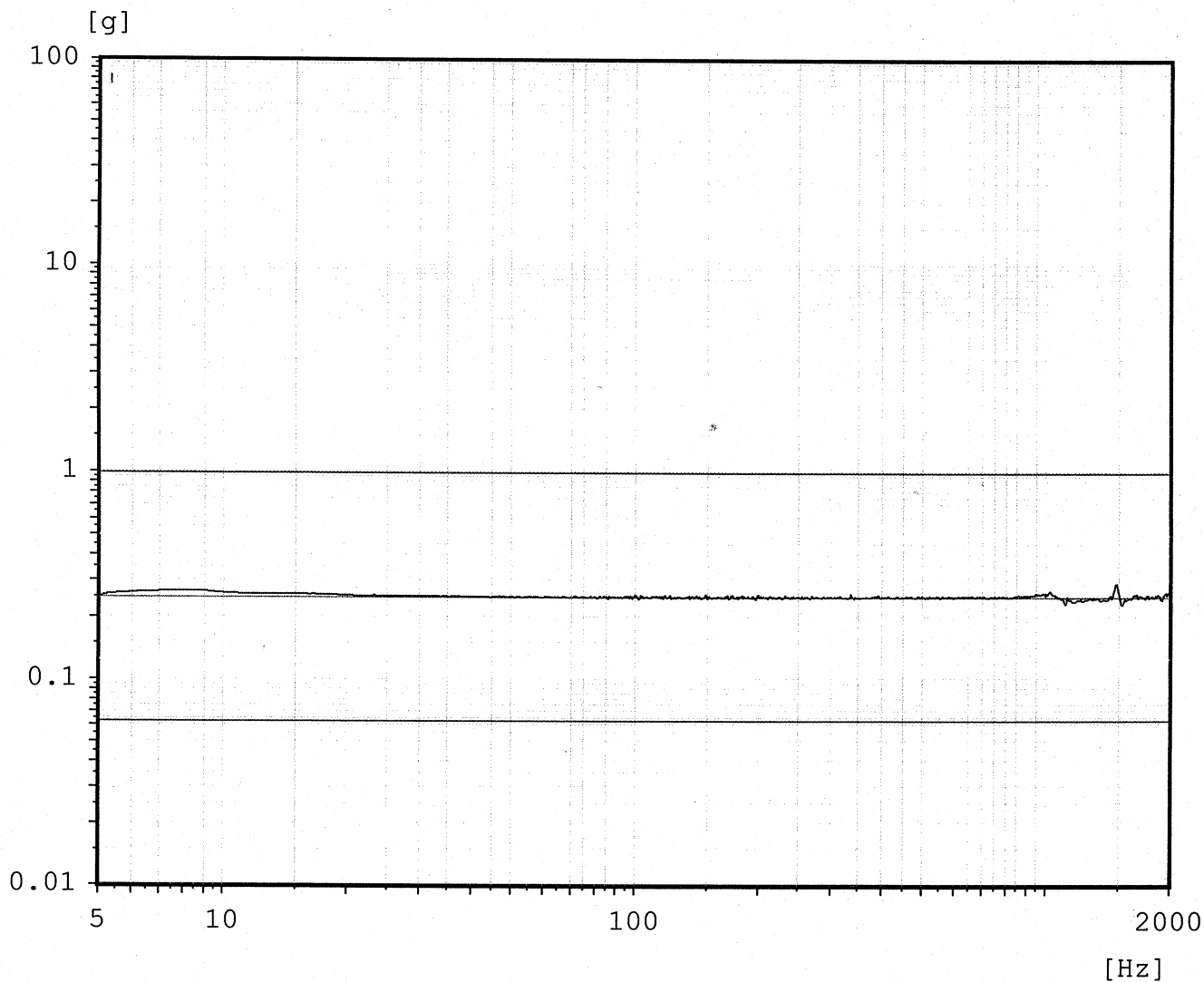
101530, Run 7, X axis

Spire BDA

P/N 10209800-2, S/N : 011

Control channel

After Shake, Cold
Initial PF Test



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: 06-24-04
Time: 12:15:53

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

Sine

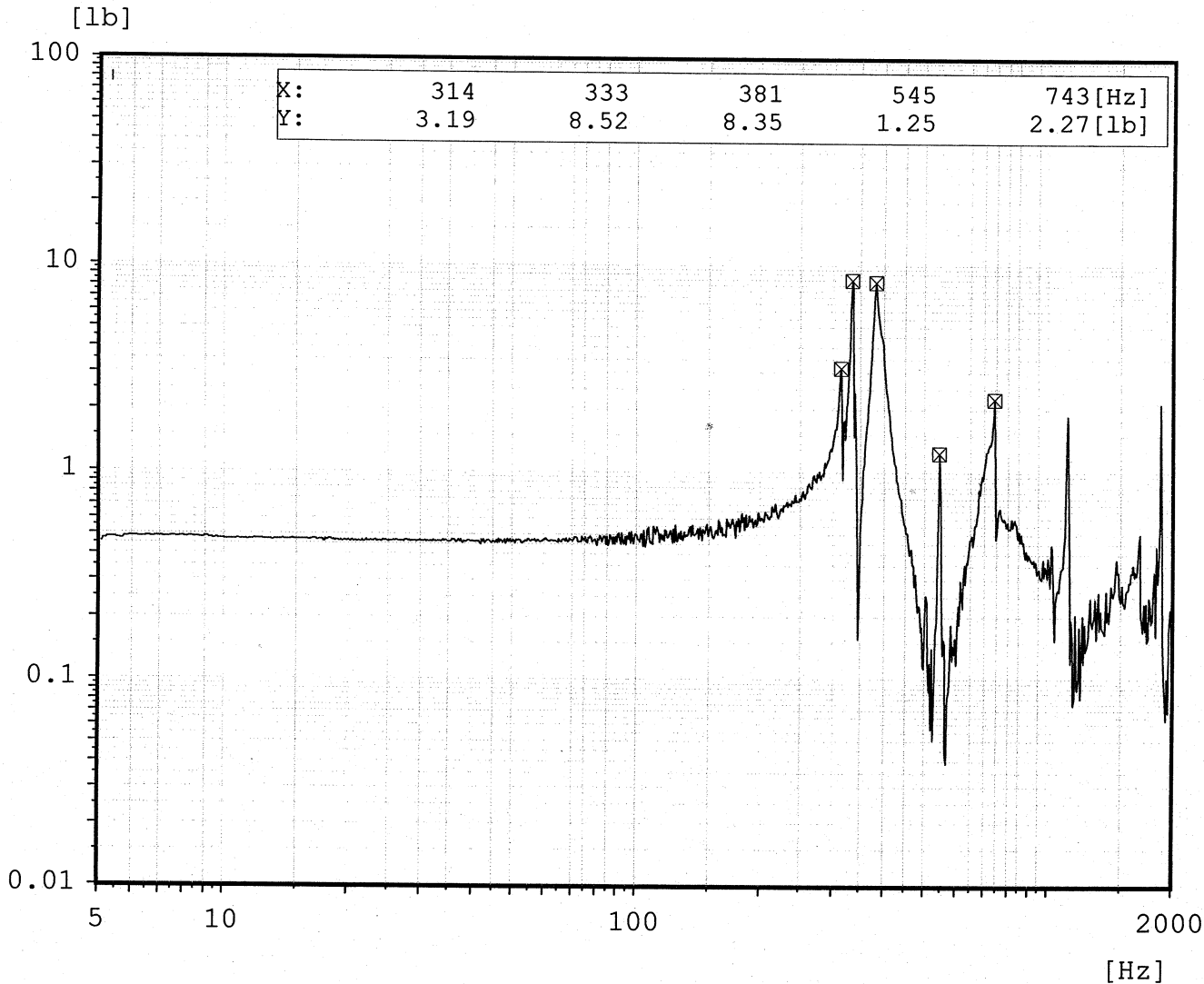
101530, Run 7, X axis

Spire BDA

P/N 10209800-2, S/N : 011

Force Sum X

After Shake, Cold
Initial PF Test



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: 06-24-04
Time: 12:15:53

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

Sine

101530, Run 7, X axis

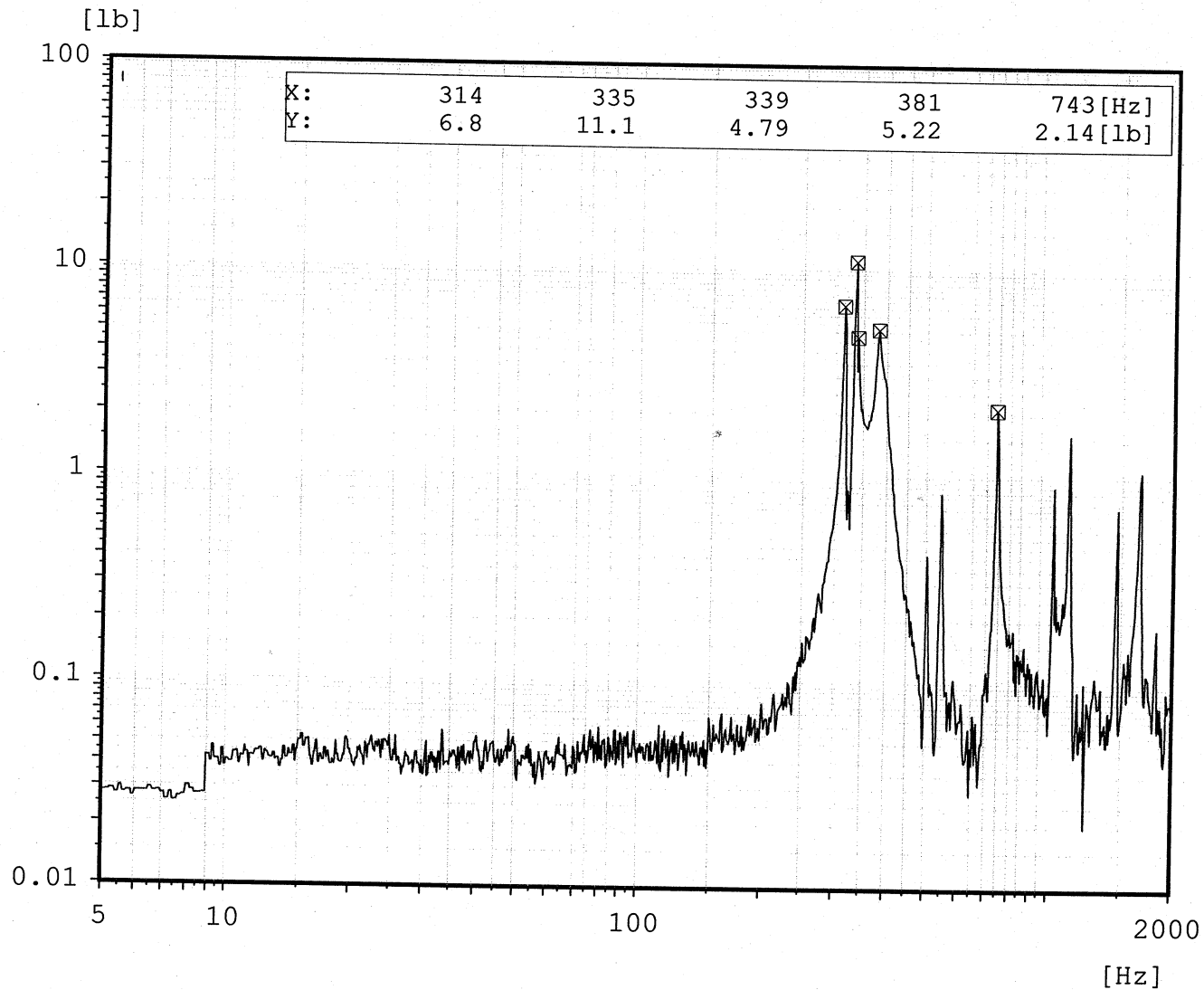
Spire BDA

P/N 10209800-2, S/N : 011

Force Sum Y

After Shake, Cold
Initial PF Test

JPL



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: 06-24-04
Time: 12:15:53

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

Sine

101530, Run 7, X axis

Spire BDA

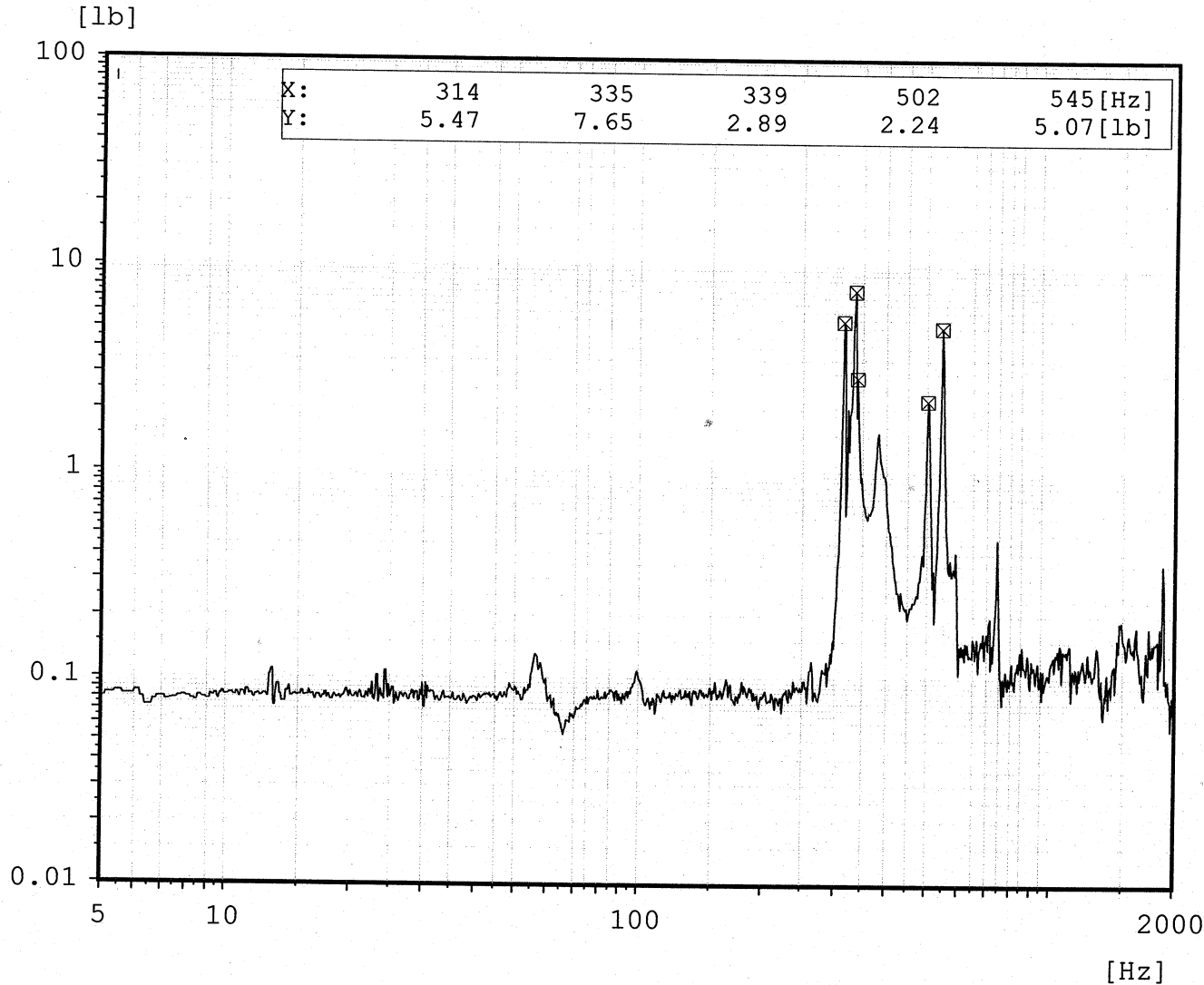
P/N 10209800-2, S/N : 011

Force Sum Z

After Shake, Cold

Initial PF Test

JPL



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: 06-24-04
Time: 12:15:53

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



ENVIRONMENTAL TEST AUTHORIZATION AND SUMMARY (ETAS)

AUTHORIZATION SECTION

PROJECT Herschel			LOG NO. HS045		
SUBSYSTEM/ASSEMBLY TITLE E PLW BDA SN019				DATE ISSUED 5/12/2005	
REFERENCE DESIGNATION NUMBER		PART NO. (IF MULTIPLE, ATTACH LIST) 10209800-2		REV. SERIAL NO. 019	
HARDWARE TYPE <input type="checkbox"/> EM QUAL <input checked="" type="checkbox"/> FLIGHT <input type="checkbox"/> FLIGHT SPARE <input type="checkbox"/> OTHER			PRE-ENVIRONMENTAL INSPECTION REPORT NUMBER (ATTACH IR)		
WIRING HARNESS <input type="checkbox"/> EM QUAL <input type="checkbox"/> FLIGHT <input type="checkbox"/> EM <input type="checkbox"/> SE			PART NO.		REV. SERIAL NO.
TEST DESCRIPTION (CHECK ALL APPLICABLE) <input type="checkbox"/> SINE VIBRATION <input type="checkbox"/> PYROSHOCK <input type="checkbox"/> ACOUSTIC <input type="checkbox"/> EMC <input type="checkbox"/> OTHER _____ <input checked="" type="checkbox"/> RANDOM VIBRATION <input checked="" type="checkbox"/> THERMAL VAC. <input type="checkbox"/> THERMAL ATMOSPHERE				TYPE OF TEST <input type="checkbox"/> QUALIFICATION <input type="checkbox"/> FLIGHT ACCEPTANCE <input checked="" type="checkbox"/> PROTO FLIGHT <input type="checkbox"/> RETEST	
WILL ALL TESTS/LEVES/DURATIONS REQUIRED BY THE PROJECT DOCUMENTS BE PERFORMED ON THIS UNIT? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) ENTER PROJ. DOC. NO. AND REV. _____					
HAS THE UNIT PASSED ALL PRE-ENVIRONMENTAL FUNCTIONAL TESTS? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION					
HAVE ALL DESIGN ANALYSES BEEN COMPLETED AND REQUIRED CHANGES BEEN IMPLEMENTED? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION					
IS THE TEST ARTICLE IDENTICAL TO OTHER FLIGHT UNITS? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION					
ARE ALL PFRs AGAINST THIS UNIT CLOSED? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION					
HAVE ALL WAIVERS AND ECRs BEEN APPROVED AND ARE THEY INCORPORATED? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION					

TEST AUTHORIZED BY

COGNIZANT ENGINEER <i>[Signature]</i>	DATE	TECHNICAL MGR./INSTR MRG./PI PREP REP <i>[Signature]</i>	DATE 6/20/05	ENVIRONMENTAL REQUIREMENTS ENG. <i>[Signature]</i>	DATE 6-20-05
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SUMMARY SECTION

TEST AGENCY (IF MULTIPLE, ATTACH SUMMARY AND TEST DATES) JPL Building 144	TEST INITIATION DATE 05/23/05	ACCUMULATED OPERATING HOURS PRIOR TO FIRST ENVIRONMENTAL TEST
SERIAL NUMBERS ACTUALLY TESTED 019	TEST TERMINATION DATE	OPERATING HOURS DURING ENVIRONMENTAL EXPOSURE

TEST DESCRIPTION

VIBRATION AXES: X Y Z SINE VIBRATION <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> RANDOM VIBRATION <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	ACOUSTIC <input type="checkbox"/>	PYROSHOCK SHOCK AXES: X Y Z <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> SHOCKS/AXIS:	<input checked="" type="checkbox"/> THERMAL VACUUM PRESSURE: <1E-5 mbar, 290K to 7K NO OF CYCLES: 2	<input type="checkbox"/> TEMPERATURE ATMOSPHERE NO OF CYCLES: _____	<input type="checkbox"/> OTHER
EMC <input type="checkbox"/> ESD	<input type="checkbox"/> COND. SUSC. <input type="checkbox"/> RAD. SUSC.	<input type="checkbox"/> COND. EMIS. <input type="checkbox"/> RAD. EMIS.	<input type="checkbox"/> ISOLATION <input type="checkbox"/> MAGNETICS	TEMP. LEVEL (°c) AND ACCUMULATED DURATION (HRS.) HOT: _____ °c, _____ h COLD: _____ °c, _____ h HOT: _____ °c, _____ h COLD: _____ °c, _____ h	
WERE THERE ANY PFRs GENERATED DURING ENVIRONMENTAL TESTS? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST)			LIST PFR NOS. / BRIEF EXPLANATION		
ARE THE POST ENVIRONMENTAL DAMAGE INSPECTIONS COMPLETE? <input checked="" type="checkbox"/> YES <input type="checkbox"/> 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? <input checked="" type="checkbox"/> YES <input type="checkbox"/> 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
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HARDWARE HAS SUCCESSFULLY COMPLETED THE ENVIRONMENTAL TESTS LISTED ON THIS FORM OR REMAINING ACTIONS HAVE BEEN TAKEN, INCLUDING RETEST.					
COGNIZANT ENGINEER <i>[Signature]</i>	DATE 7-14-05	TECHNICAL MGR./INSTR MRG./PI PREP REP <i>[Signature]</i>	DATE	ENVIRONMENTAL REQUIREMENTS ENG. <i>[Signature]</i>	DATE 7-14-2005

ENVIRONMENTAL TEST AUTHORIZATION AND SUMMARY (ETAS)

OTHER AUTHORIZATION PROVISIONS AND EXPLANATIONS

This 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.

European Flight acceptance Level (-2db)



**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
BDA (10209800)	19	45	<p>Lateral Axis, Flight acceptance -2db</p> <p>20 Hz 0.0076 g² / Hz 20-100 Hz + 3 dB / Oct. 100-138.5 Hz 0.038 g² / Hz 138.5-170 + 36 dB / Oct. 170-200 0.44 g² / Hz 200-220 - 61.46 dB / Oct. 220-300 0.063 g² / Hz 300-2000 - 9 dB / Oct. 2000 0.000189 g² / Hz</p> <p>Overall 6.31 grms</p> <p>Each axis 1/4 g sine sweep 20-2000 Hz each axis T ~ 100 K</p> <p>2 Thermal cycles from 290K to 7K</p>				

Sine

101751, Run # 3, X axis

SPIRE BDA

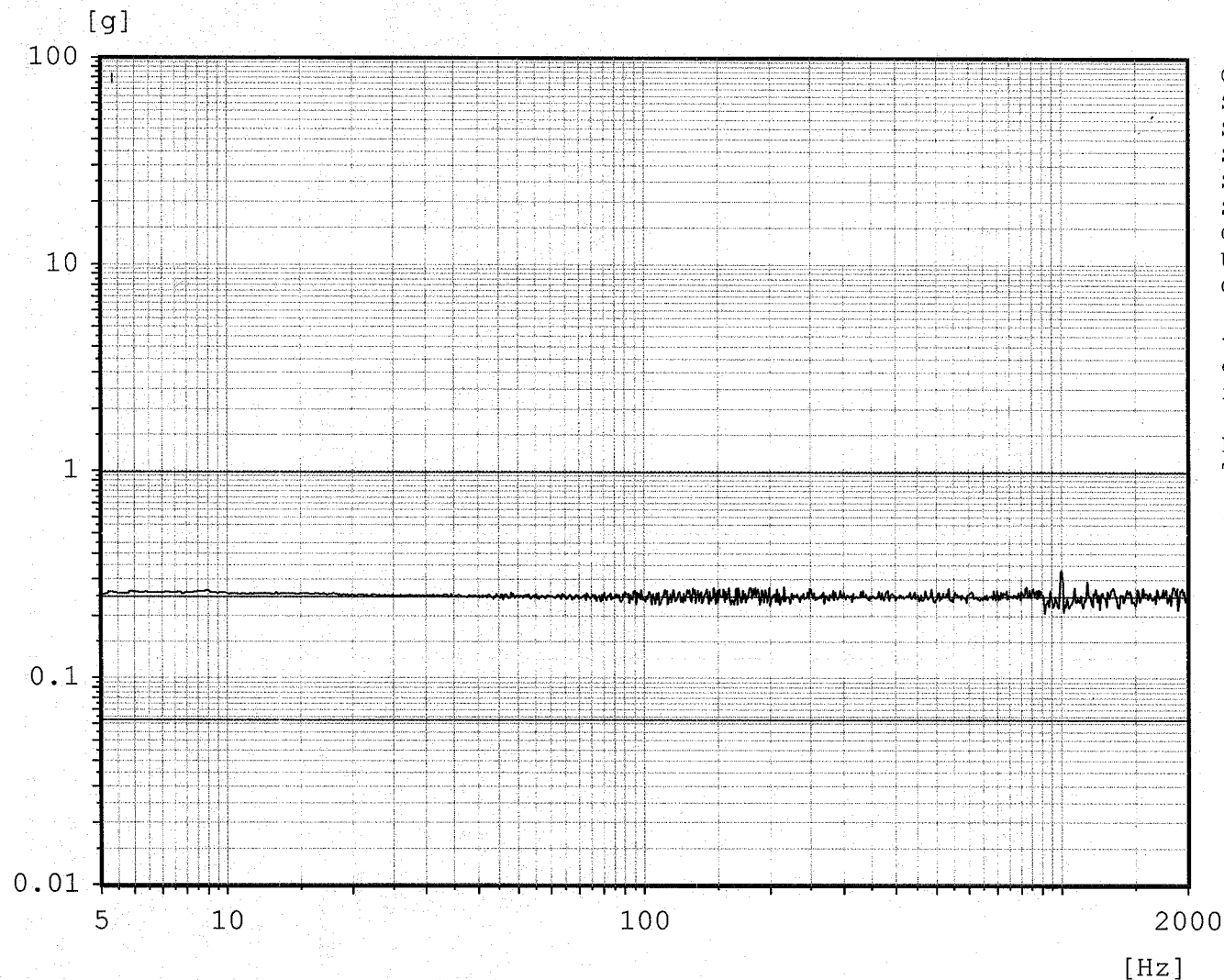
P/N 10209800-, S/N : 019

Control channel

Before Shake, Cold

FA Test

JPL



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: 06-22-05
Time: 13:56:02

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

Sine

101751, Run # 3, X axis

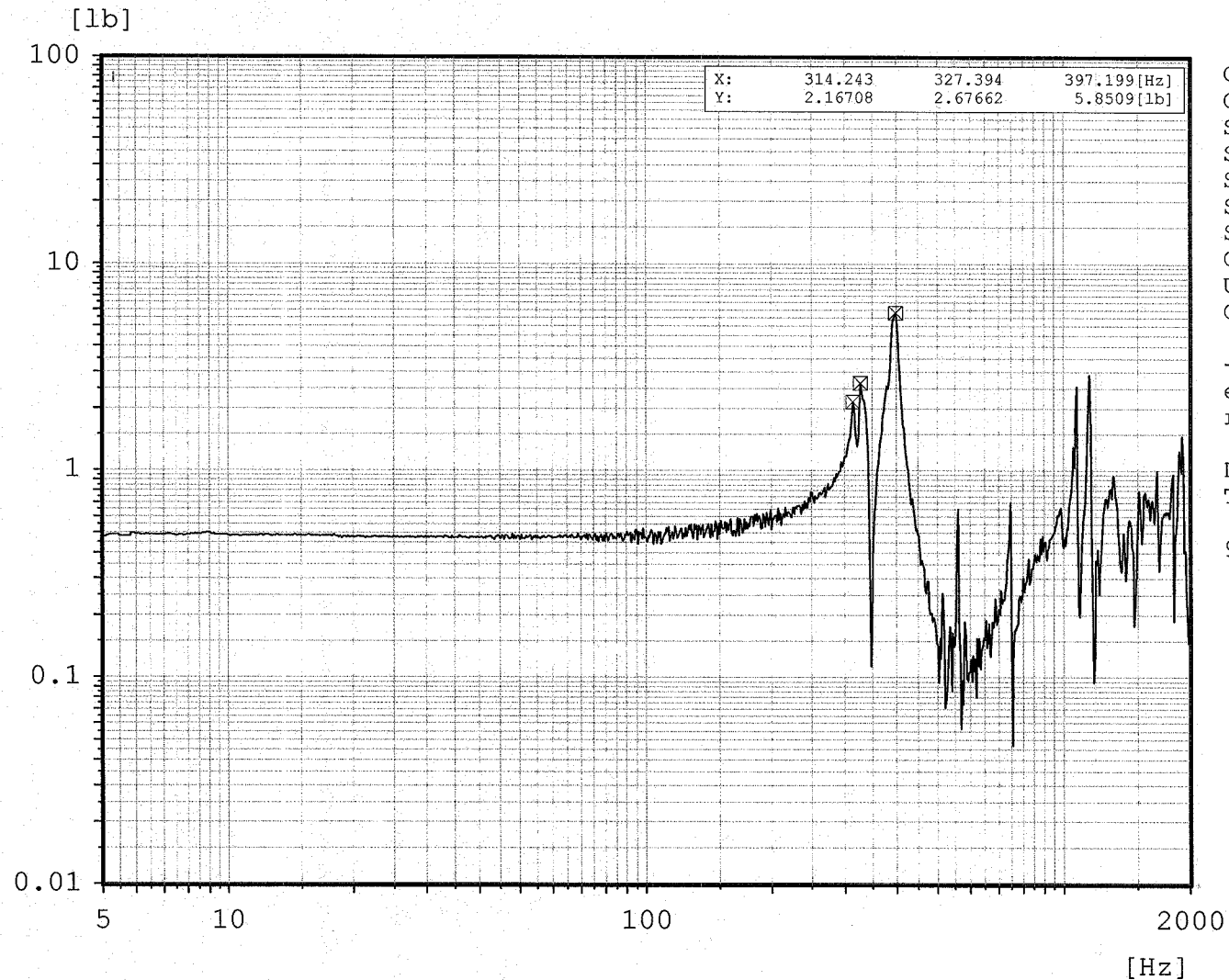
SPIRE BDA

P/N 10209800-, S/N : 019

Force Sum X

Before Shake, Cold
FA Test

JPL



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: 06-22-05
Time: 13:56:02

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

Sine

101751, Run # 3, X axis

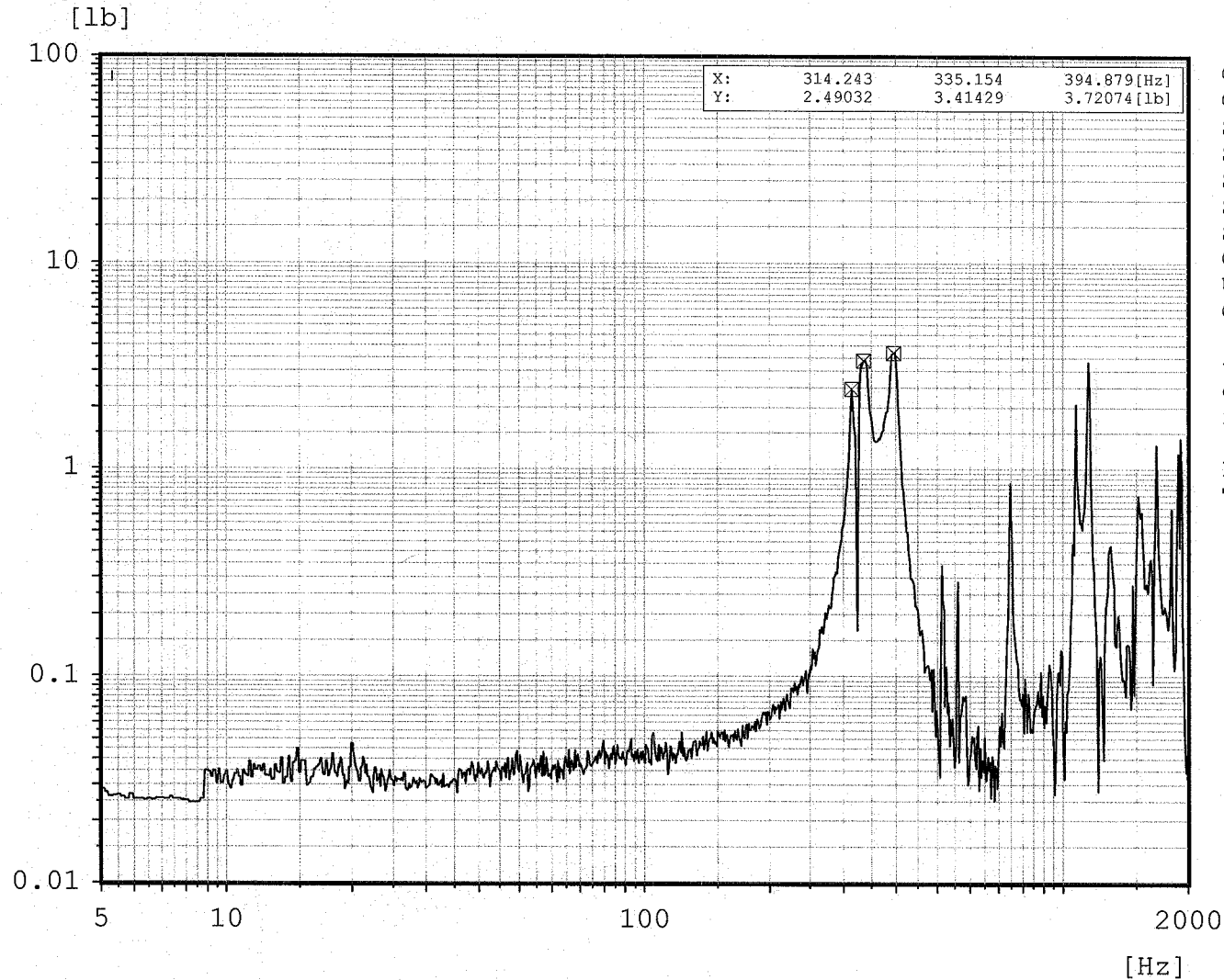
SPIRE BDA

P/N 10209800-, S/N : 019

Force Sum Y

Before Shake, Cold
FA Test

JPL



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: 06-22-05
Time: 13:56:02

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

Sine

101751, Run # 3, X axis

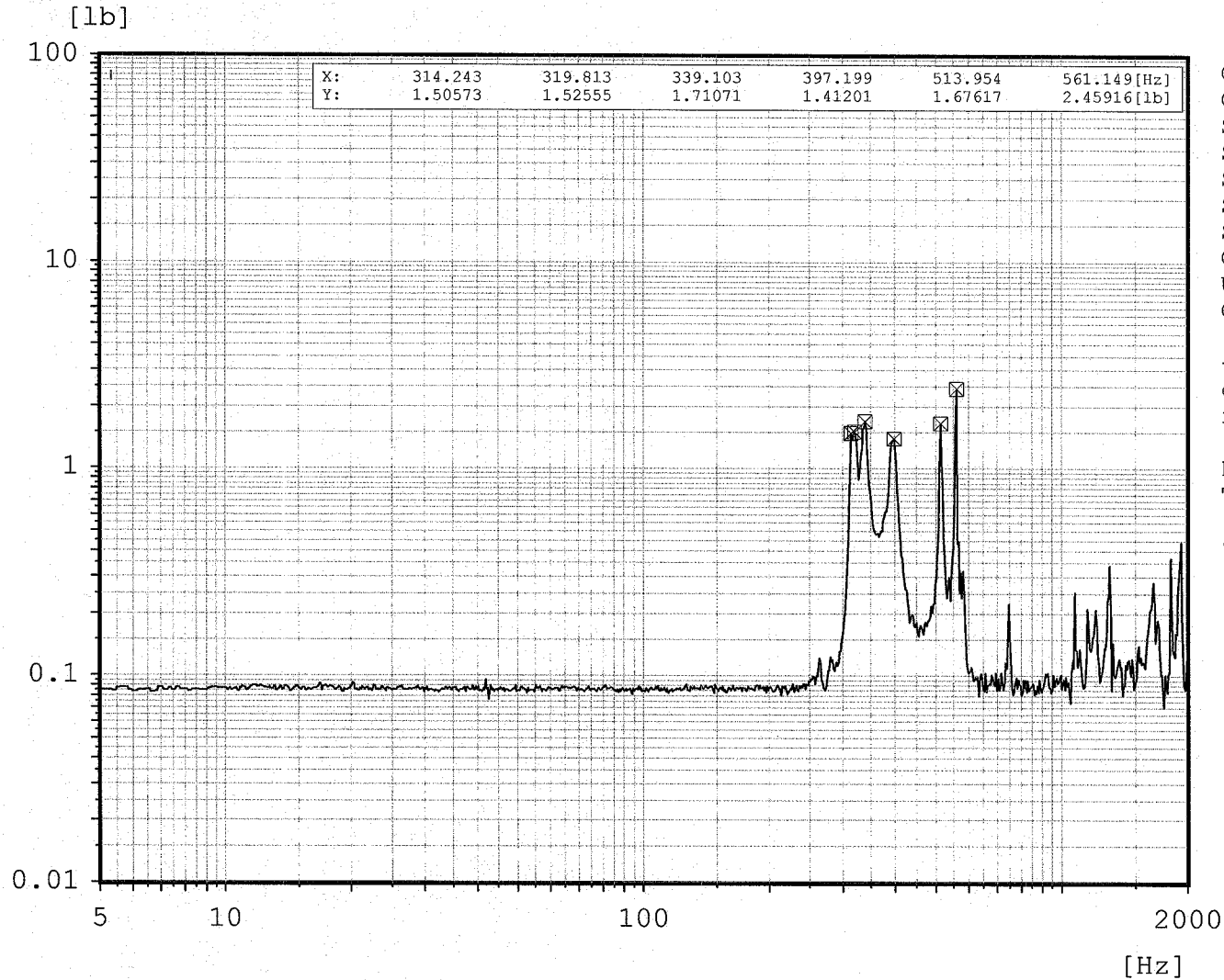
SPIRE BDA

P/N 10209800-, S/N : 019

Force Sum Z

Before Shake, Cold
FA Test

JPL



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: 06-22-05
Time: 13:56:02

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

Random

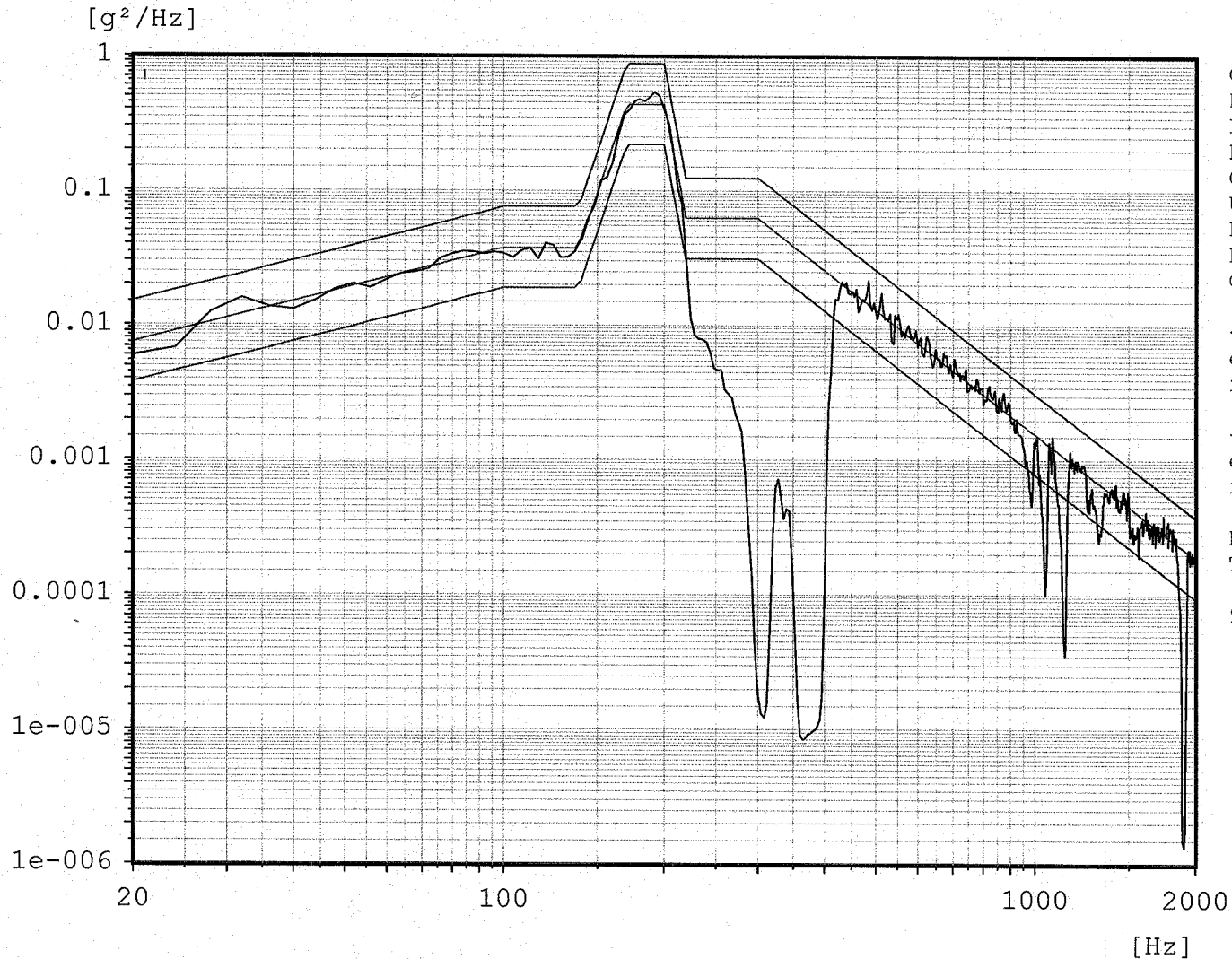
101751, Run # X axis

SPIRE BDA

P/N 10209800-, S/N : 019

Control channel

0dB, Cold
FA Test



Chan.type: X
DOF: 180
Level: 0.0 dB
Resolution: 4 Hz
Contr.strat.: Maximum
Unit: g²/Hz
RMS (act.): 5.558 g
RMS (req.): 6.305 g
Contr.strat.: Closed loop

-- Time on act. level --
elapsed: 000:02:00
remaining: 000:00:00

-- Time total --
elapsed: 000:03:17
remaining: 000:00:00

Date: 06-22-05
Time: 14:31:41

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

Random

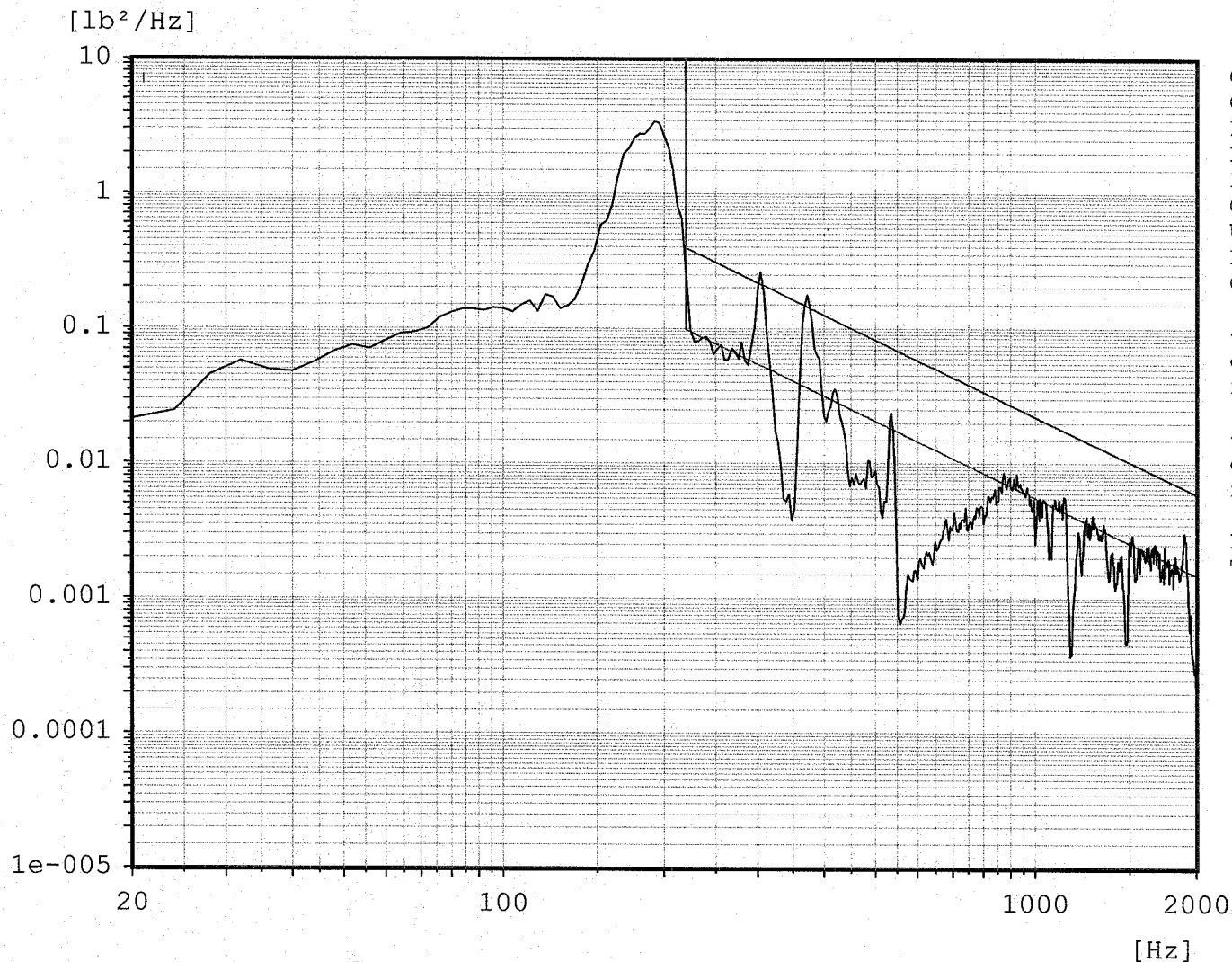
101751, Run # X axis

SPIRE BDA

P/N 10209800-, S/N : 019

Force Sum X

0dB, Cold
FA Test



Chan.no: 6
Chan.type: W
DOF: 90
Level: 0.0 dB
Resolution: 4 Hz
Contr.strat.: Maximum
Unit: lb²/Hz
RMS (act.): 13.1 lb
Contr.strat.: Closed loop

-- Time on act. level --
elapsed: 000:02:00
remaining: 000:00:00

-- Time total --
elapsed: 000:03:17
remaining: 000:00:00

Date: 06-22-05
Time: 14:31:41

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

Random

101751, Run # X axis

SPIRE BDA

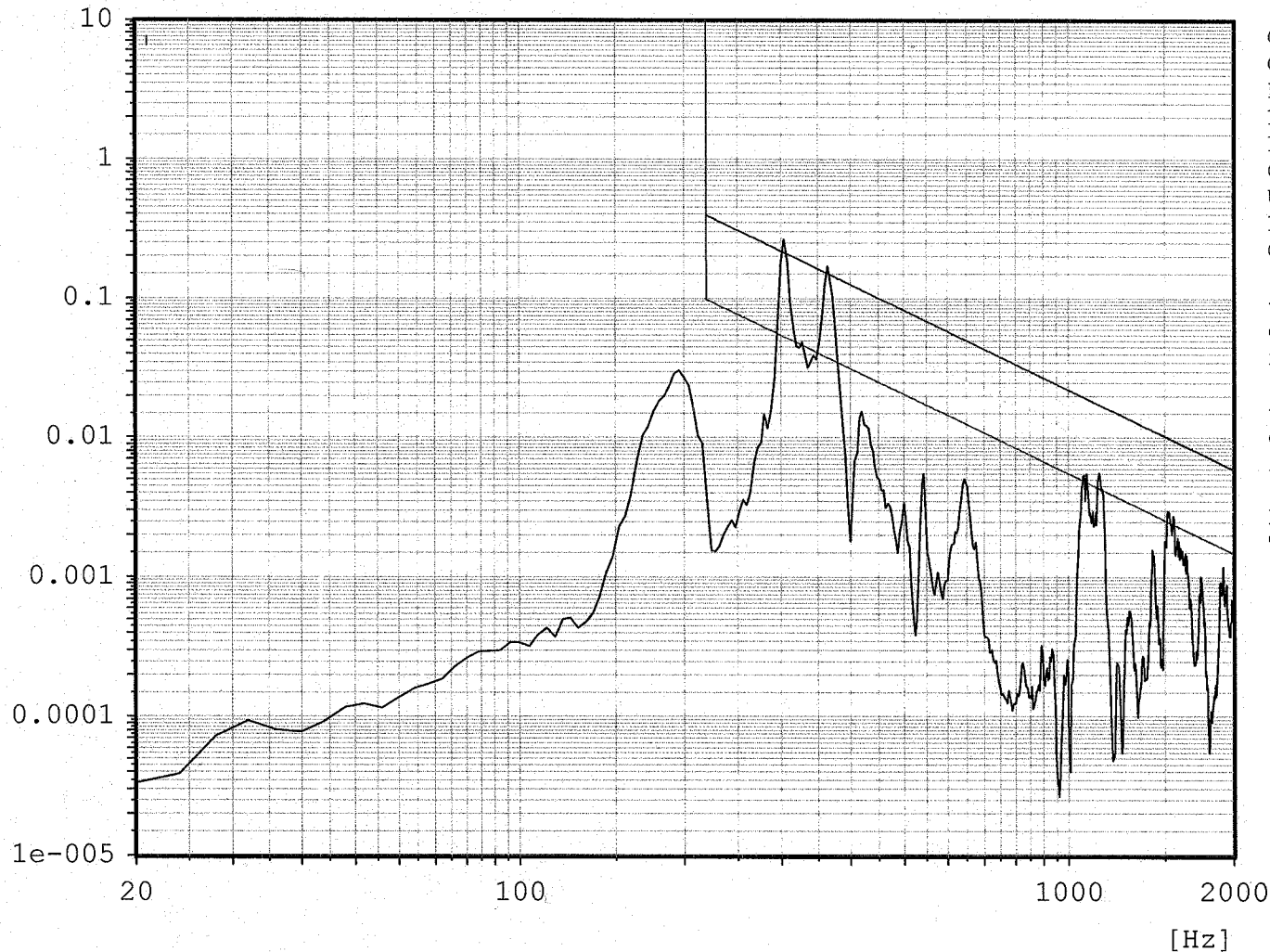
P/N 10209800-, S/N : 019

Force Sum Y

0dB, Cold
FA Test



[lb²/Hz]



Chan.no: 7
Chan.type: W
DOF: 90
Level: 0.0 dB
Resolution: 4 Hz
Contr.strat.: Maximum
Unit: lb²/Hz
RMS (act.): 3.421 lb
Contr.strat.: Closed loop

-- Time on act. level --
elapsed: 000:02:00
remaining: 000:00:00

-- Time total --
elapsed: 000:03:17
remaining: 000:00:00

Date: 06-22-05
Time: 14:31:41

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

Random

101751, Run # X axis

SPIRE BDA

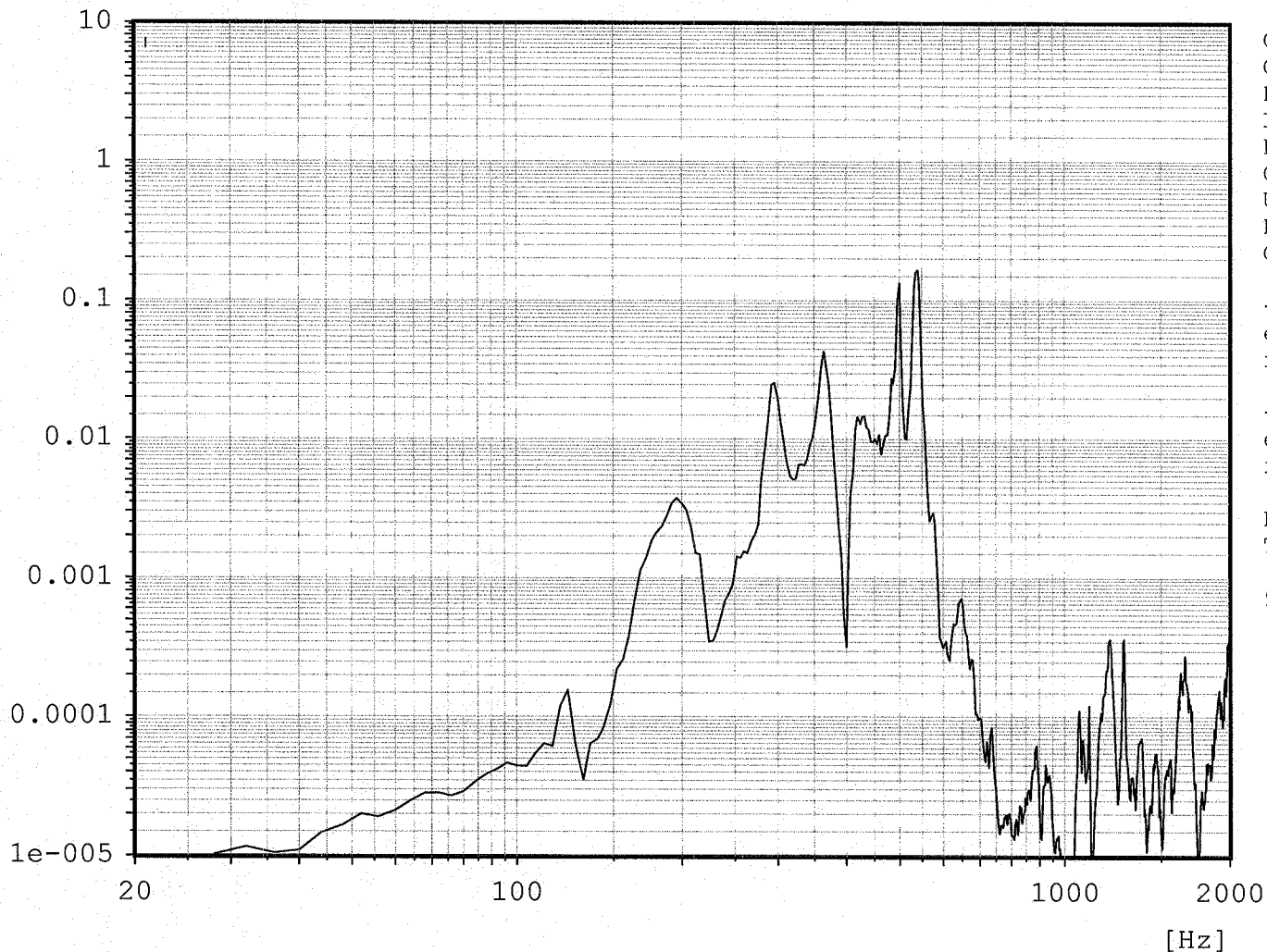
P/N 10209800-, S/N : 019

Force Sum Z

0dB, Cold
FA Test



[lb²/Hz]



Chan.no: 8
Chan.type: W
DOF: 90
Level: 0.0 dB
Resolution: 4 Hz
Contr.strat.: Maximum
Unit: lb²/Hz
RMS (act.): 2.735 lb
Contr.strat.: Closed loop

-- Time on act. level --
elapsed: 000:02:00
remaining: 000:00:00

-- Time total --
elapsed: 000:03:17
remaining: 000:00:00

Date: 06-22-05
Time: 14:31:41

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

Sine

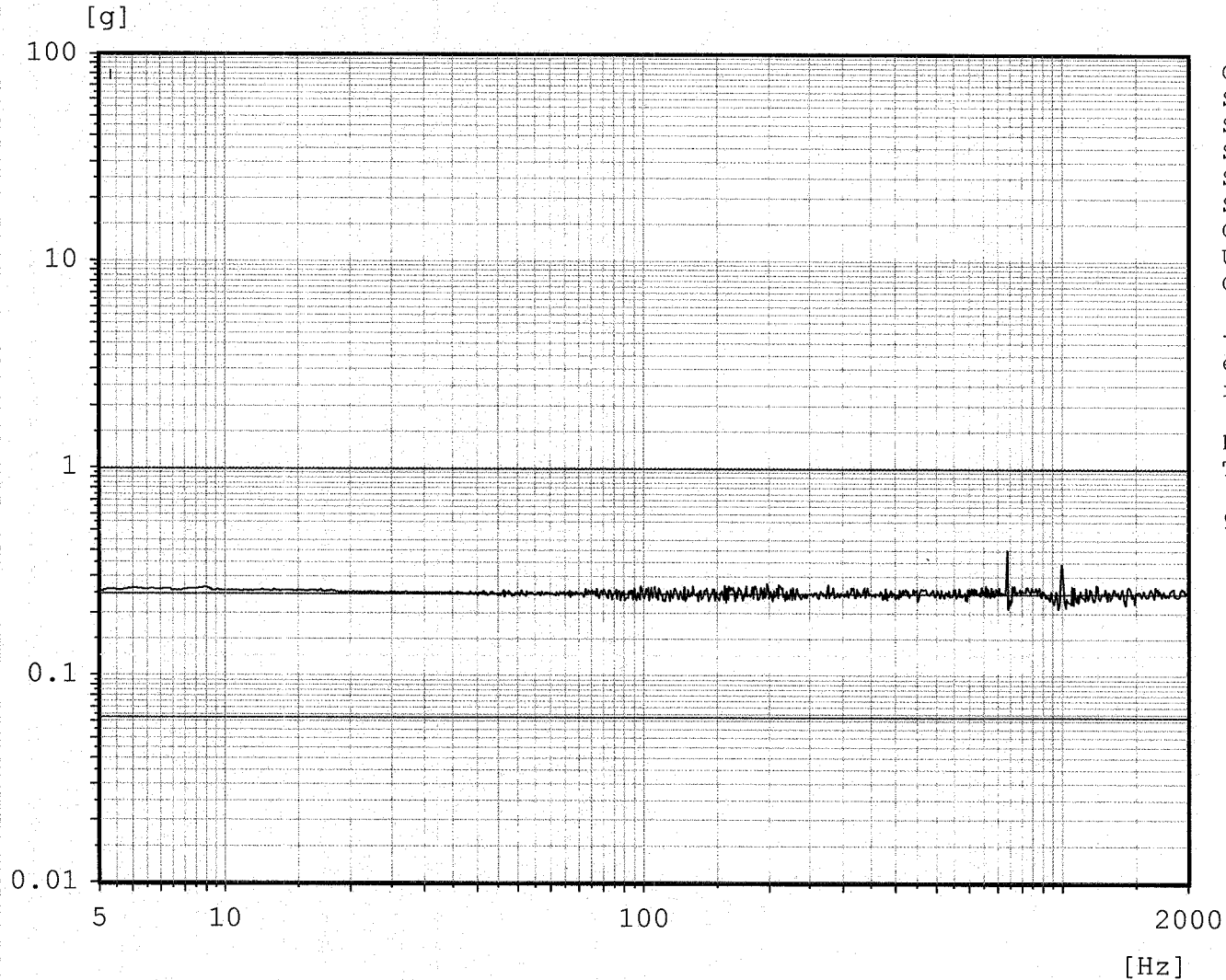
101751, Run # 5, X axis

SPIRE BDA

P/N 10209800-, S/N : 019

Control channel

After Shake, Cold
FA Test



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: 06-22-05
Time: 14:41:11

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

Sine

101751, Run # 5, X axis

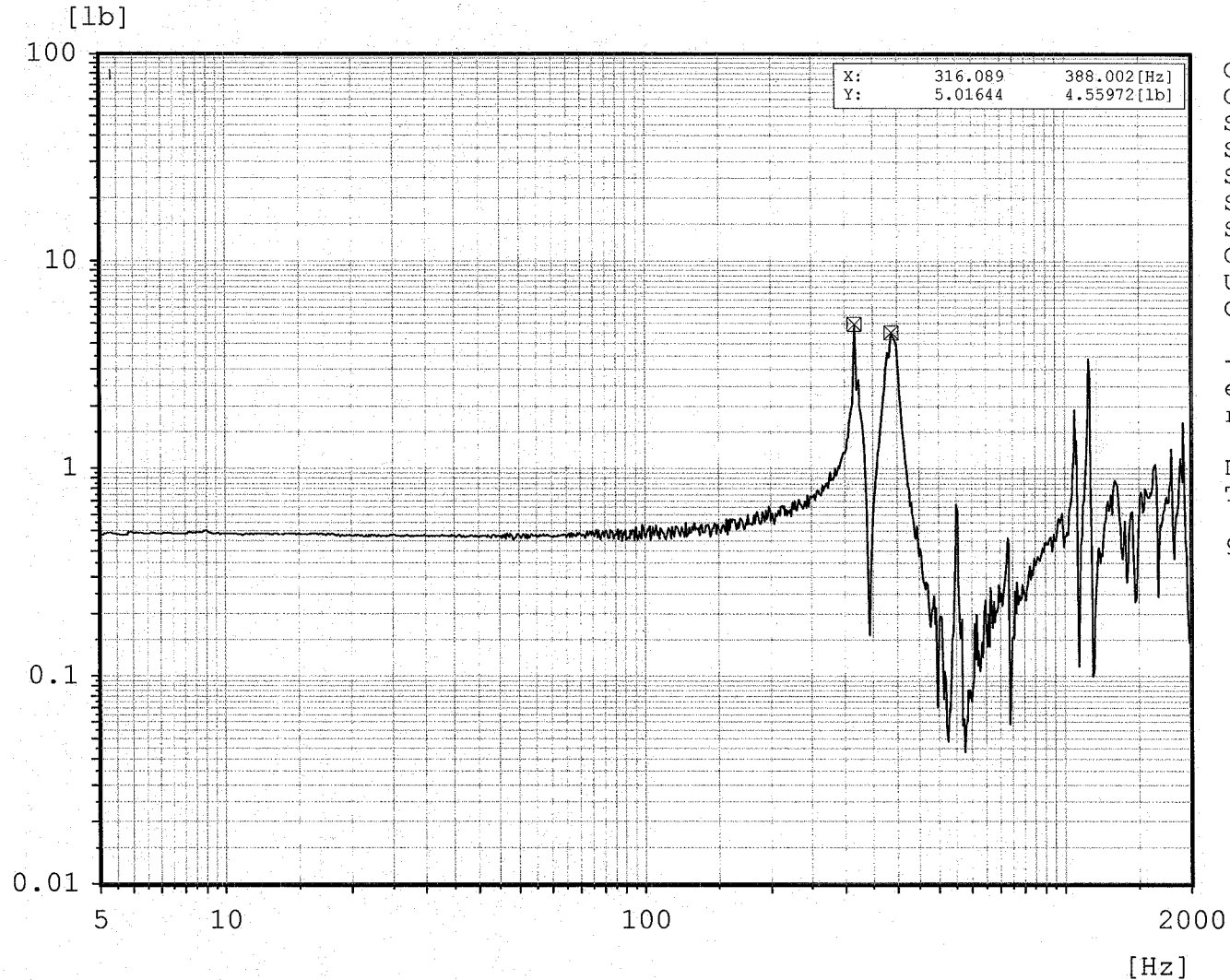
SPIRE BDA

P/N 10209800-, S/N : 019

Force Sum X

After Shake, Cold
FA Test

JPL



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: 06-22-05
Time: 14:41:11

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

Sine

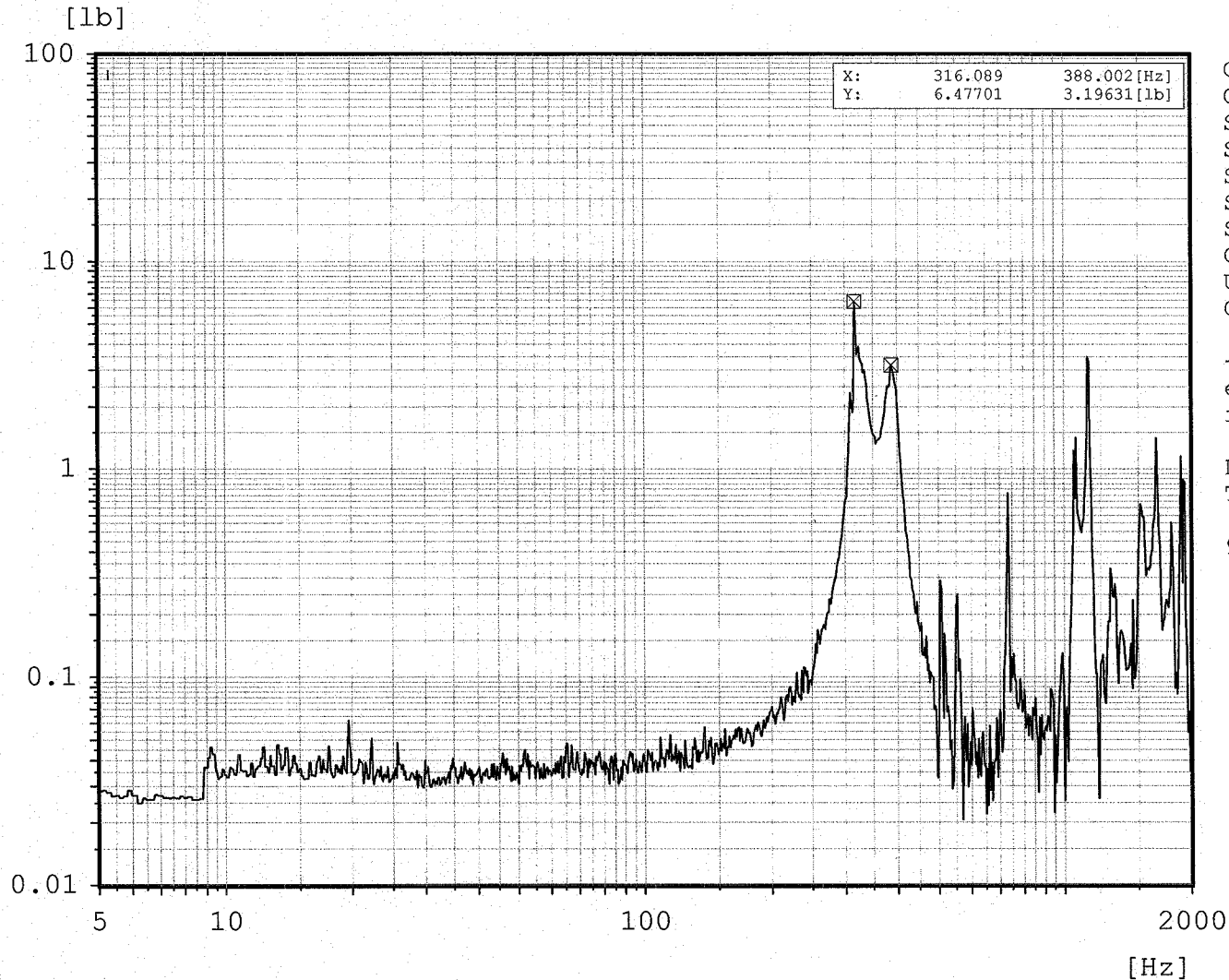
101751, Run # 5, X axis

SPIRE BDA

P/N 10209800-, S/N : 019

Force Sum Y

After Shake, Cold
FA Test



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: 06-22-05
Time: 14:41:11

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

Sine

101751, Run # 5, X axis

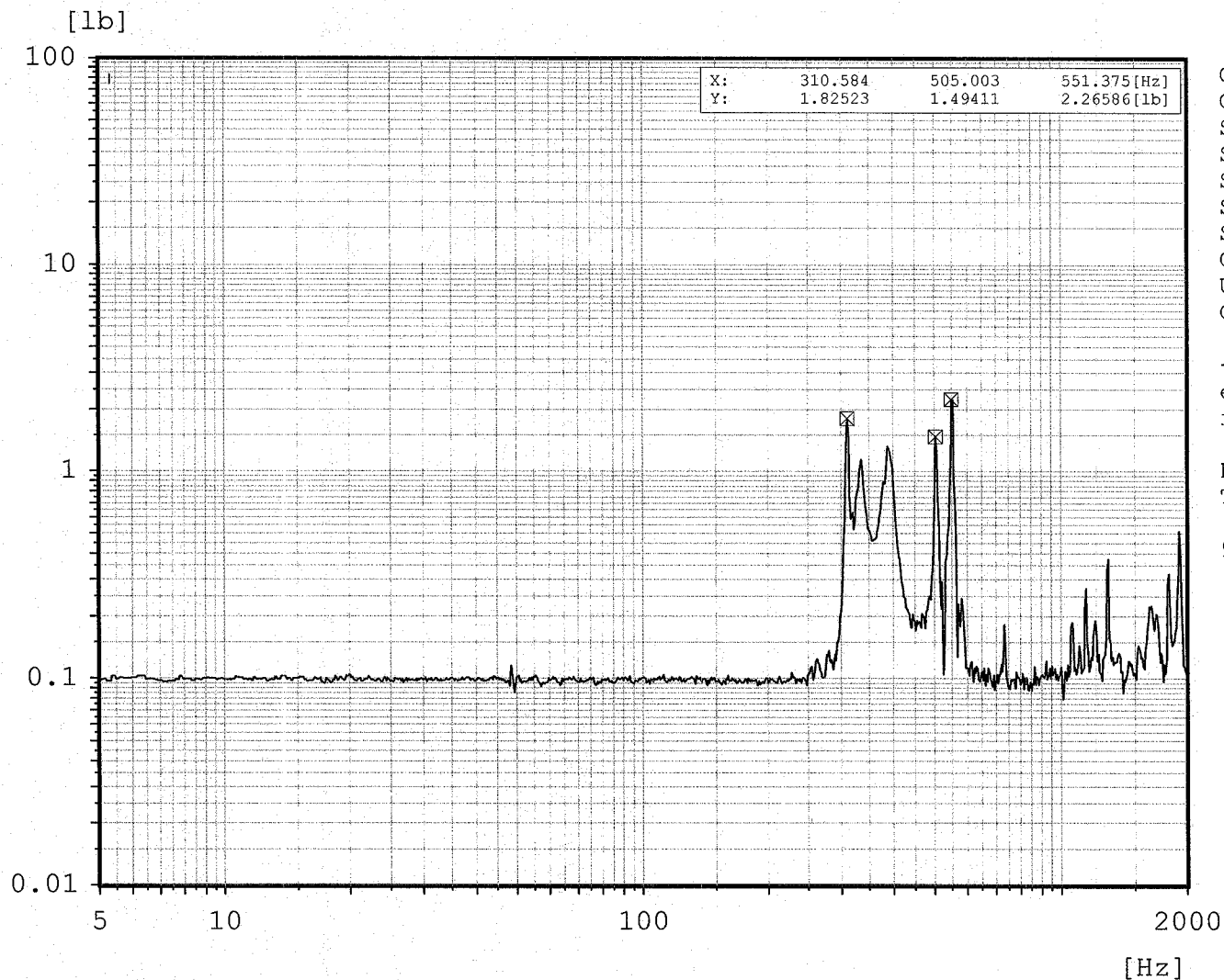
SPIRE BDA

P/N 10209800-, S/N : 019

Force Sum Z

After Shake, Cold

FA Test



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: 06-22-05
Time: 14:41:11

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

PERFORMANCE VERIFICATION MATRIX - FS PMW BDA - 10209800-2 S/N 019

BDA Performance

Item	D. Value	Min Perf	Measured Median	Unit	Reference	Note
Number of bad optical pixels	= 9	= 22	1		BDA-PER-01	F5 noisy
$(NEP_{\text{photon}}/NEP_{\text{total}})^2$ (derived)	> 0.63	> 0.53	0.642		BDA-PER-02	at 20 mV bias
Optical efficiency*	> 0.85	> 0.65	0.661		BDA-PER-03	
Detector time constant	< 13	< 32	3.787	ms	BDA-PER-06	at 20 mV bias
Vmax***	< 11***		10.7	mV	BDA-DRCU-22	max over dark array
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	55.5	mHz	BDA-PER-10	at 21.2 mVrms bias
Average conducted heat load from 1.7 K	< 1.6	< 3.0	< 3.4	uW	BDA-TEC-06	

BDA Design Values (at 300 mK)

Item	Target	Measured Median	Unit	Reference	Note
R0	180.0	103.1	Ohms	BDA-SSSD	
Delta	41.8	41.6	K	BDA-SSSD	
R300	24.0	13.5	MOhms	BDA-SSSD	
G300	53.0	72.9	pW/K	BDA-SSSD	
Beta	1.50	1.57		BDA-SSSD	
C300	1.00	0.38	pJ/K	BDA-SSSD	
Rlr	10.0	11.3	MOhms	BDA-SSSD	room temp
Dark Sdc	5.9	5.0	e8 V/W	BDA-SSSD	at 20.1 mV bias
Dark NEP (model) incl 10 nV/rtHz amp. noise		3.4	e-17 W/rtHz	derived	at 20.1 mV bias
Dark NEP (1 Hz), incl 10 nV/rtHz amp. noise	3.5	3.1	e-17 W/rtHz	derived	at 20.1 mV bias
Dark NEP (0.1 Hz), incl 10 nV/rtHz amp. noise	3.5	4.0	e-17 W/rtHz	derived	at 20.1 mV bias
Vmax	5.8	5.1	mVrms	BDA-SSSD	median over dark array
BDA temperature rise from 1.7 K	< 10	12	mK	BDA-HCO-1	
BDA thermal time constant	~ 100	100	s	BDA-HCO-2	

*assumes $v_{\text{lower}} = 1.02 v_{\text{cutoff}}$

**not tested

***other channels saturate as follows

T1 BoDAC dead

T2 saturates at 35.8 mV bias at 300 mK

R1 saturates at 47.6 mV bias

R2 saturates at 47.1 mV bias

Problem channels

	Pixel	Diagnosis	Pixel functional at			Notes
			300 K	4 K	0.3 K	
	F4	BoDAC not working	Yes	?	N/M	
	T1	BoDAC not working	Yes	?	N/M	
	D7	Dead LIA	Yes	Yes	Yes	No noise data available
	F5	Noisy BDA Channel	Yes	Yes	Yes	Counted as dead pixel. "Thin edge NTD chip" noted in optical inspection report.
	E13	Moderate 1/f noise	Yes	Yes	Yes	BoDAC (use 137 Hz bias data instead)
	A12	Excess noise at 1 Hz	Yes	Yes	Yes	BoDAC (use 137 Hz bias data instead)
	B10	Moderate 1/f noise	Yes	Yes	Yes	BoDAC (noisy on PSW-FS, PLW-FS, SSW-FS)
	G4	Moderate 1/f noise	Yes	Yes	Yes	Diagnosis unknown. Noise accounted in BDA
	B6	Slight 1/f noise	Yes	Yes	Yes	Diagnosis unknown. Noise accounted in BDA
	A2	Slight 1/f noise	Yes	Yes	Yes	Diagnosis unknown. Noise accounted in BDA
	A1	Slight 1/f noise	Yes	Yes	Yes	Diagnosis unknown. Noise accounted in BDA
	A9	Slight 1/f noise	Yes	Yes	Yes	Diagnosis unknown. Noise accounted in BDA
	B8	Slight 1/f noise	Yes	Yes	Yes	Diagnosis unknown. Noise accounted in BDA
	E3	Slight 1/f noise	Yes	Yes	Yes	Diagnosis unknown. Noise accounted in BDA
	D8	Ni liftoff problem on pixel	Yes	Yes	Yes	No performance degradation evident
	C8	Ni liftoff problem on pixel	Yes	Yes	Yes	No performance degradation evident
	B7	Ni liftoff problem on pixel	Yes	Yes	Yes	No performance degradation evident
	A10	Different NTD lot (15-12)	Yes	Yes	Yes	No performance degradation evident
	A11	Different NTD lot (15-12)	Yes	Yes	Yes	No performance degradation evident
	A12	Different NTD lot (15-12)	Yes	Yes	Yes	No performance degradation evident
	A13	Different NTD lot (15-12)	Yes	Yes	Yes	No performance degradation evident

Pixel Performance										
Item	DV	MP								
BDA connector			J01	J01	J01	J01	J01	J01	J01	J01
BDA pins			1,26	2,27	3,28	4,29	5,30	6,31	7,32	8,33
BoDAC Connector			5	5	5	5	5	5	5	5
Channel ID			1	2	3	4	5	6	7	8
Detector ID			A7	A6	B6	C7	A5	B5	C6	D6
BDA Pixel Operability			Yes	Yes	Slight 1/f	Yes	Yes	Yes	Yes	Yes
BoDAC channel Operability	N/A	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Noisy BoDAC channel	N/A	N/A	No	No	No	No	No	No	No	No
(NEP _{photon} /NEP _{total}) ² (derived)	> 0.63	> 0.53	0.63	0.62	0.63	0.61	0.64	0.64	0.66	0.62
Optical efficiency*	> 0.85	> 0.65	0.64	0.64	0.63	0.66	0.67	0.66	0.67	0.64
Detector time constant	< 13	< 32	4.22	4.64	4.41	3.27	4.15	3.08	3.79	4.14
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	9	50	96	59	66	43	64	75
Pixel Design Values										
Item	Target									
R0	180.0	83.10	94.95	106.48	78.69	93.95	129.33	124.75	92.95	
Delta	41.8	42.12	40.40	39.98	41.27	41.93	41.12	41.46	40.81	
G300	53	72.59	70.69	68.07	72.46	69.19	81.71	72.89	68.96	
Beta	1.5	1.57	1.57	1.52	1.56	1.60	1.62	1.56	1.56	
C300	1.00	0.42	0.45	0.41	0.32	0.40	0.34	0.38	0.39	
Gamma	1 (fixed)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
R300	24.1	11.6	10.4	11.0	9.8	12.8	15.7	15.9	10.8	
Rlr+	10.00	11.34	11.41	11.4	11.46	11.44	11.44	11.46	11.48	
Rlr-	10.00	11.44	11.48	11.48	11.52	11.56	11.55	11.54	11.56	
Dark Sdc	5.9	4.8	4.6	4.7	4.5	5.0	5.0	5.3	4.7	
Dark NEP (model), incl 10 nV/rtHz amp. noise	3.5	3.44	3.47	3.40	3.51	3.35	3.54	3.36	3.41	
Dark NEP (1 Hz)****, incl 10 nV/rtHz amp. noise	3.5	3.25	3.77	3.19	3.81	4.74	3.04	2.95	3.09	
Dark NEP (0.1 Hz)***, incl 10 nV/rtHz amp. noise	3.5	4.06	4.88	5.23	3.47	4.86	4.23	4.16	4.81	
Vmax	10.3	4.70	4.45	4.50	4.33	4.84	5.87	5.54	4.47	
*assumes vlower = 1.02 vcutoff										
**not tested										
***takes best data between 147 Hz and 149 Hz bias - see Mather_Dark for further information										

Pixel Performance										
Item										
BDA connector	J01	J01	J01	J01	J01	J01	J01	J01	J01	J01
BDA pins	9,34	10,35	11,36	12,37	13,38	14,39	15,40	16,41	17,42	18,43
BoDAC Connector	5	5	5	5	5	5	5	5	5	5
Channel ID	9	10	11	12	13	14	15	16	17	18
Detector ID	B4	C5	D4	A4	C4	B3	C3	B2	D2	A3
BDA Pixel Operability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BoDAC channel Operability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Noisy BoDAC channel	No	No	No	No	No	No	No	No	No	No
(NEPphoton/NEPtotal) ² (derived)	0.65	0.62	0.61	0.65	0.62	0.68	0.64	0.67	0.65	0.66
Optical efficiency*	0.65	0.69	0.68	0.60	0.63	0.62	0.64	0.60	0.66	0.62
Detector time constant	2.50	4.39	3.94	3.54	3.74	3.14	4.05	3.49	4.03	3.58
Calibration uniformity**	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
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
1/f knee frequency***	9	54	66	55	63	28	46	9	9	71
Pixel Design Values										
Item										
R0	98.69	80.78	88.33	117.79	103.05	182.50	103.13	136.17	94.99	124.59
Delta	42.65	41.99	40.92	41.48	40.30	40.99	41.34	42.16	42.80	42.19
G300	71.34	74.48	74.66	72.73	72.29	74.33	72.90	75.96	75.40	75.36
Beta	1.57	1.56	1.57	1.58	1.55	1.55	1.56	1.58	1.55	1.60
C300	0.25	0.44	0.40	0.35	0.37	0.31	0.40	0.36	0.41	0.37
Gamma	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
R300	14.9	11.1	10.4	15.1	11.1	21.8	12.9	19.2	14.6	17.6
Rlr+	11.49	11.52	11.52	11.56	11.6	11.61	11.64	11.64	11.68	11.75
Rlr-	11.6	11.64	11.64	11.72	11.52	11.72	11.76	11.8	11.8	11.84
Dark Sdc	5.2	4.7	4.5	5.2	4.7	5.8	5.0	5.6	5.2	5.5
Dark NEP (model), incl 10 nV/rtHz amp. noise	3.33	3.49	3.53	3.37	3.47	3.31	3.41	3.35	3.40	3.37
Dark NEP (1 Hz)****, incl 10 nV/rtHz amp. noise	2.92	3.70	3.22	2.98	3.10	3.13	2.90	2.80	3.39	3.22
Dark NEP (0.1 Hz)***, incl 10 nV/rtHz amp. noise	4.25	4.49	3.88	3.47	3.80	3.98	4.13	4.00	3.33	4.83
Vmax	5.25	4.65	4.56	5.39	4.66	6.56	5.00	6.18	5.34	5.90
*assumes vlower = 1.02 vcutoff										
**not tested										
***takes best data between 147 Hz and 149 Hz bias										

Pixel Performance										
Item										
BDA connector	J01	J01	J01	J01	J01	J01	J02	J02	J02	J02
BDA pins	19,44	20,45	21,46	22,47	23,48	24,49	1,26	2,27	3,28	4,29
BoDAC Connector	5	5	5	5	5	5	2	2	2	2
Channel ID	19	20	21	22	23	24	1	2	3	4
Detector ID	A2	C2	B1	A1	DK1	C1	E7	D7	F7	E8
BDA Pixel Operability	Slight 1/f	Yes	Yes	Slight 1/f	Yes	Yes	Yes	Yes	Yes	Yes
BoDAC channel Operability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Noisy BoDAC channel	No	No	No	No	No	No	No	Dead LIA	No	No
(NEPphoton/NEPtotal) ² (derived)	0.64	0.68	0.67	0.64	0.61	0.64	0.68	0.65	0.65	0.65
Optical efficiency*	0.60	0.60	0.63	0.59	0.02	0.66	0.61	0.66	0.64	0.63
Detector time constant	3.88	3.84	3.82	3.80	3.44	3.76	3.42	3.92	3.32	3.59
Calibration uniformity**	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
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
1/f knee frequency***	114	9	38	44	63	9	62	N/M	87	61
Pixel Design Values										
Item										
R0	111.49	160.78	125.63	86.08	86.32	92.67	161.77	91.47	114.35	99.73
Delta	41.01	41.52	42.59	42.80	40.81	41.69	41.91	42.71	42.00	42.33
G300	71.41	73.25	71.64	73.26	71.26	71.17	71.43	70.44	76.49	74.44
Beta	1.56	1.55	1.53	1.58	1.50	1.57	1.56	1.61	1.60	1.58
C300	0.38	0.38	0.37	0.38	0.33	0.36	0.33	0.38	0.34	0.36
Gamma	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
R300	13.3	20.7	18.8	13.3	10.0	12.2	22.0	13.9	15.7	14.4
Rlr+	11.77	11.81	11.84	11.88	11.92	11.95	11.76	11.76	11.68	11.71
Rlr-	11.88	11.9	11.92	12	12.04	12.04	11.74	11.78	11.79	11.81
Dark Sdc	5.1	5.8	5.7	5.1	4.6	5.0	6.0	5.2	5.2	5.1
Dark NEP (model), incl 10 nV/rtHz amp. noise	3.38	3.29	3.26	3.38	3.45	3.38	3.24	3.33	3.42	3.40
Dark NEP (1 Hz)****, incl 10 nV/rtHz amp. noise	2.97	2.78	2.77	3.10	3.23	3.05	2.83	N/M	2.91	2.98
Dark NEP (0.1 Hz)***, incl 10 nV/rtHz amp. noise	4.87	3.88	3.58	5.17	4.20	4.26	3.69	N/M	3.81	3.64
Vmax	5.04	6.32	5.89	5.01	4.35	4.79	6.42	5.05	5.63	5.29
*assumes vlower = 1.02 vcutoff										
**not tested										
***takes best data between 147 Hz and 149 Hz bias										

Pixel Performance										
Item										
BDA connector	J02	J02	J02	J02	J02	J02	J02	J02	J02	J02
BDA pins	5,30	6,31	7,32	8,33	9,34	10,35	11,36	12,37	13,38	14,39
BoDAC Connector	2	2	2	2	2	2	2	2	2	2
Channel ID	5	6	7	8	9	10	11	12	13	14
Detector ID	G8	F8	E9	G9	D9	F9	E10	G10	F10	E11
BDA Pixel Operability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BoDAC channel Operability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Noisy BoDAC channel	No	No	No	No	No	No	No	No	No	No
(NEPphoton/NEPtotal)^2 (derived)	0.62	0.61	0.65	0.70	0.61	0.64	0.65	0.66	0.64	0.62
Optical efficiency*	0.68	0.68	0.67	0.64	0.68	0.75	0.69	0.67	0.70	0.69
Detector time constant	4.09	4.47	3.43	3.00	4.53	3.87	3.63	3.93	3.87	3.70
Calibration uniformity**	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
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
1/f knee frequency***	97	53	54	30	81	77	70	32	51	31
Pixel Design Values										
Item										
R0	84.42	90.00	127.00	215.17	61.09	100.08	109.82	118.19	97.34	94.60
Delta	41.85	40.83	40.70	41.91	43.57	41.52	42.13	41.84	42.20	41.08
G300	74.65	73.98	73.33	71.50	75.18	72.72	74.38	72.60	74.63	74.29
Beta	1.57	1.53	1.55	1.51	1.65	1.56	1.59	1.55	1.60	1.59
C300	0.41	0.45	0.34	0.28	0.47	0.38	0.37	0.39	0.39	0.37
Gamma	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
R300	11.4	10.5	14.5	29.2	10.5	12.9	15.4	15.9	13.8	11.4
Rlr+	11.72	11.72	11.76	11.76	11.8	11.83	11.84	11.88	11.88	11.9
Rlr-	11.84	11.84	11.88	11.88	11.92	11.92	11.94	11.96	11.96	12
Dark Sdc	4.7	4.6	5.1	6.6	4.6	5.0	5.3	5.4	5.1	4.7
Dark NEP (model), incl 10 nV/rtHz amp. noise	3.48	3.50	3.39	3.16	3.50	3.40	3.38	3.33	3.41	3.48
Dark NEP (1 Hz)****, incl 10 nV/rtHz amp. noise	3.32	3.37	3.13	3.17	3.14	2.97	2.85	2.85	2.98	3.06
Dark NEP (0.1 Hz)***, incl 10 nV/rtHz amp. noise	4.37	3.94	3.75	3.67	3.53	3.61	3.51	3.31	3.43	3.74
Vmax	4.73	4.55	5.34	7.38	4.51	4.97	5.48	5.50	5.19	4.77
*assumes vlower = 1.02 vcutoff										
**not tested										
***takes best data between 147 Hz and 149 Hz bias										

Pixel Performance										
Item										
BDA connector	J02	J02	J02	J02	J02	J02	J02	J02	J02	J02
BDA pins	15,40	16,41	17,42	18,43	19,44	20,45	21,46	22,47	23,48	24,49
BoDAC Connector	2	2	2	2	2	2	2	2	2	2
Channel ID	15	16	17	18	19	20	21	22	23	24
Detector ID	G11	F11	E12	G12	F12	G13	DK2	SH	SH	R2
BDA Pixel Operability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes
BoDAC channel Operability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Noisy BoDAC channel	No	No	No	No	No	No	No	No	No	No
(NEPphoton/NEPtotal)^2 (derived)	0.64	0.63	0.63	0.62	0.63	0.62	N/A	N/A	N/A	N/A
Optical efficiency*	0.61	0.73	0.76	0.69	0.76	0.73	0.05	N/A	N/A	N/A
Detector time constant	3.95	3.84	4.21	4.44	2.97	4.25	N/M	N/A	N/A	N/A
Calibration uniformity**	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
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
1/f knee frequency***	62	9	67	80	83	79	36	N/A	N/A	41
Pixel Design Values										
Item										
R0	102.52	83.86	92.41	96.12	124.22	76.57	79.23	N/A	N/A	7.32E+06
Delta	41.52	42.66	41.79	40.23	40.81	42.27	43.00	N/A	N/A	0.00
G300	74.29	78.33	74.00	70.41	87.03	75.98	77.97	N/A	N/A	N/A
Beta	1.58	1.58	1.59	1.54	1.58	1.57	1.56	N/A	N/A	N/A
C300	0.40	0.41	0.42	0.42	0.34	0.44	N/M	N/A	N/A	N/A
Gamma	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
R300	13.2	12.7	12.4	10.3	14.4	10.9	N/M	N/A	N/M	7.4
Rlr+	11.92	11.96	11.99	11.96	12.04	12.04	12.04	12.08	12.12	12.08
Rlr-	12.02	12.04	12.08	12.08	12.12	12.12	12.16	12.12	12.18	12.2
Dark Sdc	5.0	4.9	4.9	4.7	4.8	4.7	4.9	N/A	N/A	N/A
Dark NEP (model), incl 10 nV/rtHz amp. noise	3.43	3.49	3.43	3.44	3.65	3.50	3.48	N/A	N/A	N/A
Dark NEP (1 Hz)****, incl 10 nV/rtHz amp. noise	3.02	3.04	3.00	3.29	3.20	3.22	3.21	N/A	N/A	N/A
Dark NEP (0.1 Hz)***, incl 10 nV/rtHz amp. noise	3.40	3.39	2.85	4.08	4.35	3.80	3.88	N/A	N/A	N/A
Vmax	5.10	5.07	4.91	4.42	5.81	4.66	5.02	N/A	N/A	N/A
*assumes vlower = 1.02 vcutoff										
**not tested										
***takes best data between 147 Hz and 149 Hz bias										

Pixel Performance										
Item										
BDA connector	J03	J03	J03	J03	J03	J03	J03	J03	J03	J03
BDA pins	1,26	2,27	3,28	4,29	5,30	6,31	7,32	8,33	9,34	10,35
BoDAC Connector	4	4	4	4	4	4	4	4	4	4
Channel ID	1	2	3	4	5	6	7	8	9	10
Detector ID	A13	T1	B12	C13	A12	D12	C12	B11	A11	E13
BDA Pixel Operability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BoDAC channel Operability	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Noisy BoDAC channel	No	No	No	No	OK 137 Hz	No	No	No	No	OK 137 Hz
(NEPphoton/NEPtotal) ² (derived)	0.66	N/A	0.66	0.66	0.63	0.65	0.64	0.64	0.65	0.64
Optical efficiency*	0.71	N/A	0.71	0.74	0.67	0.69	0.68	0.66	0.66	0.76
Detector time constant	3.89	N/A	3.53	3.49	3.70	3.69	3.11	3.74	3.70	3.84
Calibration uniformity**	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
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
1/f knee frequency***	18	N/M	41	31	67	9	74	18	52	127
Pixel Design Values										
Item										
R0	127.39	N/M	130.02	141.70	95.50	115.86	109.14	101.12	99.03	98.42
Delta	41.72	N/M	41.90	41.29	40.93	41.76	41.29	41.64	42.48	42.10
G300	71.91	N/A	71.69	73.13	70.22	74.40	72.90	69.91	72.38	74.76
Beta	1.55	N/A	1.58	1.53	1.59	1.57	1.56	1.59	1.62	1.57
C300	0.39	N/A	0.35	0.35	0.36	0.38	0.31	0.37	0.37	0.40
Gamma	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
R300	5.05	N/M	17.6	17.6	11.3	15.4	13.6	13.2	14.6	13.7
Rlr+	10.65	10.66	10.68	10.69	10.67	10.69	10.68	10.76	10.76	10.7
Rlr-	10.68	10.72	10.76	10.76	10.74	10.76	10.78	10.76	10.76	10.76
Dark Sdc	5.3	N/A	5.4	5.3	4.6	5.1	4.9	4.9	5.0	4.9
Dark NEP (model), incl 10 nV/rtHz amp. noise	3.36	N/A	3.35	3.37	3.46	3.43	3.45	3.40	3.41	3.47
Dark NEP (1 Hz)****, incl 10 nV/rtHz amp. noise	3.62	N/A	2.91	2.93	3.24	5.59	3.07	3.07	3.06	3.20
Dark NEP (0.1 Hz)***, incl 10 nV/rtHz amp. noise	3.89	N/A	3.81	3.21	3.91	4.71	3.58	3.56	3.53	3.78
Vmax	5.65	N/A	5.77	5.84	4.61	5.50	5.12	4.95	5.26	5.19
*assumes vlower = 1.02 vcutoff										
**not tested										
***takes best data between 147 Hz and 149 Hz bias										

Pixel Performance										
Item										
BDA connector	J03	J03	J03	J03	J03	J03	J03	J03	J03	J03
BDA pins	11,36	12,37	13,38	14,39	15,40	16,41	17,42	18,43	19,44	20,45
BoDAC Connector	4	4	4	4	4	4	4	4	4	4
Channel ID	11	12	13	14	15	16	17	18	19	20
Detector ID	D11	C11	B10	A10	D10	B9	C10	C9	A9	B8
BDA Pixel Operability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Slight 1/f	Slight 1/f
BoDAC channel Operability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Noisy BoDAC channel	No	No	Mod. 1/f	No	No	No	No	No	No	No
(NEPphoton/NEPtotal) ² (derived)	0.66	0.63	0.66	0.66	0.62	0.62	0.68	0.62	0.63	0.62
Optical efficiency*	0.69	0.66	0.68	0.72	0.68	0.66	0.64	0.65	0.67	0.65
Detector time constant	3.30	3.77	3.39	3.50	4.04	3.98	3.34	4.50	4.01	6.20
Calibration uniformity**	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
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
1/f knee frequency***	37	85	370	29	48	37	9	37	61	73
Pixel Design Values										
Item										
R0	151.74	108.06	135.07	111.82	88.86	91.75	164.87	91.58	80.22	67.99
Delta	40.72	40.47	41.53	42.08	41.24	41.01	41.76	40.57	42.07	42.72
G300	74.20	70.77	70.80	70.74	73.71	70.89	72.85	71.09	70.85	72.00
Beta	1.56	1.52	1.58	1.61	1.56	1.60	1.56	1.53	1.60	1.65
C300	0.33	0.37	0.33	0.35	0.41	0.39	0.33	0.44	0.40	0.62
Gamma	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
R300	17.4	12.0	17.4	15.6	11.0	11.0	21.9	10.3	11.1	10.4
Rlr+	10.76	10.76	10.76	10.76	10.8	10.8	10.84	10.88	10.8	10.84
Rlr-	10.82	10.84	10.84	10.84	10.88	10.88	10.84	10.88	10.88	10.92
Dark Sdc	5.3	4.7	5.4	5.2	4.6	4.6	5.8	4.5	4.7	4.5
Dark NEP (model), incl 10 nV/rtHz amp. noise	3.41	3.45	3.34	3.36	3.52	3.48	3.31	3.50	3.45	3.50
Dark NEP (1 Hz)****, incl 10 nV/rtHz amp. noise	3.06	3.08	3.03	3.30	4.76	3.11	2.87	3.24	3.20	3.64
Dark NEP (0.1 Hz)***, incl 10 nV/rtHz amp. noise	3.40	3.53	8.84	3.61	5.18	4.24	4.19	4.42	5.37	5.83
Vmax	5.88	4.76	5.71	5.39	4.64	4.57	6.48	4.42	4.56	4.42
*assumes vlower = 1.02 vcutoff										
**not tested										
***takes best data between 147 Hz and 149 Hz bias										

Pixel Performance											
Item											
BDA connector	J03	J03	J03	J03	J04	J04	J04	J04	J04	J04	J04
BDA pins	21,46	22,47	23,48	24,49	1,26	2,27	3,28	4,29	5,30	6,31	
BoDAC Connector	4	4	4	4	3	3	3	3	3	3	
Channel ID	21	22	23	24	1	2	3	4	5	6	
Detector ID	A8	C8	C8	B7	R1	G1	T2	E1	D1	F1	
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	No	No	No	No	No	No	No	No	No	No	No
(NEPphoton/NEPtotal) ² (derived)	0.63	0.67	0.62	0.63	N/A	0.67	N/A	0.63	0.65	0.64	
Optical efficiency*	0.64	0.66	0.67	0.68	N/A	0.68	N/A	0.65	0.63	0.71	
Detector time constant	3.81	3.59	4.28	4.14	N/A	3.89	N/A	4.06	3.89	2.09	
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***	59	9	67	32	64	72	27	80	68	25	
Pixel Design Values											
Item											
R0	105.10	132.63	82.44	89.54	6.53E+06	128.65	85.35	88.70	118.09	107.19	
Delta	40.44	42.00	41.43	41.43	0.00	41.55	40.55	42.25	41.30	41.06	
G300	67.14	71.98	70.42	70.81	N/A	68.28	N/A	76.15	71.03	72.02	
Beta	1.65	1.61	1.59	1.63	N/A	1.50	N/A	1.53	1.56	1.54	
C300	0.36	0.36	0.42	0.41	N/A	0.37	N/A	0.42	0.38	0.21	
Gamma	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
R300	11.6	18.2	10.5	11.4	6.6	16.6	9.6	12.6	14.7	12.9	
Rlr+	10.84	10.83	10.85	10.86	10.92	10.92	10.88	10.72	10.92	10.94	
Rlr-	10.94	10.92	10.95	10.96	11.04	11.04	10.76	11.08	11.08	11.08	
Dark Sdc	4.7	5.4	4.6	4.7	N/A	5.4	N/A	4.8	5.1	4.9	
Dark NEP (model), incl 10 nV/rtHz amp. noise	3.40	3.34	3.47	3.46	N/A	3.28	N/A	3.50	3.37	3.43	
Dark NEP (1 Hz)****, incl 10 nV/rtHz amp. noise	3.17	2.91	3.05	3.07	N/A	2.93	N/A	3.18	3.04	3.69	
Dark NEP (0.1 Hz)***, incl 10 nV/rtHz amp. noise	4.29	4.22	3.99	3.92	N/A	3.00	N/A	3.75	3.58	3.80	
Vmax	4.61	5.89	4.43	4.64	N/A	5.45	N/A	5.00	5.27	4.97	
*assumes vlower = 1.02 vcutoff											
**not tested											
***takes best data between 147 Hz and 149 Hz bias											

Pixel Performance										
Item										
BDA connector	J04	J04	J04	J04	J04	J04	J04	J04	J04	J04
BDA pins	7,32	8,33	9,34	10,35	11,36	12,37	13,38	14,39	15,40	16,41
BoDAC Connector	3	3	3	3	3	3	3	3	3	3
Channel ID	7	8	9	10	11	12	13	14	15	16
Detector ID	E2	G2	F2	G3	E3	D3	F3	G4	E4	F4
BDA Pixel Operability	Yes	Yes	Yes	Yes	Slight 1/f	Yes	Yes	Mod. 1/f	Yes	Yes
BoDAC channel Operability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
Noisy BoDAC channel	No	No	No	No	No	No	No	No	No	No
(NEPphoton/NEPtotal) ² (derived)	0.73	0.63	0.63	0.63	0.65	0.65	0.66	0.65	0.64	N/M
Optical efficiency*	0.64	0.67	0.70	0.64	0.66	0.67	0.67	0.68	0.63	N/M
Detector time constant	2.30	3.29	3.76	3.96	3.57	3.43	3.83	3.78	3.82	N/M
Calibration uniformity**	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
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
1/f knee frequency***	9	64	57	59	89	77	66	284	94	N/M
Pixel Design Values										
Item										
R0	469.38	106.10	93.42	97.33	128.36	120.05	111.55	131.62	100.84	N/M
Delta	41.64	40.86	41.27	41.39	41.21	41.65	42.29	40.92	41.79	N/M
G300	71.50	73.73	73.63	74.93	73.89	74.91	74.75	74.60	75.44	N/M
Beta	1.51	1.50	1.56	1.54	1.54	1.57	1.52	1.54	1.58	N/M
C300	0.19	0.33	0.38	0.41	0.36	0.35	0.39	0.38	0.40	N/M
Gamma	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
R300	61.4	12.4	11.6	12.3	15.8	15.7	16.0	15.5	13.5	N/M
Rlr+	10.96	10.92	10.96	10.96	11	11.04	11.06	11.01	11	11.03
Rlr-	11.08	11.08	11.12	11.04	11.12	11.14	11.12	11.16	11.16	11.2
Dark Sdc	8.4	4.8	4.7	4.7	5.2	5.2	5.2	5.1	4.9	N/M
Dark NEP (model), incl 10 nV/rtHz amp. noise	3.00	3.47	3.49	3.49	3.40	3.42	3.39	3.42	3.47	N/M
Dark NEP (1 Hz)****, incl 10 nV/rtHz amp. noise	3.96	3.87	4.22	3.61	2.97	3.35	3.31	3.28	3.07	N/M
Dark NEP (0.1 Hz)***, incl 10 nV/rtHz amp. noise	4.04	4.67	5.11	5.21	5.00	4.36	4.80	8.81	4.79	N/M
Vmax	10.72	4.93	4.76	4.93	5.56	5.57	5.57	5.56	5.18	N/M
*assumes vlower = 1.02 vcutoff										
**not tested										
***takes best data between 147 Hz and 149 Hz bias										

Pixel Performance									
Item									Unit
BDA connector	J04	J04	J04	J04	J04	J04	J04	J04	
BDA pins	17,42	18,43	19,44	20,45	21,46	22,47	23,48	24,49	
BoDAC Connector	3	3	3	3	3	3	3	3	
Channel ID	17	18	19	20	21	22	23	24	
Detector ID	E5	D5	F5	G5	E6	G6	F6	G7	
BDA Pixel Operability	Yes	Yes	Noisy	Yes	Yes	Yes	Yes	Yes	
BoDAC channel Operability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Noisy BoDAC channel	No	No	No	No	No	No	No	No	
(NEPphoton/NEPtotal)^2 (derived)	0.67	0.64	0.64	0.67	0.64	0.69	0.60	0.68	
Optical efficiency*	0.66	0.64	0.61	0.62	0.65	0.64	0.66	0.60	
Detector time constant	2.50	3.24	4.59	3.19	3.57	3.33	4.14	3.40	ms
Calibration uniformity**	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	
Cross-talk (non n-n)**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
1/f knee frequency***	9	27	295	28	48	9	77	56	mHz
Pixel Design Values									
Item									Unit
R0	139.24	106.89	90.94	142.45	89.48	197.77	69.52	162.08	Ohms
Delta	42.42	41.93	42.65	41.77	42.65	42.42	41.63	42.10	K
G300	76.47	82.11	67.27	75.32	76.17	77.91	72.57	75.31	pW/K
Beta	1.58	1.60	1.86	1.55	1.61	1.55	1.60	1.54	
C300	0.26	0.36	0.45	0.33	0.37	0.34	0.41	0.34	pJ/K
Gamma	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
R300	20.3	14.6	13.7	19.0	13.5	28.9	9.1	22.6	MOhms
Rlr+	11.04	11	11.04	11.08	11.08	11.12	11.16	11.24	MOhms
Rlr-	11.12	11.2	11.22	11.24	11.04	11.2	11.24	11.28	MOhms
Dark Sdc	5.6	4.9	5.0	5.5	4.9	6.3	4.3	5.9	e8 V/W
Dark NEP (model), incl 10 nV/rtHz amp. noise	3.37	3.57	3.35	3.37	3.48	3.30	3.55	3.31	e-17 W/rtHz
Dark NEP (1 Hz)****, incl 10 nV/rtHz amp. noise	3.23	3.75	13.07	2.96	3.31	2.92	3.27	3.03	e-17 W/rtHz
Dark NEP (0.1 Hz)***, incl 10 nV/rtHz amp. noise	4.34	4.61	33.98	3.47	4.15	3.33	4.08	4.31	e-17 W/rtHz
Vmax	6.37	5.62	5.00	6.13	5.18	7.64	4.18	6.67	mVrms
*assumes vlower = 1.02 vcutoff									
**not tested									
***takes best data between 147 Hz and 149 Hz bias									

Pixel Performance		
Item	Reference	Note
BDA connector		
BDA pins		
BoDAC Connector		
Channel ID		
Detector ID		
BDA Pixel Operability		
BoDAC channel Operability		
Noisy BoDAC channel		
(NEP _{photon} /NEP _{total}) ² (derived)	BDA-PER-02	at 20.1 mV bias
Optical efficiency*	BDA-PER-05	
Detector time constant	BDA-PER-07	at 20 mV bias
Calibration uniformity**	BDA-PER-08	
Cross-talk (n-n)**	BDA-PER-09	
Cross-talk (non n-n)**	BDA-PER-09	
1/f knee frequency***	BDA-PER-10	at 21.2 mV bias
Pixel Design Values		
Item	Reference	Note
R0	BDA-SSSD	
Delta	BDA-SSSD	
G300	BDA-SSSD	
Beta	BDA-SSSD	
C300	BDA-SSSD	
Gamma		
R300	BDA-SSSD	
R _{lr} +	BDA-SSSD	room temp
R _{lr} -	BDA-SSSD	room temp
Dark Sdc	BDA-SSSD	at 20.1 mV bias
Dark NEP (model), incl 10 nV/rtHz amp. noise	derived	at 20.1 mV bias
Dark NEP (1 Hz)****, incl 10 nV/rtHz amp. noise	derived	at 20.1 mV bias
Dark NEP (0.1 Hz)***, incl 10 nV/rtHz amp. noise	derived	at 20.1 mV bias
V _{max}	BDA-DRCU-22	
*assumes v _{lower} = 1.02 v _{cutoff}		
**not tested		
***takes best data between 147 Hz and 149 Hz bias		

Symbol	Value	Parameter	Equation (or Comments)
T0			
Vn			
Q			
NEP _{photon}			
Vbias			
Gain			
Detector ID	G7		
P _{thermal}	3.834	Power as function of Temperature	$P_{\text{thermal}} = [G300/(1+\beta)][(T/0.3)]^{\beta} T$ evaluated from To to Tb
Pelec+Q	3.834	Electrical + Absorbed Power	$P_e + Q = [V_{\text{bias}}/(2R_L + R_B)]^2 R_B + Q$
Tbolo	0.34546	Bolometer Temperature	Solve for Tb using Newtonian recursion such that $P_{\text{thermal}} = P_e + Q$
Tb (0)	0.45	First Guess for Solver	
T/T0	1.152		$T/T_0 = T_{\text{bolo}}/T_0$
Rbolo	1.01E+07	Bolometer Resistance	$R_{\text{bolo}} = (R_0)\exp[(\Delta T_b)^{1/2}]$
Vbolo	6.22	Voltage across Bolometer	$V_{\text{bolo}} = [V_{\text{bias}}/(2R_L + R_B)]R_B$
Ibolo	0.62	Current through Bolometer	$I_{\text{bolo}} = V_{\text{bias}}/(2R_L + R_B)$
A	-5.52		$A = (T/R)(dR/dT) = -(1/2)[(\Delta T_b)^{1/2}]$
C	0.40	Dynamic Heat Capacity	$C = C300[(T/0.3)^{\gamma}]$
G	93.6	Dynamic Thermal Conductance	$G = G300[(T/0.3)^{\beta}]$
Z/R	0.209		$Z/R = (I/V)(dV/dI) = [-1 - GT_b/(P_e A)] / [1 - GT_b/(P_e A)]$
τ	3.389	Electrical Time Constant	$\tau = [C/2G][(Z/R + 1)(1 + 2R_L/R_B)] / [Z/R + 2R_L/R_B]$
Sdc	5.87E+08	Electrical Responsivity at 0 Hz	$S_{dc} = (1/2)[R_B/P_e]^{1/2} [1 - Z/R] / [1 + (Z/R)(R_B/2R_L)]$
NEP _{johnson}	1.633	Johnson Noise = Vn(infinity)/Sdc	$NEP_{\text{johnson}} = [2/((Z/R)+1)] [(Z/R)+(R/LR)] / [(1+(R/LR))] [(4k(T_b)^3 G^2)/(P_e A^2)]^{1/2}$
NEP _{phonon}	2.220	Phonon Noise	$= [4kT_0^2 G(\beta+1)(T/T_0)^{2\beta+3} - 1] / [(2\beta+3)(T/T_0)^{\beta} ((T/T_0)^{\beta+1} - 1)]^{1/2}$
NEP _{load}	1.019	Load Noise = Vn(infinity)/Sdc	$NEP_{\text{load}} = [4kT_0/2R_L]^{1/2} [2(Z/R)R_B I_{\text{bolo}} / [(Z/R) - 1]] [(R+(R/L)/(Z/R)) / (R + R/L)]$
NEP _{amp}	1.534	Amplifier Noise	$NEP_{\text{amp}} = V_n / S_{dc}$
NEP _{det}	3.314	Detector Noise after Demodulation	$NEP_{\text{det}} = [NEP_{\text{john}}^2 + NEP_{\text{phon}}^2 + NEP_{\text{load}}^2 + NEP_{\text{amp}}^2]^{1/2}$
DQE	0.000	BLIP Figure-of-Merit for Detector	$DQE = NEP_{\text{photon}}^2 / (NEP_{\text{photon}}^2 + NEP_{\text{det}}^2)$
Vn(det)	19.4	Voltage Noise of Detector After Demod.	$V_n(\text{det}) = NEP_{\text{det}} S_{dc}$
Vn(total)	19.4	Total Noise after Demodulation	$V_n(\text{total}) = [NEP_{\text{det}}^2 + NEP_{\text{photon}}^2]^{1/2} S_{dc}$
Vn(measured) at 1	23.6		
NEP(measured) at	4.02		
Vn(measured) at .1	25.3		
NEP(measured) at	4.31		
Vn(measured) at 1	17.8		
NEP(measured) at	3.03		
Vn(measured) at .1	30.6		
NEP(measured) at	5.21		
Vn(1 Hz, no TC); G	23.6		
Vn(0.1Hz, no Tc); G	25.3		
Vn(1Hz,TC at 300 r	17.8		
Vn(0.1 Hz, TC at 30	30.6		
Vn(measured) at .1	51.4		
Vn(measured) at 1	21.9		
Vn(measured) at .1	41.8		
Vn(measured) at 1	20.0		

Symbol	Units	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	10	Amplifier Voltage Noise				corrected for ETF in Johnson and load resistor te					
Q	pW	3.3	Absorbed Power Onto Bolometer				assumes only first harmonic of amplifier, Johnson					
NEP _{photon}	1e-17 W/rtHz	6.30	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	A7	A6	B6	C7	A5	B5	C6	D6	B4	
Pthermal	pW	6.532	5.486	5.334	5.367	5.257	5.534	5.999	5.875	5.330	5.730	
Pelec+Q	pW	6.532	5.486	5.334	5.367	5.257	5.534	5.999	5.875	5.330	5.730	
Tbolo	K	0.39798	0.36432	0.36426	0.36702	0.36215	0.36734	0.36247	0.36807	0.36564	0.36778	
Tb (0)	K	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	
T/T0		1.327	1.214	1.214	1.223	1.207	1.224	1.208	1.227	1.219	1.226	
Rbolo	Ω	5.08E+06	3.89E+06	3.56E+06	3.63E+06	3.41E+06	4.10E+06	5.46E+06	5.07E+06	3.60E+06	4.69E+06	
Vbolo	mV	4.05	2.91	2.69	2.74	2.58	3.03	3.84	3.61	2.70	3.37	
Ibolo	nA	0.80	0.75	0.76	0.75	0.76	0.74	0.70	0.71	0.75	0.72	
A		-5.12	-5.38	-5.27	-5.22	-5.34	-5.34	-5.33	-5.31	-5.28	-5.38	
C	pJ/K	1.33	0.51	0.54	0.50	0.39	0.49	0.41	0.46	0.48	0.30	
G	pW/K	81.0	98.4	95.8	92.5	97.2	95.7	110.9	100.2	93.9	98.2	
Z/R		0.321	0.506	0.530	0.518	0.542	0.493	0.473	0.459	0.524	0.468	
τ	ms	12.547	4.211	4.642	4.416	3.282	4.115	3.022	3.737	4.141	2.475	
Sdc	V/W	3.94E+08	3.03E+08	2.87E+08	2.95E+08	2.80E+08	3.16E+08	3.37E+08	3.44E+08	2.93E+08	3.37E+08	
NEP _{johnson}	1e-17 W/rtHz	2.141	2.493	2.551	2.507	2.571	2.452	2.508	2.415	2.516	2.405	
NEP _{phonon}	1e-17 W/rtHz	2.180	2.313	2.282	2.252	2.294	2.285	2.447	2.344	2.263	2.319	
NEP _{load}	1e-17 W/rtHz	0.937	0.934	0.913	0.903	0.901	0.936	1.112	1.024	0.901	0.979	
NEP _{amp}	1e-17 W/rtHz	2.541	3.302	3.485	3.386	3.577	3.168	2.969	2.903	3.412	2.966	
NEP _{det}	1e-17 W/rtHz	4.083	4.831	4.969	4.862	5.048	4.706	4.726	4.561	4.889	4.573	
DQE		0.704	0.630	0.616	0.627	0.609	0.642	0.640	0.656	0.624	0.655	
Vn(det)	nV/rtHz	16.1	14.6	14.3	14.4	14.1	14.9	15.9	15.7	14.3	15.4	
Vn(total)	nV/rtHz	29.5	24.0	23.0	23.5	22.6	24.8	26.5	26.8	23.4	26.2	

Symbol	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
T0												
Vn _{rms}												
Q	i, and LR propagates											
NEP _{photon}												
Vbias												
Gain												
Detector ID	C5	D4	A4	C4	B3	C3	B2	D2	A3	A2	C2	B1
Pthermal	5.405	5.348	5.763	5.410	6.275	5.552	6.095	5.710	5.952	5.542	6.120	5.939
Pelec+Q	5.405	5.348	5.763	5.410	6.275	5.552	6.095	5.710	5.952	5.542	6.120	5.939
Tbolo	0.36217	0.36141	0.36692	0.36391	0.37092	0.36482	0.36764	0.36453	0.36660	0.36589	0.37027	0.36994
Tb (0)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
T/T0	1.207	1.205	1.223	1.213	1.236	1.216	1.225	1.215	1.222	1.220	1.234	1.233
Rbolo	3.83E+06	3.69E+06	4.88E+06	3.83E+06	6.71E+06	4.33E+06	6.10E+06	4.83E+06	5.68E+06	4.41E+06	6.39E+06	5.74E+06
Vbolo	2.84	2.75	3.47	2.84	4.47	3.12	4.13	3.41	3.88	3.15	4.24	3.89
lbolo	0.74	0.74	0.71	0.74	0.67	0.72	0.68	0.71	0.68	0.71	0.66	0.68
A	-5.38	-5.32	-5.32	-5.26	-5.26	-5.32	-5.35	-5.42	-5.36	-5.29	-5.29	-5.37
C	0.54	0.48	0.43	0.45	0.39	0.49	0.44	0.50	0.45	0.46	0.47	0.46
G	99.9	99.9	100.0	97.4	103.2	98.9	104.8	102.0	103.9	97.3	101.5	98.7
Z/R	0.523	0.537	0.474	0.523	0.420	0.501	0.441	0.480	0.456	0.500	0.431	0.441
τ	4.387	3.936	3.490	3.733	3.052	4.023	3.411	4.000	3.504	3.857	3.750	3.757
Sdc	2.96E+08	2.87E+08	3.37E+08	2.96E+08	3.89E+08	3.16E+08	3.71E+08	3.35E+08	3.58E+08	3.21E+08	3.83E+08	3.72E+08
NEP _{Johnson}	2.534	2.583	2.441	2.546	2.342	2.490	2.381	2.443	2.411	2.480	2.348	2.341
NEP _{phonon}	2.326	2.325	2.337	2.302	2.386	2.320	2.394	2.357	2.379	2.304	2.364	2.332
NEP _{load}	0.939	0.939	1.011	0.941	1.130	0.971	1.097	1.005	1.070	0.970	1.097	1.037
NEP _{amp}	3.374	3.489	2.970	3.382	2.572	3.160	2.698	2.988	2.790	3.116	2.608	2.685
NEP _{det}	4.909	5.013	4.611	4.910	4.367	4.745	4.459	4.633	4.517	4.702	4.371	4.382
DQE	0.622	0.612	0.651	0.622	0.675	0.638	0.666	0.649	0.660	0.642	0.675	0.674
Vn(det)	14.5	14.4	15.5	14.5	17.0	15.0	16.5	15.5	16.2	15.1	16.8	16.3
Vn(total)	23.7	23.1	26.3	23.6	29.8	25.0	28.6	26.2	27.8	25.2	29.4	28.6

Symbol	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
T0												
Vn												
Q												
NEP _{photon}												
Vbias												
Gain												
Detector ID	A1	DK1	C1	E7	D7	F7	E8	G8	F8	E9	G9	
Pthermal	5.504	5.160	5.379	6.199	5.573	5.841	5.680	5.390	5.295	5.686	6.544	
Pelec+Q	5.504	5.160	5.379	6.199	5.573	5.841	5.680	5.390	5.295	5.686	6.544	
Tbolo	0.36396	0.36237	0.36432	0.37249	0.36666	0.36473	0.36477	0.36183	0.36155	0.36586	0.37627	
Tb (0)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	
T/T0	1.213	1.208	1.214	1.242	1.222	1.216	1.216	1.206	1.205	1.220	1.254	
Rbolo	4.41E+06	3.51E+06	4.10E+06	6.54E+06	4.45E+06	5.23E+06	4.76E+06	3.96E+06	3.71E+06	4.84E+06	8.25E+06	
Vbolo	3.12	2.55	2.92	4.36	3.18	3.65	3.36	2.88	2.72	3.40	5.17	
Ibolo	0.71	0.73	0.71	0.67	0.71	0.70	0.71	0.73	0.73	0.70	0.63	
A	-5.42	-5.31	-5.35	-5.30	-5.40	-5.37	-5.39	-5.38	-5.31	-5.27	-5.28	
C	0.46	N/A	0.44	0.41	0.47	0.42	0.44	0.50	0.54	0.42	0.35	
G	99.3	94.6	96.5	100.2	97.3	104.5	101.5	100.1	98.5	99.8	100.7	
Z/R	0.503	0.553	0.520	0.416	0.488	0.473	0.486	0.527	0.541	0.488	0.377	
τ	3.785	N/A	3.745	3.325	3.880	3.262	3.550	4.088	4.482	3.394	2.882	
Sdc	3.22E+08	2.84E+08	3.10E+08	3.93E+08	3.28E+08	3.42E+08	3.31E+08	2.99E+08	2.88E+08	3.32E+08	4.39E+08	
NEP _{johnson}	2.471	2.572	2.503	2.310	2.436	2.454	2.458	2.543	2.579	2.473	2.212	
NEP _{phonon}	2.323	2.268	2.291	2.353	2.302	2.382	2.348	2.328	2.310	2.334	2.373	
NEP _{load}	0.964	0.895	0.939	1.094	0.958	1.051	1.003	0.949	0.932	1.013	1.167	
NEP _{amp}	3.110	3.520	3.227	2.546	3.051	2.924	3.019	3.342	3.470	3.014	2.280	
NEP _{det}	4.702	4.995	4.776	4.307	4.632	4.621	4.656	4.894	4.990	4.656	4.133	
DQE	0.642	0.614	0.635	0.681	0.649	0.650	0.647	0.624	0.615	0.647	0.699	
Vn(det)	15.1	14.2	14.8	16.9	15.2	15.8	15.4	14.6	14.4	15.4	18.1	
Vn(total)	25.3	22.8	24.5	30.0	25.6	26.7	25.9	23.9	23.2	26.0	33.0	

Symbol	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
T0												
Vn												
Q												
NEP _{photon}												
Vbias												
Gain												
Detector ID	D9	F9	E10	G10	F10	E11	G11	F11	E12	G12	F12	G13
Pthermal	5.259	5.496	5.734	5.743	5.589	5.363	5.526	5.502	5.422	5.179	5.781	5.281
Pelec+Q	5.259	5.496	5.734	5.743	5.589	5.363	5.526	5.502	5.422	5.179	5.781	5.281
Tbolo	0.35974	0.36437	0.36534	0.36702	0.36366	0.36171	0.36337	0.36032	0.36251	0.36301	0.35742	0.35982
Tb (0)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
T/T0	1.199	1.215	1.218	1.223	1.212	1.206	1.211	1.201	1.208	1.210	1.191	1.199
Rbolo	3.68E+06	4.33E+06	5.06E+06	5.12E+06	4.64E+06	4.02E+06	4.50E+06	4.46E+06	4.26E+06	3.58E+06	5.43E+06	3.90E+06
Vbolo	2.68	3.08	3.51	3.54	3.26	2.88	3.17	3.13	3.00	2.60	3.67	2.78
lbolo	0.73	0.71	0.69	0.69	0.70	0.72	0.70	0.70	0.71	0.72	0.68	0.71
A	-5.50	-5.34	-5.37	-5.34	-5.39	-5.33	-5.34	-5.44	-5.37	-5.26	-5.34	-5.42
C	0.56	0.46	0.45	0.47	0.48	0.45	0.48	0.49	0.51	0.51	0.41	0.52
G	101.4	98.5	101.7	99.3	101.5	100.0	100.6	104.6	100.0	94.4	114.8	101.0
Z/R	0.544	0.508	0.479	0.473	0.499	0.534	0.509	0.517	0.522	0.552	0.512	0.544
τ	4.522	3.847	3.581	3.881	3.831	3.683	3.923	3.821	4.185	4.452	2.934	4.257
Sdc	2.88E+08	3.16E+08	3.41E+08	3.47E+08	3.25E+08	2.99E+08	3.19E+08	3.13E+08	3.10E+08	2.86E+08	3.24E+08	2.94E+08
NEP _{johnson}	2.567	2.495	2.446	2.420	2.486	2.569	2.510	2.536	2.529	2.580	2.608	2.577
NEP _{phonon}	2.332	2.315	2.352	2.331	2.345	2.324	2.335	2.374	2.325	2.265	2.481	2.334
NEP _{load}	0.923	0.966	1.022	1.014	0.996	0.959	0.989	0.997	0.967	0.906	1.133	0.945
NEP _{amp}	3.470	3.162	2.936	2.886	3.077	3.349	3.138	3.193	3.225	3.498	3.086	3.400
NEP _{det}	4.992	4.745	4.602	4.544	4.705	4.913	4.752	4.822	4.810	4.984	4.875	4.954
DQE	0.614	0.638	0.652	0.658	0.642	0.622	0.637	0.631	0.632	0.615	0.625	0.618
Vn(det)	14.4	15.0	15.7	15.7	15.3	14.7	15.1	15.1	14.9	14.2	15.8	14.6
Vn(total)	23.2	24.9	26.6	26.9	25.6	23.9	25.1	24.8	24.6	23.0	25.8	23.6

Symbol	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
T0												
Vn												
Q												
NEP _{photon}												
Vbias												
Gain												
Detector ID	DK2	SH	SH	R2	A13	T1	B12	C13	A12	D12	C12	B11
Pthermal	5.454	#VALUE!	#VALUE!	#VALUE!	6.203	#VALUE!	6.245	6.273	5.627	6.098	5.902	5.805
Pelec+Q	5.454	#VALUE!	#VALUE!	#VALUE!	6.203	#VALUE!	6.245	6.273	5.627	6.098	5.902	5.805
Tbolo	0.36016	#VALUE!	#VALUE!	#VALUE!	0.37221	#VALUE!	0.37261	0.37203	0.36753	0.36902	0.36833	0.36961
Tb (0)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
T/T0	1.201	#VALUE!	#VALUE!	#VALUE!	1.241	#VALUE!	1.242	1.240	1.225	1.230	1.228	1.232
Rbolo	4.41E+06	#VALUE!	#VALUE!	#VALUE!	5.05E+06	#VALUE!	5.24E+06	5.33E+06	3.66E+06	4.83E+06	4.32E+06	4.11E+06
Vbolo	3.08	#VALUE!	#VALUE!	#VALUE!	3.83	#VALUE!	3.93	3.98	2.92	3.68	3.35	3.21
Ibolo	0.70	#VALUE!	#VALUE!	#VALUE!	0.76	#VALUE!	0.75	0.75	0.80	0.76	0.78	0.78
A	-5.46	#VALUE!	#VALUE!	#VALUE!	-5.29	#VALUE!	-5.30	-5.27	-5.28	-5.32	-5.29	-5.31
C	#VALUE!	#VALUE!	N/A	#VALUE!	0.48	#VALUE!	0.44	0.43	0.44	0.47	0.39	0.45
G	103.8	#VALUE!	#VALUE!	#VALUE!	100.4	#VALUE!	101.0	101.6	97.0	102.9	100.4	97.4
Z/R	0.521	#VALUE!	#VALUE!	#VALUE!	0.417	#VALUE!	0.413	0.414	0.487	0.437	0.457	0.461
τ	#VALUE!	#VALUE!	N/A	#VALUE!	3.812	#VALUE!	3.446	3.415	3.674	3.625	3.076	3.691
Sdc	3.13E+08	#VALUE!	#VALUE!	#VALUE!	3.50E+08	#VALUE!	3.55E+08	3.56E+08	2.96E+08	3.37E+08	3.20E+08	3.18E+08
NEP _{Johnson}	2.531	#VALUE!	#VALUE!	#VALUE!	2.356	#VALUE!	2.347	2.356	2.481	2.403	2.435	2.422
NEP _{phonon}	2.366	#VALUE!	#VALUE!	#VALUE!	2.357	#VALUE!	2.361	2.371	2.302	2.376	2.346	2.312
NEP _{load}	0.986	#VALUE!	#VALUE!	#VALUE!	1.029	#VALUE!	1.041	1.055	0.926	1.028	0.987	0.954
NEP _{amp}	3.197	#VALUE!	#VALUE!	#VALUE!	2.860	#VALUE!	2.813	2.812	3.373	2.968	3.121	3.149
NEP _{det}	4.816	#VALUE!	#VALUE!	#VALUE!	4.510	#VALUE!	4.482	4.494	4.867	4.613	4.706	4.694
DQE	0.631	#VALUE!	#VALUE!	#VALUE!	0.661	#VALUE!	0.664	0.663	0.626	0.651	0.642	0.643
Vn(det)	15.1	#VALUE!	#VALUE!	#VALUE!	15.8	#VALUE!	15.9	16.0	14.4	15.5	15.1	14.9
Vn(total)	24.8	#VALUE!	#VALUE!	#VALUE!	27.1	#VALUE!	27.5	27.5	23.6	26.3	25.2	25.0

Symbol	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
T0														
Vn														
Q														
NEP _{photon}														
Vbias														
Gain														
Detector ID	A11	E13	D11	C11	B10	A10	D10	B9	C10	C9	A9	B8	A8	C8
Pthermal	5.968	5.934	6.266	5.686	6.189	6.024	5.595	5.560	6.533	5.469	5.561	5.467	5.574	6.246
Pelec+Q	5.968	5.934	6.266	5.686	6.189	6.024	5.595	5.560	6.533	5.469	5.561	5.467	5.574	6.246
Tbolo	0.36903	0.36711	0.37085	0.36811	0.37279	0.37102	0.36465	0.36624	0.37457	0.36554	0.36628	0.36412	0.36923	0.37213
Tb (0)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
T/T0	1.230	1.224	1.236	1.227	1.243	1.237	1.215	1.221	1.249	1.218	1.221	1.214	1.231	1.240
Rbolo	4.52E+06	4.41E+06	5.40E+06	3.87E+06	5.18E+06	4.72E+06	3.69E+06	3.62E+06	6.35E+06	3.44E+06	3.62E+06	3.44E+06	3.69E+06	5.45E+06
Vbolo	3.47	3.41	4.00	3.04	3.87	3.58	2.91	2.86	4.53	2.73	2.86	2.73	2.90	4.01
lbolo	0.77	0.77	0.74	0.79	0.75	0.76	0.79	0.79	0.71	0.79	0.79	0.79	0.79	0.74
A	-5.36	-5.35	-5.24	-5.24	-5.28	-5.32	-5.32	-5.29	-5.28	-5.27	-5.36	-5.42	-5.23	-5.31
C	0.46	0.48	0.41	0.45	0.41	0.43	0.50	0.48	0.41	0.54	0.48	0.76	0.44	0.44
G	101.1	102.6	103.2	96.7	99.9	99.5	99.8	97.5	103.0	96.2	97.5	99.1	94.5	101.8
Z/R	0.446	0.455	0.423	0.480	0.419	0.436	0.498	0.498	0.387	0.510	0.493	0.509	0.491	0.416
τ	3.635	3.789	3.222	3.754	3.309	3.431	4.026	3.959	3.235	4.504	3.987	6.168	3.761	3.491
Sdc	3.30E+08	3.22E+08	3.52E+08	3.05E+08	3.54E+08	3.39E+08	2.94E+08	2.93E+08	3.86E+08	2.86E+08	2.96E+08	2.86E+08	2.99E+08	3.60E+08
NEP _{Johnson}	2.404	2.433	2.387	2.465	2.356	2.381	2.510	2.502	2.295	2.518	2.475	2.509	2.480	2.351
NEP _{phonon}	2.352	2.368	2.385	2.304	2.349	2.338	2.332	2.304	2.391	2.293	2.304	2.314	2.271	2.368
NEP _{load}	0.994	0.997	1.074	0.942	1.035	1.000	0.940	0.925	1.112	0.907	0.915	0.905	0.920	1.056
NEP _{amp}	3.030	3.104	2.839	3.278	2.829	2.951	3.406	3.414	2.590	3.498	3.377	3.494	3.345	2.779
NEP _{det}	4.635	4.707	4.539	4.798	4.487	4.566	4.921	4.907	4.351	4.966	4.866	4.967	4.832	4.468
DQE	0.649	0.642	0.658	0.633	0.663	0.656	0.621	0.622	0.677	0.617	0.626	0.617	0.630	0.665
Vn(det)	15.3	15.2	16.0	14.6	15.9	15.5	14.4	14.4	16.8	14.2	14.4	14.2	14.4	16.1
Vn(total)	25.8	25.3	27.3	24.2	27.3	26.4	23.5	23.4	29.6	22.9	23.6	23.0	23.7	27.8

Symbol	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
T0														
Vn														
Q														
NEP _{photon}														
Vbias														
Gain														
Detector ID	C8	B7	R1	G1	T2	E1	D1	F1	E2	G2	F2	G3	E3	D3
Pthermal	5.467	5.581	#VALUE!	6.008	#VALUE!	5.779	5.896	5.734	7.671	5.711	5.606	5.708	6.020	6.014
Pelec+Q	5.467	5.581	#VALUE!	6.008	#VALUE!	5.779	5.896	5.734	7.671	5.711	5.606	5.708	6.020	6.014
Tbolo	0.36571	0.36632	#VALUE!	0.37381	#VALUE!	0.36480	0.36983	0.36749	0.38723	0.36611	0.36482	0.36497	0.36883	0.36779
Tb (0)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
T/T0	1.219	1.221	#VALUE!	1.246	#VALUE!	1.216	1.233	1.225	1.291	1.220	1.216	1.217	1.229	1.226
Rbolo	3.46E+06	3.72E+06	#VALUE!	4.87E+06	#VALUE!	4.18E+06	4.59E+06	4.18E+06	1.50E+07	4.11E+06	3.89E+06	4.10E+06	5.00E+06	5.02E+06
Vbolo	2.74	2.91	#VALUE!	3.63	#VALUE!	3.22	3.45	3.19	8.09	3.15	2.99	3.14	3.69	3.69
lbolo	0.79	0.78	#VALUE!	0.75	#VALUE!	0.77	0.75	0.76	0.54	0.77	0.77	0.77	0.74	0.74
A	-5.32	-5.32	#VALUE!	-5.27	#VALUE!	-5.38	-5.28	-5.29	-5.18	-5.28	-5.32	-5.32	-5.29	-5.32
C	0.51	0.50	#VALUE!	0.46	#VALUE!	0.51	0.47	0.25	0.24	0.40	0.46	0.49	0.44	0.43
G	96.5	98.0	#VALUE!	95.0	#VALUE!	102.7	98.4	98.4	105.1	99.5	99.8	101.3	101.6	103.1
Z/R	0.507	0.495	#VALUE!	0.427	#VALUE!	0.475	0.452	0.475	0.285	0.482	0.496	0.485	0.445	0.448
τ	4.270	4.100	#VALUE!	3.836	#VALUE!	4.034	3.832	2.075	2.098	3.275	3.742	3.940	3.515	3.367
Sdc	2.88E+08	2.97E+08	#VALUE!	3.51E+08	#VALUE!	3.13E+08	3.33E+08	3.15E+08	5.55E+08	3.10E+08	3.01E+08	3.08E+08	3.42E+08	3.41E+08
NEP _{johnson}	2.504	2.493	#VALUE!	2.336	#VALUE!	2.463	2.407	2.454	1.921	2.474	2.501	2.485	2.409	2.417
NEP _{phonon}	2.292	2.308	#VALUE!	2.300	#VALUE!	2.367	2.326	2.322	2.453	2.335	2.332	2.350	2.363	2.375
NEP _{load}	0.903	0.931	#VALUE!	0.986	#VALUE!	0.978	0.990	0.965	1.393	0.968	0.952	0.973	1.033	1.039
NEP _{amp}	3.473	3.364	#VALUE!	2.846	#VALUE!	3.198	3.006	3.171	1.803	3.223	3.324	3.243	2.926	2.936
NEP _{det}	4.940	4.871	#VALUE!	4.452	#VALUE!	4.780	4.607	4.733	3.860	4.785	4.863	4.813	4.584	4.602
DQE	0.619	0.626	#VALUE!	0.667	#VALUE!	0.635	0.652	0.639	0.727	0.634	0.627	0.631	0.654	0.652
Vn(det)	14.2	14.5	#VALUE!	15.6	#VALUE!	14.9	15.3	14.9	21.4	14.8	14.6	14.8	15.7	15.7
Vn(total)	23.0	23.7	#VALUE!	27.1	#VALUE!	24.7	26.0	24.8	41.0	24.5	23.9	24.4	26.6	26.6

Symbol	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value	Value
T0												
Vn												
Q												
NEP _{photon}												
Vbias												
Gain												
Detector ID	F3	G4	E4	F4	E5	D5	F5	G5	E6	G6	F6	G7
Pthermal	6.018	6.007	5.814	#VALUE!	6.388	6.010	5.714	6.256	5.821	6.862	5.241	6.457
Pelec+Q	6.018	6.007	5.814	#VALUE!	6.388	6.010	5.714	6.256	5.821	6.862	5.241	6.457
Tbolo	0.36822	0.36812	0.36536	#VALUE!	0.37005	0.36237	0.36912	0.36988	0.36471	0.37353	0.36167	0.37188
Tb (0)	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
T/T0	1.227	1.227	1.218	#VALUE!	1.234	1.208	1.230	1.233	1.216	1.245	1.206	1.240
Rbolo	5.03E+06	4.99E+06	4.45E+06	#VALUE!	6.21E+06	5.02E+06	4.24E+06	5.87E+06	4.45E+06	8.41E+06	3.17E+06	6.77E+06
Vbolo	3.70	3.68	3.34	#VALUE!	4.38	3.69	3.20	4.17	3.35	5.47	2.48	4.62
Ibolo	0.73	0.74	0.75	#VALUE!	0.70	0.73	0.75	0.71	0.75	0.65	0.78	0.68
A	-5.36	-5.27	-5.35	#VALUE!	-5.35	-5.38	-5.37	-5.31	-5.41	-5.33	-5.36	-5.32
C	0.48	0.47	0.48	#VALUE!	0.32	0.44	0.55	0.40	0.46	0.42	0.50	0.43
G	102.2	102.2	103.0	#VALUE!	106.5	111.1	99.0	104.3	104.3	109.4	97.9	104.9
Z/R	0.442	0.450	0.474	#VALUE!	0.409	0.469	0.476	0.421	0.472	0.366	0.545	0.398
τ	3.776	3.719	3.778	#VALUE!	2.435	3.187	4.457	3.118	3.524	3.196	4.145	3.303
Sdc	3.45E+08	3.39E+08	3.20E+08	#VALUE!	3.76E+08	3.27E+08	3.18E+08	3.67E+08	3.20E+08	4.28E+08	2.70E+08	3.94E+08
NEP _{johnson}	2.388	2.425	2.467	#VALUE!	2.340	2.499	2.452	2.361	2.462	2.232	2.584	2.303
NEP _{phonon}	2.369	2.369	2.368	#VALUE!	2.419	2.451	2.307	2.395	2.379	2.463	2.298	2.408
NEP _{load}	1.027	1.039	1.002	#VALUE!	1.116	1.081	0.965	1.091	1.001	1.228	0.886	1.134
NEP _{amp}	2.897	2.950	3.127	#VALUE!	2.659	3.058	3.141	2.724	3.124	2.334	3.707	2.541
NEP _{det}	4.557	4.613	4.741	#VALUE!	4.432	4.772	4.705	4.463	4.742	4.243	5.147	4.341
DQE	0.657	0.651	0.638	#VALUE!	0.669	0.635	0.642	0.666	0.638	0.688	0.600	0.678
Vn(det)	15.7	15.6	15.2	#VALUE!	16.7	15.6	15.0	16.4	15.2	18.2	13.9	17.1
Vn(total)	26.8	26.5	25.2	#VALUE!	29.0	25.8	25.0	28.3	25.2	32.5	21.9	30.1

Symbol	Parameter	Equation (or Comments)
T0		
Vn		
Q		
NEP _{photon}		
Vbias		
Gain		
Detector ID		
P _{thermal}	Power as function of Temperature	$P_{\text{thermal}} = [G300/(1+\beta)][T/0.3]^\beta T$ evaluated from T _o to T _b
P _{elec+Q}	Electrical + Absorbed Power	$P_e + Q = [V_{\text{bias}}/(2R_L + R_B)]^2 R_B + Q$
T _{bolo}	Bolometer Temperature	Solve for T _b using Newtonian recursion such that P _{thermal} = P _e + Q
T _b (0)	First Guess for Solver	
T/T _o		$T/T_o = T_{\text{bolo}}/T_o$
R _{bolo}	Bolometer Resistance	$R_{\text{bolo}} = (R_o)\exp[(\Delta/T_b)^{1/2}]$
V _{bolo}	Voltage across Bolometer	$V_{\text{bolo}} = [V_{\text{bias}}/(2R_L + R_B)]R_B$
I _{bolo}	Current through Bolometer	$I_{\text{bolo}} = V_{\text{bias}}/(2R_L + R_B)$
A		$A = (T/R)(dR/dT) = -(1/2)[(\Delta/T_b)^{1/2}]$
C	Dynamic Heat Capacity	$C = C300[(T/0.3)^\gamma]$
G	Dynamic Thermal Conductance	$G = G300[(T/0.3)^\beta]$
Z/R		$Z/R = (I/V)(dV/dI) = [-1 - GT_b/(P_e A)] / [1 - GT_b/(P_e A)]$
τ	Electrical Time Constant	$\tau = [C/2G][(Z/R + 1)(1 + 2R_L/R_B)] / [Z/R + 2R_L/R_B]$
S _{dc}	Electrical Responsivity at 0 Hz	$S_{\text{dc}} = (1/2)[R_B/P_e]^{1/2} [1 - Z/R] / [1 + (Z/R)(R_B/2R_L)]$
NEP _{johnson}	Johnson Noise = Vn(infinity)/S _{dc}	$NEP_{\text{johnson}} = [2/((Z/R)+1)] [((Z/R)+(R_I/R))/((1+(R_I/R)))] [(4k(T_b)^3 G^2)/(P_e A^2)]^{1/2}$
NEP _{phonon}	Phonon Noise	$= \{ [(4kT_o^2 G)(\beta+1)((T/T_o)^{2\beta+3}-1)] / [(2\beta+3)(T/T_o)^\beta ((T/T_o)^{\beta+1}-1)] \}^{1/2}$
NEP _{load}	Load Noise = Vn(infiinty)/S _{dc}	$NEP_{\text{load}} = [4kT_o/2R_L]^{1/2} 2(Z/R)R_B I_{\text{bolo}} / [(Z/R) - 1] [(R+(R_I/(Z/R)))/(R + R_I)]$
NEP _{amp}	Amplifier Noise	$NEP_{\text{amp}} = V_n / S_{\text{dc}}$
NEP _{det}	Detector Noise after Demodulation	$NEP_{\text{det}} = [NEP_{\text{john}}^2 + NEP_{\text{phon}}^2 + NEP_{\text{load}}^2 + NEP_{\text{amp}}^2]^{1/2}$
DQE	BLIP Figure-of-Merit for Detector	$DQE = NEP_{\text{photon}}^2 / (NEP_{\text{photon}}^2 + NEP_{\text{det}}^2)$
Vn(det)	Voltage Noise of Detector After Demod.	$V_n(\text{det}) = NEP_{\text{det}} S_{\text{dc}}$
Vn(total)	Total Noise after Demodulation	$V_n(\text{total}) = [NEP_{\text{det}}^2 + NEP_{\text{photon}}^2]^{1/2} S_{\text{dc}}$

Version	Issue Date	Sheet	Changes from Previous Version			
v6	9/19/2005	Draft issued to RAL	Internal work only			

EIDP Coverage For QM PLW BDA

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

Environmental 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 Herschel		LOG NO. HS013	
STEM/ASSEMBLY TITLE SPIRE Qual BDA S/N007			DATE ISSUED 7/23/2003
REFERENCE DESIGNATION NUMBER	PART NO. (IF MULTIPLE, ATTACH LIST) 10209800-8	REV.	SERIAL NO. 007
HARDWARE TYPE <input checked="" type="checkbox"/> EM QUAL <input type="checkbox"/> FLIGHT <input type="checkbox"/> FLIGHT SPARE <input type="checkbox"/> OTHER		PRE-ENVIRONMENTAL INSPECTION REPORT NUMBER (ATTACH IR)	
WIRING HARNESS <input type="checkbox"/> EM QUAL <input type="checkbox"/> FLIGHT <input type="checkbox"/> EM <input type="checkbox"/> SE		PART NO.	REV. SERIAL NO.
TEST DESCRIPTION (CHECK ALL APPLICABLE) <input checked="" type="checkbox"/> SINE VIBRATION <input type="checkbox"/> PYROSHOCK <input type="checkbox"/> ACOUSTIC <input type="checkbox"/> EMC <input type="checkbox"/> OTHER _____ <input checked="" type="checkbox"/> RANDOM VIBRATION <input type="checkbox"/> THERMAL VAC. <input type="checkbox"/> THERMAL ATMOSPHERE		TYPE OF TEST <input type="checkbox"/> QUALIFICATION <input type="checkbox"/> FLIGHT ACCEPTANCE <input type="checkbox"/> PROTO FLIGHT <input type="checkbox"/> RETEST	
WILL ALL TESTS/LEVELS/DURATIONS REQUIRED BY THE PROJECT DOCUMENTS BE PERFORMED ON THIS UNIT? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) ENTER PROJ. DOC. NO. AND REV. _____			
HAS THE UNIT PASSED ALL PRE-ENVIRONMENTAL FUNCTIONAL TESTS? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION			
HAVE ALL DESIGN ANALYSES BEEN COMPLETED AND REQUIRED CHANGES BEEN IMPLEMENTED? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION			
IS THE TEST ARTICLE IDENTICAL TO OTHER FLIGHT UNITS? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION			
ARE ALL PFRs AGAINST THIS UNIT CLOSED? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION			
HAVE ALL WAIVERS AND ECRs BEEN APPROVED AND ARE THEY INCORPORATED? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION			
TEST AUTHORIZED BY			
COGNIZANT ENGINEER <i>M. Sankhatne</i>	DATE 7/29/03	TECHNICAL MGR./INSTR MRG./PI PREP REP <i>M. Mantel</i>	DATE 7-25-03
		ENVIRONMENTAL REQUIREMENTS ENG. <i>Henry Abela</i>	DATE 7/28/03

SUMMARY SECTION

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

TEST DESCRIPTION

VIBRATION AXES: X Y Z SINE VIBRATION <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> RANDOM VIBRATION <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	ACOUSTIC <input type="checkbox"/>	PYROSHOCK SHOCK AXES: X Y Z <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> SHOCKS/AXIS:	<input type="checkbox"/> THERMAL VACUUM PRESSURE: NO OF CYCLES:	<input type="checkbox"/> TEMPERATURE ATMOSPHERE NO OF CYCLES:	<input type="checkbox"/> OTHER
EMC <input type="checkbox"/> ESD	<input type="checkbox"/> COND. SUSC. <input type="checkbox"/> RAD. SUSC.	<input type="checkbox"/> COND. EMIS. <input type="checkbox"/> RAD. EMIS.	<input type="checkbox"/> ISOLATION <input type="checkbox"/> MAGNETICS	TEMP. LEVEL (°C) AND ACCUMULATED DURATION (HRS.) HOT: _____°C, _____h COLD: _____°C, _____h HOT: _____°C, _____h COLD: _____°C, _____h	
WERE THERE ANY PFRs GENERATED DURING ENVIRONMENTAL TESTS? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST)		LIST PFR NOS. / BRIEF EXPLANATION			
ARE THE POST ENVIRONMENTAL DAMAGE INSPECTIONS COMPLETE? <input checked="" type="checkbox"/> YES <input type="checkbox"/> 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? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST)		LIST PFR NOS. / BRIEF EXPLANATION			

<input type="checkbox"/> 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 <input checked="" type="checkbox"/> <i>R. Miller</i>	DATE 2/18/04	TECHNICAL MGR./INSTR MRG./PI PREP REP <i>M. Mantel</i>	DATE 3/17/05
		ENVIRONMENTAL REQUIREMENTS ENG. <i>Chen B.</i>	DATE 2-18-04



ENVIRONMENTAL TEST AUTHORIZATION AND SUMMARY (ETAS)

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	<p>LATERAL 2 minute Random Vibe +3dB/octave 20-100Hz 0.06 g²/Hz 100-138.5 Hz +36dB/octave 138.5-170 Hz 0.7 g²/Hz 170-200 Hz -48dB/octave 200-220 Hz .1 g²/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</p> <p>LONGITUDINAL 2 minute Random Vibe +3dB/octave 20-100Hz 0.08g²/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</p> <p>Each axis 1/4 g sine sweep 20-2000 Hz each axis T ~ 100 K</p>				



ENVIRONMENTAL TEST AUTHORIZATION AND SUMMARY (ETAS)

AUTHORIZATION SECTION

PROJECT Herschel		LOG NO. HS017	
ITEM/ASSEMBLY TITLE S... Qual BDA SN007			DATE ISSUED 9/2/2003
REFERENCE DESIGNATION NUMBER	PART NO. (IF MULTIPLE, ATTACH LIST) 10209800	REV.	SERIAL NO. 007
HARDWARE TYPE <input checked="" type="checkbox"/> EM QUAL <input type="checkbox"/> FLIGHT <input type="checkbox"/> FLIGHT SPARE <input type="checkbox"/> OTHER		PRE-ENVIRONMENTAL INSPECTION REPORT NUMBER (ATTACH IR)	
WIRING HARNESS <input type="checkbox"/> EM QUAL <input type="checkbox"/> FLIGHT <input type="checkbox"/> EM <input type="checkbox"/> SE		PART NO.	REV. SERIAL NO.
TEST DESCRIPTION (CHECK ALL APPLICABLE) <input type="checkbox"/> SINE VIBRATION <input type="checkbox"/> PYROSHOCK <input type="checkbox"/> ACOUSTIC <input type="checkbox"/> EMC <input type="checkbox"/> OTHER _____ <input type="checkbox"/> RANDOM VIBRATION <input checked="" type="checkbox"/> THERMAL VAC. <input type="checkbox"/> THERMAL ATMOSPHERE		TYPE OF TEST <input checked="" type="checkbox"/> QUALIFICATION <input type="checkbox"/> FLIGHT ACCEPTANCE <input type="checkbox"/> PROTO FLIGHT <input type="checkbox"/> RETEST	
WILL ALL TESTS/LEVELS/DURATIONS REQUIRED BY THE PROJECT DOCUMENTS BE PERFORMED ON THIS UNIT? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) ENTER PROJ. DOC. NO. AND REV. _____			
HAS THE UNIT PASSED ALL PRE-ENVIRONMENTAL FUNCTIONAL TESTS? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION			
HAVE ALL DESIGN ANALYSES BEEN COMPLETED AND REQUIRED CHANGES BEEN IMPLEMENTED? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION			
IS THE TEST ARTICLE IDENTICAL TO OTHER FLIGHT UNITS? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION			
ARE ALL PFRs AGAINST THIS UNIT CLOSED? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION			
HAVE ALL WAIVERS AND ECRs BEEN APPROVED AND ARE THEY INCORPORATED? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST) BRIEF EXPLANATION			
TEST AUTHORIZED BY			
COGNIZANT ENGINEER <i>[Signature]</i>	DATE 10/9/03	TECHNICAL MGR./INSTR MRG./PI PREP REP <i>[Signature]</i>	DATE 10-16-03
		ENVIRONMENTAL REQUIREMENTS ENG. <i>[Signature]</i>	DATE 10/9/03

SUMMARY SECTION

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

TEST DESCRIPTION

VIBRATION AXES: X Y Z SINE VIBRATION <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> RANDOM VIBRATION <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	ACOUSTIC <input type="checkbox"/>	PYROSHOCK SHOCK AXES: X Y Z <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> SHOCKS/AXIS:	<input checked="" type="checkbox"/> THERMAL VACUUM PRESSURE: <1E-5 mbar, 290K to 7K NO OF CYCLES: 27	<input type="checkbox"/> TEMPERATURE ATMOSPHERE NO OF CYCLES: _____	<input type="checkbox"/> OTHER
EMC <input type="checkbox"/> ESD	<input type="checkbox"/> COND. SUSC. <input type="checkbox"/> RAD. SUSC.	<input type="checkbox"/> COND. EMIS. <input type="checkbox"/> RAD. EMIS.	<input type="checkbox"/> ISOLATION <input type="checkbox"/> MAGNETICS	TEMP. LEVEL (°c) AND ACCUMULATED DURATION (HRS.) HOT: _____°c, _____ h COLD: _____°c, _____ h HOT: _____°c, _____ h COLD: _____°c, _____ h	
WERE THERE ANY PFRs GENERATED DURING ENVIRONMENTAL TESTS? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST)			LIST PFR NOS. / BRIEF EXPLANATION		
ARE THE POST ENVIRONMENTAL DAMAGE INSPECTIONS COMPLETE? <input checked="" type="checkbox"/> YES <input type="checkbox"/> 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? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO (IF NO, ATTACH EXCEPTIONS LIST)			LIST PFR NOS. / BRIEF EXPLANATION		

<input type="checkbox"/> 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 <input checked="" type="checkbox"/> <i>[Signature]</i>	DATE 2/18/04	TECHNICAL MGR./INSTR MRG./PI PREP REP <i>[Signature]</i>	DATE 3/17/05	ENVIRONMENTAL REQUIREMENTS ENG. <i>[Signature]</i>	DATE 2-18-04



ENVIRONMENTAL TEST AUTHORIZATION AND SUMMARY (ETAS)

OTHER AUTHORIZATION PROVISIONS AND EXPLANATIONS

Final 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

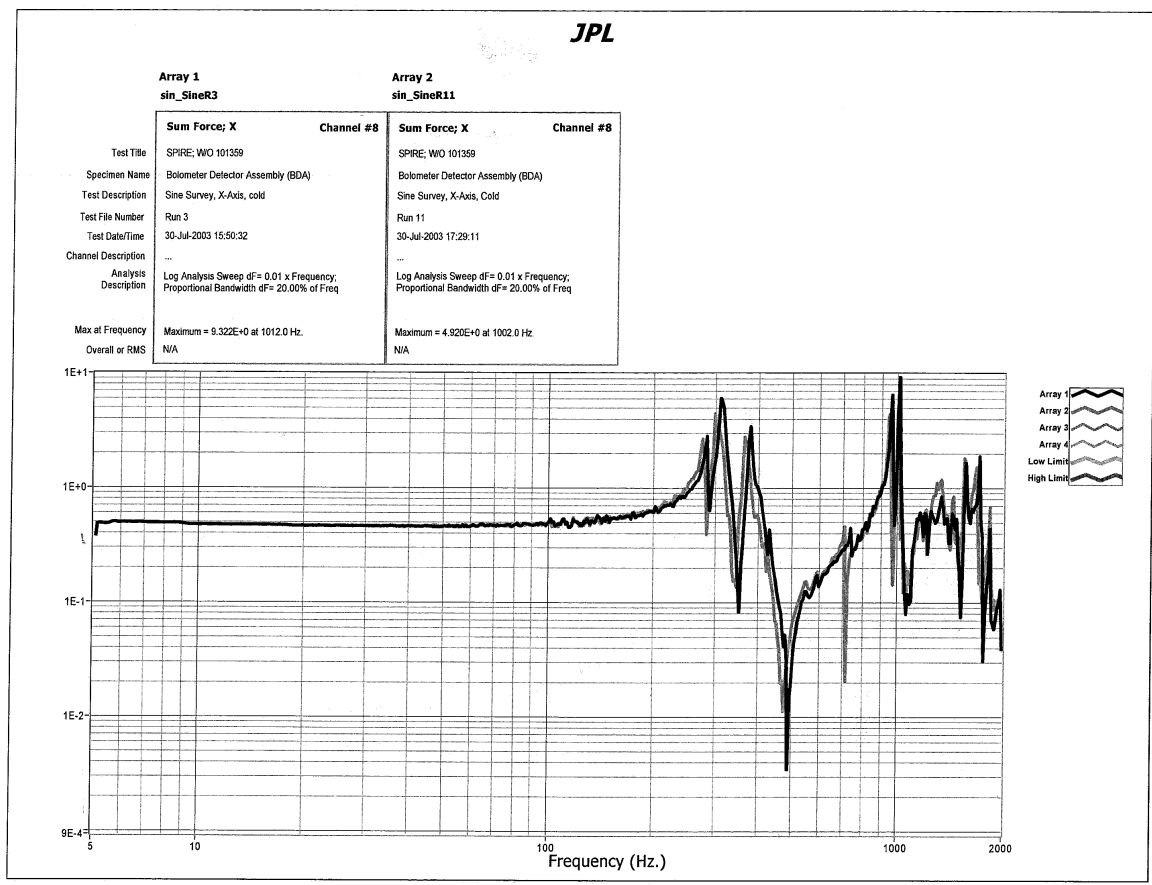
HARDWARE	S/N	ETAS	TEST ENVIRONMENT LEVELS & DURATION	DATE TEST PERFORMED	TEST AGENCY	PASS/ FAIL	COMMENTS
Qual BDA (10209800)	7	HSO17	27 Thermal cycles from 290K to 7K				

QM BDA Random Vibration Test

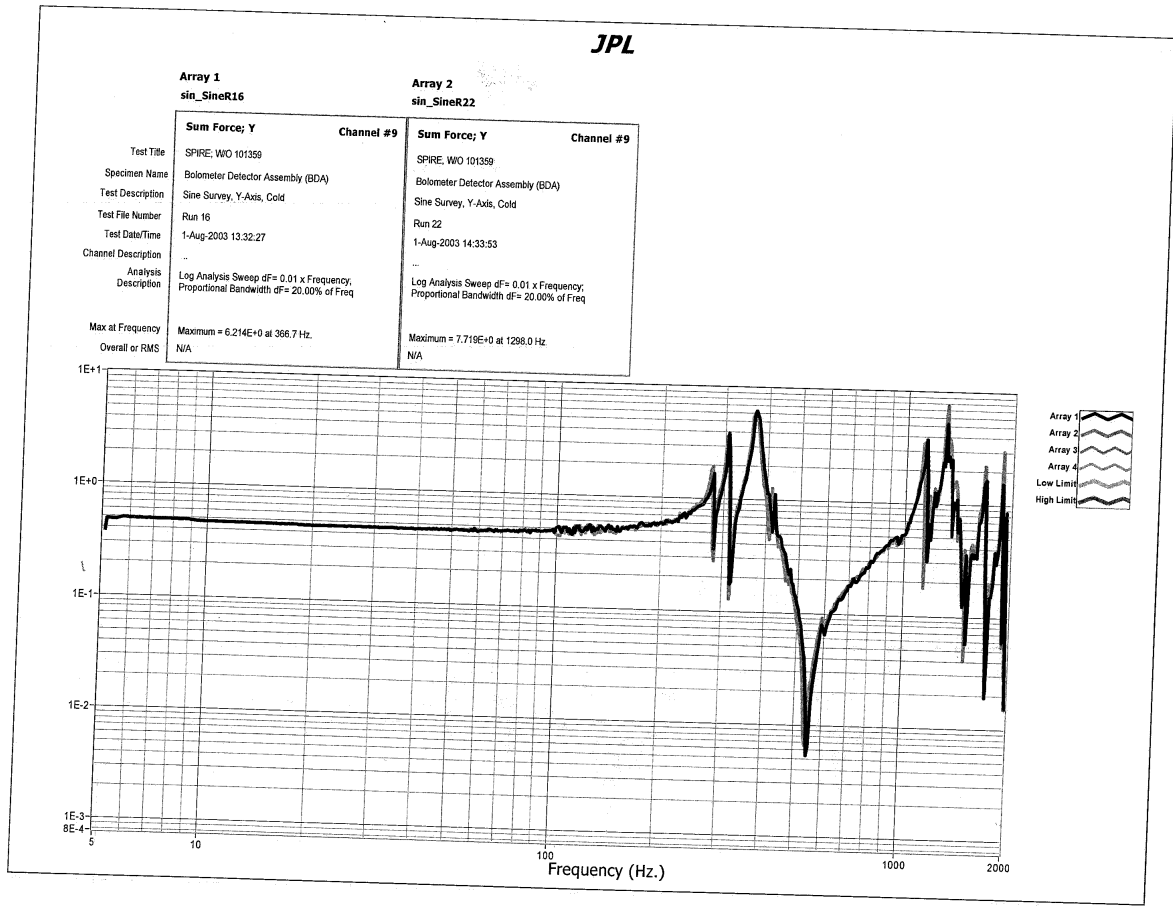
P/N 10209800-8

S/N 007

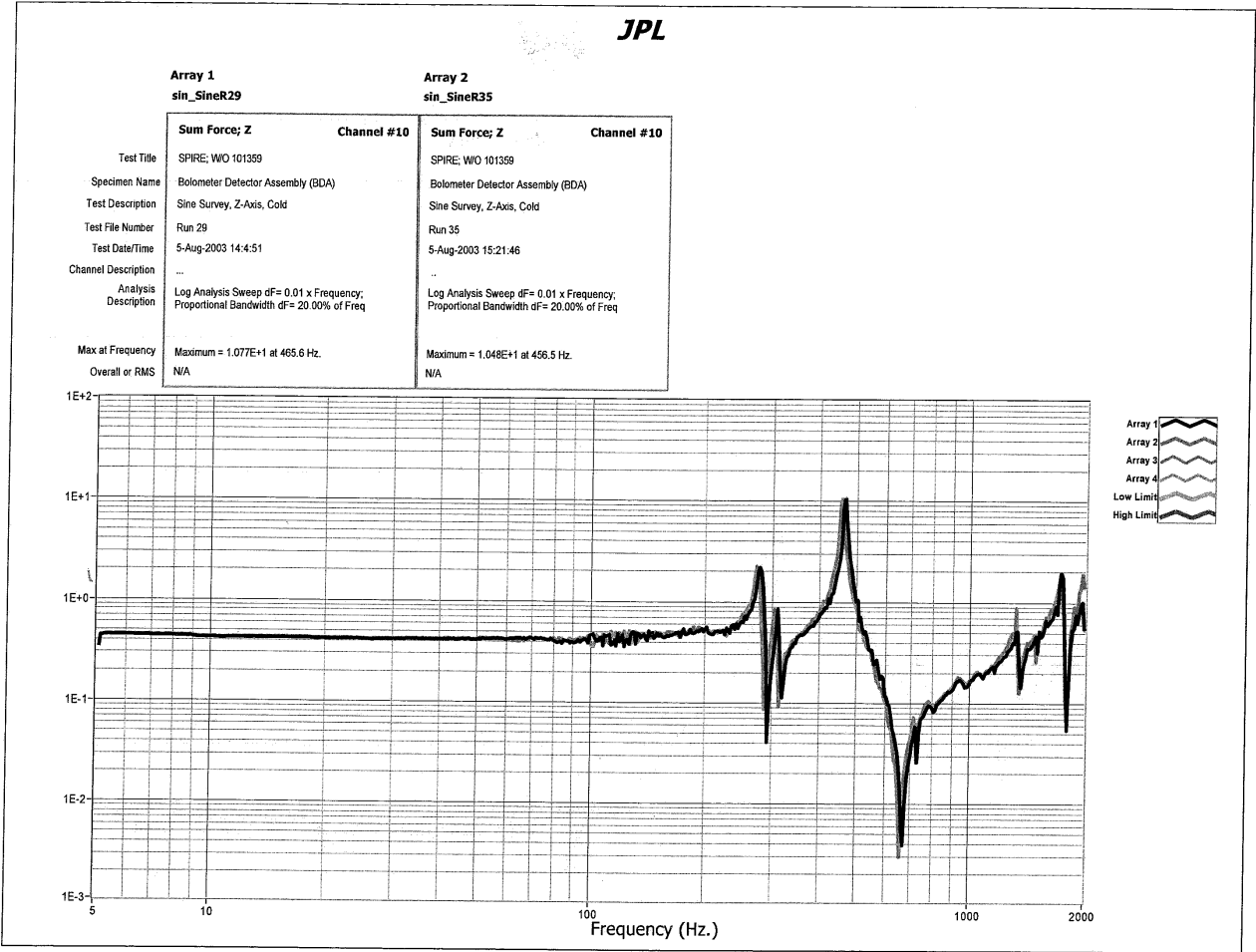
X-axis Shake, Cold, Sine Surveys (Before and After 0 dB Random Vibe)



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

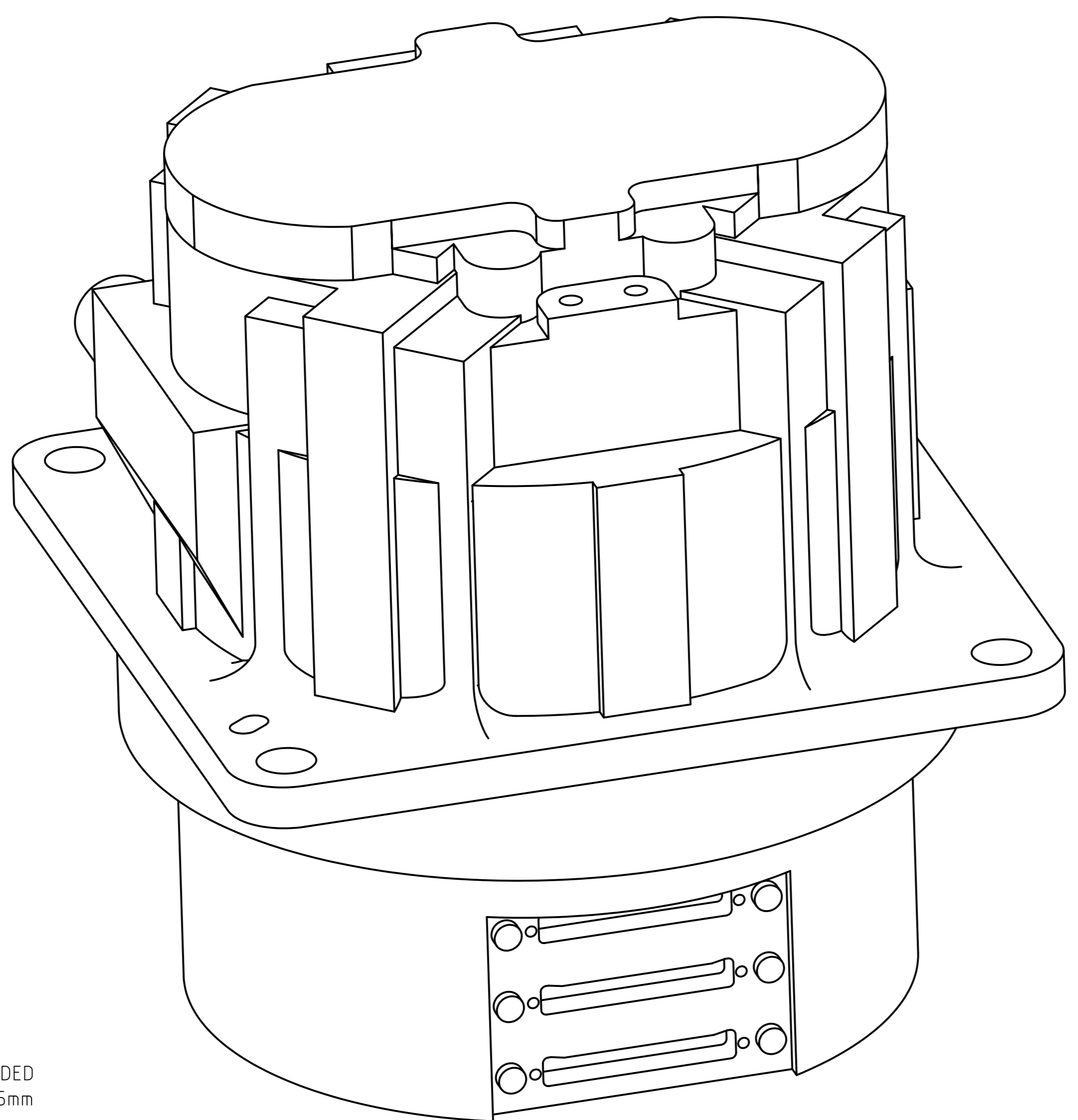


Z-axis Shake, Cold, Sine Surveys (Before and After 0 dB Random Vibe)



Date	Time	AIDS	Power	Mate	Demate	Transport	Notes
							SN011 BDA Operations (applies to suspension only)
24-Jun-2004		243158					cold shake test, prototflight levels
interim		243184					BODAC testing (one or more thermal cycles)
25-Jul-2004		243375					Cold alignment measurement TC1
4-Aug-2004		243462					Cold alignment measurement TC2
interim		243617					BODAC testing (one or more thermal cycles)
13-Sep-2004		243758					Removal from BODAC
interim							BDA SN011 drybox storage
17-Feb-2005		244891					disassemble suspension from BDA SN011
interim		244891					suspension sn009 drybox storage
							SN019 Assembly Process Connector Mates
19-Jul-2004		240857		J01	J01		kapton cable sub-assembly test
19-Jul-2004		240856		J02	J02		kapton cable sub-assembly test
1-Jun-2005		244978		J03	J03		kapton cable sub-assembly test
1-Jun-2005		244979		J04	J04		kapton cable sub-assembly test
8-Jun-2005		245546		J01-J04	J01-J04		kapton cable post-installation test
10-Jun-2005		245546		J01-J04	J01-J04		load resistor test
13-Jun-2005		245546		J01-J04	J01-J04		detector test
14-Jun-2005		245546		J01-J04	J01-J04		detector test, after feedhorn installation
							Assembly Complete (note: suspension re-used)
16-Jun-2005		245609		J01-J04	J01-J04		assembly complete electrical test (pre-bakeout)
16-Jun-2005		245609				x	103 -> MDL -> 103, for optical metrology
17-Jun-2005		245609					Filter installation
17-Jun-2005		245609				x	103 -> bld 158 for Vacuum Bakeout
interim		245609					Vacuum Bake (80C, 10E-5 torr, 24hr)
20-Jun-2005		245609				x	158 -> 170 -> 103-109D for metrology
20-Jun-2005		245609		J01-J04	J01-J04		post-bakeout, pre-shake electrical test
20-Jun-2005		245609				x	bld 103 -> 183 delivery to environmental test

LTR		ZONE	DESCRIPTION	CODE	DWN	CHK	STRUCT	MATL	THRM CONT	PEM	ENGR	DSGN SUPV	DATA MGT	RELEASE DATE
A			INITIAL RELEASE	B										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 FDR -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 ± 0.5 mm 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 REFERENCE ONLY. ALL OTHER 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								
				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 KNDPP	11/19/01		
				THRM CONT				
				MSSL	A. J. COKER	11/7/01	SIZE	CAGE NO
				PEM	G. LILENTHAL	12/13/01	A1	23835
				ENGR	L. HUSTED	11/19/01	10209721	
				DSGN SUPV				
				APPLICATION	DO NOT SCALE DRAWING		UNCLASSIFIED	
				INTERPRET DWG PER	ASME Y14.100M		SHEET 1 OF 7	

MATERIAL

METRIC

THIRD ANGLE PROJECTION

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) $\sqrt{32}$

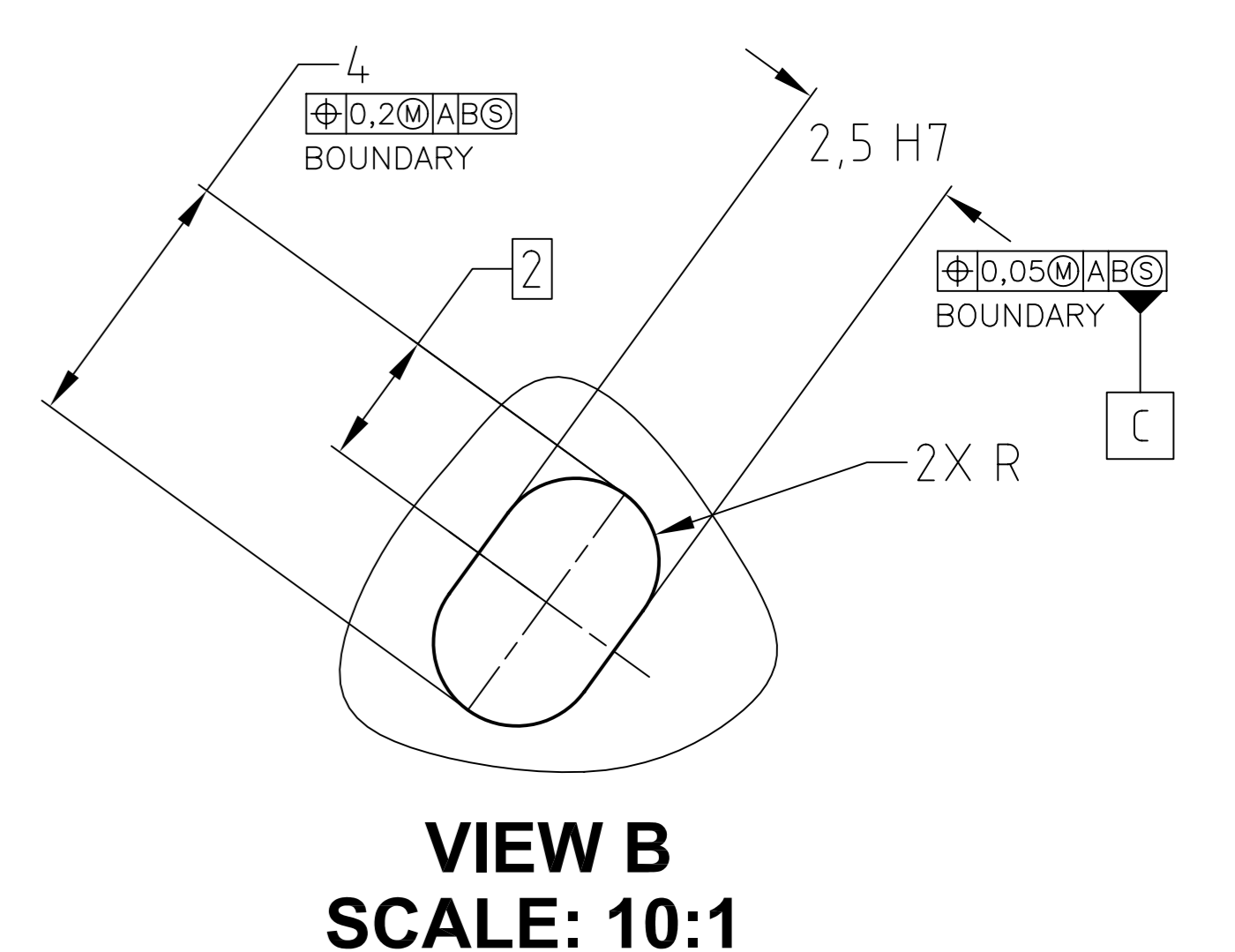
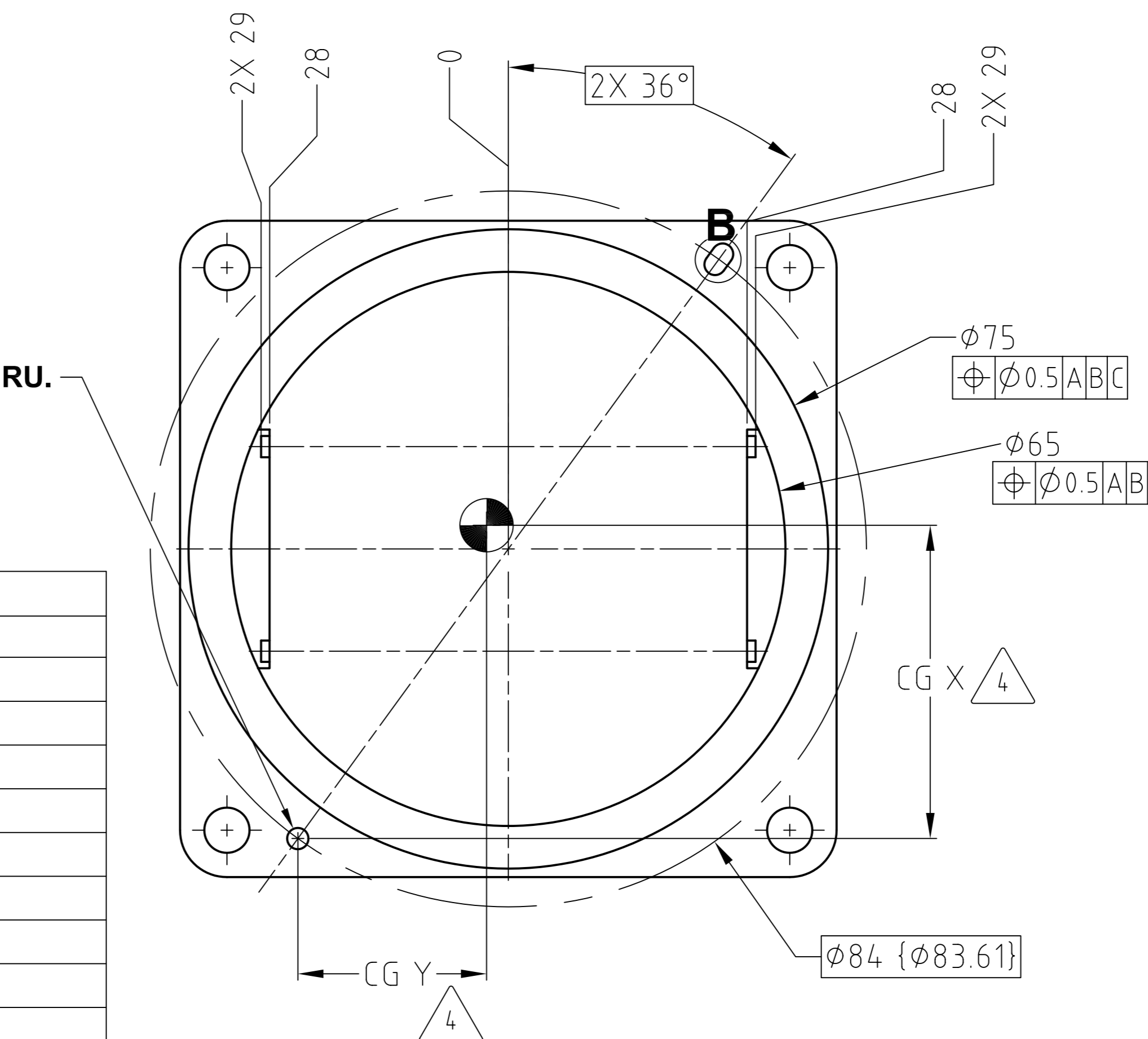
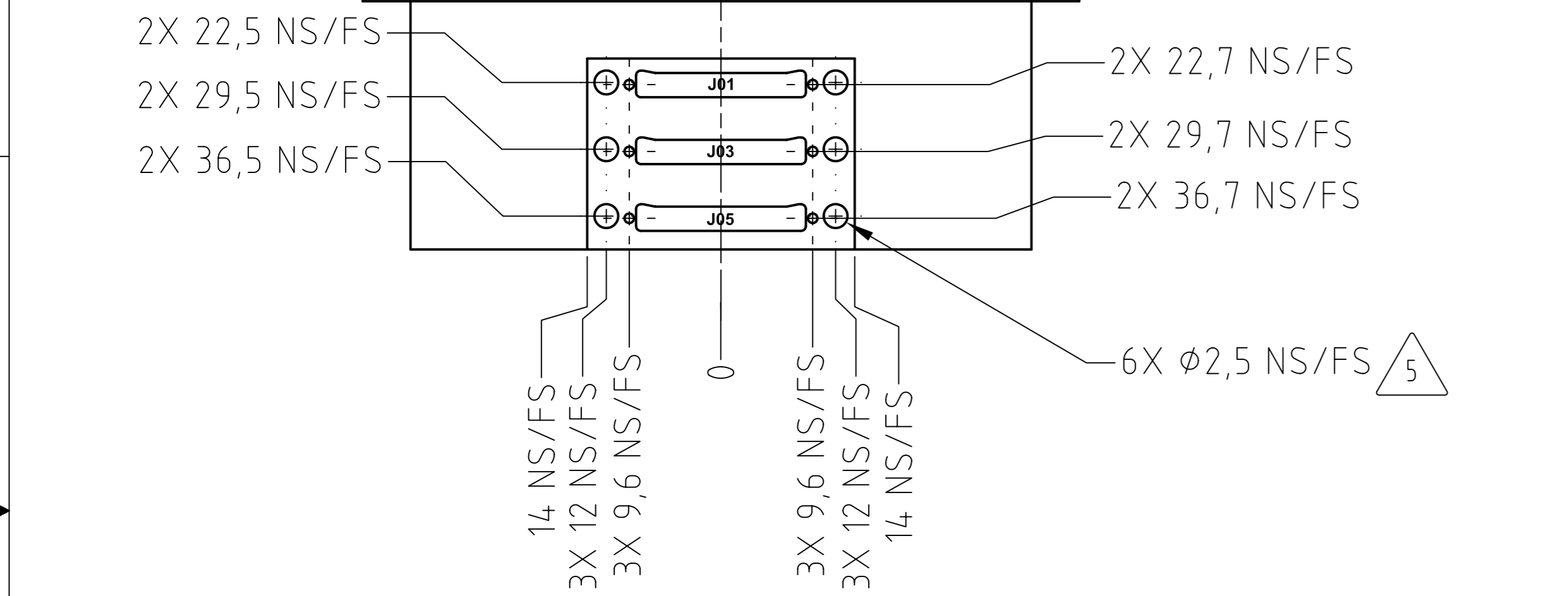
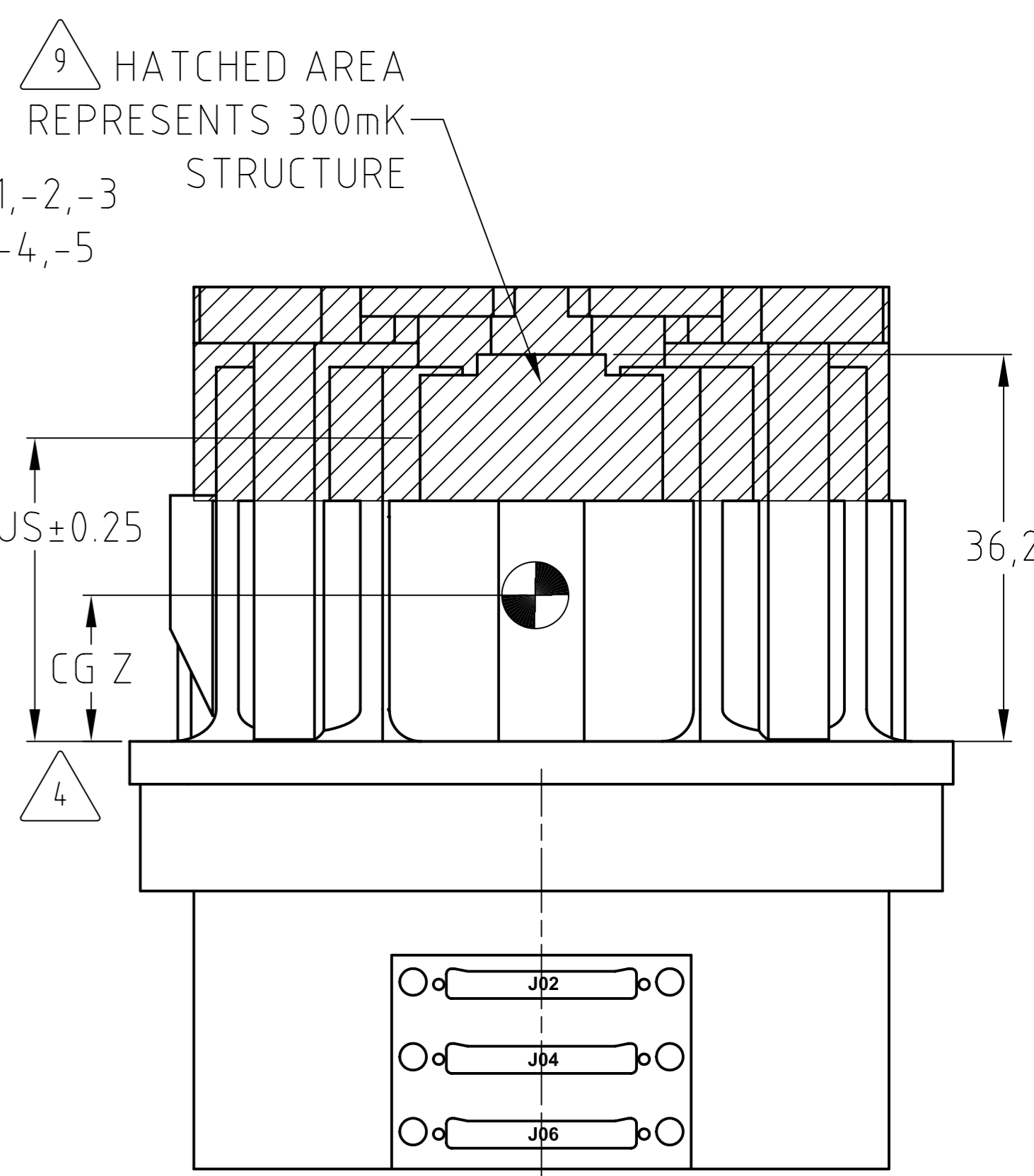
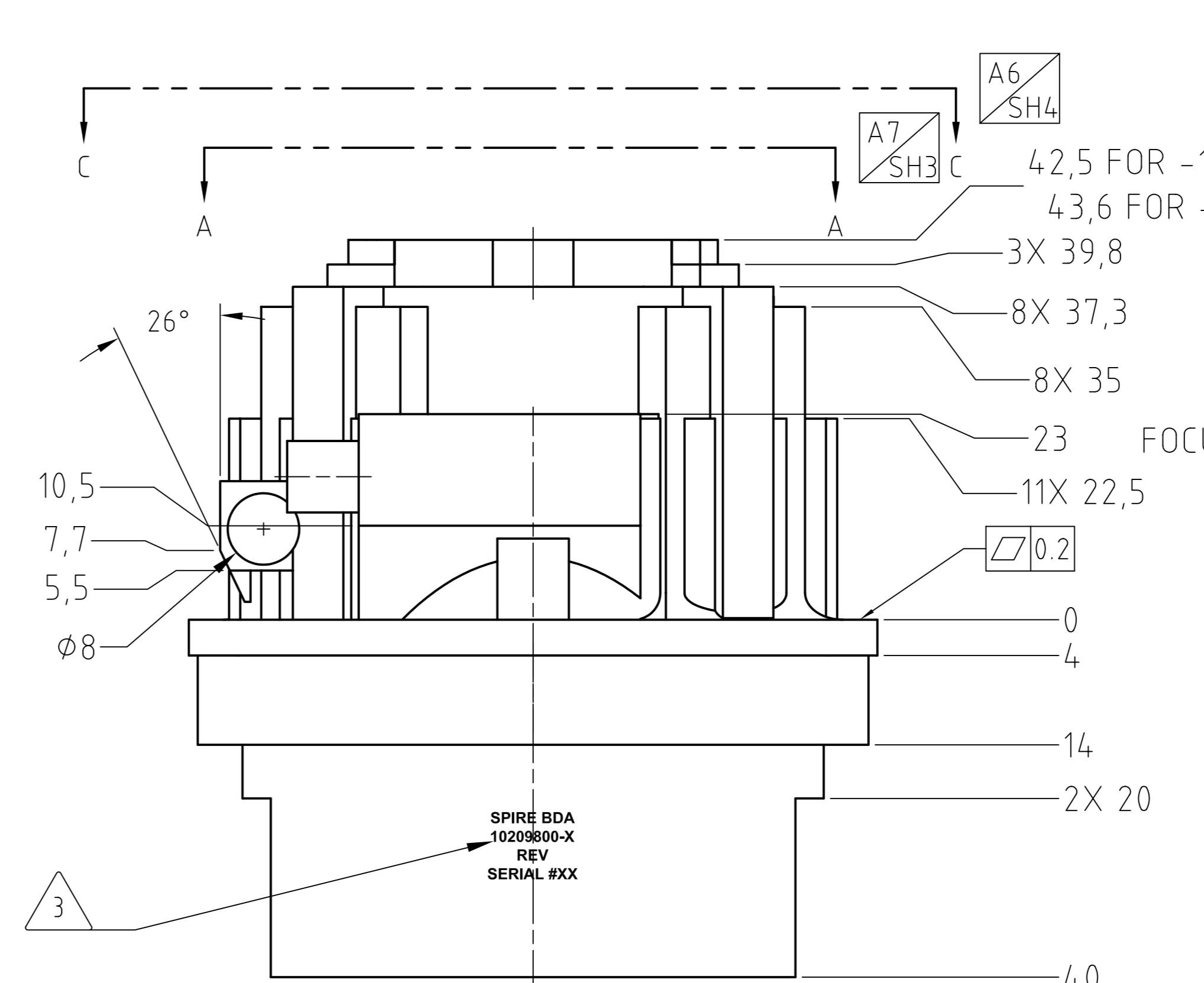
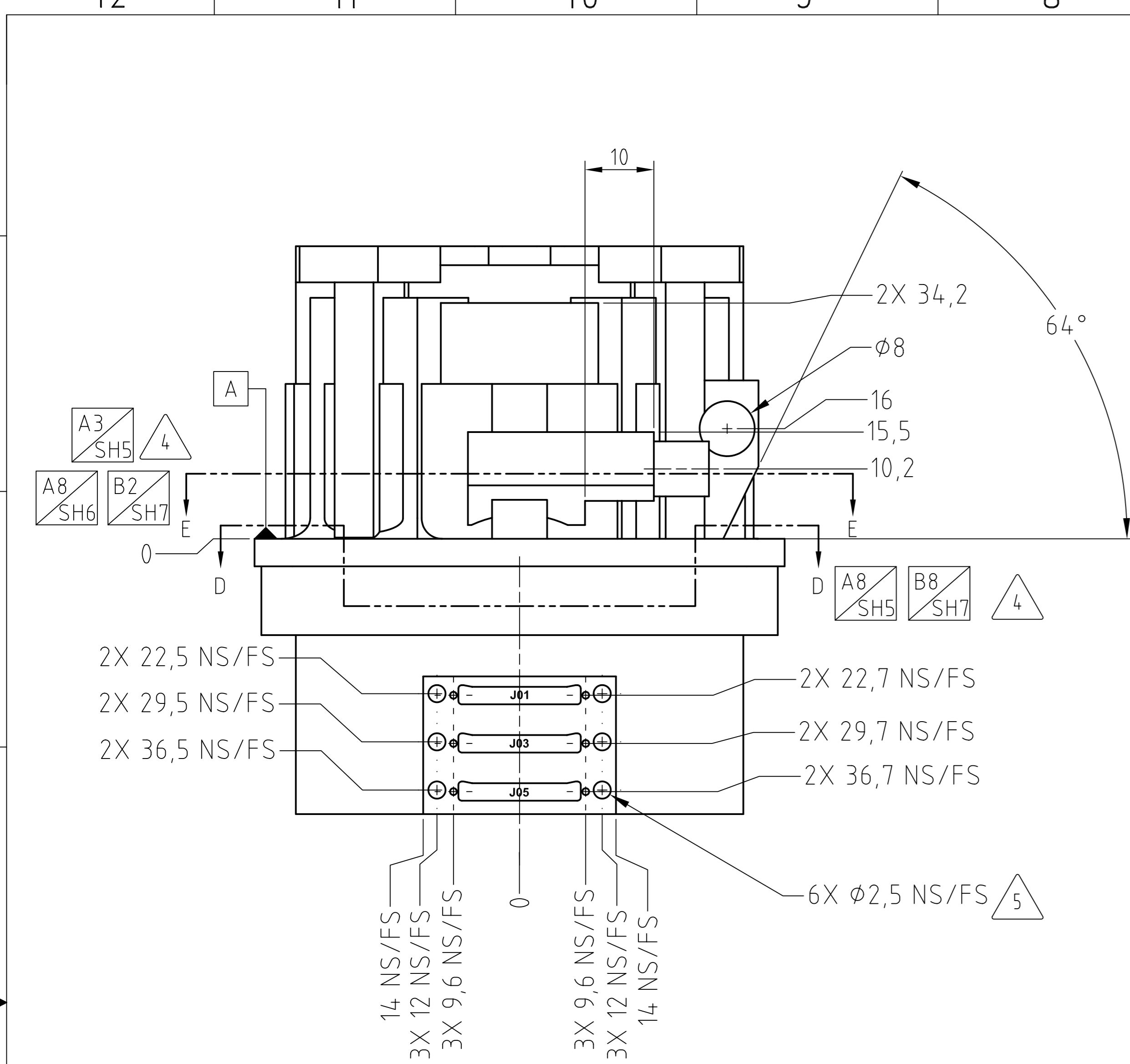
DO NOT SCALE DRAWING
INTERPRET DWG PER ASME Y14.100M

JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CA 91109

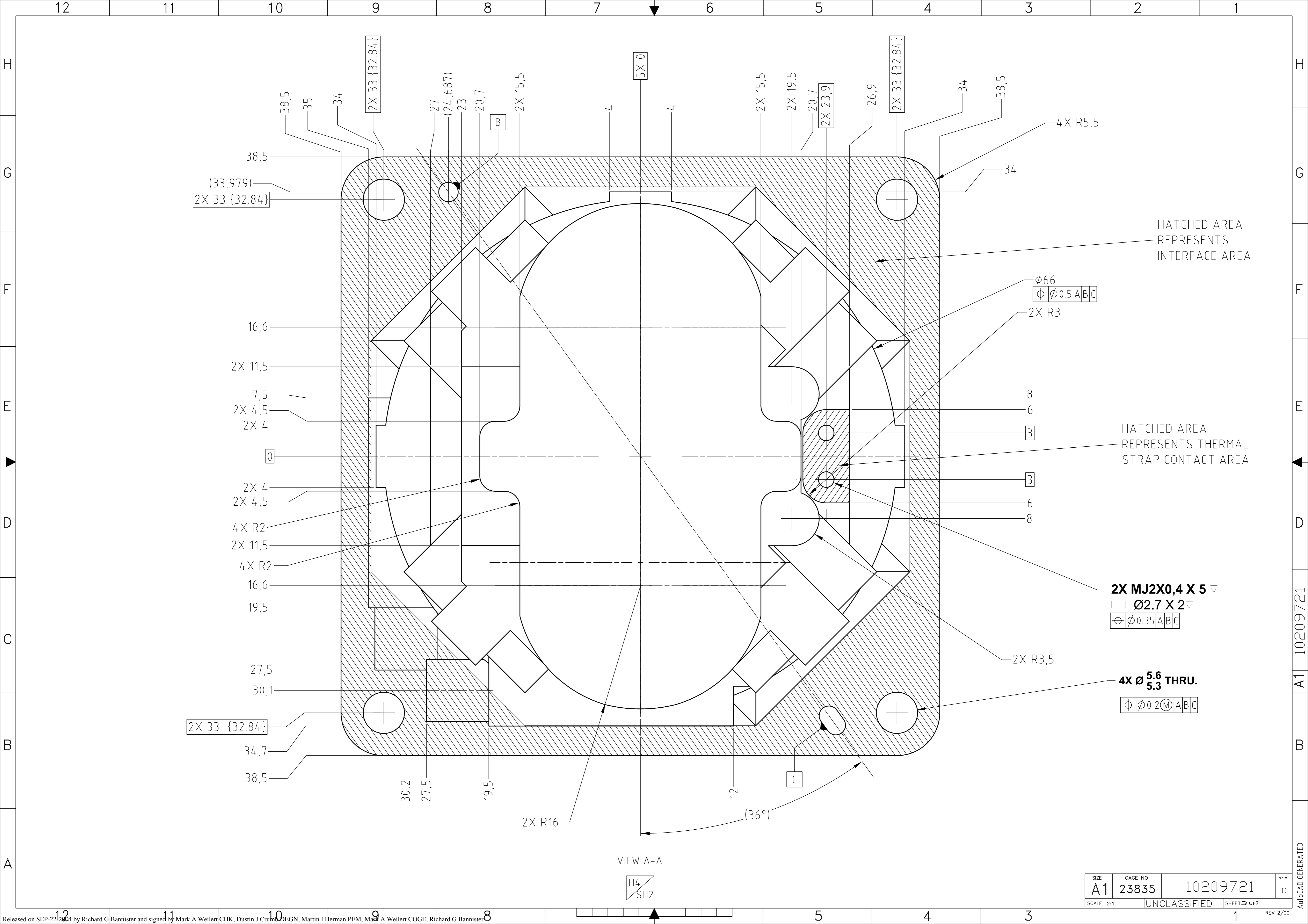
RELEASED THROUGH EDMG

**BOLOMETER DETECTOR
ARRAY,
SPIRE**

SCALE NONE



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

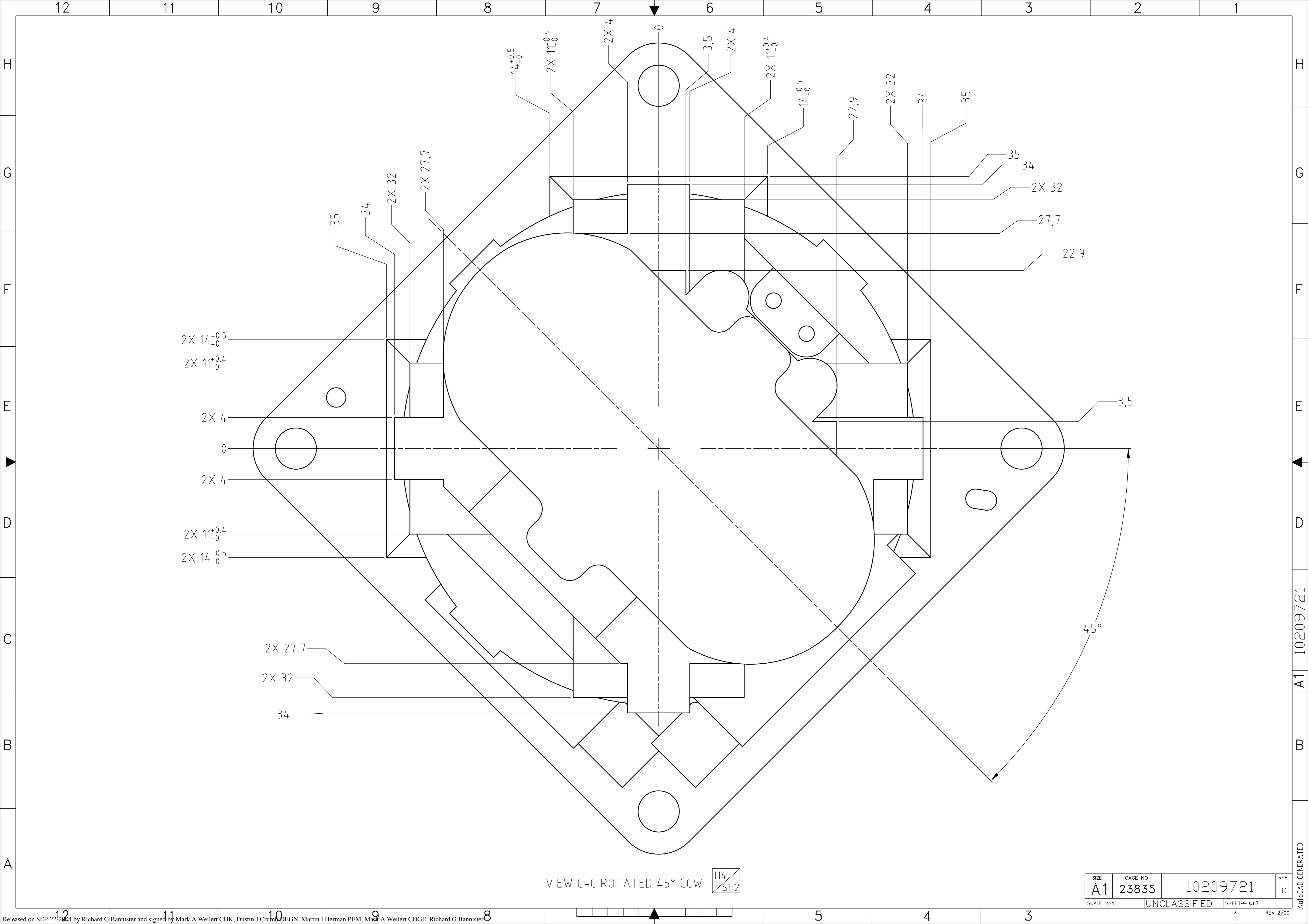


38,5 35 34 2X 33 {32.84} 27 (24,687) 23 20,7 2X 15,5 4 4 5X 0 2X 15,5 2X 19,5 20,7 2X 23,9 26,9 2X 33 {32.84} 34 38,5 4X R5,5 34
 (33,979) 2X 33 {32.84} 16,6 2X 11,5 7,5 2X 4,5 2X 4 0 8 6 3 8 8 2X R3
 2X 4 2X 4,5 4X R2 2X 11,5 4X R2 16,6 19,5 27,5 30,1 2X 33 {32.84} 34,7 38,5 30,2 27,5 19,5 12 2X R3,5 2X R16 (36°)
 HATCHED AREA REPRESENTS INTERFACE AREA
 HATCHED AREA REPRESENTS THERMAL STRAP CONTACT AREA
 2X MJ2X0,4 X 5
 Ø2.7 X 2
 Ø0.35|A|B|C
 4X Ø 5.6 THRU.
 Ø0.2(M)|A|B|C

VIEW A-A

H4
SH2

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



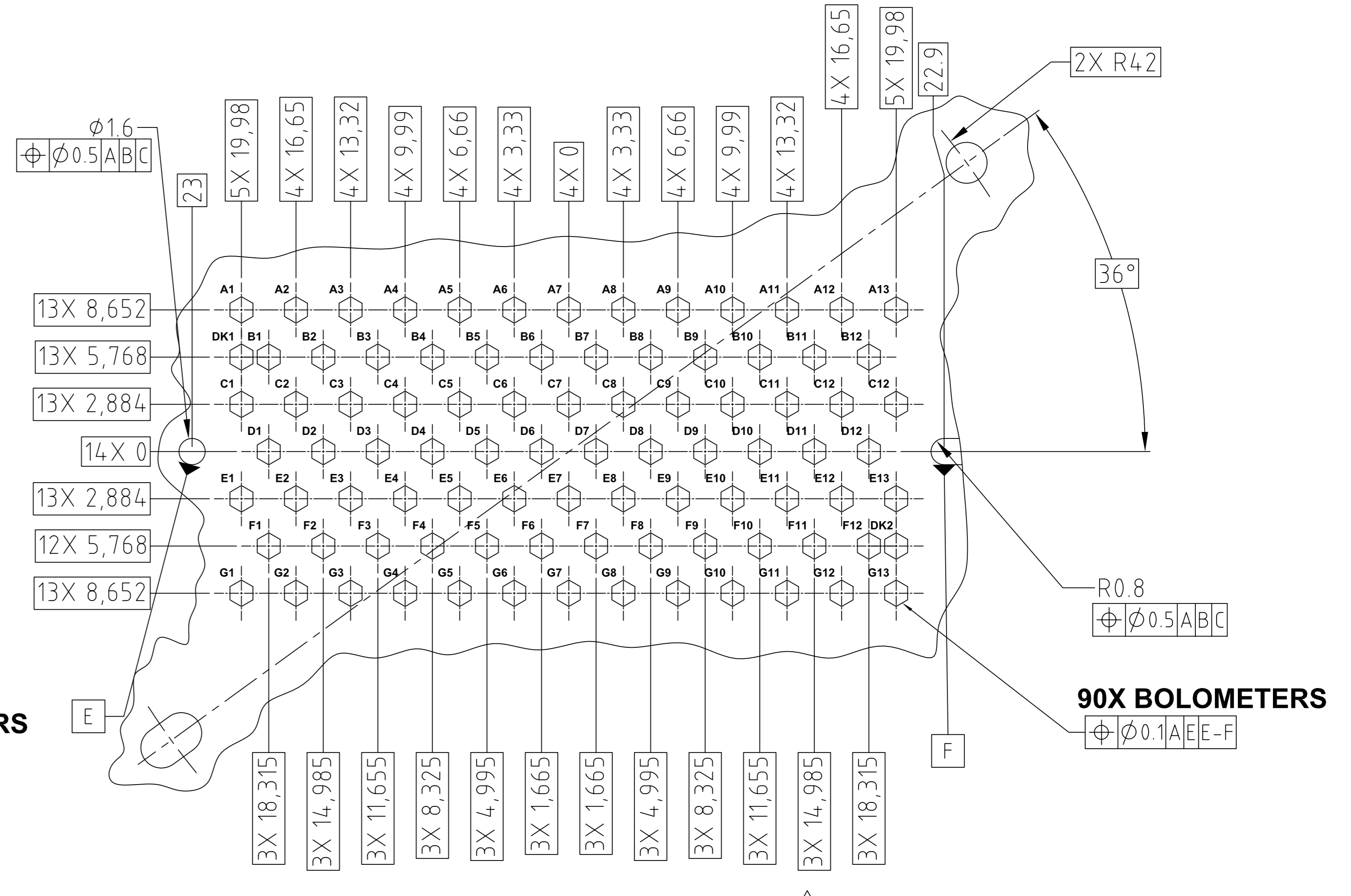
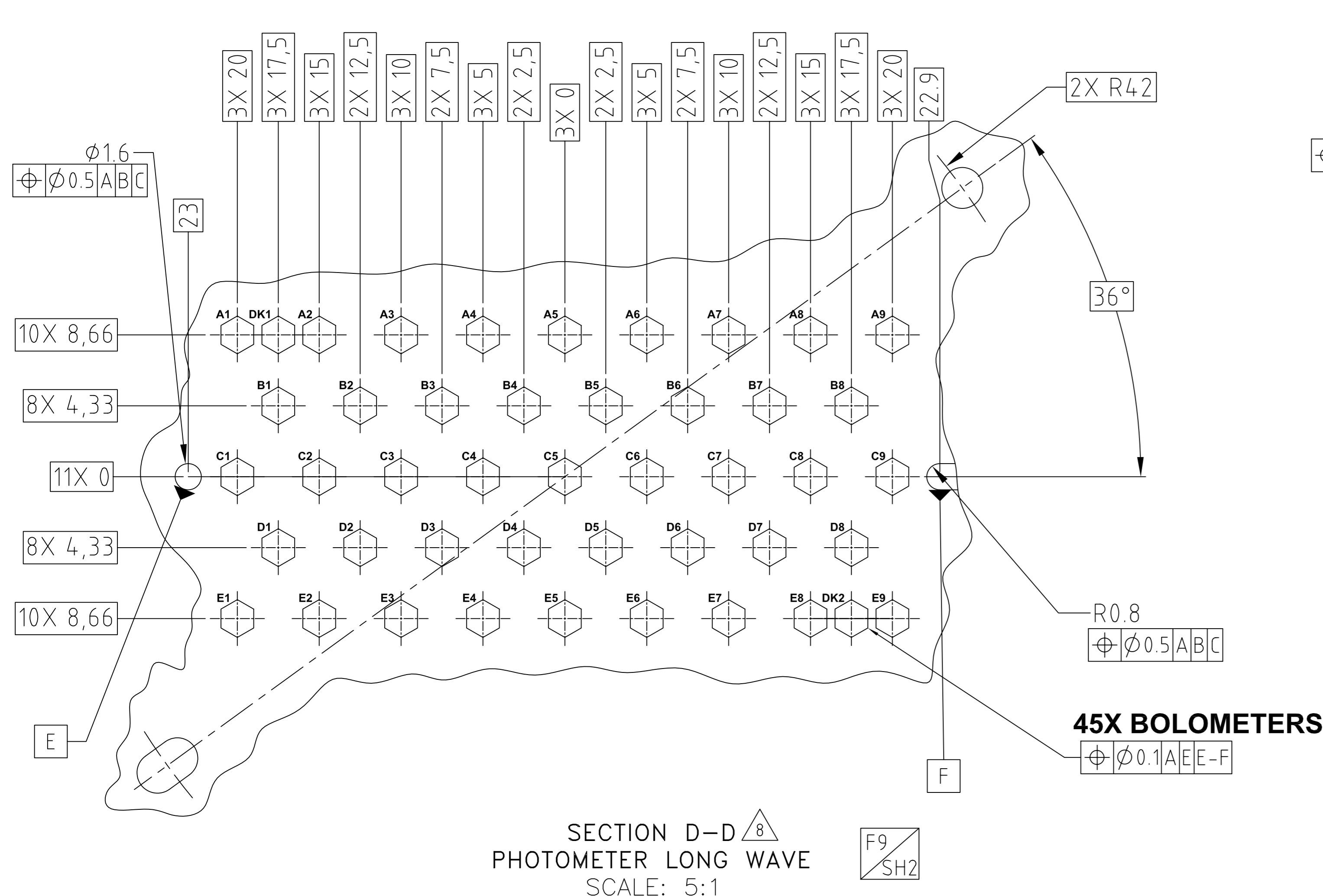
VIEW C-C ROTATED 45° CCW

H4
SH2

SIZE A1	CAGE NO 23835	10209721	REV c
SCALE 2:1	UNCLASSIFIED	SHEET 4 OF 7	REV 2/00

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 μ m			
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 μ m			

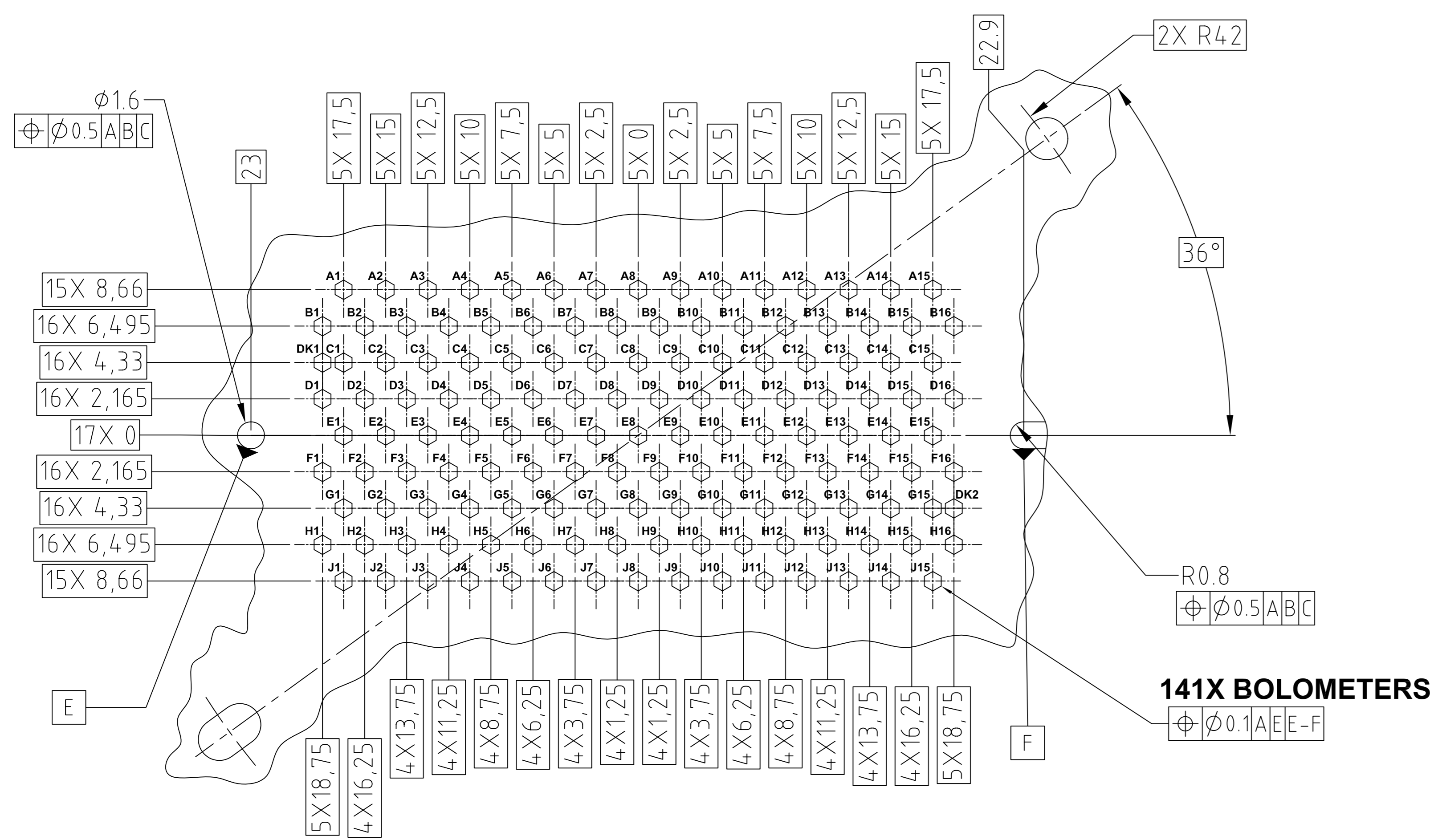
SUBSYSTEM INTERFACE DATA			
UNIT: P/MW			
NUMBER: 10209800-2			
FOCUS: 32.2			
CONNECTOR POSITIONS USED: J01, J02, J03, J04			
MECHANICAL CHARACTERISTICS			
MASS: 632 g			
C.O.G. LOCATION W.R.T. LOCATION HOLE:			
X	34.4	Y	24.3
Z	8.5		
MOMENT OF INERTIA:			
I_x	764 Kg*mm ²	I_y	1,152 Kg*mm ²
I_z	1,428 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 μ m			
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 μ m			



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

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 μm			
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 μm			



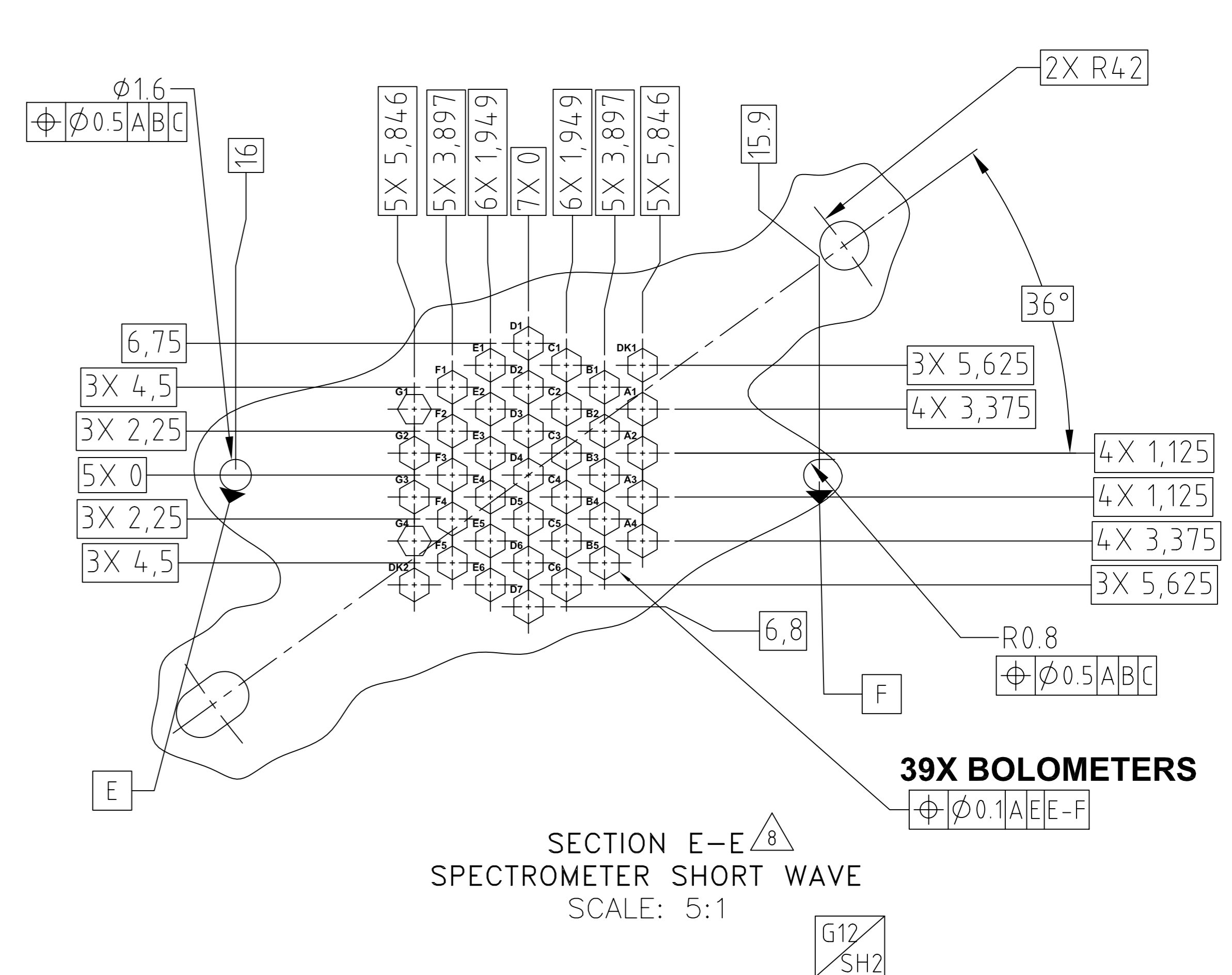
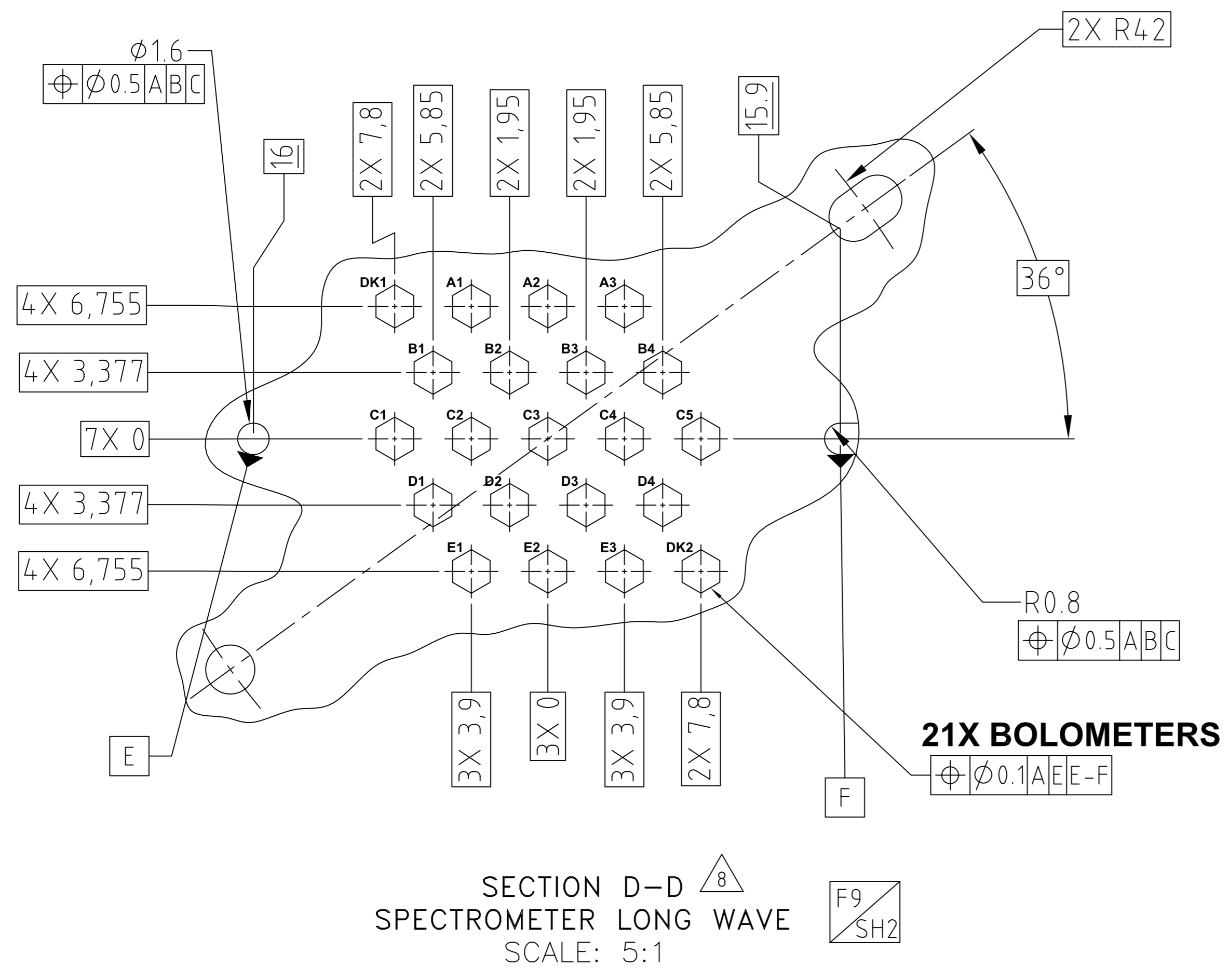
SECTION E-E
PHOTOMETER SHORT WAVE
SCALE: 5:1

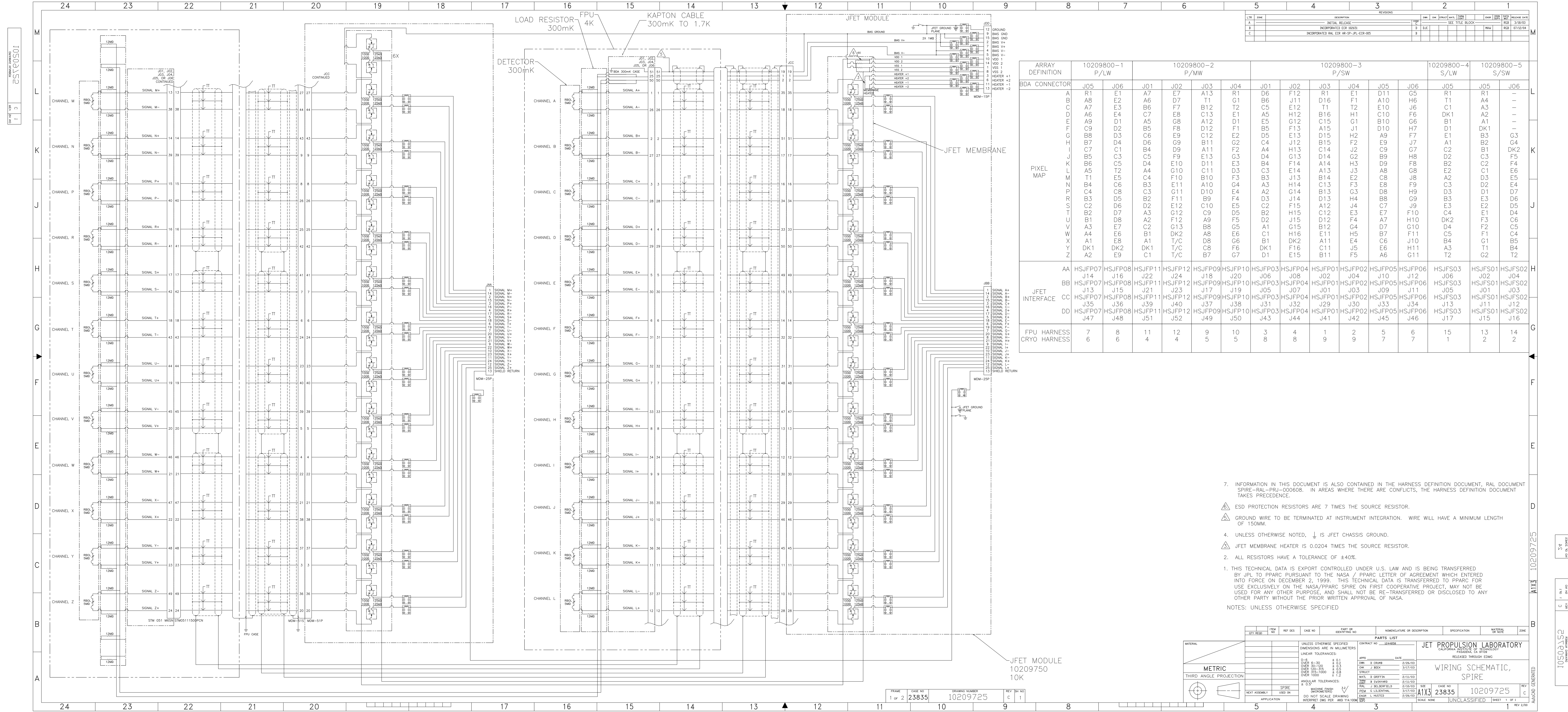


SIZE	CAGE NO	10209721	REV
A1	23835		c
SCALE NOTED	UNCLASSIFIED	SHEET 6 OF 7	REV 2/00

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 μ M			
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 μ M			

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 μ M			
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 μ M			





LT#	ZONE	DESCRIPTION	REV	DATE	BY	CHK	APP
A		INITIAL RELEASE	1				
B		INCORPORATED ESR ISSUES	2				
C		INCORPORATED RAL ESR HR-SP-RAL-EOR-005	3				

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

- INFORMATION IN THIS DOCUMENT IS ALSO CONTAINED IN THE HARNESS DEFINITION DOCUMENT, RAL DOCUMENT SPIRE-RAL-PRJ-006808. IN AREAS WHERE THERE ARE CONFLICTS, THE HARNESS DEFINITION DOCUMENT TAKES PRECEDENCE.
 - ESD PROTECTION RESISTORS ARE 7 TIMES THE SOURCE RESISTOR.
 - GROUND WIRE TO BE TERMINATED AT INSTRUMENT INTEGRATION. WIRE WILL HAVE A MINIMUM LENGTH OF 150MM.
 - UNLESS OTHERWISE NOTED, \perp IS JFET CHASSIS GROUND.
 - JFET MEMBRANE HEATER IS 0.0204 TIMES THE SOURCE RESISTOR.
 - ALL RESISTORS HAVE A TOLERANCE OF $\pm 40\%$.
 - 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, 1995. 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	ITEM NO.	REF DES	CASE NO.	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	MATERIAL OR NOTE	ZONE

PARTS LIST

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN MILLIMETERS

LINEAR TOLERANCES:

D-F 6-30 ± 0.1

OVER 30-120 ± 0.2

OVER 120-315 ± 0.3

OVER 315-1000 ± 0.5

OVER 1000 ± 0.8

ANGULAR TOLERANCES:

$\pm 0.5^\circ$

FINISH: MACHINING FINISH (UNLESS OTHERWISE SPECIFIED)

DO NOT SCALE DRAWING

INTERPRET DWG PER ANSI Y14.100M

CONTRACT NO. 10209725

DATE: 2/26/03

DATE: 3/17/03

DATE: 2/11/03

DATE: 2/19/03

DATE: 3/17/03

DATE: 2/26/03

SCALE: NONE

UNCLASSIFIED

10209725

1 OF 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

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Reviewed by:


M. Knopp M&P Engineer

SPIRE Assembly Array/Backshort Assembly Traveller
 Revised by A Turner March 5, 2003

AIDS: 245556

Device #	PMW 2.2	PMW BS 5.1
Date	9-Jun-05	
Collected by	A Turner	

Height measurements of Backshort to Detector to NTD chip

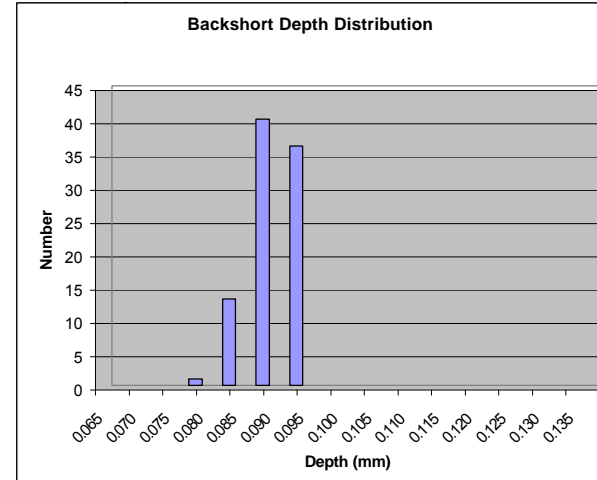
a= BS height
 b= to web
 c= NTD height

Device Thickness Measurements		
Zero at	Measure at	Meas (mm)
1	1	0.0000
1	2	-1.0375
1	3	-1.0430
1	4	-1.0450
1	5	-0.0025
1	6	-1.0350
1	7	-1.0390
1	8	-1.0425
1	9	-1.0440
1	10	-1.0450
1	11	-1.0350
1	12	-1.0395
1	13	-1.0395
1	14	-1.0455
1	15	-1.0460
1	16	-0.0020
1	17	-1.0390
1	18	-1.0425
1	19	-1.0460
1	20	-0.0030

Targets	mm	tol (mm)
Stack thick	1.0360	0.0375
NTD chip	0.0250	0.0100
BS dist	0.091	0.01

Stack Thickness (mm)	
Average	1.0433
max	1.0485
min	1.0355
p-p	0.0130
Backshort Thickness(mm)	
Average	0.9550
max	0.9585
min	0.9530
p-p	0.0055
Backshort Distance (mm)	
Average	0.0883
max	0.0925
min	0.0785
p-p	0.0140
NTD Chip Thickness(mm)	
Average	0.0305
max	0.0355
min	0.0245
p-p	0.0110

Pillar Height Measurements							
Zero at	Row	Pixel	a (mm)	b(mm)	c(mm)	NTD chip (mm)	BS dist (mm)
1	A	1	-0.9570	-1.0355	-1.0625	0.0270	0.0785
1	A	2	-0.9555	-1.0370	-1.0620	0.0250	0.0815
1	A	3	-0.9545	-1.0390	-1.0605	0.0215	0.0845
1	A	4	-0.9535	-1.0400	-1.0635	0.0235	0.0865
1	A	5	-0.9535	-1.0425	-1.0705	0.0280	0.0890
1	A	6	-0.9530	-1.0425	-1.0735	0.0310	0.0895
1	A	7	-0.9530	-1.0435	-1.0770	0.0335	0.0905
1	A	8	-0.9530	-1.0445	-1.0710	0.0265	0.0915
1	A	9	-0.9540	-1.0445	-1.0740	0.0295	0.0905
1	A	10	-0.9540	-1.0445	-1.0695	0.0250	0.0905
1	A	11	-0.9555	-1.0445	-1.0695	0.0250	0.0890
1	A	12	-0.9575	-1.0445	-1.0730	0.0285	0.0870
1	A	13	-0.9575	-1.0445	-1.0680	0.0235	0.0870
1	K	1	-0.9570	-1.0375	-1.0705	0.0330	0.0805
1	B	1	-0.9570	-1.0385	-1.0630	0.0245	0.0815
1	B	2	-0.9560	-1.0395	-1.0590	0.0195	0.0835
1	B	3	-0.9550	-1.0415	-1.0580	0.0165	0.0865
1	B	4	-0.9545	-1.0430	-1.0715	0.0285	0.0885
1	B	5	-0.9540	-1.0445	-1.0645	0.0200	0.0905
1	B	6	-0.9530	-1.0440	-1.0755	0.0315	0.0910
1	B	7	-0.9535	-1.0455	-1.0755	0.0300	0.0920
1	B	8	-0.9540	-1.0450	-1.0790	0.0340	0.0910
1	B	9	-0.9540	-1.0465	-1.0735	0.0270	0.0925
1	B	10	-0.9550	-1.0465	-1.0670	0.0205	0.0915
1	B	11	-0.9565	-1.0465	-1.0730	0.0265	0.0900
1	B	12	-0.9580	-1.0465	-1.0680	0.0215	0.0885
1	T	1		-1.0465	-1.0745	0.0280	
1	C	1	-0.9570	-1.0375	-1.0635	0.0260	0.0805
1	C	2	-0.9555	-1.0390	-1.0580	0.0190	0.0835
1	C	3	-0.9540	-1.0405	-1.0695	0.0290	0.0865
1	C	4	-0.9540	-1.0405	-1.0695	0.0290	0.0865
1	C	5	-0.9535	-1.0415	-1.0765	0.0350	0.0880
1	C	6	-0.9535	-1.0425	-1.0655	0.0230	0.0890
1	C	7	-0.9530	-1.0425	-1.0775	0.0350	0.0895
1	C	8	-0.9530	-1.0440	-1.0765	0.0325	0.0910
1	C	9	-0.9535	-1.0450	-1.0785	0.0335	0.0915
1	C	10	-0.9540	-1.0455	-1.0645	0.0190	0.0915
1	C	11	-0.9550	-1.0455	-1.0760	0.0305	0.0905
1	C	12	-0.9570	-1.0460	-1.0735	0.0275	0.0890
1	C	13	-0.9585	-1.0465	-1.0700	0.0235	0.0880
1	D	1	-0.9570	-1.0395	-1.0650	0.0255	0.0825
1	D	2	-0.9555	-1.0400	-1.0695	0.0295	0.0845
1	D	3	-0.9550	-1.0415	-1.0650	0.0235	0.0865
1	D	4	-0.9545	-1.0420	-1.0720	0.0300	0.0875
1	D	5	-0.9540	-1.0425	-1.0680	0.0255	0.0885
1	D	6	-0.9540	-1.0430	-1.0750	0.0320	0.0890
1	D	7	-0.9540	-1.0440	-1.0685	0.0245	0.0900
1	D	8	-0.9540	-1.0455	-1.0660	0.0205	0.0915
1	D	9	-0.9550	-1.0455	-1.0775	0.0320	0.0905
1	D	10	-0.9560	-1.0460	-1.0780	0.0320	0.0900
1	D	11	-0.9570	-1.0475	-1.0675	0.0200	0.0905
1	D	12	-0.9580	-1.0475	-1.0700	0.0225	0.0895



SPIRE Assembly Array/Backshort Assembly Traveller
 Revised by A Turner March 5, 2003

AIDS: 245556

Device #	PMW 2.2	PMW BS 5.1
Date	9-Jun-05	
Collected by	A Turner	

Height measurements of Backshort to Detector to NTD chip

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

Device Thickness Measurements		
Zero at	Measure at	Meas (mm)

Pillar Height Measurements							
Zero at	Row	Pixel	a (mm)	b(mm)	c(mm)	NTD chip (mm)	BS dist (mm)
1	E	1	-0.9570	-1.0385	-1.0705	0.0320	0.0815
1	E	2	-0.9560	-1.0400	-1.0515	0.0115	0.0840
1	E	3	-0.9550	-1.0400	-1.0635	0.0235	0.0850
1	E	4	-0.9545	-1.0415	-1.0655	0.0240	0.0870
1	E	5	-0.9540	-1.0415	-1.0620	0.0205	0.0875
1	E	6	-0.9540	-1.0415	-1.0680	0.0265	0.0875
1	E	7	-0.9540	-1.0425	-1.0595	0.0170	0.0885
1	E	8	-0.9540	-1.0440	-1.0690	0.0250	0.0900
1	E	9	-0.9545	-1.0455	-1.0690	0.0235	0.0910
1	E	10	-0.9545	-1.0465	-1.0695	0.0230	0.0920
1	E	11	-0.9555	-1.0470	-1.0730	0.0260	0.0915
1	E	12	-0.9570	-1.0470	-1.0735	0.0265	0.0900
1	E	13	-0.9585	-1.0470	-1.0730	0.0260	0.0885
1	T	2		-1.0390	-1.0755	0.0365	
1	F	1	-0.9555	-1.0390	-1.0635	0.0245	0.0835
1	F	2	-0.9550	-1.0400	-1.0695	0.0295	0.0850
1	F	3	-0.9540	-1.0415	-1.0695	0.0280	0.0875
1	F	4	-0.9540	-1.0415	-1.0685	0.0270	0.0875
1	F	5	-0.9535	-1.0415	-1.0580	0.0165	0.0880
1	F	6	-0.9535	-1.0420	-1.0770	0.0350	0.0885
1	F	7	-0.9535	-1.0435	-1.0640	0.0205	0.0900
1	F	8	-0.9540	-1.0450	-1.0770	0.0320	0.0910
1	F	9	-0.9545	-1.0460	-1.0735	0.0275	0.0915
1	F	10	-0.9550	-1.0470	-1.0730	0.0260	0.0920
1	F	11	-0.9565	-1.0470	-1.0780	0.0310	0.0905
1	F	12	-0.9580	-1.0480	-1.0710	0.0230	0.0900
1	K	2	-0.9580	-1.0475	-1.0800	0.0325	0.0895
1	G	1	-0.9565	-1.0400	-1.0620	0.0220	0.0835
1	G	2	-0.9550	-1.0405	-1.0680	0.0275	0.0855
1	G	3	-0.9545	-1.0410	-1.0700	0.0290	0.0865
1	G	4	-0.9545	-1.0410	-1.0630	0.0220	0.0865
1	G	5	-0.9535	-1.0420	-1.0615	0.0195	0.0885
1	G	6	-0.9535	-1.0425	-1.0595	0.0170	0.0890
1	G	7	-0.9530	-1.0440	-1.0615	0.0175	0.0910
1	G	8	-0.9530	-1.0445	-1.0730	0.0285	0.0915
1	G	9	-0.9535	-1.0455	-1.0605	0.0150	0.0920
1	G	10	-0.9545	-1.0470	-1.0700	0.0230	0.0925
1	G	11	-0.9555	-1.0470	-1.0700	0.0230	0.0915
1	G	12	-0.9570	-1.0480	-1.0800	0.0320	0.0910
1	G	13	-0.9580	-1.0485	-1.0800	0.0315	0.0905

SPIRE Assembly Array/Backshort Assembly Traveller
 Revised by A Turner Jan 12, 2004
 Backshort Distance map

Device	PMW 2.2 and PMW BS 5.1
Date	6/6/05
Proc by	A Turner
AIDS	245556

A1 0.0785	A2 0.0815	A3 0.0845	A4 0.0865	A5 0.089	A6 0.0895	A7 0.0905	A8 0.0915	A9 0.0905	A10 0.0905	A11 0.089	A12 0.087	A13 0.087	
K1 0.0805	B1 0.0815	B2 0.0835	B3 0.0865	B4 0.0885	B5 0.0905	B6 0.091	B7 0.092	B8 0.091	B9 0.0925	B10 0.0915	B11 0.09	B12 0.0885	T1 0.0885
C1 0.0805	C2 0.0835	C3 0.0865	C4 0.0865	C5 0.088	C6 0.089	C7 0.0895	C8 0.091	C9 0.0915	C10 0.0915	C11 0.0905	C12 0.089	C13 0.088	
D1 0.0825	D2 0.0845	D3 0.0865	D4 0.0875	D5 0.0885	D6 0.089	D7 0.09	D8 0.0915	D9 0.0905	D10 0.09	D11 0.0905	D12 0.0895		
E1 0.0815	E2 0.084	E3 0.085	E4 0.087	E5 0.0875	E6 0.0875	E7 0.0885	E8 0.09	E9 0.091	E10 0.092	E11 0.0915	E12 0.09	E13 0.0885	
T2 0.0835	F1 0.0835	F2 0.085	F3 0.0875	F4 0.0875	F5 0.088	F6 0.0885	F7 0.09	F8 0.091	F9 0.0915	F10 0.092	F11 0.0905	F12 0.09	K2 0.0895
G1 0.0835	G2 0.0855	G3 0.0865	G4 0.0865	G5 0.0885	G6 0.089	G7 0.091	G8 0.0915	G9 0.092	G10 0.0925	G11 0.0915	G12 0.091	G13 0.0905	

BS Dist Criteria (mm)	
Low	0.0810
High	0.1010

Stack Thickness (mm)	
Average	1.0433
max	1.0485
min	1.0355
p-p	0.0130
BS Thickness(mm)	
Average	0.9550
max	0.9585
min	0.9530
p-p	0.0055

BS Distance (mm)	
Average	0.0883
max	0.0925
min	0.0785
p-p	0.0140
NTD Chip Thick(mm)	
Average	0.0305
max	0.0355
min	0.0245
p-p	0.0110

Front Short Gap

FH-PMWSN01							
	xaxis						
yaxis	0.000	-6.250	-12.500	-18.750	-25.000	-31.250	-37.500
	0.000	-0.002	-0.003	-0.003	-0.003	-0.001	0.001
	-4.467	-1.840	-1.839	-1.839	-1.838	-1.838	-1.838
	-8.933	-1.839	-1.837	-1.837	-1.837	-1.837	-1.836
	-13.400	-1.837	-1.837	-1.837	-1.836	-1.835	-1.835
	-17.867	-1.834	-1.836	-1.835	-1.834	-1.834	-1.834
	-22.333	-1.834	-1.834	-1.832	-1.832	-1.832	-1.831
	-26.800	0.006	0.007	0.007	0.009	0.009	0.010
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	-0.002	-0.003	-0.003	-0.003	-0.001	0.000
	-4.467	-1.840	-1.841	-1.840	-1.839	-1.839	-1.839
	-8.933	-1.840	-1.840	-1.839	-1.839	-1.839	-1.838
	-13.400	-1.840	-1.839	-1.839	-1.839	-1.838	-1.838
	-17.867	-1.838	-1.839	-1.839	-1.838	-1.838	-1.838
	-22.333	-1.838	-1.838	-1.838	-1.837	-1.837	-1.836
	-26.800	0.000	0.001	0.001	0.001	0.003	0.004
ave =	-1.839						
max =	-1.836						
min =	-1.841						
p-p =	0.004						

cp-26 sn010 with PMW 2.2 and PMW BS 5.1 clipped in							
	xaxis						
yaxis	0.000	-6.250	-12.500	-18.750	-25.000	-31.250	-37.500
	0.000	2.558	2.556	2.554	2.554	2.558	0.000
	4.467	1.971	1.961	1.955	1.951	1.952	1.955
	8.933	1.969	1.960	1.953	1.951	1.950	1.954
	13.400	1.967	1.958	1.953	1.950	1.949	1.952
	17.867	1.964	1.955	1.950	1.948	1.946	1.949
	22.333	1.958	1.951	1.946	1.945	1.945	1.954
	26.800	-0.001	2.546	2.538	2.539	2.546	-0.005
xaxis							
	xaxis						
yaxis	0.000	-6.250	-12.500	-18.750	-25.000	-31.250	-37.500
	0	0.000	2.558	2.556	2.554	2.554	2.558
	4.467	1.971	1.961	1.955	1.951	1.952	1.955
	8.933	1.969	1.960	1.953	1.951	1.950	1.954
	13.400	1.967	1.958	1.953	1.950	1.949	1.952
	17.867	1.964	1.955	1.950	1.948	1.946	1.949
	22.333	1.958	1.951	1.946	1.945	1.947	1.954
	26.800	-0.001	2.546	2.538	2.539	2.546	-0.005
ave =	1.954						
max =	1.971						
min =	1.945						
p-p =	0.026						

6/13/2005
Front short Estimation
GAP

yaxis	0.000	-6.250	-12.500	-18.750	-25.000	-31.250	-37.500
	0.000	0.000					0.000
	-4.467	0.130	0.121	0.114	0.111	0.113	0.116
	-8.933		0.119	0.114	0.111	0.110	0.115
	-13.400		0.118	0.113	0.111	0.110	0.114
	-17.867		0.115	0.111	0.110	0.108	0.111
	-22.333	0.120	0.113	0.108	0.108	0.108	0.111
	-26.800	-0.001					-0.001

ave =	0.114
max =	0.130
min =	0.108
p-p =	0.023

Coverplate SN	10209826 SN010
Feedhorn SN	PMW sn01
Detector SN	PMW 2.2
Backshort SN	PMW BS 5.1
PMW FS	0.127
PMW FS tol	0.044
PMW BS	0.091
PMW BS tol	0.010

Custom Microwave Inc.
940 Boston Avenue
Longmont, CO 80501

CERTIFICATE OF COMPLIANCE

JPL
CUSTOMER

1249812
PURCHASE ORDER NUMBER

3868
INVOICE NUMBER

10209823 REV X4
PART NUMBER(S)

P8757-01
LOT NUMBER(S)/SERIAL

1 EA.
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

11/25/03
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 # 12302 attached

CUSTOMER 19698		SHIP DATE 11/21/00 SHP		GROSS WEIGHT 86		QUOTE 18-757538-3		OF 3		PACKING LIST	
BILL TO: CUSTOM MICROWAVE INC				WORK ORDER 331844 **		ORDER DATE 11/17/00 ORD		TEST RESULTS			
SHIP TO CUSTOM MICROWAVE INC 01 440 BOSTON AVENUE LONGMONT CO 80501						DELIVERY DATE 11/27/00 DEL		SHIP BRANCH 03-CLE		SELL BRANCH 18-STL	
CUSTOMER P.O. NUMBER 11725		TERRITORY 03		ENTRY ID 04JDF		THYSSEN COPPER AND BRASS SALES AIN PLASTICS TMX		5755 GRANT AVENUE CLEVELAND OH 44105-5635			
BUYER MIKE		INSIDE SALES JOHN D. FITZPATRICK		ENTRY ID 04JDF							
BUYER TELEPHONE (303) 651-0707		INSIDE SALES TELEPHONE (847) 490-9870 239									
SHIP VIA		SHIPPING STATUS									
INTERNAL		COMPLETE X		PARTIAL		CANCEL		CUSTOMER SIGNATURE: DATE:			
TO CUSTOMER COMMON/FRT-		FOB ORIG						QUANTITY ORDERED SHIPPED			
BILL OF LADING		FREIGHT STATUS PPD						INVENTORY 69.92 LB 70.00			
PART DESCRIPTION		185966-9						BILLING 1.00 PC 1.00			
CR COPPER PLATE C11000 1-1/2 CUT SAW 12" (+.063,-0) X 12" (+.063,-0) Test Results Attn to: QA Department.								WAREHOUSE 1.00 PC			
								PACKED WITH OTHER GOODS			
								FINISHED GOODS LOCATION			
								FULL SCRAP FILLED BY GIL PACKED BY Q/A AUDIT			
								CUSTOMER RECEIVING HOURS MAXIMUM SKID WEIGHT			
								LOADING INSTRUCTIONS MAXIMUM BUNDLE WEIGHT			
								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

33565 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 CATHY ST. THOMAS
 ONE REVERE PARK
 ROME, NY 13440-5561

WANTED



DPT 11

PAGE 1

REVERE NO. 74450

CUSTOMER DATE 04/18/2000		CUSTOMER ORDER NUMBER 862732						
CUSTOMER CODE 148035004	DIV RM	SALESMAN 21	IND. CODE	CL 3	KS 1	TAX	TO 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

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.

1.500" X 36.5" X 144.5"

FOB	MILL	PREPAID
VIA		
MARK	185966-9	

NET WEIGHT - 7727 CUST PART#

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

HEAT#/LOT CU
 00287001 99.98%
 00288201 99.99%

997

CU INCLUDES- +Ag

PHYSICAL ANALYSIS

HEAT#/LOT	HARDNESS	TENSILE	COND
	RF	KSI	XIACS
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 331844
 WGT 7727 PCS
Jim L. Maxwell 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



EDM Supplies, Inc.

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

SHIPPER

Sales Order Number
Shipper Number
Ship Date
Page

250913
2
06/28/02
1

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

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

T
O

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 <i>Rm 1200</i>		5	0
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2	10	EA	C22-024 .024 DIA. X 12 PBR <i>Rm 1201</i>		10	0
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5	10	EA	C22-027 .027 DIA. X 12 PBR <i>Rm 1204</i>		4	0
---	----	----	--	--	---	---

*****CERTIFICATIONS*****
WE HEREBY CERTIFY THIS
MATERIAL TO BE PRECISION
BRASS ROD, ALLOY 260

SIGNED: *Dan Jongsma*

ORDERED BY DAN JONGSMA

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



Packing List # 3325511
 Cust. Phone: 3036510707
 Page: 1 / 1

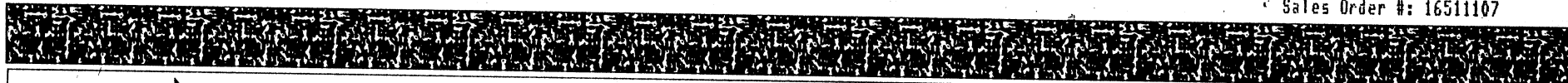
Sold To: CUSTOM MICROWAVE
 940 BOSTON AVENUE
 LONGMONT CO 80501
 USA

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		DATE 06/13/03	CUSTOMER NO. 10498	Sales Subject: Robin Griffo		ORDERED BY	PCS.	WT.	BILL OF LADING 3325511
SHIP VIA FRT FPD & CBG		SALESMAN		SHIP DATE 06/13/03		SALESMAN 364		PICKED BY		DATE	

CATALOG	COLOR:	DESCRIPTION	U / M	QUANTITY ORDERED	QUANTITY SHIPPED	QUANTITY BACK ORDERED
NOTE: ITEMS NOT APPEARING ON THIS PACKING LIST MAY HAVE BEEN BACKORDERED OR SHIPPED FROM ANOTHER EIS LOCATION. DO NOT SHIP WITHOUT CERTIFICATE OF ANALYSIS						
2306B		96.3/A93.7, SOLID WIRE, .031 DIA, 1 LB		2.00	2.00	0.00
MUST HAVE CERTIFICATE OF ANALYSIS WITH SHIPPED MATERIALS INCLUDED IN THIS SHIPMENT ARE THOSE SPECIFIED IN THE PURCHASE ORDER. ALL SPECIFICATIONS AND PROPERTIES OF THE MATERIAL ARE DETERMINED BY THE MANUFACTURER.						
CERTIFICATE OF COMPLIANCE						
Authorized Signature / Title: Scott Beeth / Ship Lead						
Lot/Batch Number (MFG DATE) or MFG 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

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: *TA*

 MAP #
MP13192

 Rev.
0

 Date: *7-16-03*

Proj #	<i>P8757</i>	Description	Feedhorn Block, 10209823, Final Assembly		Part #	10209823	Rev.	X4
--------	--------------	-------------	--	--	--------	----------	------	----

Customer	JPL	Total Quantity	/	Serial Numbers	-01	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	65		C							
	CMI dwg # 18207										
10	1.9449+.005/-0.000	65	D1	C		<i>1.948</i>	1	1	0		
15	1.3386+.000/-0.008	65	E2	C		<i>1.3355</i>	↓	↓	↓		↓
20	.9186±.005	65	B2	C		<i>.920</i>	↓	↓	↓		↓
25	.0002	65	B5	C		<i>.0002</i>	↓	↓	↓		↓
30	.1952	65	B6	C		<i>.1955</i>	↓	↓	↓		↓
35	// .0002 X	65	E6	C		<i>.0002</i>	↓	↓	↓		↓
	CMI dwg # 18208										
40	.6136±.010	65	E5	C		<i>.6189</i>	↓	↓	↓		↓
45	.2550±.003	65	B5	C		<i>.2577</i>	↓	↓	↓		↓
	CMI dwg # 18201										
50	.1420	65	D3	C		<i>REPORT</i>	108	108	0		
55	1.2988	80	D4	C		<i>REPORT</i>	105	105	0		
	JPL dwg # 10209823										
60	⊕ Ø0,04 X-Y-Z	115	C3	C		<i>Loose .0327 MAX</i>	88	88	0		

CMI Quality Assurance Inspection Plan				Checked By:		DC Stamp CIA DC		MAP # MP13192		Rev. 0	
Proj #	Description	Feedhorn Block, 10209823, Final Assembly				Part #	10209823			Rev.	X4
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
65	⊙ 0.015 E	115	F10	C		ACCEPT	88	88	0		11-22-13
	CMI dwg # 18209										
70	.9796	133	E5	C		ACCEPT	1	1	0		11-25-13
75	.2490	133	B6	C		ACCEPT					
80	.1892	133	E6	C		ACCEPT					
85	.8386+.000/-.008	133	E2	C		.8364					
90	1.7373+.000/-.008	133	C1	C		1.7369					
95	4X R.3543±.008	133	E2	C		.3493 - .3540					
100	2X R.9724+.000/-.008	133	D2	C		.9697 - .9721					
105	4X R.0787±.004	133	B4	C		.077					
	JPL dwg # 10209823										
110	Inspect assembly for aluminum, stains, and debris	175		C		ACCEPT	1	1	0		11-17-13
115	4X R2 NS/FS	190	H12	C		ACCEPT	1	1	0		11-24-13
120	45,1932 MAX NS/FS	190	F11	C		45.1902 - 45.1059					
125	1,0656MIN	190	F10	C		1.0756 - 1.1092					

CMI Quality Assurance Inspection Plan

Checked By:

DC Stamp

 MAP #
MP13192

 Rev.
0

Date:



Proj #	Description	Feedhorn Block, 10209823, Final Assembly				Part #	10209823	Rev.	X4		
Customer		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	// 0.05 A	190	F11	C		.0363	1	1	0		11-25-03
135	32,6592±0.2 (4 corners)	190	E12	C		32.7544	1	1	0		11-25-03
140	// 0,003 A	190	D12	C	11-25-03 22A	.0106 0.0106 (21 POINTS) NCR 12302	1	0	1		11-25-03
145	2X R24.7+0/-0,2	190	C12	C		24.6924 - 24.6300	1	1	0		11-25-03
150	2X 17+0/-0,2	190	C12	C		16.9458 - 16.9549	↓	↓	↓		↓
155	4X R9	190	D10	C		8.9913 - 8.8737	↓	↓	↓		↓
160	15,3677	190	E8	C		15.3971	↓	↓	↓		↓
165	10,65 MAX NS/FS	190	G12	C		10.6412 - 10.6242 10.6242 ¹¹⁻²⁵⁻⁰³	↓	↓	↓		↓
170	10,65 MAX NS/FS	190	G12	C		10.6412 - 10.6242	↓	↓	↓		↓
175	2X R0,5 NS/FS DELETE PER REDLINE 11-25-03	190	E9	C			↓	↓	↓		↓
180	3	190	E8	C		2.975	↓	↓	↓		↓
185	4,5178	190	E8	C		4.564 - 4.574	↓	↓	↓		↓
190	1,8322+0,02/-0 44 boss points, 44 land points	190	E8	C		1.8365 - 1.8470	↓	↓	↓		↓
195	2X 4,5 MIN	190	C12	C		4.511 - 4.519	↓	↓	↓		↓
200	2X 4,5 MIN	190	C12	C		4.511 - 4.519	↓	↓	↓		↓
205	1,0375 MIN 2 places	190	E5	C		1.0454 - 1.0518	↓	↓	↓		↓

CMI Quality Assurance Inspection Plan

Checked By:

DC Stamp


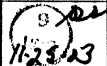


MAP #
MP13192

Rev.
0

Date:

Proj #	Description	Feedhorn Block, 10209823, Final Assembly	Part #	10209823	Rev.	X4					
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
210	∇ 0,003	190	D8	C		→0045 (21 POINTS) DATA PAD AREA ONLY .0024	1	1	0		11-25-03
215	88X Ø3,237/Ø3,223 ⊙ 0.015 E	190	F10	C		SEE REPORT ACCEPT PER PREVIOUS NCR 12302	1	0	1		11-25-03
220	88X Ø0,253/Ø0,239 ⊕ Ø0.04 X-Y-Z	190	C3	C		SEE REPORT ATTACHED	1	1	0		11-25-03
225	88X 0.2 Surface Finish	190	D6	C		ACCEPT					
230	4X Ø2,25/Ø2 THRU ⊕ Ø0,05(M) A-B-BD	190	B10	C	11-25-03	2.0651 - 2.0704 - 2.1005 2.1005 - 2.0876 .0198 MAX					
235	2X Ø3,2/Ø3,12 THRU ∇ Ø3,85/Ø3,6 X 90° M3,5 X 0,35-6H THRU ⊕ Ø0,35 X-Y-Z	190	H9	C		3.1496 3.607 ACCEPT .0486 , .0411					
240	Ø1,61/Ø1,6 THRU ⊕ Ø0,1 (M) A	190	C9	C		1.6066 .0027					
245	1,6 +0,01/-0 ⊕ Ø0,05 A-B-C	190	F4			1,6027 .0008					
250	0,25 ⊕ Ø0,1 A-B-C	190	F5	C		.2547 .0008					
255	2X R	190	E5	C		ACCEPT					

CMI Quality Assurance Inspection Plan				Checked By:		DC Stamp 		MAP # MP13192		Rev. 0	
Proj #	Description	Feedhorn Block, 10209823, Final Assembly				Part #	10209823		Rev.	X4	
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
260	Weigh parts and record results	190		C		172.4 grams	1	1	0		
265	Inspect plating as per SP1019, section 6.2	190		C		ACCEPT	↓	↓	↓		↓
270	Final inspect as per SP1019	190		C		ACCEPT	↓	↓	↓		↓



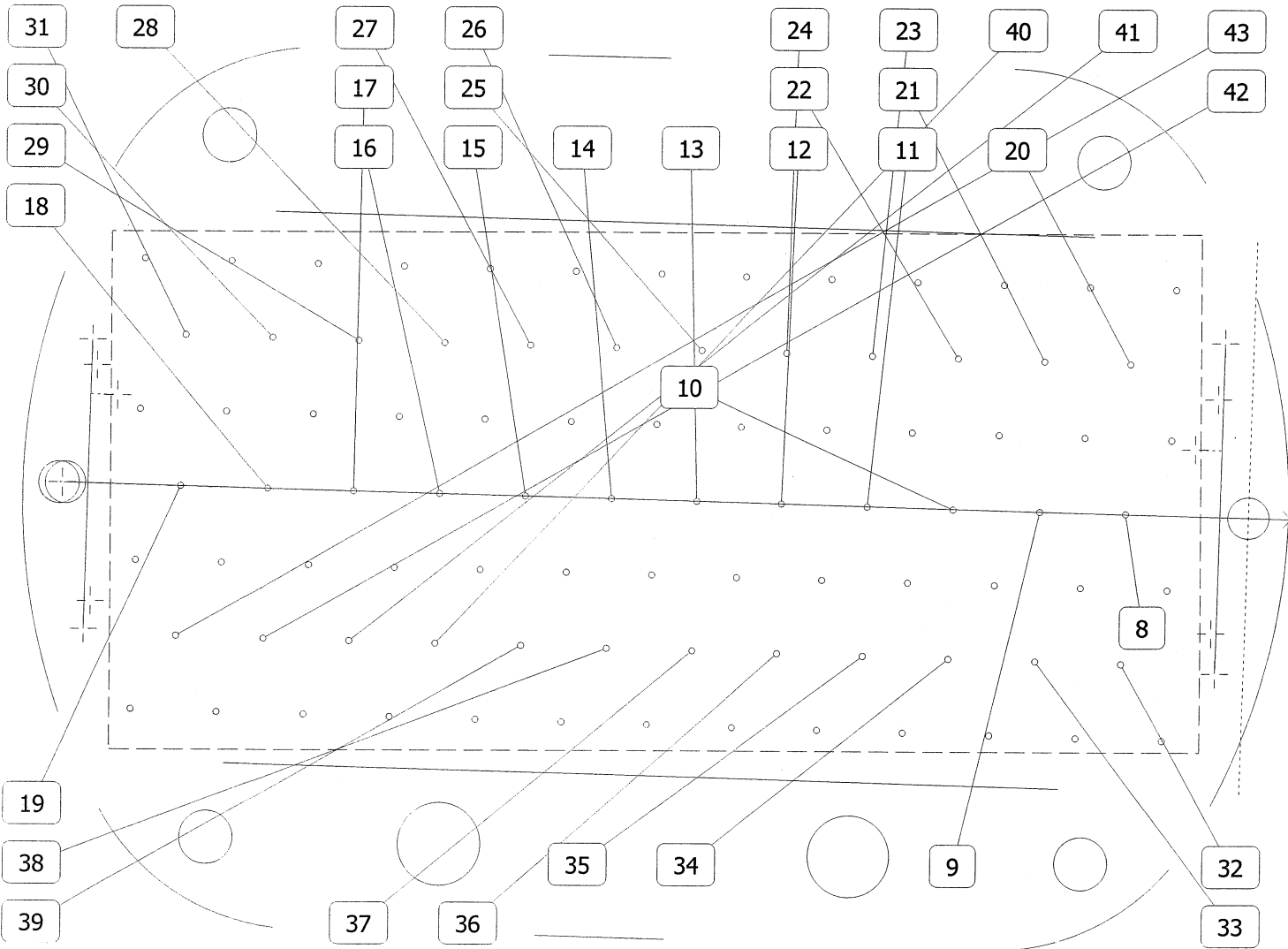
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#1		.1418	SCRAP
#2		.1417	1.2993
#3		.1420	1.2992
#4		.1420	1.2989
#5		.1421	1.2990
#6		.1418	1.2988
#7		.1420	1.2989
#8		.1417	1.2989
#9		.1421	1.2990
#10		.1420	1.2985
#11		.1420	1.2994
#12		.1421	1.2993
#13		.1422	1.2992
#14		.1417	1.2993
#15		.1423	1.2989
#16		.1417	1.2992
#17		.1417 .1418	1.2988
#18		.1417	1.2992
#19		.1420	1.2989
#20		.1420	1.2988
#21		.1417	1.2988
#22		.1416	1.2993
#23		.1417	1.2990
#24		.1417	1.2992
#25		.1417	1.2993
#26		.1418	1.2988
#27		.1421	1.2989
#28		.1417	1.2993
#29		.1420	1.2991
#30		.1420	1.2984
#31		.1418	1.2988
#32		.1417	1.2992
#33		.1417	1.2987
#34		.1417 .1416	1.2993
#35		.1417	1.2991
#36		.1421	1.2989
#37		.1418	1.2988
#38		.1421	1.29874
#39		.1417	1.2992
#40		.1420	1.2988
#41		.1417	1.2989
#42		.1418	1.2992
#43		.1422	1.2984
#44		.1416	1.2988
#45		.1420	1.2986
#46		.1420	1.2988
#47		.1420	1.2990
#48		.1421	1.2987
#49		.1420	1.2990
#50		.1420	1.2990
#51		.1420	1.2984
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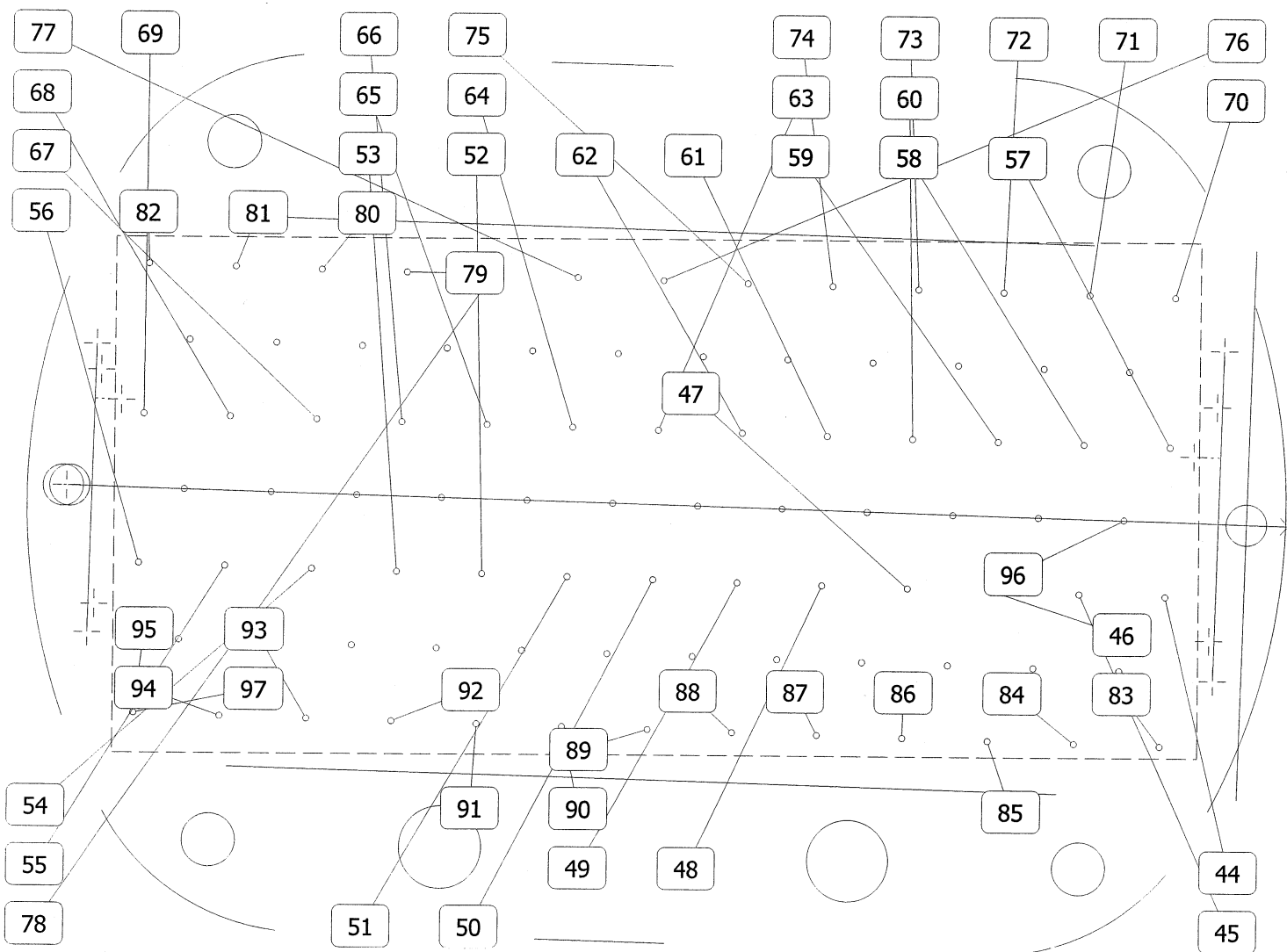
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#60		.1420 .1415	1.2988 SCRAP
#61		.1417	1.2986
#62		.1420	1.2984
#63		.1420	1.2989
#64		.1420 1417	1.2988 SCRAP
#65		.1418	1.2989
#66		.1420 .1415	1.2989
#67		.1420	1.2985
#68		.1420 .1417	1.2987
#69		.1417	1.2993
#70		.1418	1.2991
#71		.1417	1.2989
#72		.1417	1.2989
#73		.1420 1420	1.2991
#74		.1420 .1418	1.2990
#75		.1414	1.2991
#76		.1420	1.2990
#77		.1420 .1418	1.2992
#78		.1420 .1423	1.2989
#79		.1421	1.2988
#80		1418	1.2985
#81		.1418	1.2985
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#83		.1421	1.2987
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#85		.1420 .1418	1.2989
#86		.1422	1.2991
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#89		.1420 .1422	1.2985
#90		.1418	1.2987
#91		.1418	1.2988
#92		.1417	1.2993
#93		.1415	1.2994
#94		.1421	1.2987
#95		.1418	1.2988
#96		.1417	1.2987
#97		.1412	1.2994
#98		.1417	1.2987
#99		.1417	1.2990
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#101		.1419	1.2984
#102		.1418	1.2989
#103		.1418	1.2989
#104		.1417	1.2989
#105		.1421	1.2987
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#109			
#110			

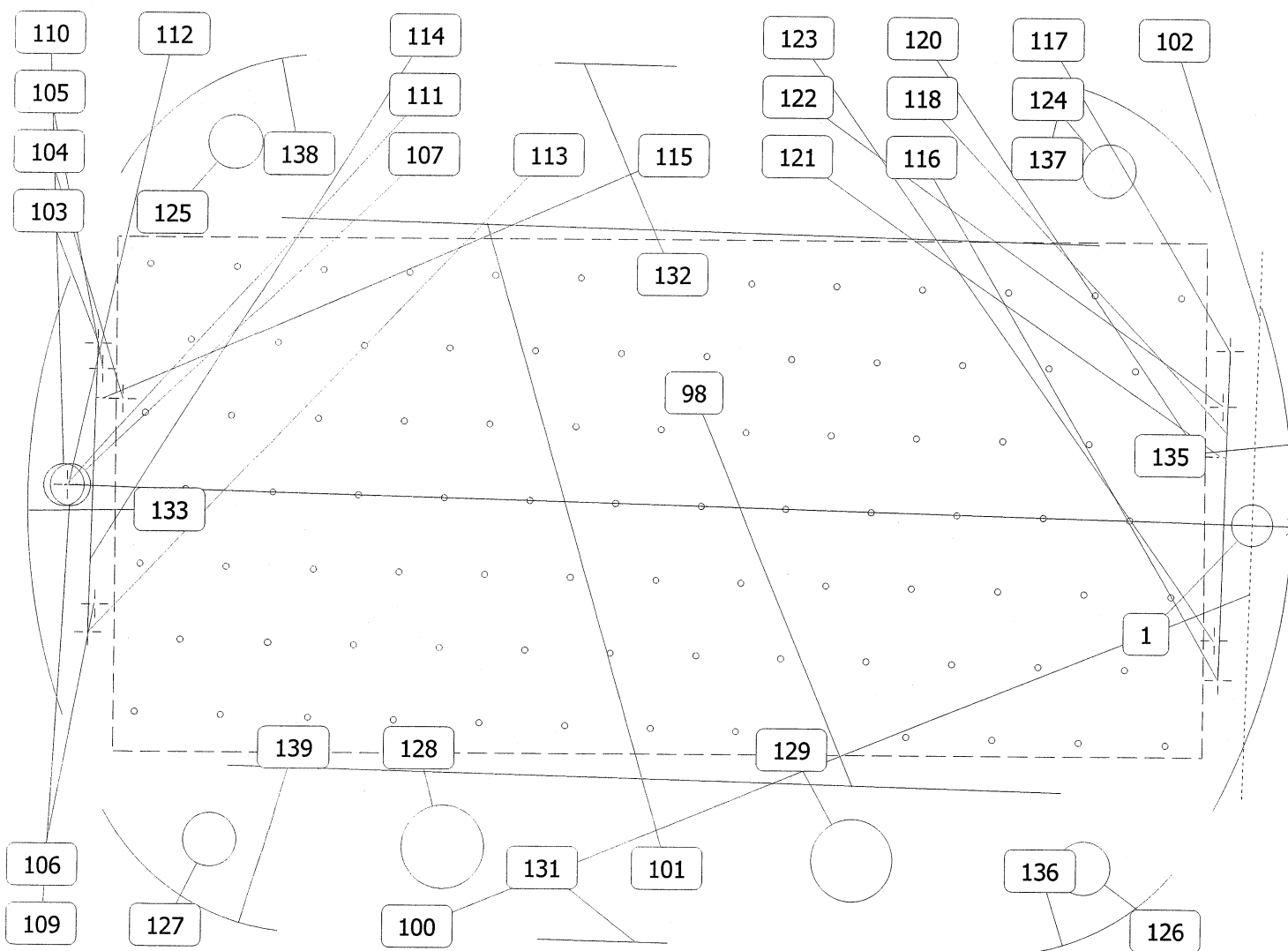
~~AFTR DRILL SCHEDULE CLEANSING~~

FINAL INSPECT

S/N-01







Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 1	[MCS]					
Diameter	1.6052	1.6000	0.0100	0.0000	0.0052	
Circle 8	[System 7]					
Center X	-4.7775	-4.7613			-0.0162	
Center Y	0.0115	0.0000			0.0115	
Diameter	0.2456	0.2390	0.0140	0.0000	0.0066	
Circularity	0.0059					
TP RFS	0.0397		0.0400			
Circle 9	[System 7]					
Center X	-8.1087	-8.1009			-0.0078	
Center Y	-0.0052	0.0000			-0.0052	
Diameter	0.2397	0.2390	0.0140	0.0000	0.0007	
Circularity	0.0027					
TP RFS	0.0187		0.0400			
Circle 10	[System 7]					
Center X	-11.4448	-11.4406			-0.0042	
Center Y	-0.0158	0.0000			-0.0158	
Diameter	0.2424	0.2390	0.0140	0.0000	0.0034	
Circularity	0.0021					
TP RFS	0.0328		0.0400			
Circle 11	[System 7]					
Center X	-14.7868	-14.7802			-0.0066	
Center Y	-0.0114	0.0000			-0.0114	
Diameter	0.2443	0.2390	0.0140	0.0000	0.0053	
Circularity	0.0012					
TP RFS	0.0264		0.0400			
Circle 12	[System 7]					
Center X	-18.1306	-18.1199			-0.0107	
Center Y	-0.0003	0.0000			-0.0003	
Diameter	0.2458	0.2390	0.0140	0.0000	0.0068	
Circularity	0.0033					
TP RFS	0.0213		0.0400			
Circle 13	[System 7]					
Center X	-21.4603	-21.4596			-0.0007	
Center Y	-0.0018	0.0000			-0.0018	
Diameter	0.2398	0.2390	0.0140	0.0000	0.0008	
Circularity	0.0029					
TP RFS	0.0040		0.0400			
Circle 14	[System 7]					
Center X	-24.7972	-24.7992			0.0020	
Center Y	-0.0036	0.0000			-0.0036	
Diameter	0.2393	0.2390	0.0140	0.0000	0.0003	
Circularity	0.0041					
TP RFS	0.0083		0.0400			
Circle 15	[System 7]					
Center X	-28.1400	-28.1389			-0.0011	
Center Y	0.0002	0.0000			0.0002	
Diameter	0.2425	0.2390	0.0140	0.0000	0.0035	
Circularity	0.0049					
TP RFS	0.0023		0.0400			
Circle 16	[System 7]					
Center X	-31.4800	-31.4785			-0.0015	
Center Y	-0.0002	0.0000			-0.0002	
Diameter	0.2420	0.2390	0.0140	0.0000	0.0030	
Circularity	0.0029					
TP RFS	0.0030		0.0400			

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 17	[System 7]					
Center X	-34.8225	-34.8182			-0.0043	
Center Y	0.0006	0.0000			0.0006	
Diameter	0.2445	0.2390	0.0140	0.0000	0.0055	
Circularity	0.0061					
TP RFS	0.0088		0.0400			
Circle 18	[System 7]					
Center X	-38.1552	-38.1578			0.0026	
Center Y	0.0073	0.0000			0.0073	
Diameter	0.2391	0.2390	0.0140	0.0000	0.0001	
Circularity	0.0032					
TP RFS	0.0155		0.0400			
Circle 19	[System 7]					
Center X	-41.4878	-41.4975			0.0097	
Center Y	0.0098	0.0000			0.0098	
Diameter	0.2426	0.2390	0.0140	0.0000	0.0036	
Circularity	0.0023					
TP RFS	0.0276		0.0400			
Circle 20	[System 7]					
Center X	-4.7686	-4.7613			-0.0073	
Center Y	5.7705	5.7845			-0.0140	
Diameter	0.2402	0.2390	0.0140	0.0000	0.0012	
Circularity	0.0057					
TP RFS	0.0316		0.0400			
Circle 21	[System 7]					
Center X	-8.1031	-8.1009			-0.0022	
Center Y	5.7745	5.7845			-0.0100	
Diameter	0.2396	0.2390	0.0140	0.0000	0.0006	
Circularity	0.0020					
TP RFS	0.0204		0.0400			
Circle 22	[System 7]					
Center X	-11.4372	-11.4406			0.0034	
Center Y	5.7839	5.7845			-0.0006	
Diameter	0.2418	0.2390	0.0140	0.0000	0.0028	
Circularity	0.0023					
TP RFS	0.0069		0.0400			
Circle 23	[System 7]					
Center X	-14.7715	-14.7802			0.0087	
Center Y	5.7782	5.7845			-0.0063	
Diameter	0.2414	0.2390	0.0140	0.0000	0.0024	
Circularity	0.0035					
TP RFS	0.0214		0.0400			
Circle 24	[System 7]					
Center X	-18.1115	-18.1199			0.0084	
Center Y	5.7812	5.7845			-0.0033	
Diameter	0.2434	0.2390	0.0140	0.0000	0.0044	
Circularity	0.0032					
TP RFS	0.0180		0.0400			
Circle 25	[System 7]					
Center X	-21.4565	-21.4596			0.0031	
Center Y	5.7807	5.7845			-0.0038	
Diameter	0.2460	0.2390	0.0140	0.0000	0.0070	
Circularity	0.0045					
TP RFS	0.0098		0.0400			

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 26	[System 7]					
Center X	-24.7872	-24.7992			0.0120	
Center Y	5.7877	5.7845			0.0032	
Diameter	0.2427	0.2390	0.0140	0.0000	0.0037	
Circularity	0.0019					
TP RFS	0.0248		0.0400			
Circle 27	[System 7]					
Center X	-28.1328	-28.1389			0.0061	
Center Y	5.7835	5.7845			-0.0010	
Diameter	0.2392	0.2390	0.0140	0.0000	0.0002	
Circularity	0.0051					
TP RFS	0.0124		0.0400			
Circle 28	[System 7]					
Center X	-31.4716	-31.4785			0.0069	
Center Y	5.7840	5.7845			-0.0005	
Diameter	0.2411	0.2390	0.0140	0.0000	0.0021	
Circularity	0.0020					
TP RFS	0.0138		0.0400			
Circle 29	[System 7]					
Center X	-34.8038	-34.8182			0.0144	
Center Y	5.7765	5.7845			-0.0080	
Diameter	0.2410	0.2390	0.0140	0.0000	0.0020	
Circularity	0.0041					
TP RFS	0.0330		0.0400			
Circle 30	[System 7]					
Center X	-38.1449	-38.1578			0.0129	
Center Y	5.7893	5.7845			0.0048	
Diameter	0.2455	0.2390	0.0140	0.0000	0.0065	
Circularity	0.0028					
TP RFS	0.0275		0.0400			
Circle 31	[System 7]					
Center X	-41.4812	-41.4975			0.0163	
Center Y	5.7916	5.7845			0.0071	
Diameter	0.2410	0.2390	0.0140	0.0000	0.0020	
Circularity	0.0021					
TP RFS	0.0356		0.0400			
Circle 32	[System 7]					
Center X	-4.7707	-4.7613			-0.0094	
Center Y	-5.7901	-5.7845			-0.0056	
Diameter	0.2473	0.2390	0.0140	0.0000	0.0083	
Circularity	0.0027					
TP RFS	0.0218		0.0400			
Circle 33	[System 7]					
Center X	-8.1035	-8.1009			-0.0026	
Center Y	-5.7833	-5.7845			0.0012	
Diameter	0.2422	0.2390	0.0140	0.0000	0.0032	
Circularity	0.0019					
TP RFS	0.0058		0.0400			
Circle 34	[System 7]					
Center X	-11.4423	-11.4406			-0.0017	
Center Y	-5.7909	-5.7845			-0.0064	
Diameter	0.2426	0.2390	0.0140	0.0000	0.0036	
Circularity	0.0037					
TP RFS	0.0133		0.0400			

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 35	[System 7]					
Center X	-14.7835	-14.7802			-0.0033	
Center Y	-5.7878	-5.7845			-0.0033	
Diameter	0.2487	0.2390	0.0140	0.0000	0.0097	
Circularity	0.0029					
TP RFS	0.0093		0.0400			
Circle 36	[System 7]					
Center X	-18.1223	-18.1199			-0.0024	
Center Y	-5.7895	-5.7845			-0.0050	
Diameter	0.2450	0.2390	0.0140	0.0000	0.0060	
Circularity	0.0031					
TP RFS	0.0110		0.0400			
Circle 37	[System 7]					
Center X	-21.4664	-21.4596			-0.0068	
Center Y	-5.7809	-5.7845			0.0036	
Diameter	0.2411	0.2390	0.0140	0.0000	0.0021	
Circularity	0.0023					
TP RFS	0.0153		0.0400			
Circle 38	[System 7]					
Center X	-24.8051	-24.7992			-0.0059	
Center Y	-5.7887	-5.7845			-0.0042	
Diameter	0.2457	0.2390	0.0140	0.0000	0.0067	
Circularity	0.0031					
TP RFS	0.0145		0.0400			
Circle 39	[System 7]					
Center X	-28.1360	-28.1389			0.0029	
Center Y	-5.7713	-5.7845			0.0132	
Diameter	0.2431	0.2390	0.0140	0.0000	0.0041	
Circularity	0.0021					
TP RFS	0.0271		0.0400			
Circle 40	[System 7]					
Center X	-31.4762	-31.4785			0.0023	
Center Y	-5.7804	-5.7845			0.0041	
Diameter	0.2422	0.2390	0.0140	0.0000	0.0032	
Circularity	0.0032					
TP RFS	0.0095		0.0400			
Circle 41	[System 7]					
Center X	-34.8148	-34.8182			0.0034	
Center Y	-5.7750	-5.7845			0.0095	
Diameter	0.2418	0.2390	0.0140	0.0000	0.0028	
Circularity	0.0033					
TP RFS	0.0203		0.0400			
Circle 42	[System 7]					
Center X	-38.1530	-38.1578			0.0048	
Center Y	-5.7793	-5.7845			0.0052	
Diameter	0.2433	0.2390	0.0140	0.0000	0.0043	
Circularity	0.0024					
TP RFS	0.0141		0.0400			
Circle 43	[System 7]					
Center X	-41.4915	-41.4975			0.0060	
Center Y	-5.7721	-5.7845			0.0124	
Diameter	0.2453	0.2390	0.0140	0.0000	0.0063	
Circularity	0.0023					
TP RFS	0.0276		0.0400			

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 44	[System 7]					
Center X	-3.0902	-3.0914			0.0012	
Center Y	-2.8948	-2.8922			-0.0026	
Diameter	0.2403	0.2390	0.0140	0.0000	0.0013	
Circularity	0.0033					
TP RFS	0.0057		0.0400			
Circle 45	[System 7]					
Center X	-6.4370	-6.4311			-0.0059	
Center Y	-2.8960	-2.8922			-0.0038	
Diameter	0.2396	0.2390	0.0140	0.0000	0.0006	
Circularity	0.0038					
TP RFS	0.0141		0.0400			
Circle 46	[System 7]					
Center X	-9.7667	-9.7708			0.0041	
Center Y	-2.8918	-2.8922			0.0004	
Diameter	0.2403	0.2390	0.0140	0.0000	0.0013	
Circularity	0.0029					
TP RFS	0.0083		0.0400			
Circle 47	[System 7]					
Center X	-13.1160	-13.1104			-0.0056	
Center Y	-2.8982	-2.8922			-0.0060	
Diameter	0.2420	0.2390	0.0140	0.0000	0.0030	
Circularity	0.0023					
TP RFS	0.0163		0.0400			
Circle 48	[System 7]					
Center X	-16.4584	-16.4501			-0.0083	
Center Y	-2.8961	-2.8922			-0.0039	
Diameter	0.2427	0.2390	0.0140	0.0000	0.0037	
Circularity	0.0035					
TP RFS	0.0183		0.0400			
Circle 49	[System 7]					
Center X	-19.7988	-19.7897			-0.0091	
Center Y	-2.8982	-2.8922			-0.0060	
Diameter	0.2427	0.2390	0.0140	0.0000	0.0037	
Circularity	0.0026					
TP RFS	0.0218		0.0400			
Circle 50	[System 7]					
Center X	-23.1236	-23.1294			0.0058	
Center Y	-2.8937	-2.8922			-0.0015	
Diameter	0.2472	0.2390	0.0140	0.0000	0.0082	
Circularity	0.0044					
TP RFS	0.0121		0.0400			
Circle 51	[System 7]					
Center X	-26.4687	-26.4690			0.0003	
Center Y	-2.8907	-2.8922			0.0015	
Diameter	0.2431	0.2390	0.0140	0.0000	0.0041	
Circularity	0.0028					
TP RFS	0.0030		0.0400			
Circle 52	[System 7]					
Center X	-29.8090	-29.8087			-0.0003	
Center Y	-2.8808	-2.8922			0.0114	
Diameter	0.2390	0.2390	0.0140	0.0000	0.0000	
Circularity	0.0030					
TP RFS	0.0227		0.0400			

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 53	[System 7]					
Center X	-33.1439	-33.1484			0.0045	
Center Y	-2.8944	-2.8922			-0.0022	
Diameter	0.2412	0.2390	0.0140	0.0000	0.0022	
Circularity	0.0034					
TP RFS	0.0099		0.0400			
Circle 54	[System 7]					
Center X	-36.4741	-36.4880			0.0139	
Center Y	-2.8904	-2.8922			0.0018	
Diameter	0.2399	0.2390	0.0140	0.0000	0.0009	
Circularity	0.0030					
TP RFS	0.0280		0.0400			
Circle 55	[System 7]					
Center X	-39.8207	-39.8277			0.0070	
Center Y	-2.8884	-2.8922			0.0038	
Diameter	0.2428	0.2390	0.0140	0.0000	0.0038	
Circularity	0.0042					
TP RFS	0.0159		0.0400			
Circle 56	[System 7]					
Center X	-43.1547	-43.1673			0.0126	
Center Y	-2.8838	-2.8922			0.0084	
Diameter	0.2394	0.2390	0.0140	0.0000	0.0004	
Circularity	0.0026					
TP RFS	0.0302		0.0400			
Circle 57	[System 7]					
Center X	-3.0957	-3.0914			-0.0043	
Center Y	2.8867	2.8922			-0.0055	
Diameter	0.2434	0.2390	0.0140	0.0000	0.0044	
Circularity	0.0047					
TP RFS	0.0140		0.0400			
Circle 58	[System 7]					
Center X	-6.4481	-6.4311			-0.0170	
Center Y	2.8909	2.8922			-0.0013	
Diameter	0.2416	0.2390	0.0140	0.0000	0.0026	
Circularity	0.0044					
TP RFS	0.0341		0.0400			
Circle 59	[System 7]					
Center X	-9.7784	-9.7708			-0.0076	
Center Y	2.8859	2.8922			-0.0063	
Diameter	0.2427	0.2390	0.0140	0.0000	0.0037	
Circularity	0.0036					
TP RFS	0.0198		0.0400			
Circle 60	[System 7]					
Center X	-13.1229	-13.1104			-0.0125	
Center Y	2.8791	2.8922			-0.0131	
Diameter	0.2410	0.2390	0.0140	0.0000	0.0020	
Circularity	0.0019					
TP RFS	0.0363		0.0400			
Circle 61	[System 7]					
Center X	-16.4547	-16.4501			-0.0046	
Center Y	2.8807	2.8922			-0.0115	
Diameter	0.2458	0.2390	0.0140	0.0000	0.0068	
Circularity	0.0034					
TP RFS	0.0248		0.0400			

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 62	[System 7]					
Center X	-19.7959	-19.7897				
Center Y	2.8840	2.8922			-0.0062	
Diameter	0.2426	0.2390	0.0140	0.0000	-0.0082	
Circularity	0.0021				0.0036	
TP RFS	0.0205		0.0400			
Circle 63	[System 7]					
Center X	-23.1221	-23.1294				0.0073
Center Y	2.8905	2.8922			-0.0017	
Diameter	0.2466	0.2390	0.0140	0.0000	0.0076	
Circularity	0.0023					
TP RFS	0.0150		0.0400			
Circle 64	[System 7]					
Center X	-26.4581	-26.4690				0.0109
Center Y	2.8965	2.8922			0.0043	
Diameter	0.2418	0.2390	0.0140	0.0000	0.0028	
Circularity	0.0038					
TP RFS	0.0234		0.0400			
Circle 65	[System 7]					
Center X	-29.8094	-29.8087				-0.0007
Center Y	2.8933	2.8922			0.0011	
Diameter	0.2402	0.2390	0.0140	0.0000	0.0012	
Circularity	0.0037					
TP RFS	0.0026		0.0400			
Circle 66	[System 7]					
Center X	-33.1432	-33.1484				0.0052
Center Y	2.8941	2.8922			0.0019	
Diameter	0.2418	0.2390	0.0140	0.0000	0.0028	
Circularity	0.0034					
TP RFS	0.0111		0.0400			
Circle 67	[System 7]					
Center X	-36.4787	-36.4880				0.0093
Center Y	2.8936	2.8922			0.0014	
Diameter	0.2464	0.2390	0.0140	0.0000	0.0074	
Circularity	0.0032					
TP RFS	0.0187		0.0400			
Circle 68	[System 7]					
Center X	-39.8164	-39.8277				0.0113
Center Y	2.8954	2.8922			0.0032	
Diameter	0.2391	0.2390	0.0140	0.0000	0.0001	
Circularity	0.0028					
TP RFS	0.0234		0.0400			
Circle 69	[System 7]					
Center X	-43.1550	-43.1673				0.0123
Center Y	2.8984	2.8922			0.0062	
Diameter	0.2423	0.2390	0.0140	0.0000	0.0033	
Circularity	0.0049					
TP RFS	0.0275		0.0400			
Circle 70	[System 7]					
Center X	-3.1003	-3.0914				-0.0089
Center Y	8.6754	8.6766			-0.0012	
Diameter	0.2390	0.2390	0.0140	0.0000	0.0000	
Circularity	0.0032					
TP RFS	0.0180		0.0400			

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 71	[System 7]					
Center X	-6.4337	-6.4311			-0.0026	
Center Y	8.6760	8.6766			-0.0006	
Diameter	0.2404	0.2390	0.0140	0.0000	0.0014	
Circularity	0.0028					
TP RFS	0.0054		0.0400			
Circle 72	[System 7]					
Center X	-9.7711	-9.7708			-0.0003	
Center Y	8.6703	8.6766			-0.0063	
Diameter	0.2415	0.2390	0.0140	0.0000	0.0025	
Circularity	0.0024					
TP RFS	0.0126		0.0400			
Circle 73	[System 7]					
Center X	-13.1012	-13.1104			0.0092	
Center Y	8.6651	8.6766			-0.0115	
Diameter	0.2452	0.2390	0.0140	0.0000	0.0062	
Circularity	0.0048					
TP RFS	0.0295		0.0400			
Circle 74	[System 7]					
Center X	-16.4482	-16.4501			0.0019	
Center Y	8.6733	8.6766			-0.0033	
Diameter	0.2450	0.2390	0.0140	0.0000	0.0060	
Circularity	0.0020					
TP RFS	0.0077		0.0400			
Circle 75	[System 7]					
Center X	-19.7795	-19.7897			0.0102	
Center Y	8.6701	8.6766			-0.0065	
Diameter	0.2448	0.2390	0.0140	0.0000	0.0058	
Circularity	0.0025					
TP RFS	0.0243		0.0400			
Circle 76	[System 7]					
Center X	-23.1175	-23.1294			0.0119	
Center Y	8.6724	8.6766			-0.0042	
Diameter	0.2447	0.2390	0.0140	0.0000	0.0057	
Circularity	0.0042					
TP RFS	0.0252		0.0400			
Circle 77	[System 7]					
Center X	-26.4598	-26.4690			0.0092	
Center Y	8.6766	8.6766			0.0000	
Diameter	0.2469	0.2390	0.0140	0.0000	0.0079	
Circularity	0.0038					
TP RFS	0.0184		0.0400			
Circle 78	[System 7]					
Center X	-29.7975	-29.8087			0.0112	
Center Y	8.6733	8.6766			-0.0033	
Diameter	0.2434	0.2390	0.0140	0.0000	0.0044	
Circularity	0.0026					
TP RFS	0.0233		0.0400			
Circle 79	[System 7]					
Center X	-33.1396	-33.1484			0.0088	
Center Y	8.6780	8.6766			0.0014	
Diameter	0.2447	0.2390	0.0140	0.0000	0.0057	
Circularity	0.0032					
TP RFS	0.0178		0.0400			

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 80	[System 7]					
Center X	-36.4790	-36.4880			0.0090	
Center Y	8.6733	8.6766			-0.0033	
Diameter	0.2469	0.2390	0.0140	0.0000	0.0079	
Circularity	0.0057					
TP RFS	0.0192		0.0400			
Circle 81	[System 7]					
Center X	-39.8098	-39.8277			0.0179	
Center Y	8.6776	8.6766			0.0010	
Diameter	0.2471	0.2390	0.0140	0.0000	0.0081	
Circularity	0.0035					
TP RFS	0.0360		0.0400			
Circle 82	[System 7]					
Center X	-43.1589	-43.1673			0.0084	
Center Y	8.6862	8.6766			0.0096	
Diameter	0.2401	0.2390	0.0140	0.0000	0.0011	
Circularity	0.0028					
TP RFS	0.0254		0.0400			
Circle 83	[System 7]					
Center X	-3.0998	-3.0914			-0.0084	
Center Y	-8.6749	-8.6766			0.0017	
Diameter	0.2432	0.2390	0.0140	0.0000	0.0042	
Circularity	0.0025					
TP RFS	0.0172		0.0400			
Circle 84	[System 7]					
Center X	-6.4337	-6.4311			-0.0026	
Center Y	-8.6719	-8.6766			0.0047	
Diameter	0.2423	0.2390	0.0140	0.0000	0.0033	
Circularity	0.0018					
TP RFS	0.0108		0.0400			
Circle 85	[System 7]					
Center X	-9.7745	-9.7708			-0.0037	
Center Y	-8.6695	-8.6766			0.0071	
Diameter	0.2415	0.2390	0.0140	0.0000	0.0025	
Circularity	0.0024					
TP RFS	0.0161		0.0400			
Circle 86	[System 7]					
Center X	-13.1122	-13.1104			-0.0018	
Center Y	-8.6703	-8.6766			0.0063	
Diameter	0.2437	0.2390	0.0140	0.0000	0.0047	
Circularity	0.0037					
TP RFS	0.0130		0.0400			
Circle 87	[System 7]					
Center X	-16.4515	-16.4501			-0.0014	
Center Y	-8.6725	-8.6766			0.0041	
Diameter	0.2394	0.2390	0.0140	0.0000	0.0004	
Circularity	0.0024					
TP RFS	0.0087		0.0400			
Circle 88	[System 7]					
Center X	-19.7982	-19.7897			-0.0085	
Center Y	-8.6808	-8.6766			-0.0042	
Diameter	0.2425	0.2390	0.0140	0.0000	0.0035	
Circularity	0.0026					
TP RFS	0.0189		0.0400			

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 89	[System 7]					
Center X	-23.1295	-23.1294			-0.0001	
Center Y	-8.6691	-8.6766			0.0075	
Diameter	0.2395	0.2390	0.0140	0.0000	0.0005	
Circularity	0.0045					
TP RFS	0.0149		0.0400			
Circle 90	[System 7]					
Center X	-26.4644	-26.4690			0.0046	
Center Y	-8.6657	-8.6766			0.0109	
Diameter	0.2419	0.2390	0.0140	0.0000	0.0029	
Circularity	0.0024					
TP RFS	0.0237		0.0400			
Circle 91	[System 7]					
Center X	-29.8100	-29.8087			-0.0013	
Center Y	-8.6639	-8.6766			0.0127	
Diameter	0.2412	0.2390	0.0140	0.0000	0.0022	
Circularity	0.0023					
TP RFS	0.0255		0.0400			
Circle 92	[System 7]					
Center X	-33.1490	-33.1484			-0.0006	
Center Y	-8.6584	-8.6766			0.0182	
Diameter	0.2465	0.2390	0.0140	0.0000	0.0075	
Circularity	0.0099					
TP RFS	0.0363		0.0400			
Circle 93	[System 7]					
Center X	-36.4847	-36.4880			0.0033	
Center Y	-8.6620	-8.6766			0.0146	
Diameter	0.2391	0.2390	0.0140	0.0000	0.0001	
Circularity	0.0029					
TP RFS	0.0299		0.0400			
Circle 94	[System 7]					
Center X	-39.8192	-39.8277			0.0085	
Center Y	-8.6702	-8.6766			0.0064	
Diameter	0.2424	0.2390	0.0140	0.0000	0.0034	
Circularity	0.0069					
TP RFS	0.0213		0.0400			
Circle 95	[System 7]					
Center X	-43.1592	-43.1673			0.0081	
Center Y	-8.6584	-8.6766			0.0182	
Diameter	0.2473	0.2390	0.0140	0.0000	0.0083	
Circularity	0.0029					
TP RFS	0.0399		0.0400			
Arc 96	[System 7]					
Center X	-4.7758	-4.7613			-0.0145	
Center Y	0.0114	0.0000			0.0114	
Radius	0.1229	0.1247			-0.0017	
TP RFS	0.0370		0.0400			
Arc 97	[System 7]					
Center X	-43.1602	-43.1673			0.0071	
Center Y	-8.6584	-8.6767			0.0183	
Radius	0.1242	0.1232			0.0010	
TP RFS	0.0392		0.0400			
Distance 100	[System 7]					
Distance Y	10.6318	10.6500	0.0000	1.0000	-0.0182	
Distance 102	[System 7]					
Distance Y	10.6253	10.6500	0.0000	1.0000	-0.0247	

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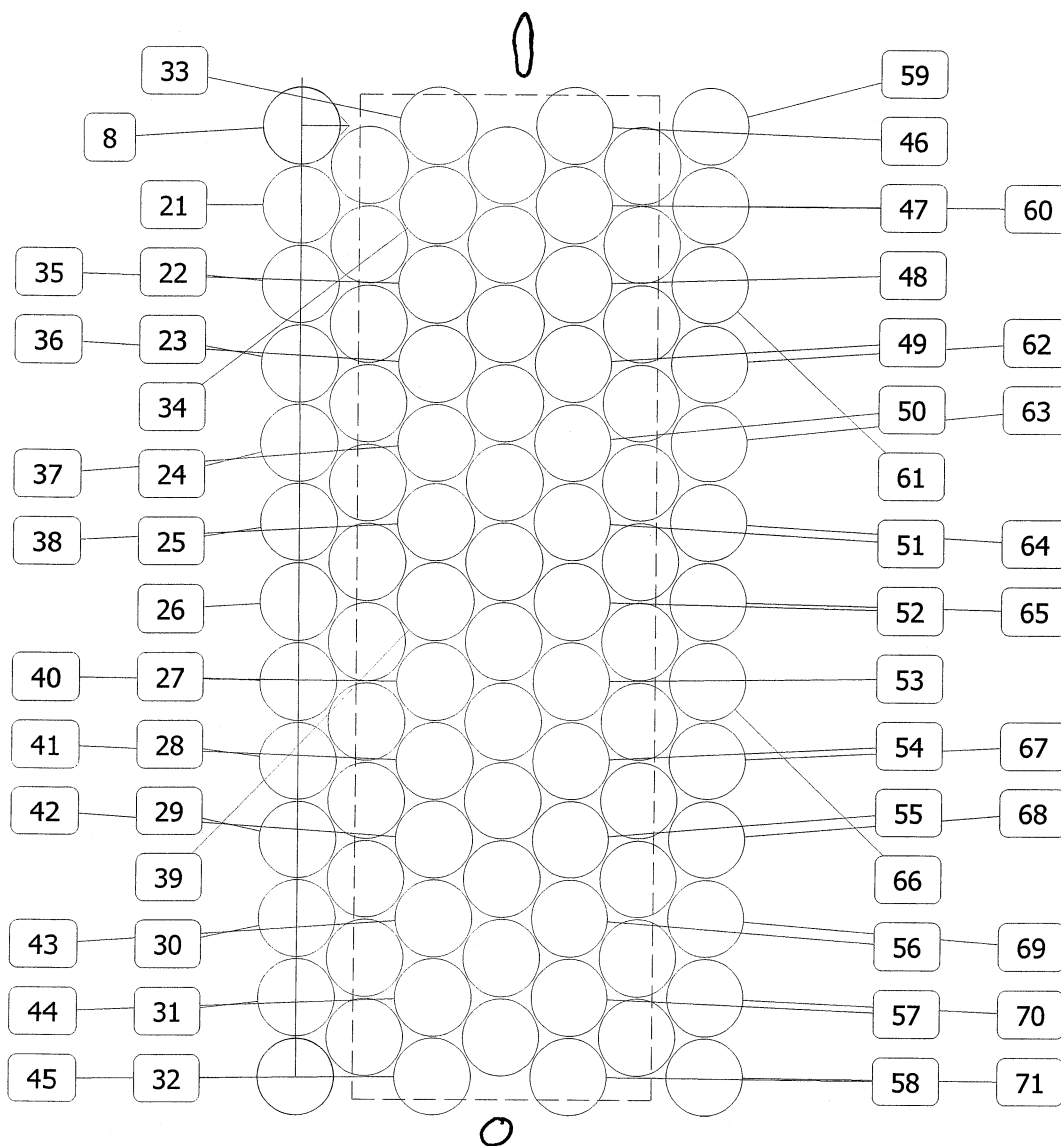
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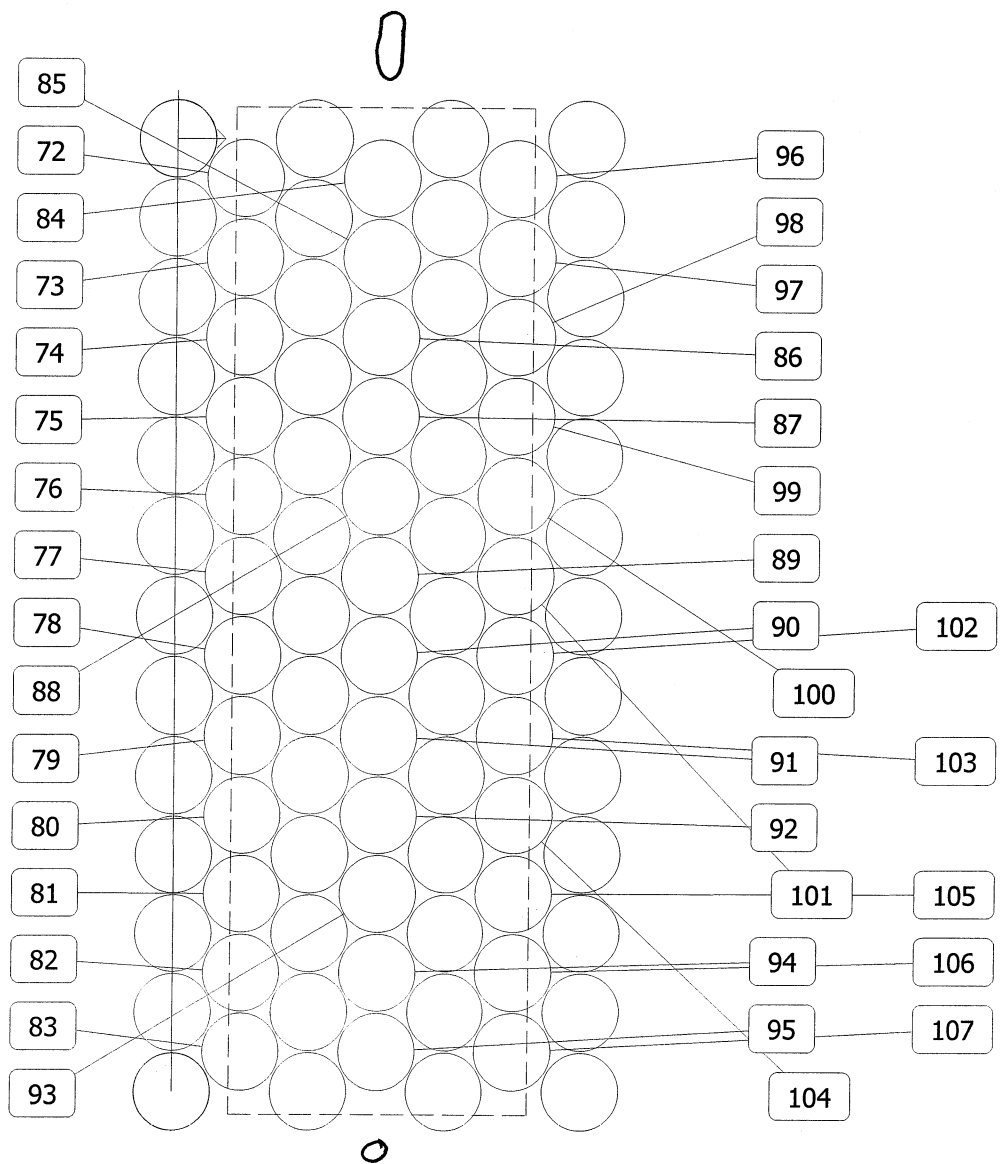
Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Point 103 Location X	[System 7] -45.1094	-45.1932	1.0000	0.0000	0.0838	
Point 104 Location X	[System 7] -44.0663	-44.1557			0.0894	
Point 105 Location Y	[System 7] 4.5148	4.5000	1.0000	0.0000	0.0148	
Point 106 Location Y	[System 7] -4.5172	-4.5000	0.0000	1.0000	-0.0172	
Circle 109 Center X Center Y Diameter	[System 7] -45.9975 0.0014 1.6096	-45.9971 0.0020 1.6000	0.0100	0.0000	-0.0004 -0.0005 0.0096	
Circle 110 Center X Center Y Diameter	[System 7] -46.2522 -0.0007 1.6037	-46.2536 -0.0005 1.6000	0.0100	0.0000	0.0014 -0.0002 0.0037	
Distance 111 Distance X	[System 7] 0.2547	0.2500	0.1000	0.1000	0.0047	
Point 112 Location X Location Y TP RFS	[System 7] -46.1248 0.0004 0.0008	-46.1250 0.0000	0.0500		0.0002 0.0004	
Distance 115 Distance XYZ	[System 7] 1.0413	1.0375	1.0000	0.0000	0.0038	
Point 116 Location X	[System 7] -1.1042	-1.0656	0.0000	1.0000	-0.0386	
Point 117 Location X	[System 7] -1.0991	-1.0656	0.0000	1.0000	-0.0335	
Distance 121 Distance X	[System 7] 1.2059	1.0375	1.0000	0.0000	0.1684	
Point 122 Location Y	[System 7] 4.5210	4.5000	1.0000	0.0000	0.0210	
Point 123 Location Y	[System 7] -4.5121	-4.5000	0.0000	1.0000	-0.0121	
Circle 124 Center X Center Y Diameter TP MMC	[System 7] -6.0619 13.4968 2.1005 0.0065	-6.0625 13.5000 2.0000	0.2500 0.0500	0.0000	0.0006 -0.0032 0.1005 -0.0940	
Circle 125 Center X Center Y Diameter TP MMC	[System 7] -40.0604 13.4947 2.0909 0.0114	-40.0625 13.5000 2.0000	0.2500 0.0500	0.0000	0.0021 -0.0053 0.0909 -0.0795	
Circle 126 Center X Center Y Diameter TP MMC	[System 7] -6.0636 -13.5075 2.0876 0.0152	-6.0625 -13.5000 2.0000	0.2500 0.0500	0.0000	-0.0011 -0.0075 0.0876 -0.0723	

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 127	[System 7]					
Center X	-40.0605	-40.0625			0.0020	
Center Y	-13.5097	-13.5000			-0.0097	
Diameter	2.0959	2.0000	0.2500	0.0000	0.0959	
TP MMC	0.0198		0.0500		-0.0761	
Circle 128	[System 7]					
Center X	-31.0729	-31.0625			-0.0104	
Center Y	-13.5219	-13.5000			-0.0219	
Diameter	3.2140	3.2000			0.0140	
TP RFS	0.0486		0.3500			
Circle 129	[System 7]					
Center X	-15.0753	-15.0625			-0.0128	
Center Y	-13.5160	-13.5000			-0.0160	
Diameter	3.1819	3.1200	0.0800	0.0000	0.0619	
TP RFS	0.0411		0.3500			
Line 131	[System 7]					
Location Y	-16.9584	-17.0000	0.2000	0.0000	0.0416	
Line 132	[System 7]					
Location Y	16.9564	17.0000	0.0000	0.2000	-0.0436	
Arc 133	[System 7]					
Radius	24.6002	24.7000	0.0000	0.2000	-0.0998	
Arc 135	[System 7]					
Radius	24.5937	24.7000	0.0000	0.2000	-0.1063	
Arc 136	[System 7]					
Radius	8.8783	9.0000	0.2000	0.2000	-0.1217	
Arc 137	[System 7]					
Radius	8.8374	9.0000	0.2000	0.2000	-0.1626	
Arc 138	[System 7]					
Radius	8.9500	9.0000	0.2000	0.2000	-0.0500	
Arc 139	[System 7]					
Radius	8.9794	9.0000	0.2000	0.2000	-0.0206	

FINAL LARGE DIAMETERS

S/N-01





Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 8	[System 4]					
Center X	0.0152	-0.0003			0.0155	
Center Y	0.0122	0.0035			0.0087	
Diameter	3.2477	3.2300	0.0070	0.0070	0.0177	0.0107
Circle 21	[System 4]					
Center X	0.0079	-0.0063			0.0142	
Center Y	-3.3200	-3.3297			0.0098	
Diameter	3.2403	3.2300	0.0070	0.0070	0.0103	0.0033
Circle 22	[System 4]					
Center X	0.0018	-0.0116			0.0134	
Center Y	-6.6593	-6.6694			0.0101	
Diameter	3.2446	3.2300	0.0070	0.0070	0.0146	0.0076
Circle 23	[System 4]					
Center X	-0.0113	-0.0252			0.0139	
Center Y	-9.9987	-10.0086			0.0099	
Diameter	3.2416	3.2300	0.0070	0.0070	0.0116	0.0046
Circle 24	[System 4]					
Center X	-0.0184	-0.0322			0.0139	
Center Y	-13.3383	-13.3477			0.0094	
Diameter	3.2643	3.2300	0.0070	0.0070	0.0343	0.0273
Circle 25	[System 4]					
Center X	-0.0080	-0.0218			0.0138	
Center Y	-16.6730	-16.6832			0.0102	
Diameter	3.2480	3.2300	0.0070	0.0070	0.0180	0.0110
Circle 26	[System 4]					
Center X	-0.0151	-0.0286			0.0135	
Center Y	-20.0182	-20.0283			0.0101	
Diameter	3.2444	3.2300	0.0070	0.0070	0.0144	0.0074
Circle 27	[System 4]					
Center X	-0.0032	-0.0163			0.0130	
Center Y	-23.3577	-23.3679			0.0102	
Diameter	3.2497	3.2300	0.0070	0.0070	0.0197	0.0127
Circle 28	[System 4]					
Center X	-0.0068	-0.0210			0.0142	
Center Y	-26.6889	-26.6989			0.0100	
Diameter	3.2545	3.2300	0.0070	0.0070	0.0245	0.0175
Circle 29	[System 4]					
Center X	0.0070	-0.0068			0.0138	
Center Y	-30.0320	-30.0423			0.0103	
Diameter	3.2484	3.2300	0.0070	0.0070	0.0184	0.0114
Circle 30	[System 4]					
Center X	0.0087	-0.0055			0.0142	
Center Y	-33.3657	-33.3758			0.0102	
Diameter	3.2539	3.2300	0.0070	0.0070	0.0239	0.0169
Circle 31	[System 4]					
Center X	0.0097	-0.0056			0.0154	
Center Y	-36.7007	-36.7103			0.0096	
Diameter	3.2478	3.2300	0.0070	0.0070	0.0178	0.0108
Circle 32	[System 4]					
Center X	0.0149	0.0000			0.0149	
Center Y	-40.0437	-40.0556			0.0118	
Diameter	3.2468	3.2300	0.0070	0.0070	0.0168	0.0098

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 33	[System 4]					
Center X	5.7937	5.7822			0.0115	
Center Y	0.0039	-0.0037			0.0076	
Diameter	3.2589	3.2300	0.0070	0.0070	0.0289	0.0219
Circle 34	[System 4]					
Center X	5.7853	5.7718			0.0135	
Center Y	-3.3343	-3.3418			0.0075	
Diameter	3.2505	3.2300	0.0070	0.0070	0.0205	0.0135
Circle 35	[System 4]					
Center X	5.7804	5.7667			0.0137	
Center Y	-6.6738	-6.6836			0.0099	
Diameter	3.2482	3.2300	0.0070	0.0070	0.0182	0.0112
Circle 36	[System 4]					
Center X	5.7940	5.7807			0.0132	
Center Y	-10.0085	-10.0178			0.0093	
Diameter	3.2422	3.2300	0.0070	0.0070	0.0122	0.0052
Circle 37	[System 4]					
Center X	5.7853	5.7718			0.0135	
Center Y	-13.3388	-13.3479			0.0091	
Diameter	3.2517	3.2300	0.0070	0.0070	0.0217	0.0147
Circle 38	[System 4]					
Center X	5.7875	5.7728			0.0147	
Center Y	-16.6843	-16.6931			0.0088	
Diameter	3.2507	3.2300	0.0070	0.0070	0.0207	0.0137
Circle 39	[System 4]					
Center X	5.7873	5.7734			0.0140	
Center Y	-20.0183	-20.0263			0.0081	
Diameter	3.2633	3.2300	0.0070	0.0070	0.0333	0.0263
Circle 40	[System 4]					
Center X	5.7877	5.7759			0.0118	
Center Y	-23.3563	-23.3651			0.0088	
Diameter	3.2518	3.2300	0.0070	0.0070	0.0218	0.0148
Circle 41	[System 4]					
Center X	5.7865	5.7716			0.0150	
Center Y	-26.6950	-26.7053			0.0103	
Diameter	3.2609	3.2300	0.0070	0.0070	0.0309	0.0239
Circle 42	[System 4]					
Center X	5.7855	5.7728			0.0127	
Center Y	-30.0340	-30.0431			0.0091	
Diameter	3.2756	3.2300	0.0070	0.0070	0.0456	0.0386
Circle 43	[System 4]					
Center X	5.7928	5.7791			0.0136	
Center Y	-33.3746	-33.3835			0.0088	
Diameter	3.2571	3.2300	0.0070	0.0070	0.0271	0.0201
Circle 44	[System 4]					
Center X	5.7975	5.7843			0.0131	
Center Y	-36.7042	-36.7131			0.0089	
Diameter	3.2597	3.2300	0.0070	0.0070	0.0297	0.0227
Circle 45	[System 4]					
Center X	5.7946	5.7798			0.0148	
Center Y	-40.0369	-40.0467			0.0098	
Diameter	3.2532	3.2300	0.0070	0.0070	0.0232	0.0162

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 46	[System 4]					
Center X	11.5750	11.5590			0.0161	
Center Y	0.0240	0.0167			0.0073	
Diameter	3.2429	3.2300	0.0070	0.0070	0.0129	0.0059
Circle 47	[System 4]					
Center X	11.5714	11.5563			0.0151	
Center Y	-3.3165	-3.3278			0.0112	
Diameter	3.2461	3.2300	0.0070	0.0070	0.0161	0.0091
Circle 48	[System 4]					
Center X	11.5804	11.5663			0.0141	
Center Y	-6.6539	-6.6611			0.0072	
Diameter	3.2378	3.2300	0.0070	0.0070	0.0078	0.0008
Circle 49	[System 4]					
Center X	11.5809	11.5669			0.0140	
Center Y	-9.9893	-9.9978			0.0085	
Diameter	3.2421	3.2300	0.0070	0.0070	0.0121	0.0051
Circle 50	[System 4]					
Center X	11.5752	11.5603			0.0149	
Center Y	-13.3341	-13.3429			0.0088	
Diameter	3.2376	3.2300	0.0070	0.0070	0.0076	0.0006
Circle 51	[System 4]					
Center X	11.5679	11.5554			0.0125	
Center Y	-16.6679	-16.6758			0.0079	
Diameter	3.2483	3.2300	0.0070	0.0070	0.0183	0.0113
Circle 52	[System 4]					
Center X	11.5826	11.5646			0.0180	
Center Y	-20.0190	-20.0275			0.0085	
Diameter	3.2391	3.2300	0.0070	0.0070	0.0091	0.0021
Circle 53	[System 4]					
Center X	11.5710	11.5558			0.0153	
Center Y	-23.3524	-23.3612			0.0089	
Diameter	3.2549	3.2300	0.0070	0.0070	0.0249	0.0179
Circle 54	[System 4]					
Center X	11.5798	11.5602			0.0196	
Center Y	-26.6988	-26.7046			0.0057	
Diameter	3.2640	3.2300	0.0070	0.0070	0.0340	0.0270
Circle 55	[System 4]					
Center X	11.5782	11.5638			0.0144	
Center Y	-30.0366	-30.0455			0.0089	
Diameter	3.2423	3.2300	0.0070	0.0070	0.0123	0.0053
Circle 56	[System 4]					
Center X	11.5702	11.5550			0.0152	
Center Y	-33.3788	-33.3879			0.0090	
Diameter	3.2447	3.2300	0.0070	0.0070	0.0147	0.0077
Circle 57	[System 4]					
Center X	11.5847	11.5707			0.0140	
Center Y	-36.7093	-36.7190			0.0097	
Diameter	3.2420	3.2300	0.0070	0.0070	0.0120	0.0050
Circle 58	[System 4]					
Center X	11.5685	11.5531			0.0153	
Center Y	-40.0487	-40.0575			0.0088	
Diameter	3.2669	3.2300	0.0070	0.0070	0.0369	0.0299

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 59	[System 4]					
Center X	17.3510	17.3372			0.0138	
Center Y	0.0172	0.0080			0.0092	
Diameter	3.2329	3.2300	0.0070	0.0070	0.0029	
Circle 60	[System 4]					
Center X	17.3665	17.3525			0.0140	
Center Y	-3.3260	-3.3348			0.0088	
Diameter	3.2286	3.2300	0.0070	0.0070	-0.0014	
Circle 61	[System 4]					
Center X	17.3609	17.3467			0.0142	
Center Y	-6.6574	-6.6656			0.0081	
Diameter	3.2393	3.2300	0.0070	0.0070	0.0093	0.0023
Circle 62	[System 4]					
Center X	17.3665	17.3523			0.0142	
Center Y	-9.9947	-10.0045			0.0097	
Diameter	3.2361	3.2300	0.0070	0.0070	0.0061	
Circle 63	[System 4]					
Center X	17.3694	17.3545			0.0149	
Center Y	-13.3314	-13.3406			0.0093	
Diameter	3.2219	3.2300	0.0070	0.0070	-0.0081	-0.0011
Circle 64	[System 4]					
Center X	17.3683	17.3534			0.0149	
Center Y	-16.6807	-16.6891			0.0084	
Diameter	3.2408	3.2300	0.0070	0.0070	0.0108	0.0038
Circle 65	[System 4]					
Center X	17.3640	17.3496			0.0144	
Center Y	-20.0122	-20.0212			0.0090	
Diameter	3.2427	3.2300	0.0070	0.0070	0.0127	0.0057
Circle 66	[System 4]					
Center X	17.3681	17.3527			0.0154	
Center Y	-23.3556	-23.3651			0.0096	
Diameter	3.2423	3.2300	0.0070	0.0070	0.0123	0.0053
Circle 67	[System 4]					
Center X	17.3682	17.3519			0.0162	
Center Y	-26.6849	-26.6938			0.0088	
Diameter	3.2436	3.2300	0.0070	0.0070	0.0136	0.0066
Circle 68	[System 4]					
Center X	17.3696	17.3544			0.0152	
Center Y	-30.0270	-30.0356			0.0086	
Diameter	3.2400	3.2300	0.0070	0.0070	0.0100	0.0030
Circle 69	[System 4]					
Center X	17.3627	17.3475			0.0152	
Center Y	-33.3689	-33.3778			0.0089	
Diameter	3.2343	3.2300	0.0070	0.0070	0.0043	
Circle 70	[System 4]					
Center X	17.3628	17.3463			0.0165	
Center Y	-36.7026	-36.7115			0.0089	
Diameter	3.2485	3.2300	0.0070	0.0070	0.0185	0.0115
Circle 71	[System 4]					
Center X	17.3657	17.3507			0.0150	
Center Y	-40.0444	-40.0538			0.0094	
Diameter	3.2549	3.2300	0.0070	0.0070	0.0249	0.0179

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 72	[System 4]					
Center X	2.8960	2.8842			0.0118	
Center Y	-1.6499	-1.6584			0.0086	
Diameter	3.2472	3.2300	0.0070	0.0070	0.0172	0.0102
Circle 73	[System 4]					
Center X	2.8938	2.8814			0.0124	
Center Y	-4.9916	-5.0021			0.0105	
Diameter	3.2442	3.2300	0.0070	0.0070	0.0142	0.0072
Circle 74	[System 4]					
Center X	2.8894	2.8777			0.0117	
Center Y	-8.3296	-8.3400			0.0103	
Diameter	3.2475	3.2300	0.0070	0.0070	0.0175	0.0105
Circle 75	[System 4]					
Center X	2.8921	2.8796			0.0125	
Center Y	-11.6709	-11.6810			0.0101	
Diameter	3.2511	3.2300	0.0070	0.0070	0.0211	0.0141
Circle 76	[System 4]					
Center X	2.8912	2.8779			0.0133	
Center Y	-15.0175	-15.0277			0.0103	
Diameter	3.2357	3.2300	0.0070	0.0070	0.0057	
Circle 77	[System 4]					
Center X	2.8885	2.8757			0.0128	
Center Y	-18.3619	-18.3711			0.0092	
Diameter	3.2510	3.2300	0.0070	0.0070	0.0210	0.0140
Circle 78	[System 4]					
Center X	2.8867	2.8739			0.0128	
Center Y	-21.6919	-21.7023			0.0104	
Diameter	3.2521	3.2300	0.0070	0.0070	0.0221	0.0151
Circle 79	[System 4]					
Center X	2.8886	2.8757			0.0129	
Center Y	-25.0285	-25.0376			0.0091	
Diameter	3.2479	3.2300	0.0070	0.0070	0.0179	0.0109
Circle 80	[System 4]					
Center X	2.8990	2.8860			0.0130	
Center Y	-28.3667	-28.3768			0.0101	
Diameter	3.2452	3.2300	0.0070	0.0070	0.0152	0.0082
Circle 81	[System 4]					
Center X	2.8989	2.8855			0.0133	
Center Y	-31.7010	-31.7119			0.0109	
Diameter	3.2437	3.2300	0.0070	0.0070	0.0137	0.0067
Circle 82	[System 4]					
Center X	2.8946	2.8804			0.0142	
Center Y	-35.0420	-35.0532			0.0113	
Diameter	3.2494	3.2300	0.0070	0.0070	0.0194	0.0124
Circle 83	[System 4]					
Center X	2.9045	2.8915			0.0129	
Center Y	-38.3729	-38.3841			0.0113	
Diameter	3.2493	3.2300	0.0070	0.0070	0.0193	0.0123
Circle 84	[System 4]					
Center X	8.6870	8.6760			0.0109	
Center Y	-1.6526	-1.6597			0.0072	
Diameter	3.2385	3.2300	0.0070	0.0070	0.0085	0.0015

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 85	[System 4]					
Center X	8.6912	8.6792			0.0120	
Center Y	-4.9828	-4.9919			0.0091	
Diameter	3.2468	3.2300	0.0070	0.0070	0.0168	0.0098
Circle 86	[System 4]					
Center X	8.6797	8.6664			0.0133	
Center Y	-8.3199	-8.3292			0.0093	
Diameter	3.2540	3.2300	0.0070	0.0070	0.0240	0.0170
Circle 87	[System 4]					
Center X	8.6881	8.6761			0.0120	
Center Y	-11.6610	-11.6696			0.0086	
Diameter	3.2434	3.2300	0.0070	0.0070	0.0134	0.0064
Circle 88	[System 4]					
Center X	8.6873	8.6722			0.0151	
Center Y	-15.0022	-15.0102			0.0080	
Diameter	3.2564	3.2300	0.0070	0.0070	0.0264	0.0194
Circle 89	[System 4]					
Center X	8.6874	8.6775			0.0099	
Center Y	-18.3510	-18.3605			0.0095	
Diameter	3.2631	3.2300	0.0070	0.0070	0.0331	0.0261
Circle 90	[System 4]					
Center X	8.6830	8.6719			0.0112	
Center Y	-21.6864	-21.6940			0.0076	
Diameter	3.2413	3.2300	0.0070	0.0070	0.0113	0.0043
Circle 91	[System 4]					
Center X	8.6781	8.6640			0.0141	
Center Y	-25.0308	-25.0396			0.0088	
Diameter	3.2481	3.2300	0.0070	0.0070	0.0181	0.0111
Circle 92	[System 4]					
Center X	8.6860	8.6709			0.0151	
Center Y	-28.3715	-28.3795			0.0081	
Diameter	3.2540	3.2300	0.0070	0.0070	0.0240	0.0170
Circle 93	[System 4]					
Center X	8.6770	8.6629			0.0141	
Center Y	-31.7080	-31.7168			0.0088	
Diameter	3.2555	3.2300	0.0070	0.0070	0.0255	0.0185
Circle 94	[System 4]					
Center X	8.6855	8.6713			0.0142	
Center Y	-35.0433	-35.0521			0.0089	
Diameter	3.2559	3.2300	0.0070	0.0070	0.0259	0.0189
Circle 95	[System 4]					
Center X	8.6846	8.6696			0.0151	
Center Y	-38.3805	-38.3896			0.0092	
Diameter	3.2469	3.2300	0.0070	0.0070	0.0169	0.0099
Circle 96	[System 4]					
Center X	14.4617	14.4486			0.0130	
Center Y	-1.6522	-1.6583			0.0061	
Diameter	3.2456	3.2300	0.0070	0.0070	0.0156	0.0086
Circle 97	[System 4]					
Center X	14.4642	14.4500			0.0142	
Center Y	-4.9813	-4.9888			0.0076	
Diameter	3.2362	3.2300	0.0070	0.0070	0.0062	

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 98	[System 4]					
Center X	14.4685	14.4537			0.0148	
Center Y	-8.3186	-8.3288			0.0102	
Diameter	3.2434	3.2300	0.0070	0.0070	0.0134	0.0064
Circle 99	[System 4]					
Center X	14.4706	14.4559			0.0148	
Center Y	-11.6542	-11.6639			0.0097	
Diameter	3.2261	3.2300	0.0070	0.0070	-0.0039	
Circle 100	[System 4]					
Center X	14.4704	14.4552			0.0152	
Center Y	-14.9977	-15.0067			0.0090	
Diameter	3.2394	3.2300	0.0070	0.0070	0.0094	0.0024
Circle 101	[System 4]					
Center X	14.4740	14.4584			0.0156	
Center Y	-18.3449	-18.3536			0.0087	
Diameter	3.2406	3.2300	0.0070	0.0070	0.0106	0.0036
Circle 102	[System 4]					
Center X	14.4720	14.4576			0.0145	
Center Y	-21.6808	-21.6886			0.0078	
Diameter	3.2381	3.2300	0.0070	0.0070	0.0081	0.0011
Circle 103	[System 4]					
Center X	14.4644	14.4492			0.0152	
Center Y	-25.0241	-25.0343			0.0102	
Diameter	3.2334	3.2300	0.0070	0.0070	0.0034	
Circle 104	[System 4]					
Center X	14.4693	14.4542			0.0150	
Center Y	-28.3685	-28.3767			0.0082	
Diameter	3.2398	3.2300	0.0070	0.0070	0.0098	0.0028
Circle 105	[System 4]					
Center X	14.4683	14.4528			0.0155	
Center Y	-31.7090	-31.7183			0.0092	
Diameter	3.2360	3.2300	0.0070	0.0070	0.0060	
Circle 106	[System 4]					
Center X	14.4728	14.4586			0.0142	
Center Y	-35.0434	-35.0520			0.0086	
Diameter	3.2485	3.2300	0.0070	0.0070	0.0185	0.0115
Circle 107	[System 4]					
Center X	14.4687	14.4535			0.0152	
Center Y	-38.3744	-38.3829			0.0084	
Diameter	3.2507	3.2300	0.0070	0.0070	0.0207	0.0137



NON CONFORMANCE REPORT

1. NCR # : 12302

2. Pg. 1 of 1

3. PART # : 10209823	REV. X4	4. PART DESCRIPTION : FEEDHORN	5. PROJ. # : P8757	6. CUSTOMER : JPL
7. SERIAL # OR BATCH # - 01	8. VENDOR NAME N/A	9. VEND CERT# N/A	10. VEND P.O # N/A	11. VEND # N/A

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	D-12, PARALLEL .003 A	.0106	4	1	OSD
2	F-10, DIAMETER 3.237	SEE ATTACHED REPORT	3	1	OSD
3	NT 2 CALLS FOR NICKEL PLATING	GOLD PLATED PART PER CUSTOMER INSTRUCTIONS	7	1	OSD
4	C11	GOLD PLATED DIRECTLY ON SOLDER	8	1	PLT

18. ORIGINATOR: Troy George (PRINT & SIGN)	DATE: 11/25/03	19. OPERATION DETECTED AT: 190	20. WORK AREA DETECTED AT: Inspection
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21. ITEM #	22. OPER #	23. DISPOSITION	24. STAMP/ SIGN
1		REQUEST UAI	
2		REQUEST UAI	
3		REQUEST UAI	
4		REQUEST UAI	

25. RTV Qty: _____	26. SCRAP Qty: _____	27. REWORK Qty: _____	28. STANDARD REPAIR Qty: _____	29. USE AS IS Qty: 1	30. REPAIR Qty: _____
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31. CLASSIFICATION CRITICAL <input type="checkbox"/> MAJOR <input type="checkbox"/> MINOR <input type="checkbox"/>	32. CUSTOMER APPROVAL REQUIRED YES <input checked="" type="checkbox"/> NO <input type="checkbox"/>	33. CORRECTIVE ACTION REQUIRED. YES <input type="checkbox"/> NO <input type="checkbox"/>
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34. Project Leader : Don Jagan	DATE : 11/25/03	35. Customer Approval: Scott Hughes	DATE : 11/25/03	36. Quality Assurance : [Signature]	DATE : 11/25/03
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37. CAUSE :

38. CAR#:	39. ACTIONEE :	40. ASSIGNED DATE:
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41. CORRECTIVE ACTION :

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

43. DATE COMPLETED :	44. APPROVED BY:	45. CACODE#:
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Custom Microwave Inc.

940 Boston Avenue
 Longmont, CO 80501
 Phone: (303) 651-0707
 Fax: (303) 651-0706

Invoice: 4172
 04/19/04

CMI Sales Order: 8420

Bill To: **Jet Propulsion Lab**
 4800 Oak Grove Drive
 M/S 601-209
 PASADENA, CA 91109

Ship To: **JPL - Central Receiving**
 4800 Oak Grove Drive
 M/S 241-104
 Pasadena, CA 91109

Purchase Order Number	Ship Via	F.O.B.	Terms
1259816	FED-X P1	Origin	Net 30

Quantity			CMI Part Number	Description	Unit Price	Amount
Req	Shipped	B.O.				
1	1		P9147	Repair/rework Feedhorn 10209823 4/23/04		

CERTIFICATION REQUIRED

A service charge of 1-1/2% per month (18% per annum) will be applied to all overdue accounts.

All claims for damaged goods or incorrect items must be made within 10 days of shipment.

Items cannot be returned without prior approval. Please call (303) 651-0707 for authorization number.

PMW Feedhorn After Rework

CMI certifies that all material and processes used in the manufacturing of supplied parts conform in all respect 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. CMI further certifies that no parts supplied against this PO contain mercury or have come in contact with mercury compounds nor do they contain beryllium or beryllium compounds except beryllium copper.

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Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 1	[MCS]					
Diameter	1.6049	1.6000	0.0100	0.0000	0.0049	
Circle 8	[System 7]					
Center X	-4.7755	-4.7613			-0.0142	
Center Y	0.0084	0.0000			0.0084	
Diameter	0.2489	0.2390	0.0100	0.0000	0.0099	
Circularity	0.0110					
TP RFS	0.0329		0.0400			
Circle 9	[System 7]					
Center X	-8.1059	-8.1009			-0.0050	
Center Y	-0.0068	0.0000			-0.0068	
Diameter	0.2407	0.2390	0.0100	0.0000	0.0017	
Circularity	0.0017					
TP RFS	0.0169		0.0400			
Circle 10	[System 7]					
Center X	-11.4420	-11.4406			-0.0014	
Center Y	-0.0197	0.0000			-0.0197	
Diameter	0.2424	0.2390	0.0100	0.0000	0.0034	
Circularity	0.0014					
TP RFS	0.0395		0.0400			
Circle 11	[System 7]					
Center X	-14.7808	-14.7802			-0.0006	
Center Y	-0.0147	0.0000			-0.0147	
Diameter	0.2409	0.2390	0.0100	0.0000	0.0019	
Circularity	0.0050					
TP RFS	0.0294		0.0400			
Circle 12	[System 7]					
Center X	-18.1269	-18.1199			-0.0070	
Center Y	-0.0045	0.0000			-0.0045	
Diameter	0.2415	0.2390	0.0100	0.0000	0.0025	
Circularity	0.0029					
TP RFS	0.0166		0.0400			
Circle 13	[System 7]					
Center X	-21.4549	-21.4596			0.0047	
Center Y	-0.0123	0.0000			-0.0123	
Diameter	0.2397	0.2390	0.0100	0.0000	0.0007	
Circularity	0.0103					
TP RFS	0.0262		0.0400			
Circle 14	[System 7]					
Center X	-24.7945	-24.7992			0.0047	
Center Y	-0.0073	0.0000			-0.0073	
Diameter	0.2417	0.2390	0.0100	0.0000	0.0027	
Circularity	0.0034					
TP RFS	0.0174		0.0400			
Circle 15	[System 7]					
Center X	-28.1316	-28.1389			0.0073	
Center Y	-0.0051	0.0000			-0.0051	
Diameter	0.2404	0.2390	0.0100	0.0000	0.0014	
Circularity	0.0058					
TP RFS	0.0178		0.0400			
Circle 16	[System 7]					
Center X	-31.4783	-31.4785			0.0002	
Center Y	0.0005	0.0000			0.0005	
Diameter	0.2414	0.2390	0.0100	0.0000	0.0024	
Circularity	0.0029					
TP RFS	0.0010		0.0400			

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 17	[System 7]					
Center X	-34.8189	-34.8182			-0.0007	
Center Y	-0.0015	0.0000			-0.0015	
Diameter	0.2391	0.2390	0.0100	0.0000	0.0001	
Circularity	0.0032					
TP RFS	0.0033		0.0400			
Circle 18	[System 7]					
Center X	-38.1518	-38.1578			0.0060	
Center Y	0.0049	0.0000			0.0049	
Diameter	0.2416	0.2390	0.0100	0.0000	0.0026	
Circularity	0.0060					
TP RFS	0.0155		0.0400			
Circle 19	[System 7]					
Center X	-41.4875	-41.4975			0.0100	
Center Y	0.0081	0.0000			0.0081	
Diameter	0.2405	0.2390	0.0100	0.0000	0.0015	
Circularity	0.0057					
TP RFS	0.0258		0.0400			
Circle 20	[System 7]					
Center X	-4.7656	-4.7613			-0.0043	
Center Y	5.7675	5.7845			-0.0170	
Diameter	0.2422	0.2390	0.0100	0.0000	0.0032	
Circularity	0.0043					
TP RFS	0.0351		0.0400			
Circle 21	[System 7]					
Center X	-8.0971	-8.1009			0.0038	
Center Y	5.7695	5.7845			-0.0150	
Diameter	0.2404	0.2390	0.0100	0.0000	0.0014	
Circularity	0.0030					
TP RFS	0.0309		0.0400			
Circle 22	[System 7]					
Center X	-11.4313	-11.4406			0.0093	
Center Y	5.7788	5.7845			-0.0057	
Diameter	0.2410	0.2390	0.0100	0.0000	0.0020	
Circularity	0.0042					
TP RFS	0.0218		0.0400			
Circle 23	[System 7]					
Center X	-14.7684	-14.7802			0.0118	
Center Y	5.7732	5.7845			-0.0113	
Diameter	0.2415	0.2390	0.0100	0.0000	0.0025	
Circularity	0.0028					
TP RFS	0.0327		0.0400			
Circle 24	[System 7]					
Center X	-18.1080	-18.1199			0.0119	
Center Y	5.7775	5.7845			-0.0070	
Diameter	0.2427	0.2390	0.0100	0.0000	0.0037	
Circularity	0.0037					
TP RFS	0.0275		0.0400			
Circle 25	[System 7]					
Center X	-21.4541	-21.4596			0.0055	
Center Y	5.7776	5.7845			-0.0069	
Diameter	0.2405	0.2390	0.0100	0.0000	0.0015	
Circularity	0.0019					
TP RFS	0.0177		0.0400			

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 26	[System 7]					
Center X	-24.7864	-24.7992			0.0128	
Center Y	5.7770	5.7845			-0.0075	
Diameter	0.2410	0.2390	0.0100	0.0000	0.0020	
Circularity	0.0050					
TP RFS	0.0296		0.0400			
Circle 27	[System 7]					
Center X	-28.1309	-28.1389			0.0080	
Center Y	5.7816	5.7845			-0.0029	
Diameter	0.2411	0.2390	0.0100	0.0000	0.0021	
Circularity	0.0044					
TP RFS	0.0169		0.0400			
Circle 28	[System 7]					
Center X	-31.4712	-31.4785			0.0073	
Center Y	5.7818	5.7845			-0.0027	
Diameter	0.2452	0.2390	0.0100	0.0000	0.0062	
Circularity	0.0071					
TP RFS	0.0156		0.0400			
Circle 29	[System 7]					
Center X	-34.8032	-34.8182			0.0150	
Center Y	5.7743	5.7845			-0.0102	
Diameter	0.2406	0.2390	0.0100	0.0000	0.0016	
Circularity	0.0050					
TP RFS	0.0363		0.0400			
Circle 30	[System 7]					
Center X	-38.1439	-38.1578			0.0139	
Center Y	5.7907	5.7845			0.0062	
Diameter	0.2439	0.2390	0.0100	0.0000	0.0049	
Circularity	0.0079					
TP RFS	0.0304		0.0400			
Circle 31	[System 7]					
Center X	-41.4762	-41.4975			0.0213	
Center Y	5.7856	5.7845			0.0011	
Diameter	0.2403	0.2390	0.0100	0.0000	0.0013	
Circularity	0.0047					
TP RFS	0.0427		0.0400			0.0027
Circle 32	[System 7]					
Center X	-4.7683	-4.7613			-0.0070	
Center Y	-5.7937	-5.7845			-0.0092	
Diameter	0.2460	0.2390	0.0100	0.0000	0.0070	
Circularity	0.0022					
TP RFS	0.0231		0.0400			
Circle 33	[System 7]					
Center X	-8.0989	-8.1009			0.0020	
Center Y	-5.7881	-5.7845			-0.0036	
Diameter	0.2427	0.2390	0.0100	0.0000	0.0037	
Circularity	0.0034					
TP RFS	0.0083		0.0400			
Circle 34	[System 7]					
Center X	-11.4398	-11.4406			0.0008	
Center Y	-5.7954	-5.7845			-0.0109	
Diameter	0.2415	0.2390	0.0100	0.0000	0.0025	
Circularity	0.0028					
TP RFS	0.0218		0.0400			

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 35	[System 7]					
Center X	-14.7773	-14.7802			0.0029	
Center Y	-5.7879	-5.7845			-0.0034	
Diameter	0.2452	0.2390	0.0100	0.0000	0.0062	
Circularity	0.0048					
TP RFS	0.0089		0.0400			
Circle 36	[System 7]					
Center X	-18.1190	-18.1199			0.0009	
Center Y	-5.7993	-5.7845			-0.0148	
Diameter	0.2399	0.2390	0.0100	0.0000	0.0009	
Circularity	0.0062					
TP RFS	0.0296		0.0400			
Circle 37	[System 7]					
Center X	-21.4654	-21.4596			-0.0058	
Center Y	-5.7852	-5.7845			-0.0007	
Diameter	0.2407	0.2390	0.0100	0.0000	0.0017	
Circularity	0.0031					
TP RFS	0.0117		0.0400			
Circle 38	[System 7]					
Center X	-24.8001	-24.7992			-0.0009	
Center Y	-5.7946	-5.7845			-0.0101	
Diameter	0.2399	0.2390	0.0100	0.0000	0.0009	
Circularity	0.0036					
TP RFS	0.0202		0.0400			
Circle 39	[System 7]					
Center X	-28.1339	-28.1389			0.0050	
Center Y	-5.7759	-5.7845			0.0086	
Diameter	0.2422	0.2390	0.0100	0.0000	0.0032	
Circularity	0.0036					
TP RFS	0.0199		0.0400			
Circle 40	[System 7]					
Center X	-31.4715	-31.4785			0.0070	
Center Y	-5.7862	-5.7845			-0.0017	
Diameter	0.2461	0.2390	0.0100	0.0000	0.0071	
Circularity	0.0030					
TP RFS	0.0143		0.0400			
Circle 41	[System 7]					
Center X	-34.8121	-34.8182			0.0061	
Center Y	-5.7789	-5.7845			0.0056	
Diameter	0.2411	0.2390	0.0100	0.0000	0.0021	
Circularity	0.0031					
TP RFS	0.0166		0.0400			
Circle 42	[System 7]					
Center X	-38.1454	-38.1578			0.0124	
Center Y	-5.7835	-5.7845			0.0010	
Diameter	0.2437	0.2390	0.0100	0.0000	0.0047	
Circularity	0.0041					
TP RFS	0.0250		0.0400			
Circle 43	[System 7]					
Center X	-41.4905	-41.4975			0.0070	
Center Y	-5.7747	-5.7845			0.0098	
Diameter	0.2448	0.2390	0.0100	0.0000	0.0058	
Circularity	0.0024					
TP RFS	0.0240		0.0400			

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 44	[System 7]					
Center X	-3.0894	-3.0914			0.0020	
Center Y	-2.9008	-2.8922			-0.0086	
Diameter	0.2437	0.2390	0.0100	0.0000	0.0047	
Circularity	0.0039					
TP RFS	0.0177		0.0400			
Circle 45	[System 7]					
Center X	-6.4337	-6.4311			-0.0026	
Center Y	-2.8991	-2.8922			-0.0069	
Diameter	0.2422	0.2390	0.0100	0.0000	0.0032	
Circularity	0.0026					
TP RFS	0.0148		0.0400			
Circle 46	[System 7]					
Center X	-9.7653	-9.7708			0.0055	
Center Y	-2.8941	-2.8922			-0.0019	
Diameter	0.2429	0.2390	0.0100	0.0000	0.0039	
Circularity	0.0022					
TP RFS	0.0117		0.0400			
Circle 47	[System 7]					
Center X	-13.1126	-13.1104			-0.0022	
Center Y	-2.9011	-2.8922			-0.0089	
Diameter	0.2402	0.2390	0.0100	0.0000	0.0012	
Circularity	0.0022					
TP RFS	0.0184		0.0400			
Circle 48	[System 7]					
Center X	-16.4566	-16.4501			-0.0065	
Center Y	-2.8997	-2.8922			-0.0075	
Diameter	0.2414	0.2390	0.0100	0.0000	0.0024	
Circularity	0.0027					
TP RFS	0.0200		0.0400			
Circle 49	[System 7]					
Center X	-19.7958	-19.7897			-0.0061	
Center Y	-2.9015	-2.8922			-0.0093	
Diameter	0.2399	0.2390	0.0100	0.0000	0.0009	
Circularity	0.0052					
TP RFS	0.0223		0.0400			
Circle 50	[System 7]					
Center X	-23.1232	-23.1294			0.0062	
Center Y	-2.8963	-2.8922			-0.0041	
Diameter	0.2407	0.2390	0.0100	0.0000	0.0017	
Circularity	0.0049					
TP RFS	0.0148		0.0400			
Circle 51	[System 7]					
Center X	-26.4688	-26.4690			0.0002	
Center Y	-2.8919	-2.8922			0.0003	
Diameter	0.2391	0.2390	0.0100	0.0000	0.0001	
Circularity	0.0023					
TP RFS	0.0008		0.0400			
Circle 52	[System 7]					
Center X	-29.8066	-29.8087			0.0021	
Center Y	-2.8836	-2.8922			0.0086	
Diameter	0.2429	0.2390	0.0100	0.0000	0.0039	
Circularity	0.0017					
TP RFS	0.0177		0.0400			

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 53	[System 7]					
Center X	-33.1474	-33.1484			0.0010	
Center Y	-2.8952	-2.8922			-0.0030	
Diameter	0.2408	0.2390	0.0100	0.0000	0.0018	
Circularity	0.0043					
TP RFS	0.0064		0.0400			
Circle 54	[System 7]					
Center X	-36.4720	-36.4880			0.0160	
Center Y	-2.8916	-2.8922			0.0006	
Diameter	0.2393	0.2390	0.0100	0.0000	0.0003	
Circularity	0.0025					
TP RFS	0.0320		0.0400			
Circle 55	[System 7]					
Center X	-39.8193	-39.8277			0.0084	
Center Y	-2.8888	-2.8922			0.0034	
Diameter	0.2474	0.2390	0.0100	0.0000	0.0084	
Circularity	0.0040					
TP RFS	0.0181		0.0400			
Circle 56	[System 7]					
Center X	-43.1538	-43.1673			0.0135	
Center Y	-2.8867	-2.8922			0.0055	
Diameter	0.2451	0.2390	0.0100	0.0000	0.0061	
Circularity	0.0050					
TP RFS	0.0291		0.0400			
Circle 57	[System 7]					
Center X	-3.0942	-3.0914			-0.0028	
Center Y	2.8838	2.8922			-0.0084	
Diameter	0.2427	0.2390	0.0100	0.0000	0.0037	
Circularity	0.0033					
TP RFS	0.0177		0.0400			
Circle 58	[System 7]					
Center X	-6.4455	-6.4311			-0.0144	
Center Y	2.8853	2.8922			-0.0069	
Diameter	0.2408	0.2390	0.0100	0.0000	0.0018	
Circularity	0.0056					
TP RFS	0.0320		0.0400			
Circle 59	[System 7]					
Center X	-9.7720	-9.7708			-0.0012	
Center Y	2.8795	2.8922			-0.0127	
Diameter	0.2394	0.2390	0.0100	0.0000	0.0004	
Circularity	0.0048					
TP RFS	0.0254		0.0400			
Circle 60	[System 7]					
Center X	-13.1198	-13.1104			-0.0094	
Center Y	2.8736	2.8922			-0.0186	
Diameter	0.2435	0.2390	0.0100	0.0000	0.0045	
Circularity	0.0027					
TP RFS	0.0416		0.0400			0.0016
Circle 61	[System 7]					
Center X	-16.4526	-16.4501			-0.0025	
Center Y	2.8774	2.8922			-0.0148	
Diameter	0.2440	0.2390	0.0100	0.0000	0.0050	
Circularity	0.0026					
TP RFS	0.0301		0.0400			

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 62	[System 7]					
Center X	-19.7939	-19.7897			-0.0042	
Center Y	2.8799	2.8922			-0.0123	
Diameter	0.2397	0.2390	0.0100	0.0000	0.0007	
Circularity	0.0021					
TP RFS	0.0260		0.0400			
Circle 63	[System 7]					
Center X	-23.1197	-23.1294			0.0097	
Center Y	2.8815	2.8922			-0.0107	
Diameter	0.2412	0.2390	0.0100	0.0000	0.0022	
Circularity	0.0133					
TP RFS	0.0288		0.0400			
Circle 64	[System 7]					
Center X	-26.4563	-26.4690			0.0127	
Center Y	2.8935	2.8922			0.0013	
Diameter	0.2405	0.2390	0.0100	0.0000	0.0015	
Circularity	0.0077					
TP RFS	0.0255		0.0400			
Circle 65	[System 7]					
Center X	-29.8065	-29.8087			0.0022	
Center Y	2.8879	2.8922			-0.0043	
Diameter	0.2413	0.2390	0.0100	0.0000	0.0023	
Circularity	0.0023					
TP RFS	0.0097		0.0400			
Circle 66	[System 7]					
Center X	-33.1425	-33.1484			0.0059	
Center Y	2.8877	2.8922			-0.0045	
Diameter	0.2410	0.2390	0.0100	0.0000	0.0020	
Circularity	0.0015					
TP RFS	0.0148		0.0400			
Circle 67	[System 7]					
Center X	-36.4749	-36.4880			0.0131	
Center Y	2.8891	2.8922			-0.0031	
Diameter	0.2416	0.2390	0.0100	0.0000	0.0026	
Circularity	0.0016					
TP RFS	0.0268		0.0400			
Circle 68	[System 7]					
Center X	-39.8130	-39.8277			0.0147	
Center Y	2.8902	2.8922			-0.0020	
Diameter	0.2416	0.2390	0.0100	0.0000	0.0026	
Circularity	0.0041					
TP RFS	0.0296		0.0400			
Circle 69	[System 7]					
Center X	-43.1539	-43.1673			0.0134	
Center Y	2.8953	2.8922			0.0031	
Diameter	0.2421	0.2390	0.0100	0.0000	0.0031	
Circularity	0.0080					
TP RFS	0.0275		0.0400			
Circle 70	[System 7]					
Center X	-3.0959	-3.0914			-0.0045	
Center Y	8.6698	8.6766			-0.0068	
Diameter	0.2402	0.2390	0.0100	0.0000	0.0012	
Circularity	0.0059					
TP RFS	0.0163		0.0400			

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 71	[System 7]					
Center X	-6.4297	-6.4311			0.0014	
Center Y	8.6728	8.6766			-0.0038	
Diameter	0.2407	0.2390	0.0100	0.0000	0.0017	
Circularity	0.0055					
TP RFS	0.0081		0.0400			
Circle 72	[System 7]					
Center X	-9.7646	-9.7708			0.0062	
Center Y	8.6663	8.6766			-0.0103	
Diameter	0.2445	0.2390	0.0100	0.0000	0.0055	
Circularity	0.0082					
TP RFS	0.0241		0.0400			
Circle 73	[System 7]					
Center X	-13.0971	-13.1104			0.0133	
Center Y	8.6603	8.6766			-0.0163	
Diameter	0.2437	0.2390	0.0100	0.0000	0.0047	
Circularity	0.0052					
TP RFS	0.0421		0.0400			0.0021
Circle 74	[System 7]					
Center X	-16.4460	-16.4501			0.0041	
Center Y	8.6709	8.6766			-0.0057	
Diameter	0.2418	0.2390	0.0100	0.0000	0.0028	
Circularity	0.0025					
TP RFS	0.0140		0.0400			
Circle 75	[System 7]					
Center X	-19.7752	-19.7897			0.0145	
Center Y	8.6647	8.6766			-0.0119	
Diameter	0.2412	0.2390	0.0100	0.0000	0.0022	
Circularity	0.0022					
TP RFS	0.0376		0.0400			
Circle 76	[System 7]					
Center X	-23.1149	-23.1294			0.0145	
Center Y	8.6670	8.6766			-0.0096	
Diameter	0.2394	0.2390	0.0100	0.0000	0.0004	
Circularity	0.0038					
TP RFS	0.0347		0.0400			
Circle 77	[System 7]					
Center X	-26.4575	-26.4690			0.0115	
Center Y	8.6734	8.6766			-0.0032	
Diameter	0.2395	0.2390	0.0100	0.0000	0.0005	
Circularity	0.0051					
TP RFS	0.0238		0.0400			
Circle 78	[System 7]					
Center X	-29.7968	-29.8087			0.0119	
Center Y	8.6696	8.6766			-0.0070	
Diameter	0.2409	0.2390	0.0100	0.0000	0.0019	
Circularity	0.0037					
TP RFS	0.0276		0.0400			
Circle 79	[System 7]					
Center X	-33.1379	-33.1484			0.0105	
Center Y	8.6756	8.6766			-0.0010	
Diameter	0.2426	0.2390	0.0100	0.0000	0.0036	
Circularity	0.0034					
TP RFS	0.0211		0.0400			

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 80	[System 7]					
Center X	-36.4762	-36.4880			0.0118	
Center Y	8.6727	8.6766			-0.0039	
Diameter	0.2394	0.2390	0.0100	0.0000	0.0004	
Circularity	0.0044					
TP RFS	0.0248		0.0400			
Circle 81	[System 7]					
Center X	-39.8083	-39.8277			0.0194	
Center Y	8.6765	8.6766			-0.0001	
Diameter	0.2424	0.2390	0.0100	0.0000	0.0034	
Circularity	0.0056					
TP RFS	0.0389		0.0400			
Circle 82	[System 7]					
Center X	-43.1571	-43.1673			0.0102	
Center Y	8.6823	8.6766			0.0057	
Diameter	0.2417	0.2390	0.0100	0.0000	0.0027	
Circularity	0.0029					
TP RFS	0.0233		0.0400			
Circle 83	[System 7]					
Center X	-3.0933	-3.0914			-0.0019	
Center Y	-8.6817	-8.6766			-0.0051	
Diameter	0.2479	0.2390	0.0100	0.0000	0.0089	
Circularity	0.0045					
TP RFS	0.0109		0.0400			
Circle 84	[System 7]					
Center X	-6.4276	-6.4311			0.0035	
Center Y	-8.6751	-8.6766			0.0015	
Diameter	0.2431	0.2390	0.0100	0.0000	0.0041	
Circularity	0.0036					
TP RFS	0.0075		0.0400			
Circle 85	[System 7]					
Center X	-9.7687	-9.7708			0.0021	
Center Y	-8.6758	-8.6766			0.0008	
Diameter	0.2419	0.2390	0.0100	0.0000	0.0029	
Circularity	0.0018					
TP RFS	0.0044		0.0400			
Circle 86	[System 7]					
Center X	-13.1075	-13.1104			0.0029	
Center Y	-8.6732	-8.6766			0.0034	
Diameter	0.2465	0.2390	0.0100	0.0000	0.0075	
Circularity	0.0037					
TP RFS	0.0090		0.0400			
Circle 87	[System 7]					
Center X	-16.4493	-16.4501			0.0008	
Center Y	-8.6764	-8.6766			0.0002	
Diameter	0.2408	0.2390	0.0100	0.0000	0.0018	
Circularity	0.0018					
TP RFS	0.0016		0.0400			
Circle 88	[System 7]					
Center X	-19.7962	-19.7897			-0.0065	
Center Y	-8.6842	-8.6766			-0.0076	
Diameter	0.2419	0.2390	0.0100	0.0000	0.0029	
Circularity	0.0020					
TP RFS	0.0200		0.0400			

Feature	Actual	Nominal	Plus (+)	Minus (-)	Dev/Nom	Out/Tol
Circle 89	[System 7]					
Center X	-23.1275	-23.1294			0.0019	
Center Y	-8.6735	-8.6766			0.0031	
Diameter	0.2402	0.2390	0.0100	0.0000	0.0012	
Circularity	0.0065					
TP RFS	0.0072		0.0400			
Circle 90	[System 7]					
Center X	-26.4584	-26.4690			0.0106	
Center Y	-8.6745	-8.6766			0.0021	
Diameter	0.2443	0.2390	0.0100	0.0000	0.0053	
Circularity	0.0042					
TP RFS	0.0216		0.0400			
Circle 91	[System 7]					
Center X	-29.8089	-29.8087			-0.0002	
Center Y	-8.6676	-8.6766			0.0090	
Diameter	0.2404	0.2390	0.0100	0.0000	0.0014	
Circularity	0.0023					
TP RFS	0.0179		0.0400			
Circle 92	[System 7]					
Center X	-33.1458	-33.1484			0.0026	
Center Y	-8.6665	-8.6766			0.0101	
Diameter	0.2391	0.2390	0.0100	0.0000	0.0001	
Circularity	0.0048					
TP RFS	0.0208		0.0400			
Circle 93	[System 7]					
Center X	-36.4831	-36.4880			0.0049	
Center Y	-8.6680	-8.6766			0.0086	
Diameter	0.2391	0.2390	0.0100	0.0000	0.0001	
Circularity	0.0025					
TP RFS	0.0198		0.0400			
Circle 94	[System 7]					
Center X	-39.8124	-39.8277			0.0153	
Center Y	-8.6730	-8.6766			0.0036	
Diameter	0.2391	0.2390	0.0100	0.0000	0.0001	
Circularity	0.0034					
TP RFS	0.0314		0.0400			
Circle 95	[System 7]					
Center X	-43.1560	-43.1673			0.0113	
Center Y	-8.6643	-8.6766			0.0123	
Diameter	0.2415	0.2390	0.0100	0.0000	0.0025	
Circularity	0.0037					
TP RFS	0.0334		0.0400			

CARL ZEISS - IMT, 3D-MEASURING PROGRAM

No. TASK	REM	SY	ACTUAL	NOMINAL	UPPERTOL	LOWERTOL	DEVIATION	OVER
1 PLANE		X	0.0000					
		Y	0.0000					
		Z	0.0001					
		AR	-123.1535					
		AI	0.0030					
		Di	0.0001					
		F1	0.0027			+0.0030		91%
2 PARALLEL		Pa	0.0023		+0.0030			76%
3 POINT		Z	1.8366	1.8322	+0.0200	+0.0000		-56%
4 POINT		Z	1.8360					
5 POINT		Z	1.8360					
6 POINT		Z	1.8360					
7 POINT		Z	1.8363					
8 POINT		Z	1.8362					
9 POINT		Z	1.8363					
10 POINT		Z	1.8364					
11 DISTANCE		Di	1.0377	1.0375	+1.0000	+0.0000		-90%
12 DISTANCE		Di	1.0357	1.0375	+1.0000	+0.0000		-96%
13 POINT		Y	4.5343	4.5000	+1.0000	+0.0000		-93%
14 POINT		Y	-4.5425	-4.5000	+0.0000	-1.0000		91%
15 POINT		Y	4.5164	4.5000	+1.0000	+0.0000		-97%
16 POINT		Y	-4.5568	4.5000	+1.0000	+0.0000		-89%



SPIRE - 300mK PMW-FS filter stack

End Item Data Package (EIDP)

SPIRE - 300mK PMW-FS filter stack

SPIRE Ref.: SPIRE-UCF-
Cardiff Ref.: HSO-CDF-EIDP-084 Issue 1.0
1 September 2004

Prepared by: Peter Hargrave

SPIRE Technical Manager



Digitally signed by Peter Hargrave
DN: cn=Peter Hargrave, o=Cardiff University, ou=Astronomy Instrumentation, c=GB
Date: 2004.09.01 12:26:35 +01'00'

Approved by: Carole Tucker

Cardiff Filter Manager



Carole Tucker

Digitally signed by Carole Tucker
DN: cn=Carole Tucker, o=Cardiff University, c=GB
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Ian Walker

Cardiff SPIRE/HFI Programme Manager



Ian Walker

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Distribution list

JPL	James Bock	RAL	Eric Sawyer
	Hien Nguyen		Eric Clark
	Martin Herman		Judy Long
	Mark Weilert		Bruce Swinyard
Cardiff	Carole Tucker		
	Peter Ade		
	Matt Griffin		
	Ian Walker		

Change Record

Issue	Section	Date	Changes
1.0		31 st August 2004	First Issue after DRB approval

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	X	
12	Copies of Waivers	X	
13	Operational Manual		
14	Historical Record	X	
15	Logbook / Diary of Events	X	
16	Operating Time / Cycle Record		
17	Connector Mating Record		
18	Age Sensitive Items Record	X	
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	X	

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

SECTION 01 - Shipping Documents

Labelling on box:-

Instructions to FedEx – Important!

At LAX, please handover to:-

PackAir Airfreight INC.,
5510 West 104 St.,
Los Angeles CA90045
USA

Power of Attorney - Roger Bachar
Telephone (310) 342 6051



Figure 1 PMW FS filter stack prior to shipping to JPL.

DRB Minutes of meeting

Minutes of SPIRE PMW FS 300-mK filter stack Cardiff, August 31 2004

Present: Matt Griffin (chair), Pete Hargrave, Peter Ade, Carole Tucker, Ian Walker, Melanie Whitehead

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DRB scope and objectives

- Review subsystem documentation, qualification and performance status of 300-mK filter stack to be sent to JPL for incorporation into the PMW FS BDA
- Performance review will include assessment of the overall performance of the filter stack
- Formal acceptance of the hardware

List of relevant documents and status

- 300mK_PMW_FS_HSO-CDF-EIDP-084_pre-DRB.pdf and relevant docs, to which it refers

EIDP run-through (300mK_PMW_FS_HSO-CDF-EIDP-084_pre-DRB.pdf)

- Section 4 Page 9: Spectral behaviour is “in and near band” and status changed to say compliant with approved waiver HSO-CDF-RFW-063.
- Section 4 Page 9: Out of band spectral behaviour: Add note that samples of the filter material will be kept for future tests if needed.
- Section 4 Page 9: Cleanliness inspection should refer to UWC-Filters Database (Hundred Acre Wood mdb) reference W872.
- Section 4 Page 9: Inspection for surface defects should refer to UWC-Filters Database (Hundred Acre Wood mdb) reference W872.
- Section 4 Page 9: Pre-bake out: Change Filters Log-book to UWC-PCH-SPIRE Filters Log-book.
- Note: For other filters already reviewed the equivalent notes should be made.

H:\Cardiff_workpackages\Deliverables\Shipped\Filters\FS-300mK-filters\FS-PMW-stack\300mK_PMW_FS_HSO-CDF-EIDP-084.doc	SPIRE - 300mK PMW-FS filter stack End Item Data Package (EIDP)	Page 8 of 39
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- Action: Pete to update PFM Filters EIDP (already reviewed but not yet issued). Issue a short note to be inserted by RAL in the JPL BDA EIDPs already issued.
- Compliance matrix: OK
- Section 5: Note to be added stating that the FS mechanical design is identical to that for the PFM, so that the drawing numbers are the same as for the PFM EIDP.
- ICD has been formally approved by JPL via an e-mail from Mark Weilert
- Action: Pete to attach the said e-mail to the ICD and re-issue
- Filt-CQM/PFM-200-01.004 has an error in the title: Should say “300-mK filter” instead of “300-mK Filter Lower Ring”)
- Action: Pete to get Brian Kiernan to correct and re-issue the drawing for the final version of the EIDP.
- Section 14: Historical record
 - T0418rX – correct number to be inserted instead of X
 - Last line: To be shipped to JPL not RAL; actual shipping date to be inserted
- Section 20: Calibration data record
 - Filter transmission (P. 26) is clearly compatible with the overall requirements on the filter chain – transition > 95% over the relevant range
 - Figures 8 and 9 P. 27 and P. 28 will be superseded when the rest of the chain is reviewed – to be deleted from this EIDP
- Section 22: Note to be added that samples will be securely stored and will be available for performance characterisation if required.
- Section 25: Test reports
 - Note that bake-out was not carried out after each individual cycle to 77 K. This is deemed acceptable by Pete and Carole.
 - Action: Carole to provide a test report based on the one already produced for the beam dividers to go in this section in replacement of the current contents.
- Section 27: Add note that this EIDP will be incorporated into the JPL PMW FS EIDP
- Section 29: Remove ‘tested’ from the cleanliness statement, as testing environment detailed under Extra Information.
- Section 30: Some better pictures to be added if possible.

Estimated performance of complete FS filter chain

- To be reviewed when the instrument filters EIDP is reviewed.
- This component is deemed to be compatible with the requirements

DRB checklist

- See Section 8 below

Conclusions and summary of outstanding work

- This unit is deemed acceptable as flight-standard hardware, and may be shipped to JPL for incorporation into the FS PMW array
- The minor changes to the EIDP noted above should be implemented in the final version of the EIDP to be shipped with the unit.

Summary of actions

Date and No.	Action	Responsible	Due date	Status
31 Aug. 1	Attach e-mail from Mark Weilert approving the ICD to the ICD and re-issue	Pete	02/09/04	
31 Aug. 2	Arrange for Brian Kiernan to correct and re-issue the drawing Filt-CQM/PFM-200-01.004 for the final version of the EIDP	Pete	02/09/04	
31 Aug. 3	Provide a test report based on the one already produced for the beam dividers to go in this section in replacement of the current contents	Carole	1 Sept.	

DRB Check-list (next page)

If all listed points are satisfactory then the item may be accepted. If not, the item may be accepted with the caveat that the requirement in question will be met within an agreed time scale.

No.	Record applicable answers and provide explanations in comment column	Yes/No/NA	Comments
1	Are all documents, drawings, etc. complete, approved, and under configuration control?	Yes	
2	Do the released items above reflect all approved changes?	Yes	
3	Is the hardware identical to other hardware delivered? If not provide difference list.	Yes in mechanical terms	Filter performance is slightly better than the PFM unit already delivered.
4	Does the hardware fulfil its functional requirements, specifications, RFWs, ICDs etc.?	Yes	
5	Does the As-built Configured Items List reflect hardware as delivered?	Yes	
6	Have all required environmental tests and analyses been completed?	Yes	
7	Are all the required test and qualification procedures and reports completed and available to review?	Yes	
8	Have all the Declared Lists, i.e. DML, DMPL, DPL and components (EEE Parts) list been released? (Need not necessarily be included in EIDP, but must be available)	No	DML complete DPL to be updated DMPL to be released
9	Have PADS been raised and approved where required?	N/A	
10	Are relevant Test Readiness Review (TRR) minutes and the Post Test Reviews (PTR) complete and available?	N/A	
11	EIDP check: Are all agreed sections of the EIDP complete? Record any anomalies.	Yes	

		Signature	Date
Ian Walker	Cardiff SPIRE PA manager		
Peter Hargrave	Cardiff SPIRE Technical Manager		
Carole Tucker	Cardiff Filter Manager		

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 PMW BDA (PFM or FS) 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:	FS	
Subsystem:	300mK PMW filter stack	
Serial No:	FILT-FS-240	
As described in this End Item Data Package: HSO-CDF-EIDP-084		
Complies with the requirements set out in: SPIRE-RAL-PRJ-000034 (Instrument requirements document)		
Responsible Authority	Signature	
Cardiff Filter Management	Prof P.A.R.Ade	 <small>Signature Not Verified</small>  <small>Digitally signed by Peter Ade Date: 2004.09.01 12:42:20 +01'00'</small>
	Dr C.E.Tucker	 <small>Signature Not Verified</small> Carole Tucker <small>Digitally signed by Carole Tucker DN: cn=Carole Tucker, o=Cardiff University, c=GB Date: 2004.09.01 12:39:25 +01'00'</small>
Cardiff Product Assurance	Dr I.Walker	 <small>Signature Not Verified</small> Ian Walker <small>Digitally signed by Ian Walker DN: cn=Ian Walker, c=GB Date: 2004.09.01 12:22:59 +01'00'</small>
Cardiff SPIRE Management	Dr P.Hargrave	 <small>Signature Not Verified</small>  <small>Digitally signed by Peter Hargrave DN: cn=Peter Hargrave, o=Cardiff University, ou=Astrophysics Instrumentation, c=GB Date: 2004.09.01 12:27:15 +01'00'</small>

SECTION 04 - Qualification Status List

Test	Status	Applicable document / Test reference	Test Institute
	FS-PMW - FILT-FS-240		
Spectral behaviour - In and near-band transmission	Tested at component and assembly level. Compliant with approved waiver (HSO-CDF-RFW-063).	HSO-CDF-SP-002-2.2 See historical record for test references	UWC
Spectral behaviour - out-of-band blocking, at $\lambda < 15\mu\text{m}$	Open test. Off-cuts of the filter material are securely stored, and may be measured to $15\mu\text{m}$ using the Bomen spectrometer if required.	HSO-CDF-SP-002-2.2 See historical record for test references	UWC
Dimension and tolerances to specification	Compliant	HSO-CDF-ICD-012-3.0	UWC
Filter flatness	Not applicable for this assembly	HSO-CDF-ICD-012-3.0	UWC
Inspection for surface defects	Passed	UWC Filters database "hundred_acre_wood.mdb" reference W872.	UWC
Mass	Compliant	HSO-CDF-ICD-012-3.0	
Thermal cycling (5 cycles 300K-77K-300K)	Passed	See historical record for test references	UWC
Cold vibration	Not tested at unit level, but qualified in SPIRE CQM cold vibration campaign	MSSL-Technote-SPIRE-26 SPIRE-RAL-REP-002007	MSSL/RAL – Cold vibration RAL – Post vibration inspection
Environmental condition - Vacuum $3 \times 10^{-1} \text{mBar}$	Passed	See historical record for test references	UWC
Differential pressure (a pumping-out rate of 10mB/sec)	Passed	See historical record for test references	UWC
Pre-bake out (not exceeding 80°C)	Passed	UWC PCH SPIRE Filters log-book	UWC
Outgassing	Test not performed. All materials used within ESA / NASA specifications		
Cleanliness checks, by visual inspection.	Passed	UWC Filters database "hundred_acre_wood.mdb" reference W872.	UWC
Degradation due to high energy radiation.	Not tested. Heritage from previous space missions (ISO, Cassini)		

Compliance Matrix

The PMW filter stack comprises the PFIL4M filter component only. This component is a higher frequency blocking filter, and the exact position of the edge is not important (see HSO-CDF-RFW-063). The edge position of PFIL4M has been selected to provide optimal overall stack transmission, taking into account all other preceding components in the SPIRE PMW filter channel.

The edge is defined by PDIC1 (not part of this EIDP).

Name	Location	Temp.	Filter type	Component Edges			Comments	Thickness (mm) HSO-CDF-ICD-012 Issue 3.0		Actual assembly thickness (mm)
				Trans.	Required	Actual		Component	Assembly	
					cm-1	cm-1				
PFIL4M	Over MW array	300 mK	Low-pass edge Blocker	90%	40.9	34.3	Blocker. Edge out of spec. – see HSO-CDF-RFW-063	0.275 ± 0.05	5.27±0.10	5.36±0.05
				50%	43.0	37.7				
				10%	45.2	38.7				

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

Although all drawings in this section have numbers of the form FILT-CQM/PFM-XXX-xx-xx, these are also the correct drawings for the flight spare model.

TOP LEVEL DRAWING LIST

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

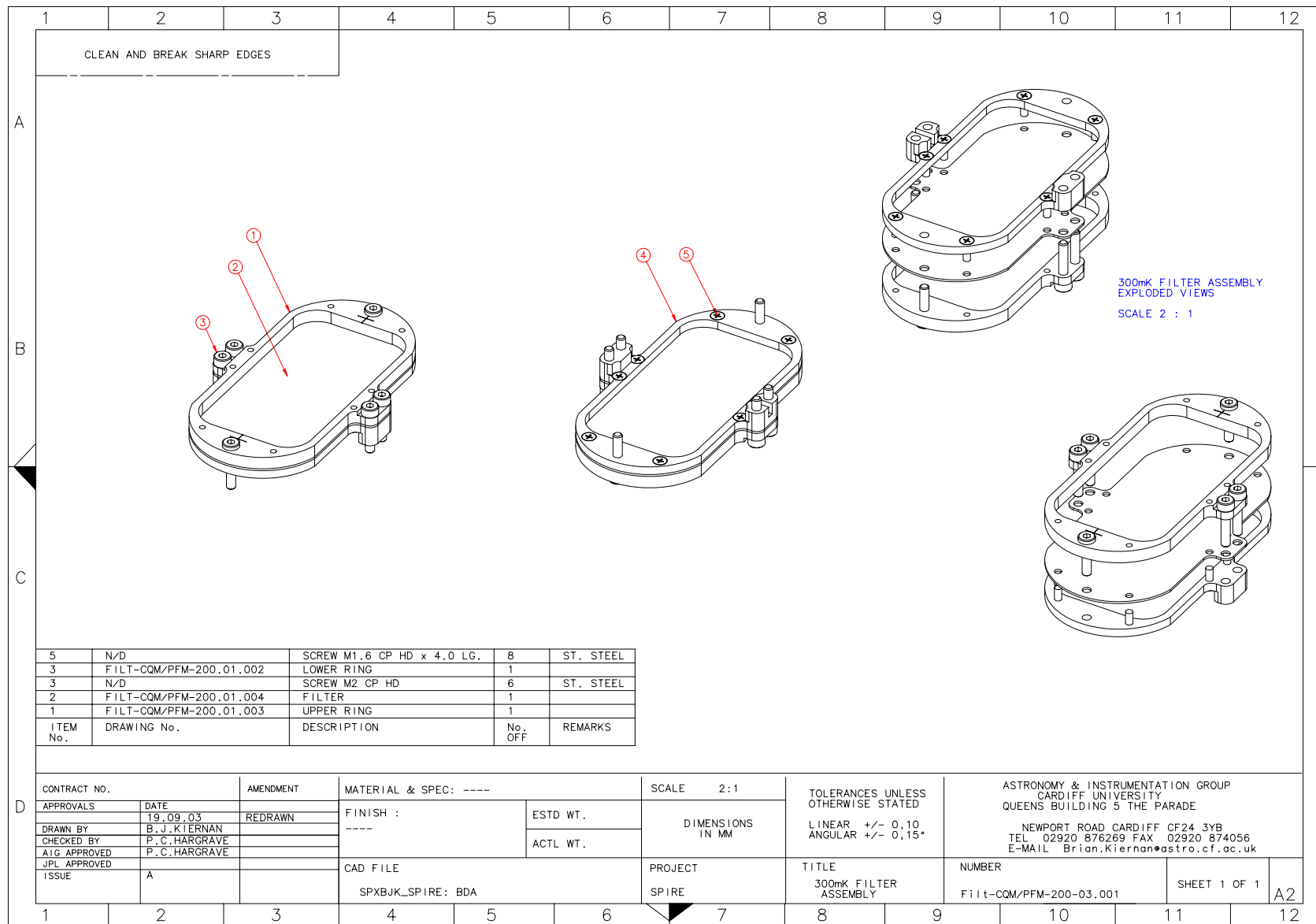


Figure 2 300mK filter stack assembly

SECTION 06 - Interface Drawings

INTERFACE DRAWING LIST

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

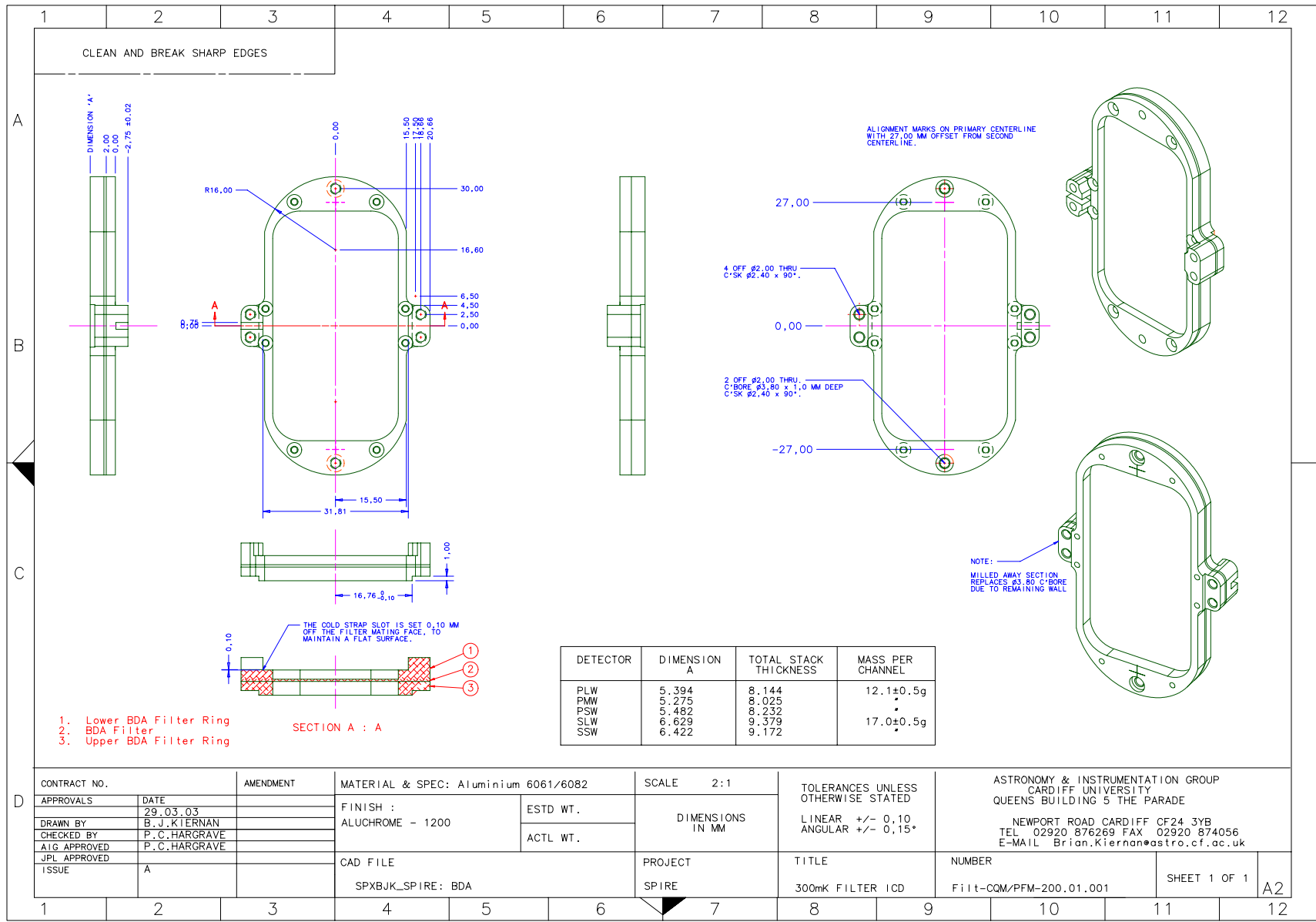


Figure 3 Interface drawing for 300mK filters

SECTION 07 - Functional, Block & Mechanical Drawings

Component drawings are given in this section.

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

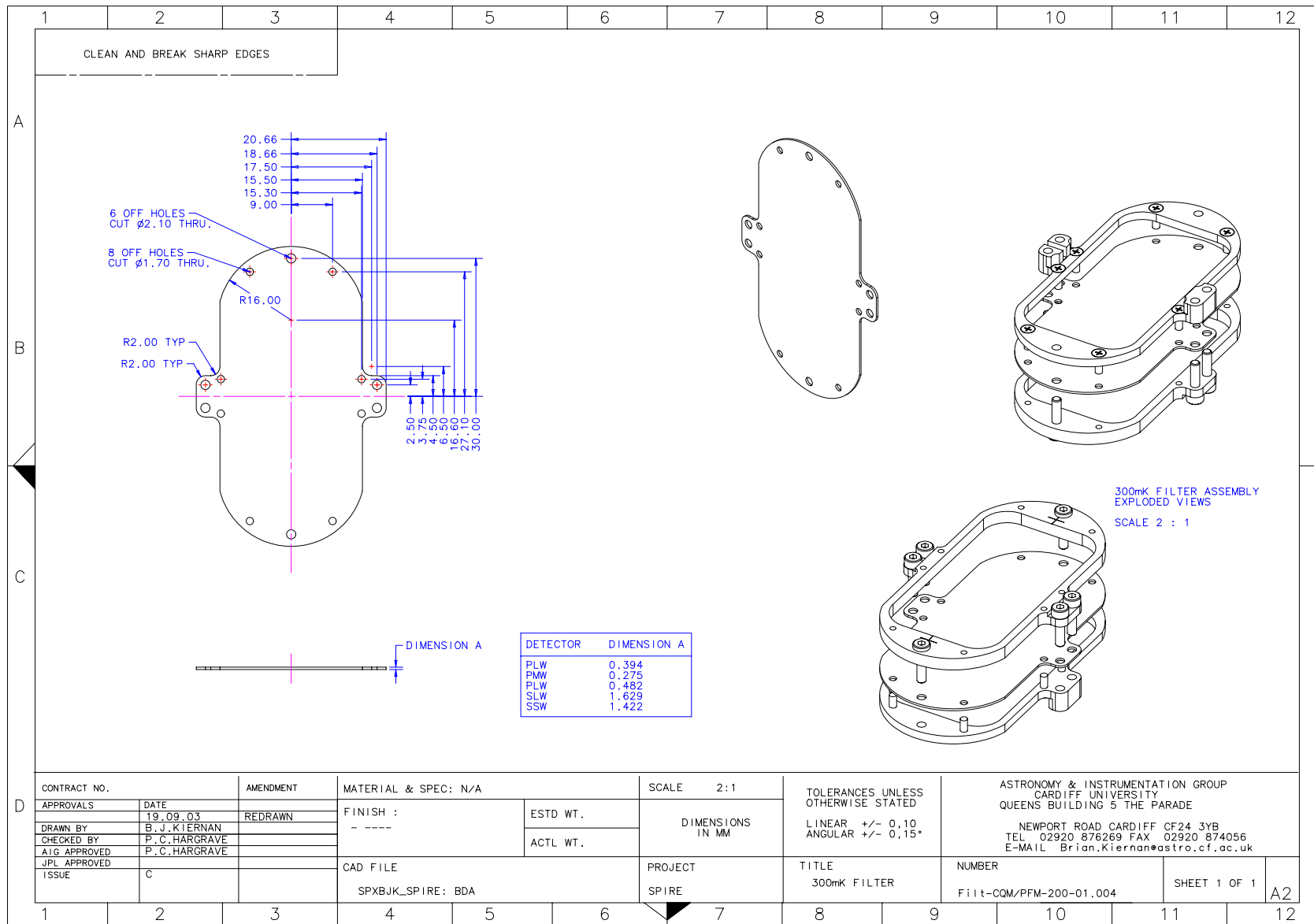


Figure 4 300mK Filter

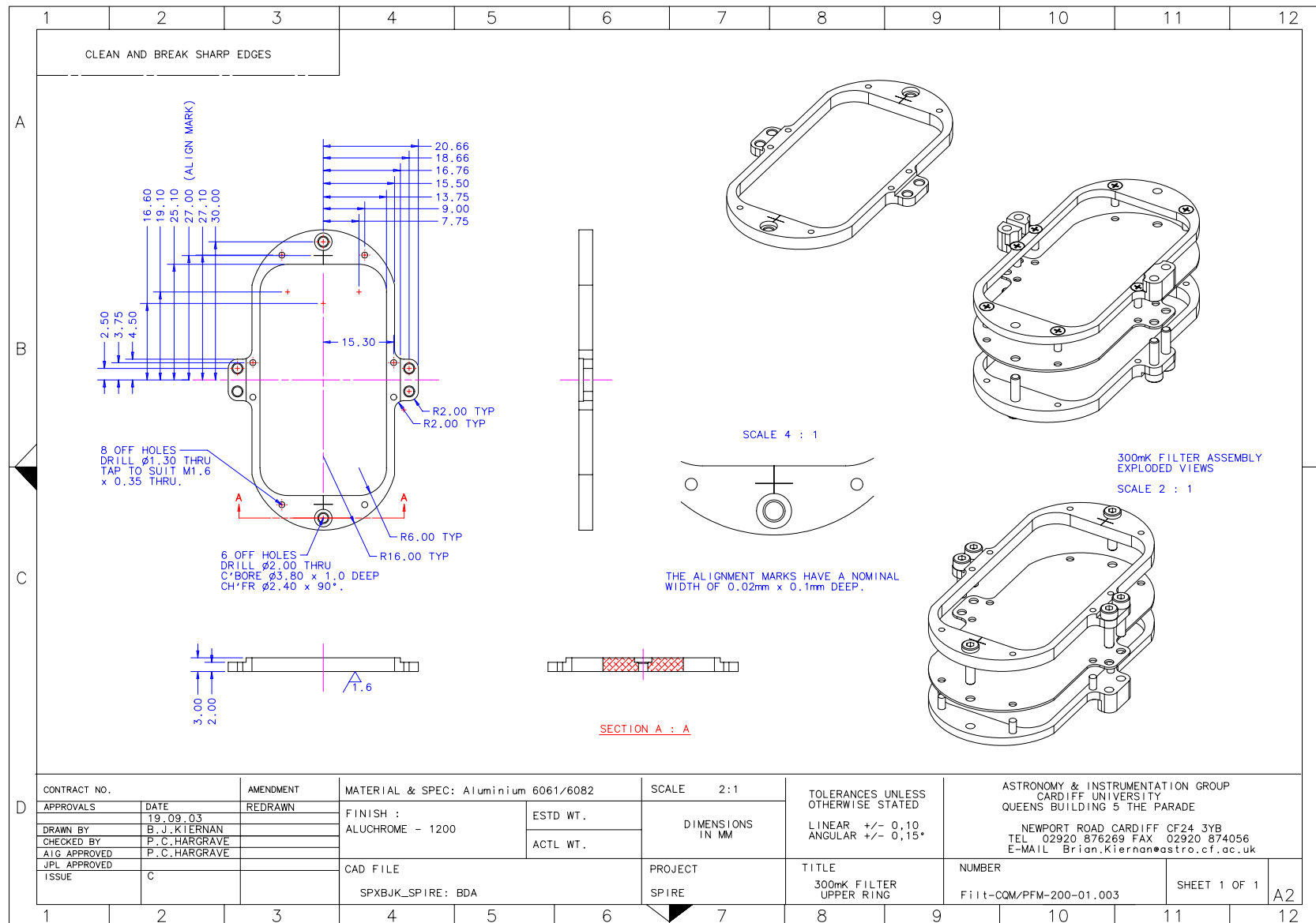


Figure 5 300mK Filter Upper Ring

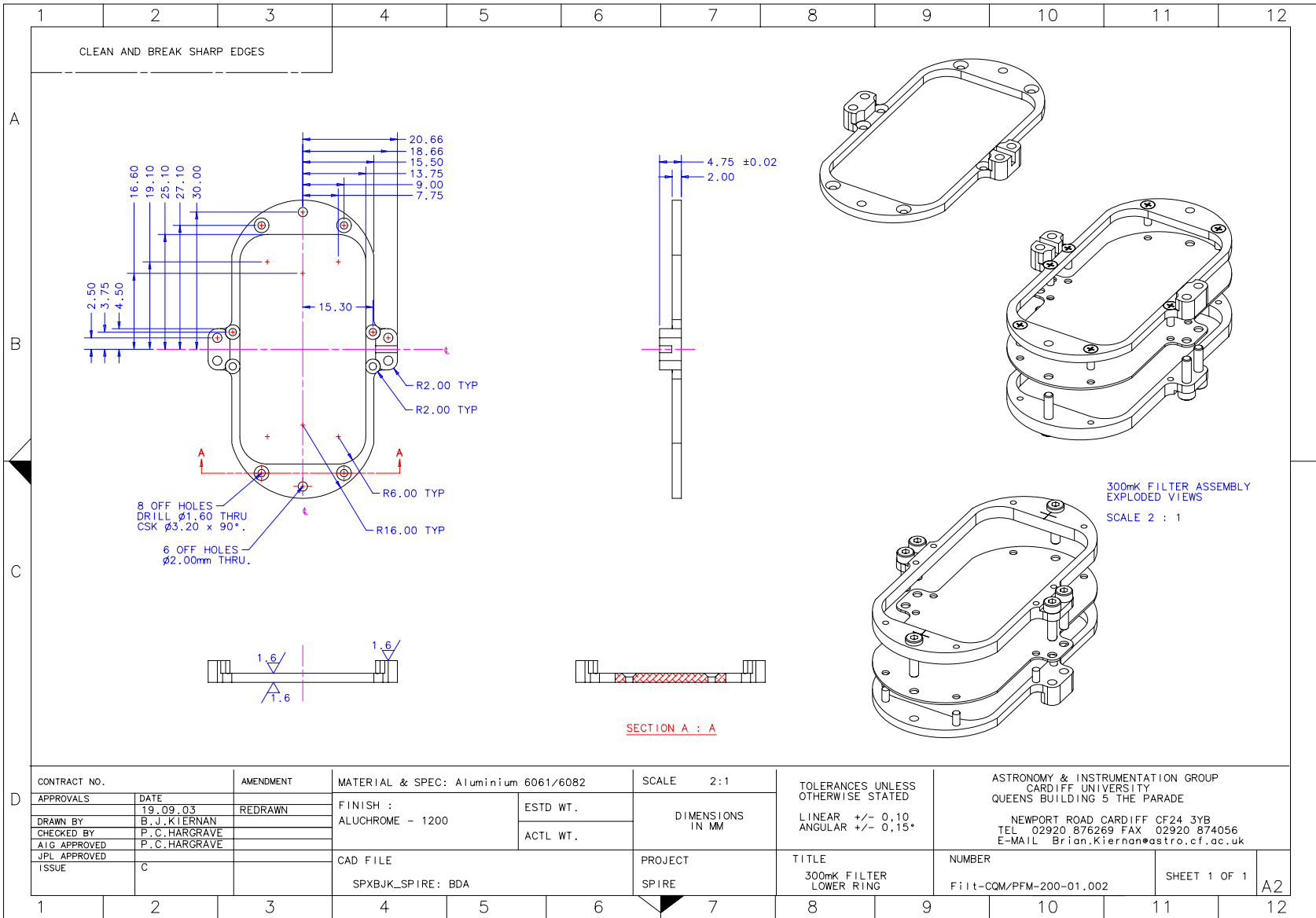


Figure 6 300mK Filter Lower Ring

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-240 Spectroscopic test data PMW-FS assembly		\\Darkstar\Astroworld\Projects\SPIRE\Cardiff_workpackages\Configured_Documents\Issued\Data\FILT-FS-240_FS_PMW_stack.xls	

Part number	Description	Details
FILT-FS-240	FS PMW FILTER ASSEMBLY	
FILT-FS-241	PMW FS lower filter ring	Aluminium-6082 – Aluchrom 1200 coated
FILT-FS-242	PMW FS upper filter ring	Aluminium-6082 – Aluchrom 1200 coated
FILT-FS-243	PFIL4M – FS – W872 filter	43 cm ⁻¹ LPE blocking filter


SECTION 11 - List of Waivers

HSO-CDF-RFW-063	SPIRE PFM Blocking Filters RFW	Closed
-----------------	--------------------------------	--------

SECTION 12 - Copies of Waivers

	REQUEST FOR WAIVER / DEVIATION (RFW/RFD)	PRODUCT ASSURANCE Space Science and Technology Department
	RFW/RFD Number: <u>HR-SP-CDF-RFW-XXX</u> , HSO-CDF-RFW-063	

RFW/RFD Number:	<u>HR-SP-CDF-RFW-XXX</u> , HSO-CDF-RFW-063
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Spacecraft / Project	HERSCHEL	Originator's Name	Peter Hargrave
System / Experiment / Model	SPiRE-PFM	Signature / Date	
Sub-System	Filters	Request Type (Highlight applicable request)	Waiver (RFW) Deviation (RFD)
Assembly		Organisation	Cardiff University
Sub-Assembly		Ref. Doc. / Drwg No.	
Item	All flight model blocking filters	References	
Serial No.			
RFW/RFD Title	Request for waiver against blocking filter edges		


End Item(s) Affected (Hardware, Software)				
Name	CI-Number	Model(s)		
SPiRE PFM blocking filters		Flight		
Requirement / Interface Documents Affected				
Specification/Drawing Title	Number	Issue	Date	App. Paragraph
Filters specification document	HSO-CDF-SP-002	2.2	29/10/02	3.2 table 1 3.3 table 2

Description of Deviation / Discrepancy / Non-Conformance
 This note requests a waiver on the nominal edge positions for the flight model instrument blocking filters.

Other Items or Requirements (Potentially) Affected
 None

Need for RFW/RFD and Rationale for Acceptance
 The flight blocking filters have been tuned in such a way as to optimise the in-band transmission and out-of-band rejection for each SPiRE band. This means that the actual edge positions are not exactly as stated in HSO-CDF-SP-002 (filters spec. document). This is not important, as the band edges are defined by edge defining filters, which are all exactly to specification, and are not included in this request for waiver.
 The differences in edge position are summarised in Table 1.
 Informal MRB held by Eric Sawyer & Bruce Swinyard. 11th August 2004 This RFW is accepted / agreed by SPiRE PROJECT, No Agreement required from Industry or Customer.

	Approved	Rejected	Name	Date
Engineering:			Bruce Swinyard	
Product Assurance:			Eric Clark	
CCB-Chairman:				
Principle Investigator				
Product Assurance:				
Co-Investigator				
Prime Contractor				
ESA Project Office				

	REQUEST FOR WAIVER / DEVIATION (RFW/RFD)	PRODUCT ASSURANCE Space Science and Technology Department
	RFW/RFD Number: <u>HR-SP-CDF-RFW-XXX</u> , HSO-CDF-RFW-063	

RFW/RFD Number:	<u>HR-SP-CDF-RFW-XXX</u> , HSO-CDF-RFW-063
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Table 1 Comparison of nominal edges as stated in HSO-CDF-SP-002 with actual PFM blocker edge positions.

Name	Filter type	Edges			Function		Comments	PFM filter performance			Difference from specification
		Trans	cm-1	µm	T = Transmit			Trans	cm-1	µm	
					B = Block;	R = Reflect					
CFIL1	Low-pass edge	90%	60.0	166.7	T	15 - 50 cm-1	Thermal blocker. Common to Photometer and FTS.	90%	71.0	140.8	11.0
		50%	100.0	100.0		666.7 - 200 µm		50%	95.0	105.3	-5.0
		10%	105.0	95.2	B	110.0 - UV cm-1 90.91 - UV µm		10%	98.0	102.0	-7.0
PFIL2	Low-pass edge	90%	60.0	166.7	T	15 - 50 cm-1	Thermal blocker.	90%	71.5	139.9	11.5
		50%	90.0	111.1		666.7 - 200 µm		50%	84.5	118.3	-5.5
		10%	94.5	105.8	B	99.5 - UV cm-1 100.5 - UV µm		10%	86.8	115.2	-7.7
PFIL3	Low-pass edge	90%	57.0	175.4	T	15 - 50 cm-1	Thermal blocker.	90%	50.2	199.2	-6.8
		50%	60.0	166.7		666.7 - 200 µm		50%	55.3	180.8	-4.7
		10%	63.0	158.7	B	68.0 - UV cm-1 147.1 - UV µm		10%	56.9	175.7	-6.1
SFIL2	Low-pass edge	90%	60.0	166.7	T	15 - 50 cm-1	Thermal blocker. Identical to PFIL2.	90%	66.9	149.5	6.9
		50%	90.0	111.1		666.7 - 200 µm		50%	89.0	112.4	-1.0
		10%	94.5	105.8	B	100 - UV cm-1 100 - UV µm		10%	91.0	109.9	-3.5
SFIL3S	Low-pass edge	90%	66.5	150.4	T	31.2 - 51.3 cm-1	Blocker	90%	59.1	169.2	-7.4
		50%	70.0	142.9		320.5 - 195 µm		50%	63.9	156.5	-6.1
		10%	73.5	136.1	B	78.5 - UV cm-1 127.4 - UV µm		10%	65.8	152.0	-7.7
SFIL3L	Low-pass edge	90%	57.0	175.4	T	14.9 - 66.5 cm-1	Blocker	90%	47.8	209.2	-9.2
		50%	60.0	166.7		671.1 - 150 µm		50%	66.4	150.6	6.4
		10%	63.0	158.7	B	68.0 - UV cm-1 147.1 - UV µm		10%	68.2	146.6	5.2

SECTION 13 - Operations Manual

No operating manual is supplied.

SECTION 14 - Historical Record

The following table contains *brief* historical details of the manufacture, assembly and testing of the FS 300mK PMW filter assembly, 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.

PMW FS filter stack

Date	Action	UWC Test reference
07/04/04	Filter W872 manufactured in class 1000 clean room	W872
15/04/04	Filter W872 spectroscopically tested in the range 10-140cm ⁻¹	T0308r7
09/08/04	Filter W872 cut to PFIL4M drawing	
11/08/04	FS-PFIL4M spectroscopically tested in the range 10-140cm ⁻¹ in 2 positions.	T0405r39, T0405r42
16/08/04	FS-PFIL4M spectroscopically tested in the range 10-140cm ⁻¹ in 2 positions.	T0408r10, T0408r13
23/08/04	FS-PFIL4M filter thermally cycled 3 x (300K-77K-300K)	THERM 0192
23/08/04	FS-PFIL4M spectroscopically tested in the range 10-140cm ⁻¹ in 2 positions.	T0414r21, T0414r24
26/08/04	FS-PFIL4M spectroscopically tested in the range 5-40cm ⁻¹	T0418r4
26/08/04	FS- PFIL4M mounted	
27/08/04	FS- PFIL4M stack final clean	
27/08/04	FS- PFIL4M baked for 17hrs at 350K	
01/09/04	FS- PFIL4M shipped to JPL	

SECTION 15 - Logbook / Diary of Events

Not provided – available from subsystem provider upon request.
Cardiff log-book, labelled “Cardiff SPIRE filters Log-book”, will be stored in a secure archive.

SECTION 16 - Operating Time / Cycle Record

See historical record.

SECTION 20 - Calibration Data Record

The recommended 300mK filter transmission for the PMW channel to be used for calibration purposes is indicated in this section.

This trace is composed of data measured over the ranges $0-40\text{cm}^{-1}$ and $0-140\text{cm}^{-1}$.

These are the measured transmission spectra prior to final cleaning and packing.

The raw data is stored in the \\Darkstar\Astroworld\Projects\SPIRE\Cardiff_workpackages\Configured_Documents\Issued\Data\FILT-FS-240_FS_PMW_stack.xls (Microsoft Excel workbook). This file is available from Cardiff, and is under configuration control on Livelink (managed by RAL).

Calibration data for all SPIRE flight model filters may be found in the file

\\Darkstar\Astroworld\Projects\SPIRE\Cardiff_workpackages\Configured_documents\Issued\ Data\ PFM-filters-summary.xls

PFIL4 FS (FILT-FS-240)

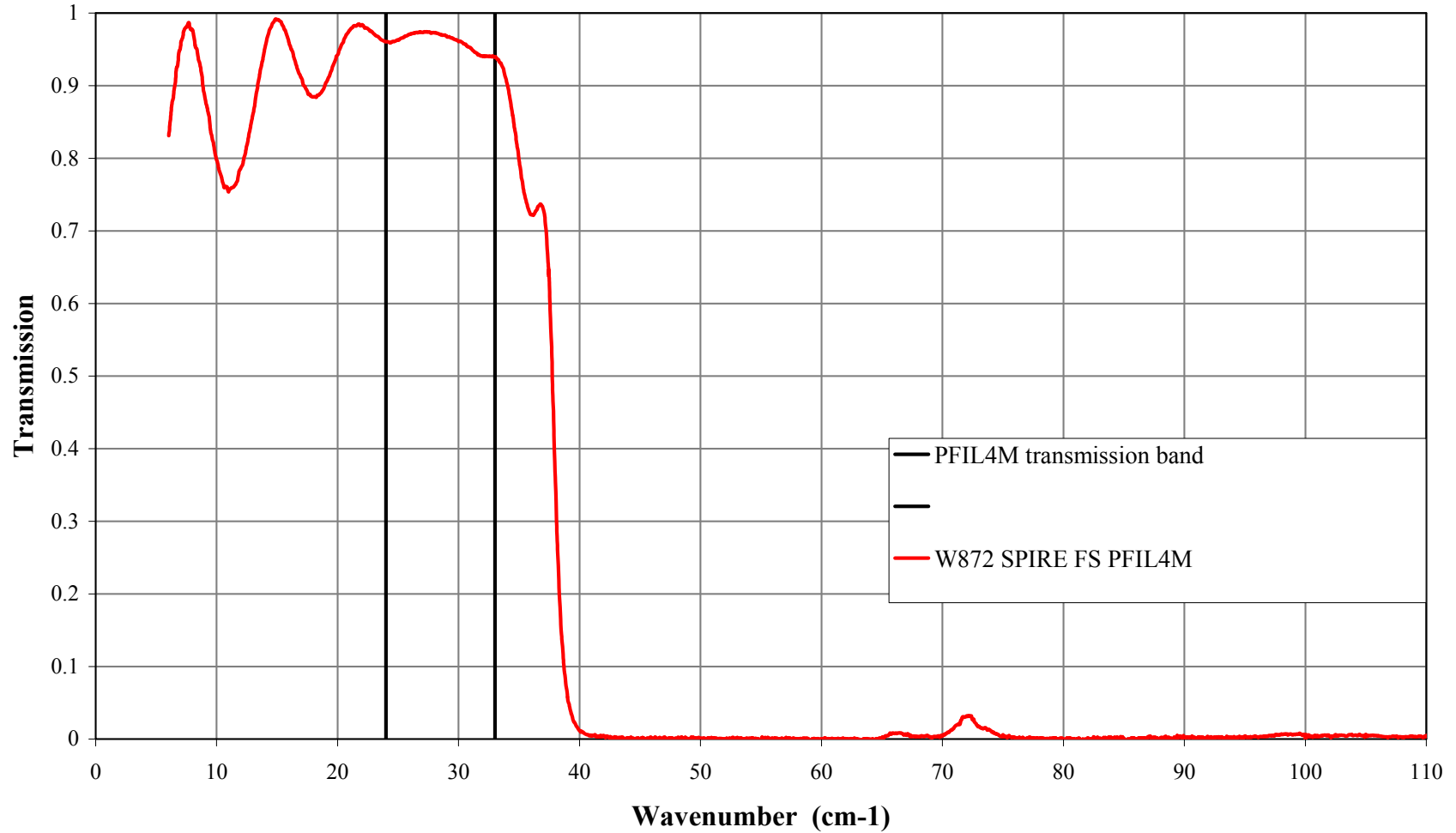


Figure 7 Spectroscopic data for FS-PMW stack

SECTION 21 – Temporary Installation Record

See historical record.

SECTION 22 - Open Work / Deferred Work / Open Tests

Off-cuts of the filter material are securely stored, and may be measured to 15µm using the Bomen spectrometer if required.

SECTION 23 - List of Non-Conformance Reports

None

SECTION 24 - Copies of Non-Conformance Reports

None

SECTION 25 - Test Reports

SPIRE FS PFIL4M test report - CT 31st August 2004

1 Visible inspection

As standard practice, each filter element is checked individually for pattern geometry and defects under an optical microscope, following the procedures laid out in the UWC internal document "UWC_Filter_production_PA_V2.0.doc".

The assembled filter then undergoes a series of optical, thermal and mechanical tests.

2 Optical measurements

The FIR spectral tests were carried out at UWC, using two Martin-Puplett polarizing Fourier transform interferometers. These instruments allow spectral evaluation from 2 to 650 cm⁻¹, using a series of in-house detectors.

The as-manufactured, unmounted, uncut PFIL4M filter was spectrally tested in- and near-band, following the standard FTS procedures of UWC.

Once the component was machined to PFIL4M drawing, measurements were made in transmission at two extreme locations, as a test for uniformity.

Following thermal cycling tests and mounting, PFIL4M was spectrally re-tested at two locations in one frequency range to verify component integrity.

3 Thermal tests

3.1 Thermal shock

Thermal shocking of the hot-pressed filter (W872) prior to cutting and mounting was performed using a liquid nitrogen bath. This cycle (300K - 77K - 300K) was performed 5 times. All spectroscopic measurements made thereafter verified no filter de-lamination or degradation.

(If any part of a filter is seen to de-laminate, or show any other signs of weakness, it is rejected and the component remade).

3.2 Thermal cycling

Once machined, PFIL4M underwent a more controlled thermal cycle 3x(300K - 77K - 300K). The component showed no signs of degradation.

4 Mechanical tests

During the evacuating of the Martin-Puplett FTS, the filter has been subjected to a differential pressure rate of change of at least 10mB/sec.

PFIL4M has been taken to a vacuum pressure of 0.5mbar, within the FTS, on at least 8 separate occasions.

The component PFIL4M has been cleaned using an ultrasonic acetone bath.

The component PFIL4M has been vacuum baked at 350 K for 17 hours with no signs of degradation.

PMW FS (FILT-FS-240) Uniformity

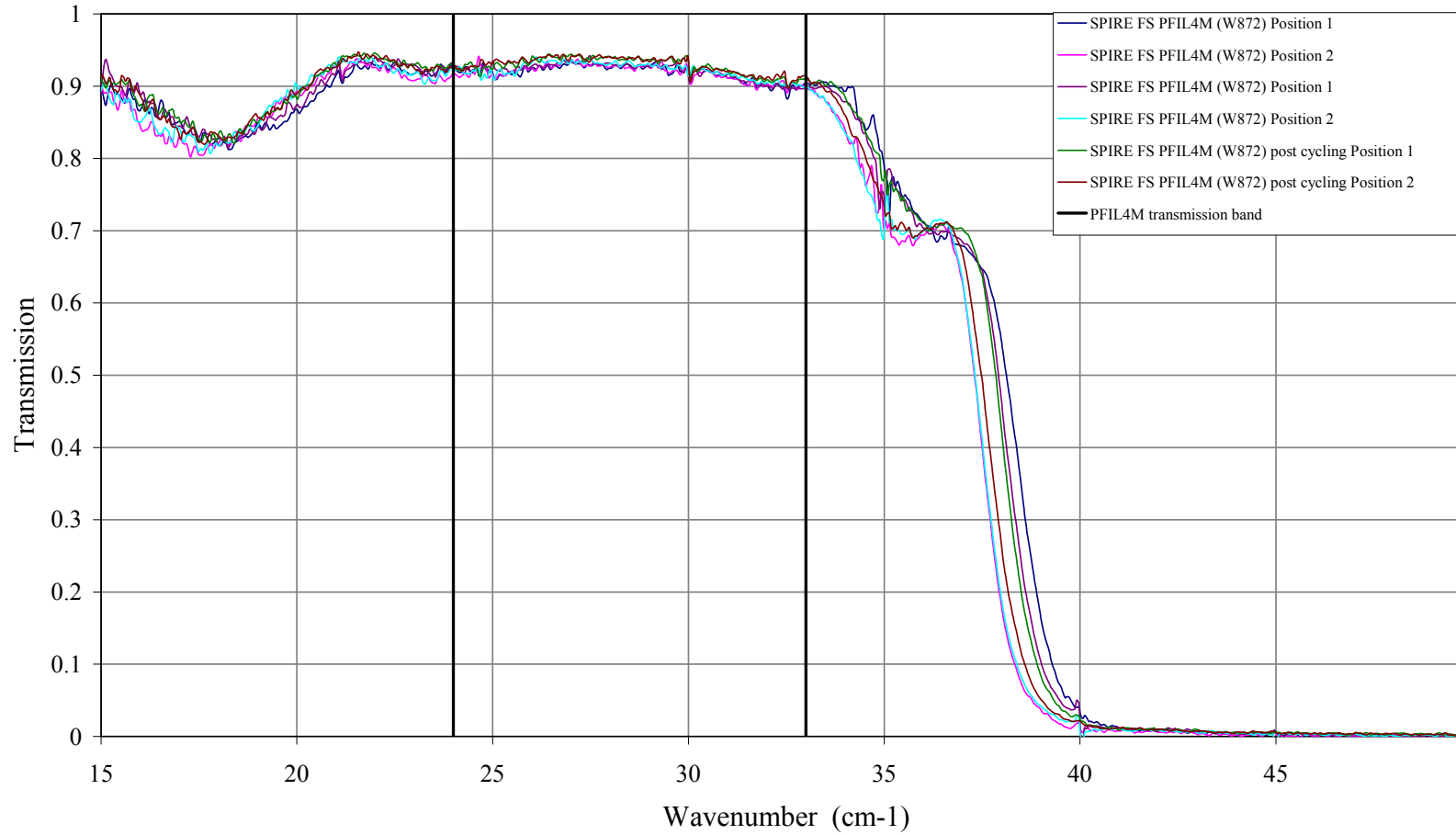


Figure 8 FS PMW stack uniformity.

SECTION 27 - Reference List of EIDP's

This EIDP will become an annex to the JPL FS PMW BDA.

Associated

<u>Title</u> (Listed in alphabetical order)	<u>ID</u> (Serial No.)	<u>Acronym</u>	<u>Document No.</u>	<u>Issue</u>	<u>Date</u>
PMW BDA PFM /FS EIDP					

Lower Level

<u>Title</u> (Listed in alphabetical order)	<u>ID</u> (Serial No.)	<u>Acronym</u>	<u>Document No.</u>	<u>Issue</u>	<u>Date</u>

SECTION 28 - Mass Records

Assembly	Final measured mass
FILT-FS-240 – FS PMW assembly	8.5 ± 0.1 g

SECTION 29 - Cleanliness Statement

Statement

The FS 300mK PMW filter assembly (FILT-FS-240) has been cleaned and assembled within a class 1000 clean room to meet the requirements of the Cardiff PA plan (HSO-CDF-PL-007).

SignedPeter Hargrave, Technical Manager, Cardiff-SPIRE deliverables

SignedCarole Tucker, Cardiff Filter Production Manager

SignedIan Walker, Programme Manager, Cardiff AIG.

Date31st August 2004

Extra Information

The manufacture of these filter elements took place within a class 1000 clean-room, following the procedures laid out in the UWC document, "UWC Filter Fabrication Procedures.doc". Although filter testing took place within a standard laboratory environment, the mounted filters were subsequently cleaned (using acetone and a de-ionised air-gun), in a class 100 laminar flow cabinet, prior to packaging.

H:\Cardiff_workpackages\Deliverables\Shipped\Filters\FS-300mK-filters\FS-PMW-stack\300mK_PMW_FS_HSO-CDF-EIDP-084.doc	SPIRE - 300mK PMW-FS filter stack End Item Data Package (EIDP)	Page 37 of 39
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SECTION 30 - Other Useful Information



Figure 9 Photographs of the FS PMW assembly prior to shipping

SECTION 31 - DPL/DML

Refer to the Cardiff-SPIRE PFM deliverables lists.

Cardiff-SPIRE-DML	HSO-CDF-LI-074
Cardiff-SPIRE-DMPL	HSO-CDF-LI-075
Cardiff-SPIRE-DPL	HSO-CDF-LI-076

SECTION 32 – List of Appendices/Attachments

<u>Appendix #</u>	<u>Title</u> (Listed in alphabetical order)	<u>Document No.</u>	<u>Issue</u>	<u>Date</u>	<u>Notes</u>