
CONSERT - Antenna on Rosetta S/C

Thermal Vacuum Test Report of the Consert Orbiter Antenna STM

RO-OCN-TR-3006

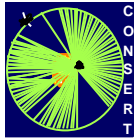
Issue: 1

Revision: -

29.07.1999

Prepared by:

W.Boogaerts / H.Perplies



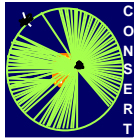
Approval Sheet

prepared by: *W.Boogaerts / H.Perplies* (signature/date)

approved by technical department: *H. Perplies* (signature/date)

approved by Consert-Management: *Dr. Nielsen* (signature/date)

approved by QA/PA : *W.Boogaerts* (signature/date)



CONSERT - Antenna

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Document Change Record

Iss./Rev.	Date	Pages affected	Description
1 / -	29.07.1999	all	

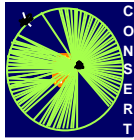
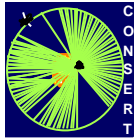


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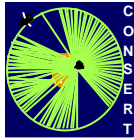
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1 General

1.1 Introduction

This test report describes the thermal vacuum test of the STM CONSERT Orbiter-Antenna. The test has been performed according to the 'Thermal Vacuum Test Procedure of the Consert-Antenna STM' RO-OCN-PR-3006.

1.2 Applicable Documents

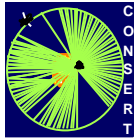
Table 1: Applicable Documents

No.	Document Name	Document Number	Iss./Rev.
AD1	Consert Antenna Mechanical Interface	RO-OCN-DW-3001	
AD2	thermal vacuum chamber short description		

1.3 Reference Documents

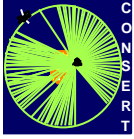
Table 2: Reference Documents

No.	Document Name	Document Number	Iss./Rev.
RD1	EIDA	RO-EST-RS-3001	1/1
RD2	EIDB	RO-EST-RS-3007	1/0
RD3	EIDC	RO-EST-RS-3001	
RD6	ECSS-10-03	Testing Procedures	Draft



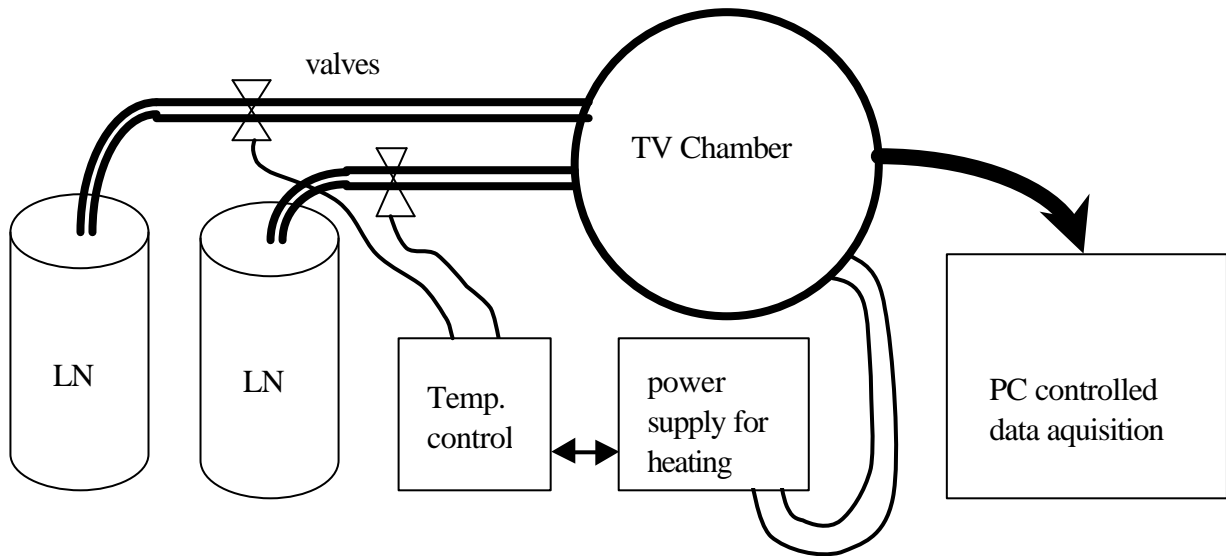
1.4 Acronyms

MPAe	Max-Planck-Institut für Aeronomie
STM	Structural and Thermal Model
TV Chamber	Thermal Vacuum Chamber
AD	Applicable Documents
RD	Reference Documents
TB	Thermal Box
LN	Liquid Nitrogen
DUT	Device under Test
PID	Proportional – Integral – Differential



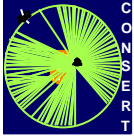
2 Test Arrangement

Fig. 1 principle arrangement

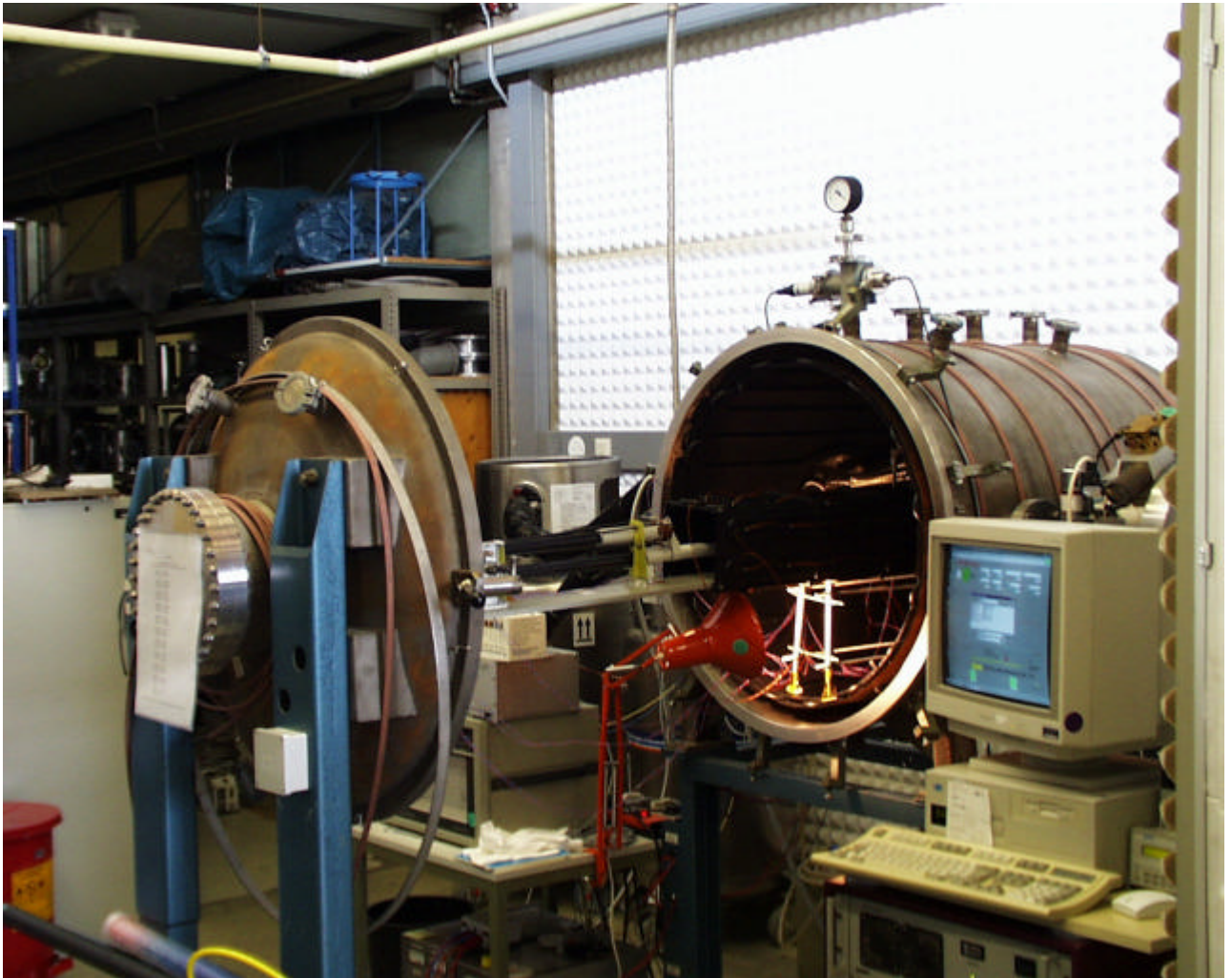


LN Liquid nitrogen container

The cooling and heating of the DUT inside the TV-Chamber is performed by a PID Temperature control unit. The data are gathered by LabView® from National Instruments.



pict. 1. TV-Chamber with test equipment



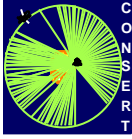
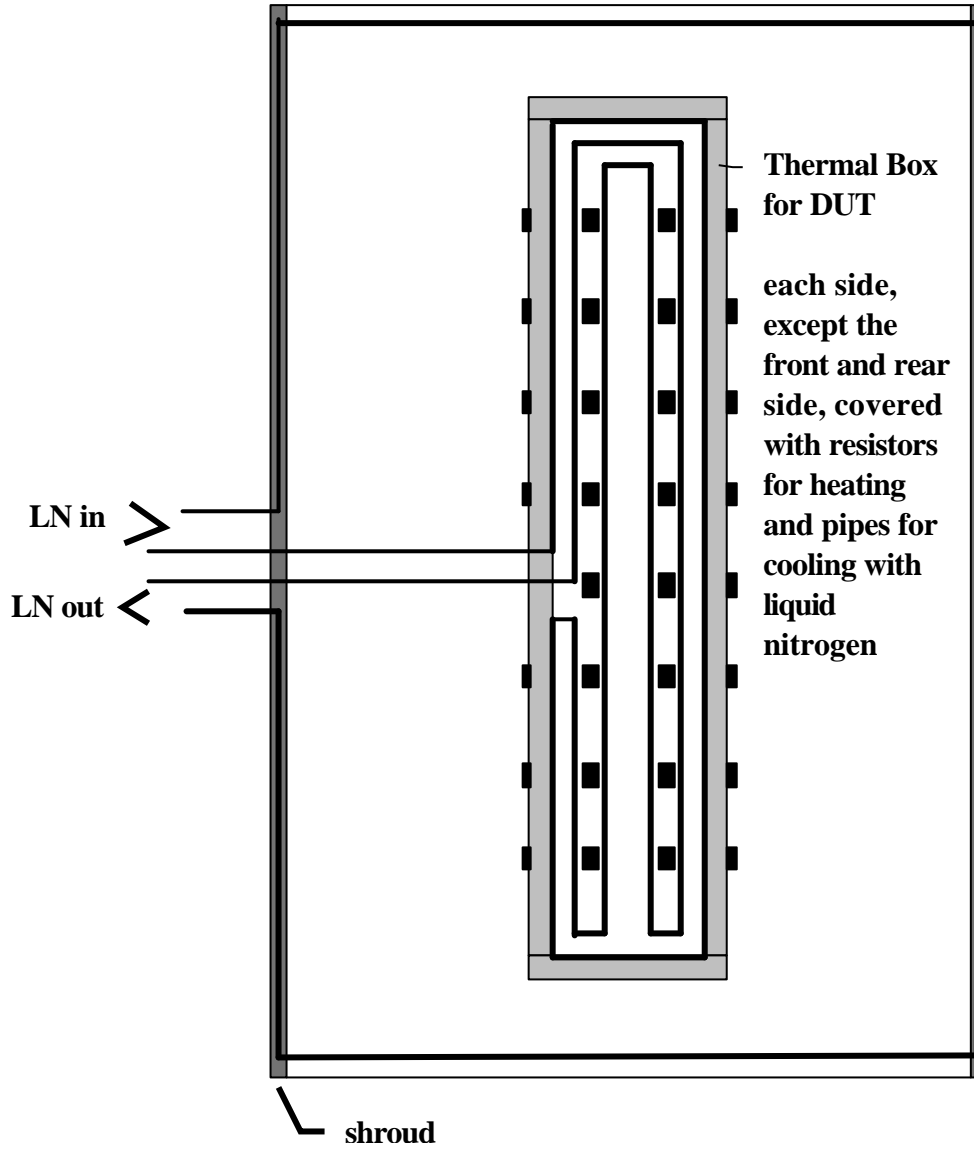
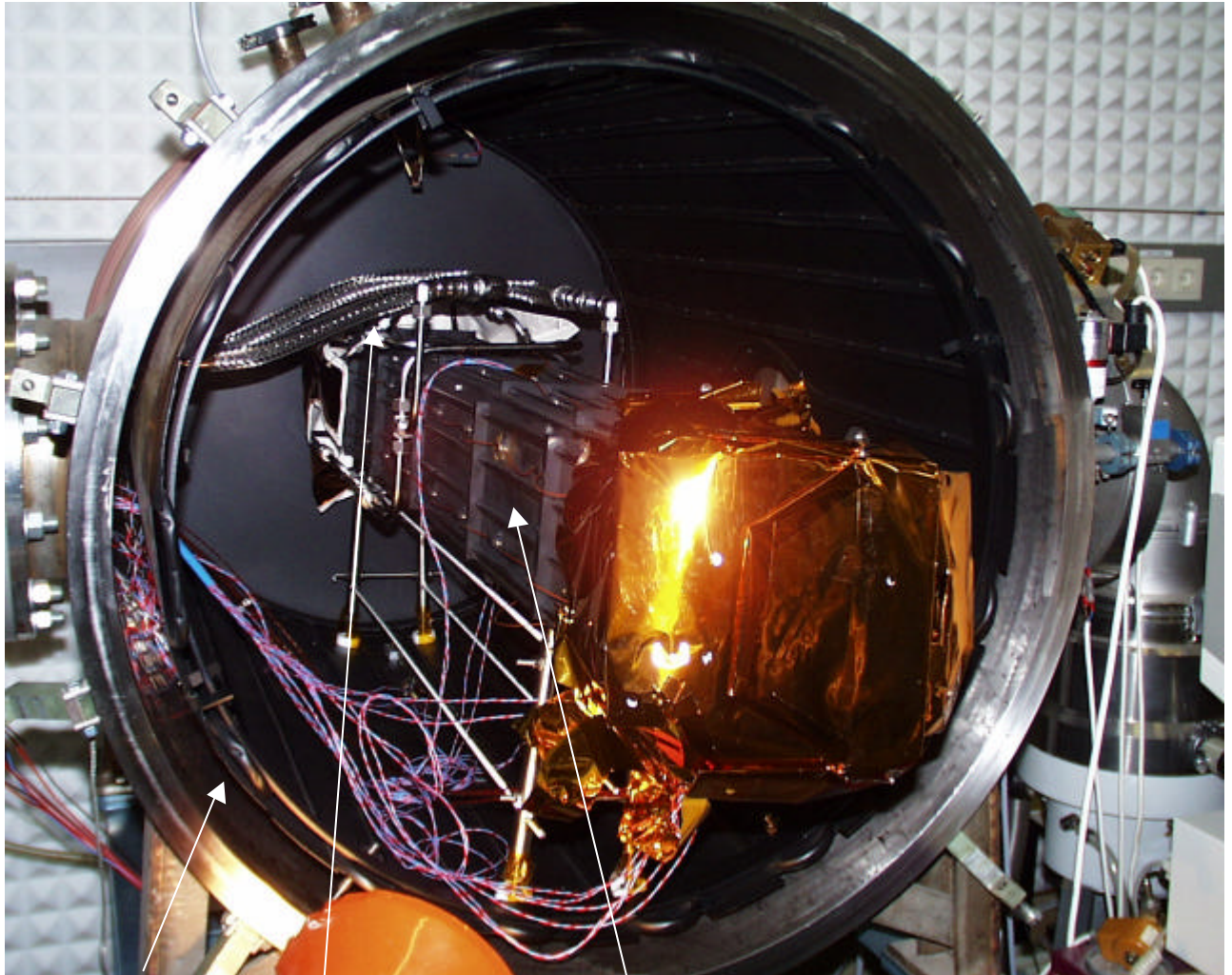
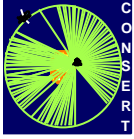


Fig. 2 TV-Chamber with thermal box



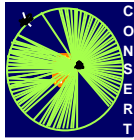


shroud

liquid nitrogen pipes

thermal box

pict. 2 Thermal vacuum chamber with thermal box

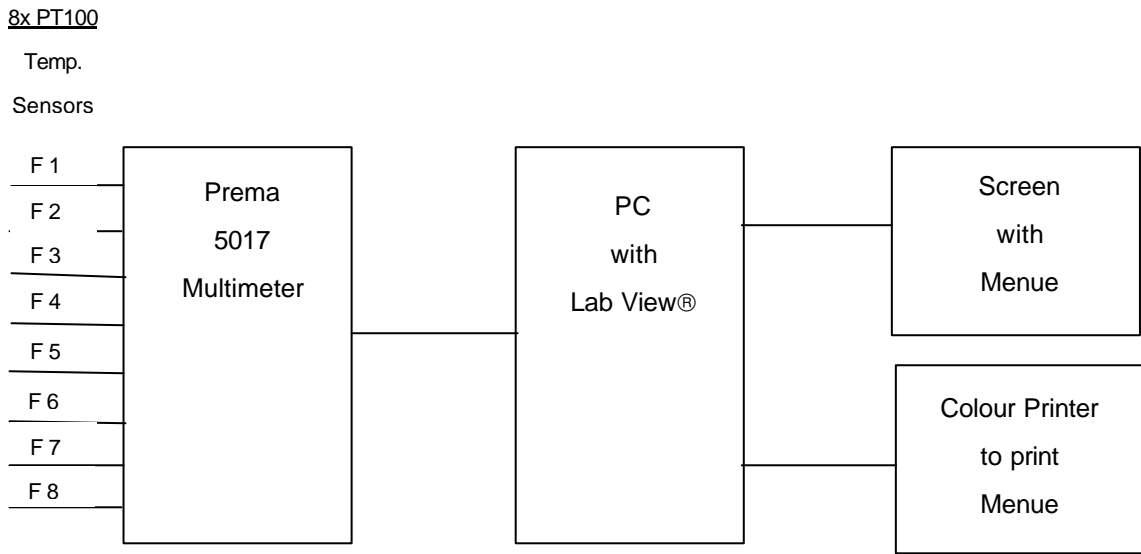


3. Data acquisition

Data Acquisition and recording by PC / Network (8 channels)

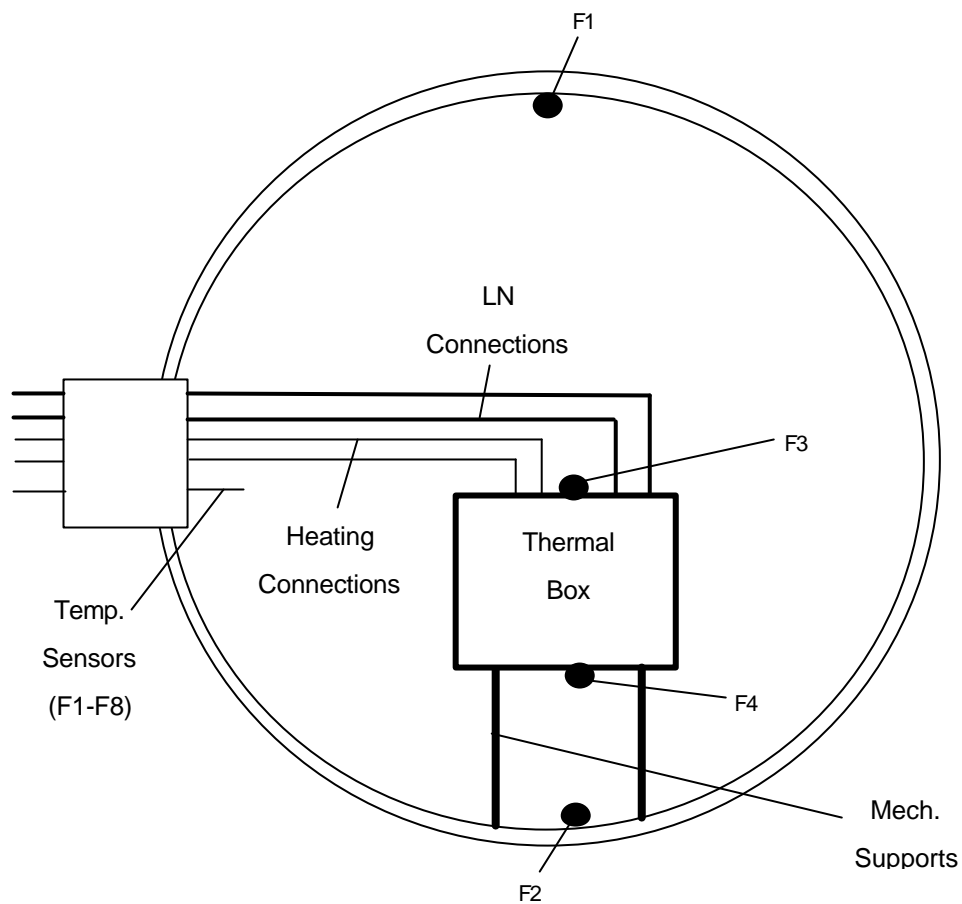
Software: Lab View®

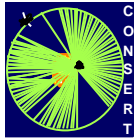
Fig. 3 Overview Acquisition System



3.1 Test Configuration in TV-Chamber

Fig. 2 Test Configuration in TV-Chamber





3.1 Temperature Sensors

The temperature data acquisition shall be performed by means of PT100 thermocouples. The measurement tolerance is better than +/- 0.5K.

Table 3: Temperature Sensor Locations

Channel No.	Temperature sensor location
1	F1 : at the top of the shroud
2	F2 : at the bottom of the shroud
3	F3 : at the top of the thermal box
4	F4 : at the bottom of the thermal box
5	F5 : at the manchet 1
6	F6 : at the aluminium base plate at support-3
7	F7 : at the pyro cutter on support-3
8	F8 : at the carbon fibre part of mast 2

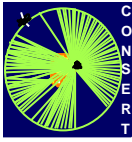
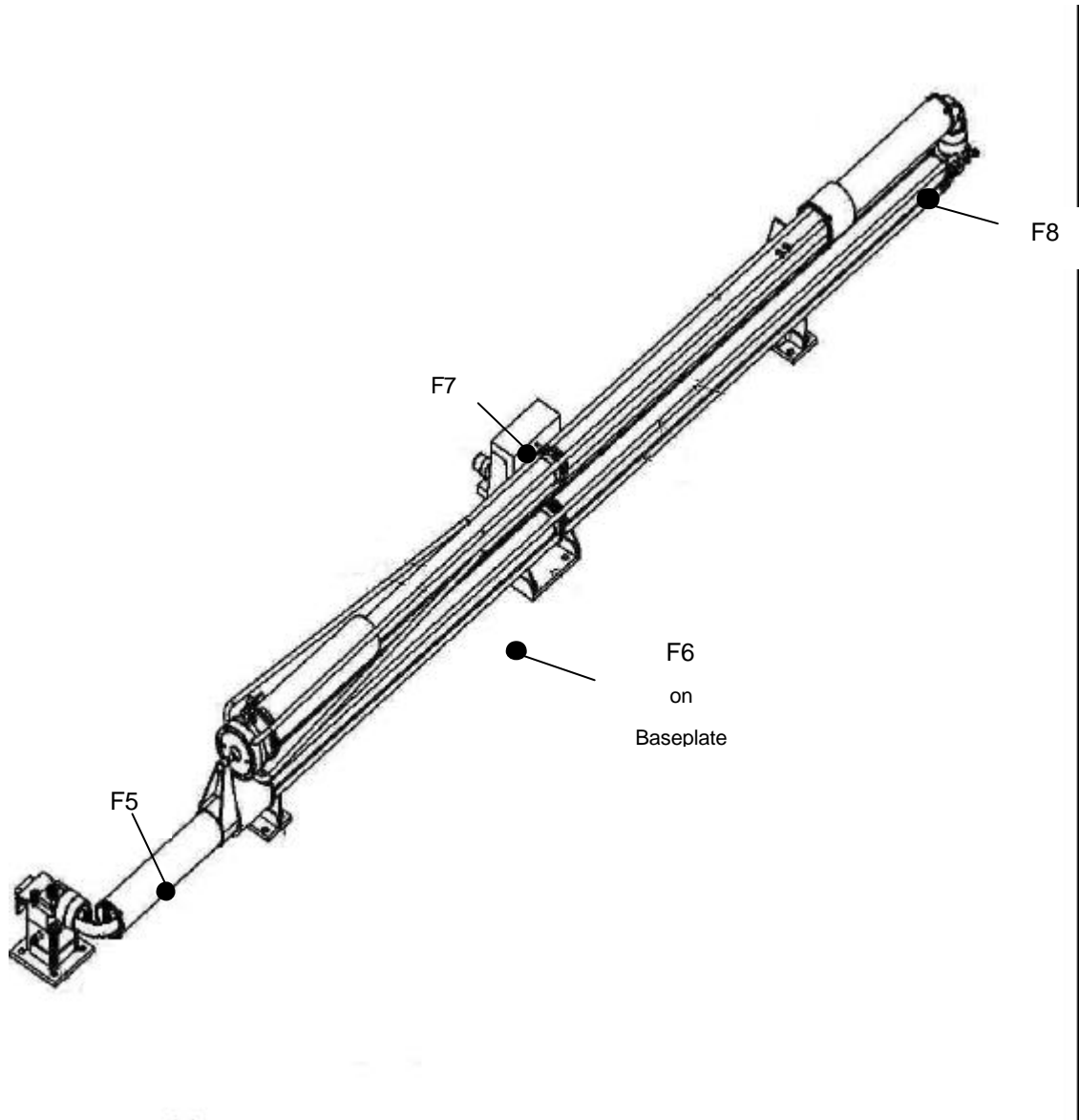
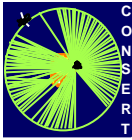


Fig. 3 Temperature sensor locations on folded Antenna





4. Test Conditions

Temperature at different points of the antenna:

no-operating hot steady state: + 100 °C

no-operating cold steady state: - 150 °C

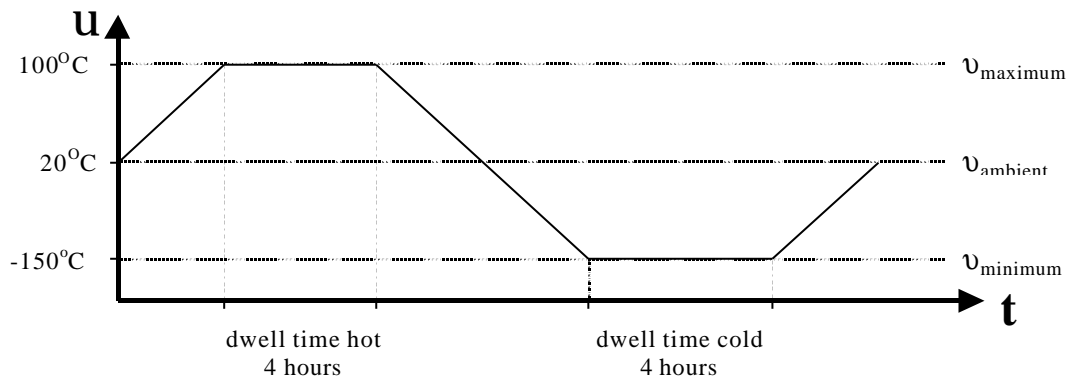
Pressure: <math> < 10^{-5} \text{ mbar} < /math> (1mPa)

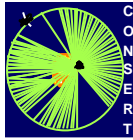
Environment Temperature : about 20 °C

Humidity : < 50 %

4.1 Temperature cycle

Fig. 4 temperature cycle



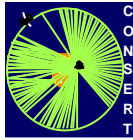


5. Test Steps

The STM CONSERT Orbiter antenna was tested from 19. July – 29. July 1999.

Table 4: Test Steps

No.	Test step	Verified	Pictures-Nr.	Remarks
Unpack and visual inspection				
1.	Unpack the Antenna immediately before installation in the TV chamber. Handle it only with cleanroom compatible gloves.	✓		
Preparation of Test Facility				
2.	check TV chamber	✓		
3.	Integrate Mechanical Supports into TV-Chamber	✓		
4.	Integrate TB on Supports in Chamber	✓		
Integration to test facility				
5.	attach Temperature sensors on the Antenna , in TV chamber, and on Thermal Box as described	✓		
6.	Integrate Antenna into TB	✓		
7.	Place MLI on the ends of TB	✓		
8.	connect the leads of the Temp. Sensors , TB- heaters and LN-Connections to the TV chamber feedthrough connector and connect the power supply outside the chamber	✓	see pict. 2	
9.	Pump down TV chamber pressure to $\leq 10^{-5}$ mbar	✓		



CONCERT - Antenna

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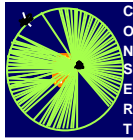
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Cycle	Step	Test step	Verified	Prints	Remarks
Test flow steady state, hot and cold environmental conditions					
	1.	Warm-up TB to 100 °C by switching on Power Supplies	✓		
	2.	Dwell Time 4 Hrs. at 100 °C	✓		
	3.	Cool down TV chamber shroud by connecting to LN-Container	✓		
	4.	Cool Down TB to -150 °C by connecting to LN-Container	✓		
	5.	Dwell Time 4 Hrs. at -150 °C	✓		
	6.	Close LN-Container to Shroud and TB	✓		
	7.	Start with Step 1 for next Cycle	✓		
End of Test after 8 Cycles					
		Let System Heat-up to Ambient	✓	Print-Nr.	
		Switch off all supplies	✓		
		Acquire temperature data at steady state (after approx. 1h)	✓		
		Purge TV chamber with dry nitrogen or synthetic air	✓		
		Open TV chamber	✓		



CONCERT - Antenna

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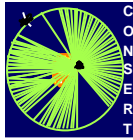
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Step	Test step	Verified	Pictures	Remarks
Disintegration of System				
	Dismount all LN- ,Temp. Sensors and Heating-Connections from TB	✓		
	Remove MLI	✓		
	Dismount temperature sensors from Antenna	✓		
	Pull out Antenna out of TB	✓		
	Remove Temp. Sensors	✓		
	Pack Antenna into clean bag and into transport container	✓		
End of the test				

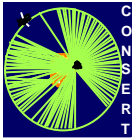


6 Results

Visual inspection of the antenna following the test:

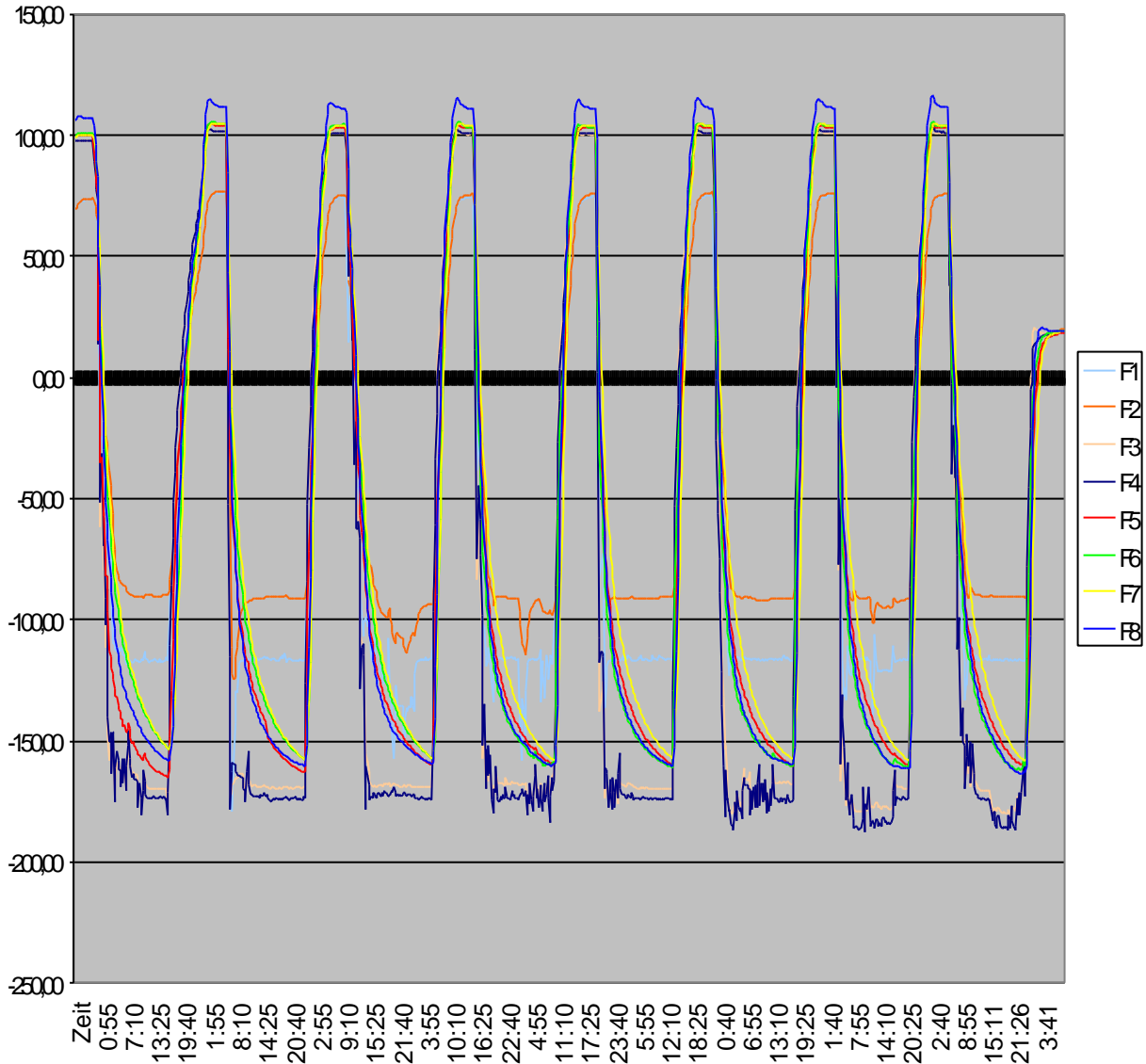
- Support-2 and Support-4 were twisted; roughly around the Z-axis (see pict. 7 and pict. 8). This is probably a result of the difference in thermal expansion coefficient of the aluminium mounting plate and the carbon fibre antenna masts. The twisting is a consequence of the large range of temperature variation during the test. Since the antenna will be deployed early in the mission, before large temperature variation have occurred, this type of damage will not happen during the mission. Thus, this damage is of no consequence for the antenna performance. Because the twisted supports may have adverse effects on the further tests of this antenna (Centrifuge tests and System test) the two supports will be remade.
- no further damage could be observed; specifically, none of the glued connections showed any sign of having deteriorated.
- Sensor F5 lost contact with Manchet-1 during the first cycle (see pict. 4).
- Sensor F6 lost good contact with the mounting plate during the third cycle.

Since the overall temperature variations of the antenna were similar for all cycles, we conclude (with reference to the last two points above) that temperatures at F5 and F6 were comparable to the temperatures during the first cycles.

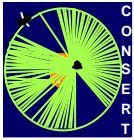


6.1 Data printout

Fig. 5 8-Cycle temperature plot

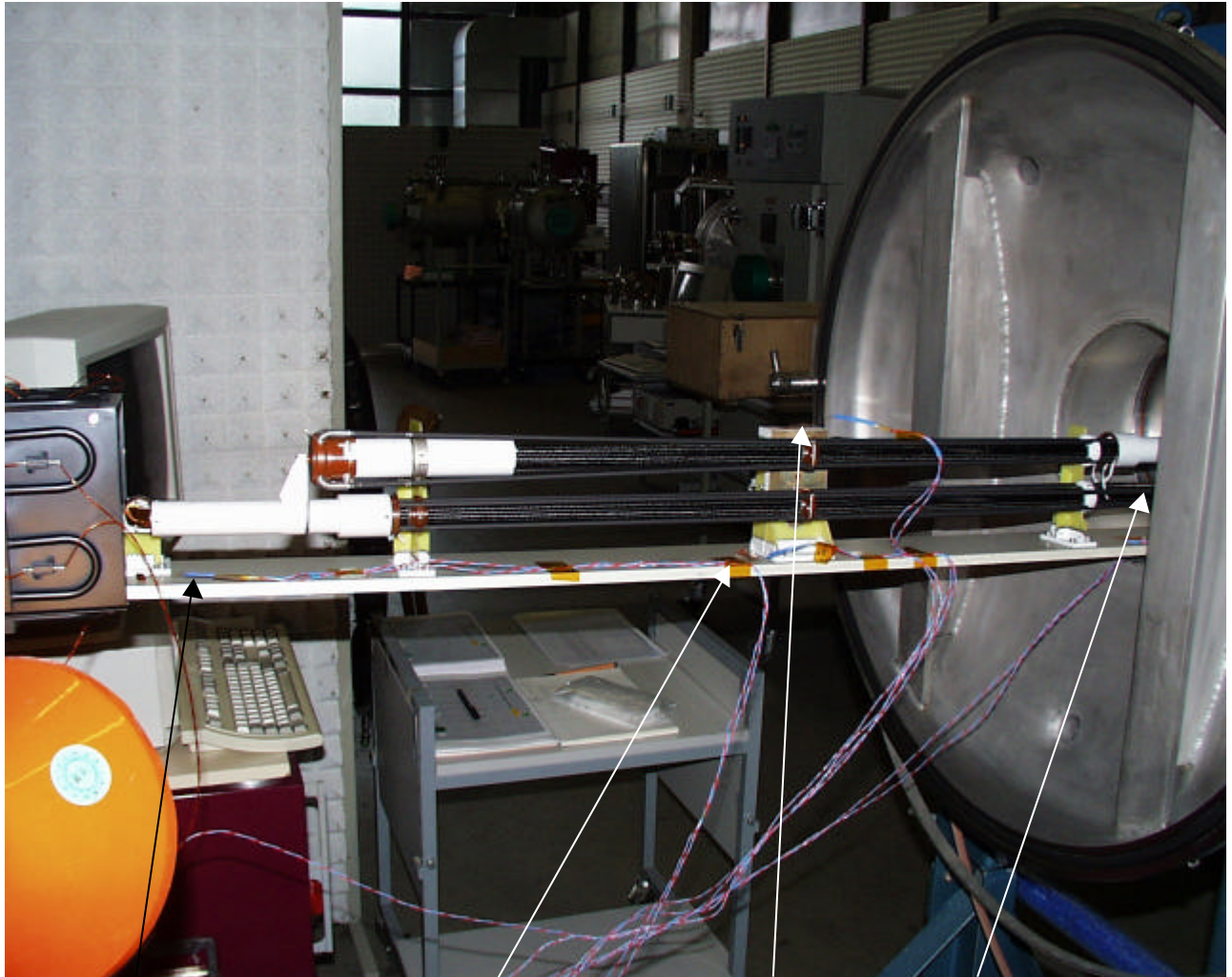


F1 – F4 Sensors of the cooling system
F5 – F8 Sensors of the antenna, see Fig. 3



6.2 Pictures after Test

pict. 3 overview of the antenna sensors (immediately after test)

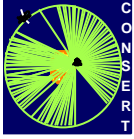


sensor F5 'antenna 1'

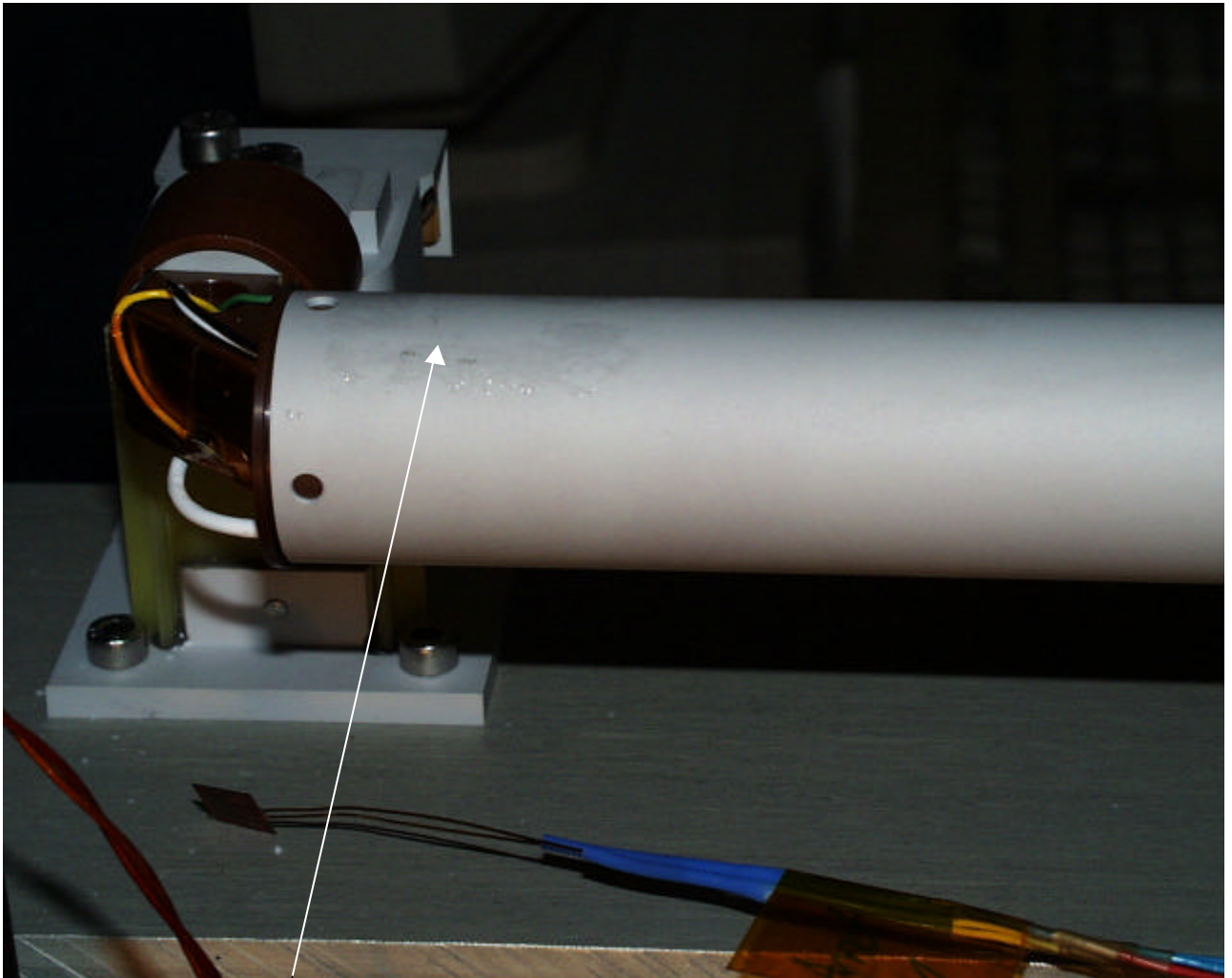
sensor F6 'mounting plate'

sensor F7 'pyro-cutter'

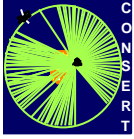
sensor F8 'antenna 4'



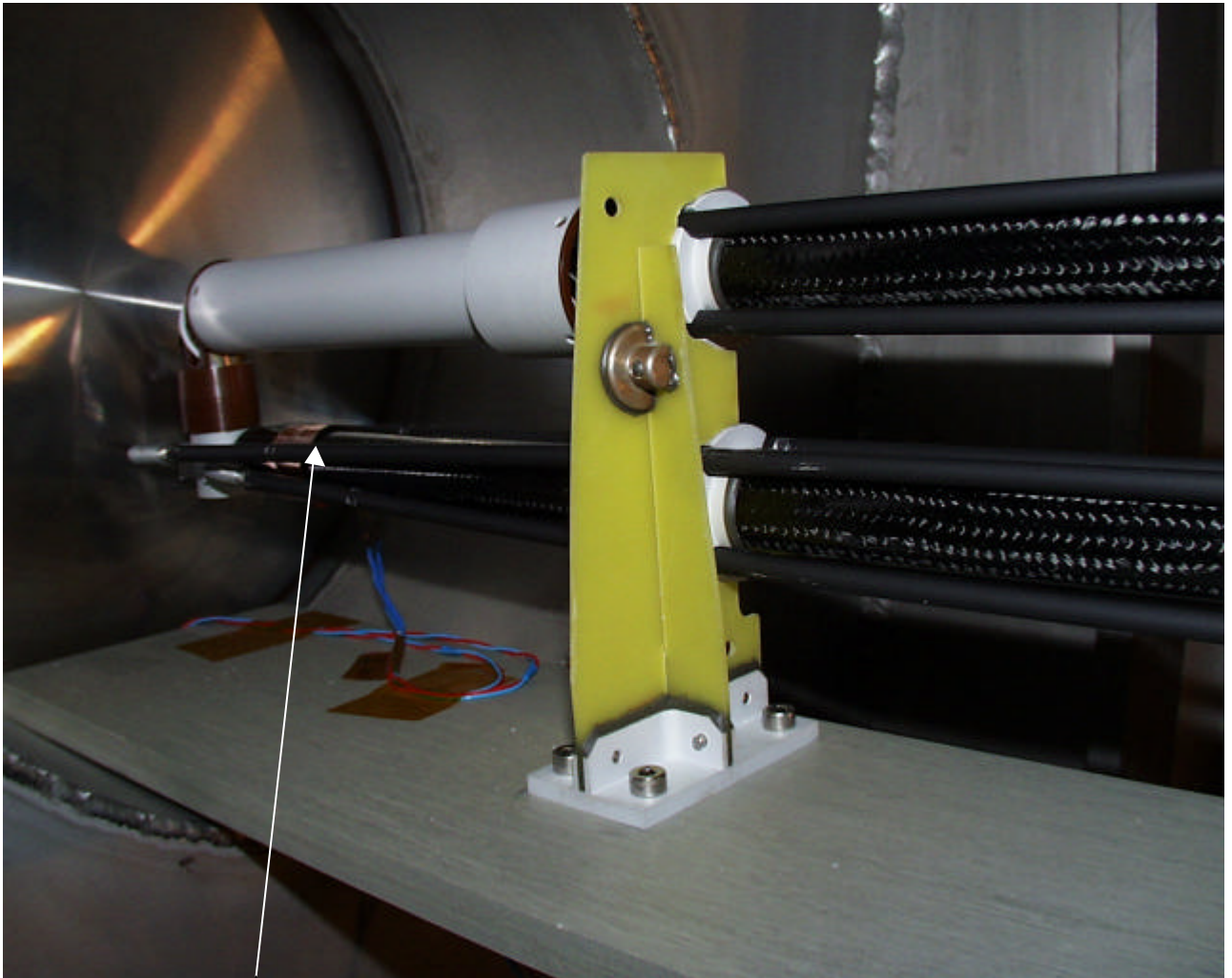
pict. 4 sensor F5



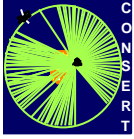
sensor F5 'antenna 1' should be at manchet 1, has been lost after 1st cycle



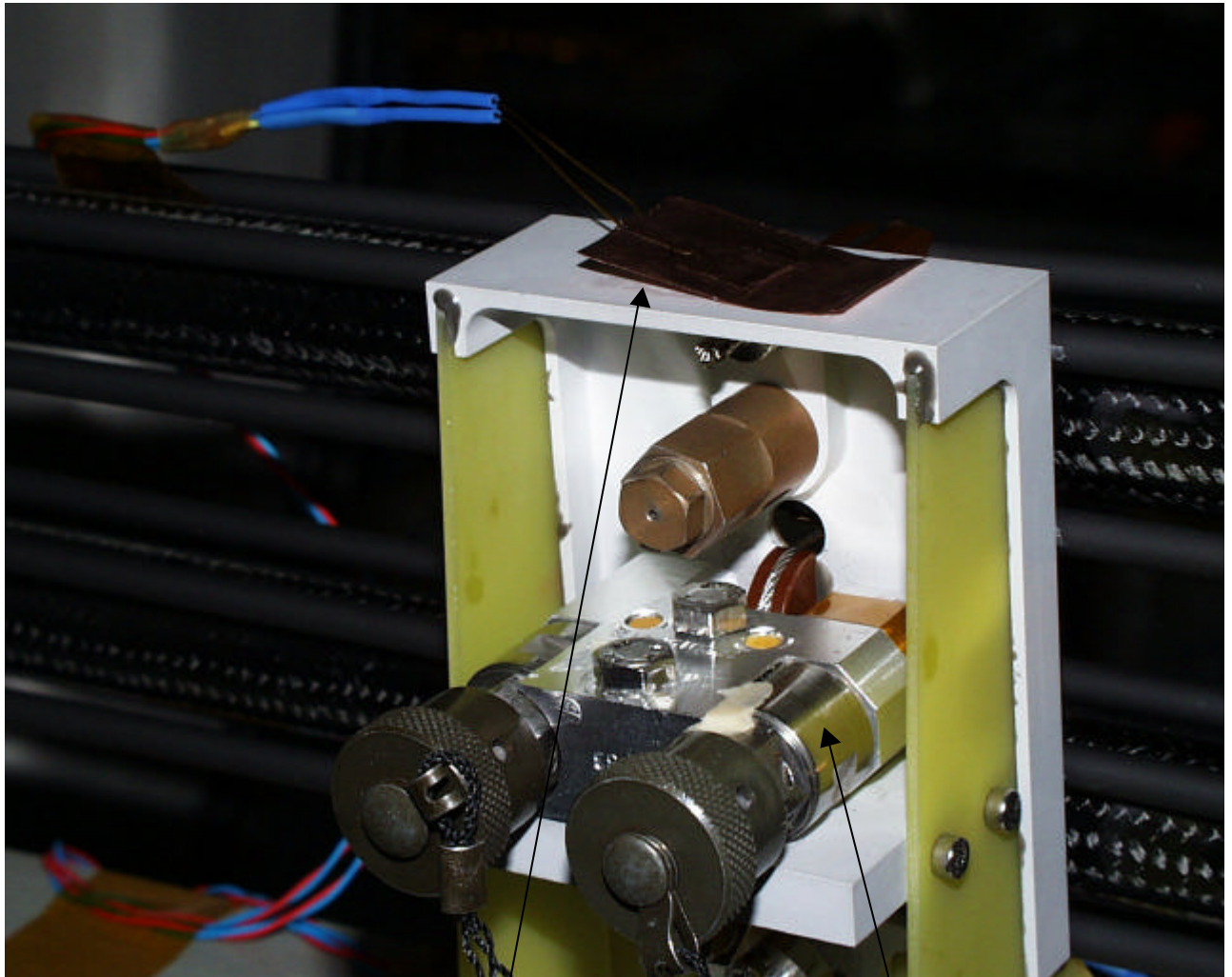
pict. 5 sensor F8



sensor F8 'antenna 4' at carbon fibre mast 1

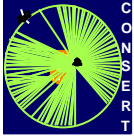


pict. 6 sensor F7

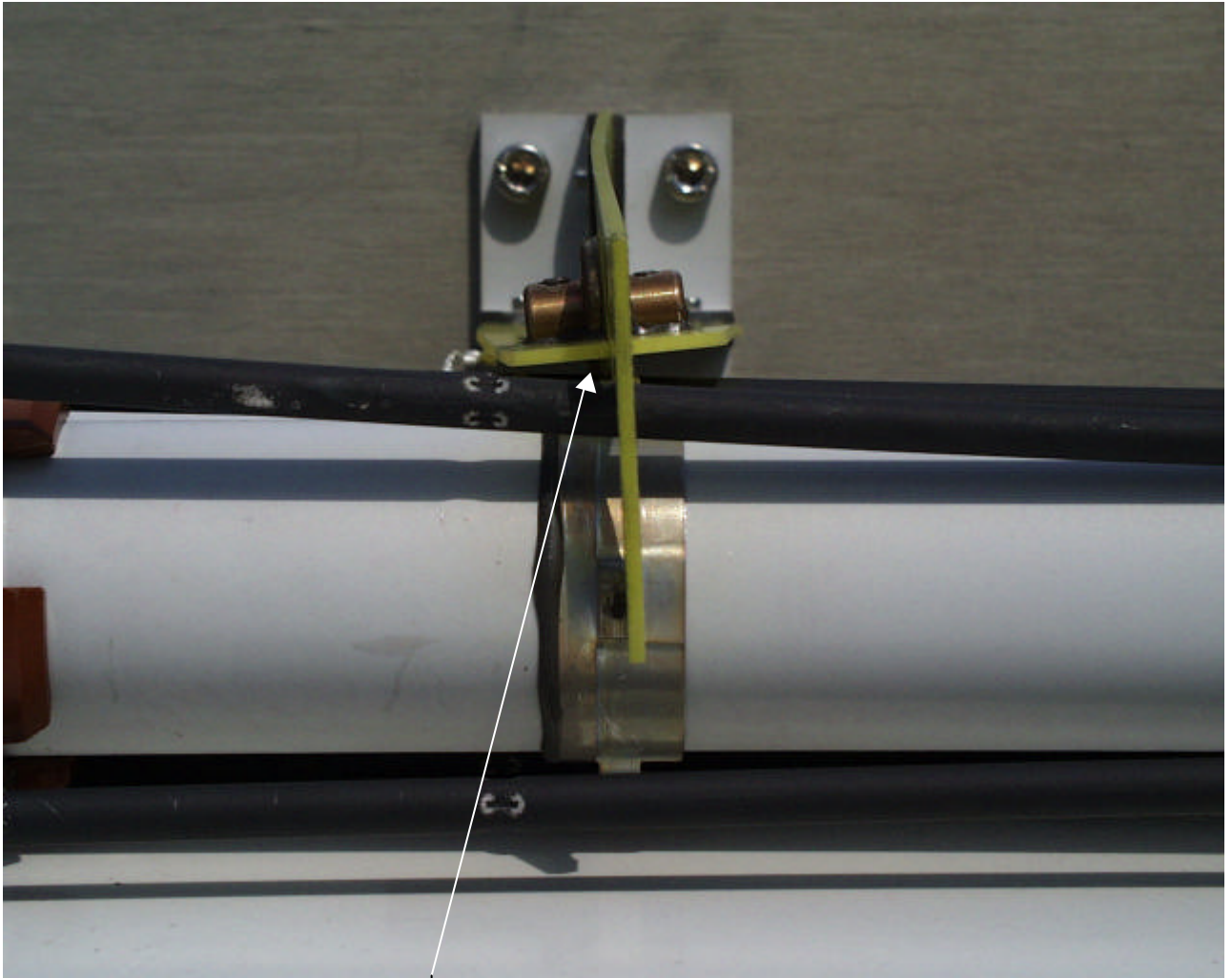


sensor F7 'pyro-cutter'

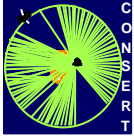
pyro



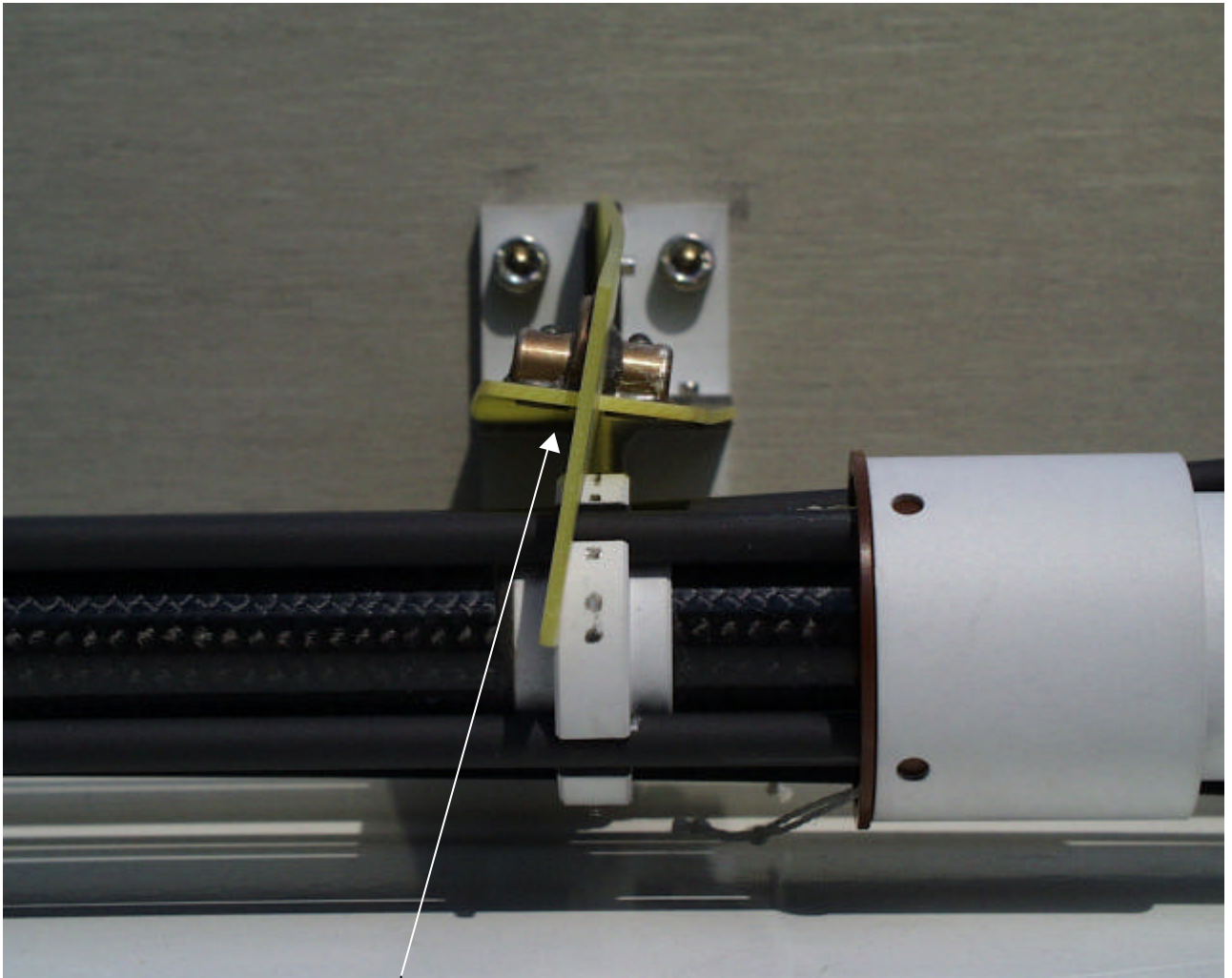
pict. 7 support 2



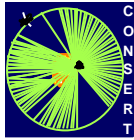
'bended' support 2



pict. 8 support 4



'bended' support 4

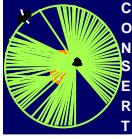


7 Procedure Sign Off Sheet

The identified test item has been successfully tested in accordance with the foregoing procedure.

Table 4 Signatures

	Date	Signature
Test Conductor :		
Quality Assurance :		
Instrument Manager:		



8 Attachments

Table 5 Attachments

No.	Doc.Nr.	Title	Version	Date	Remarks
1	--	LabView print	1	99.07.29	