



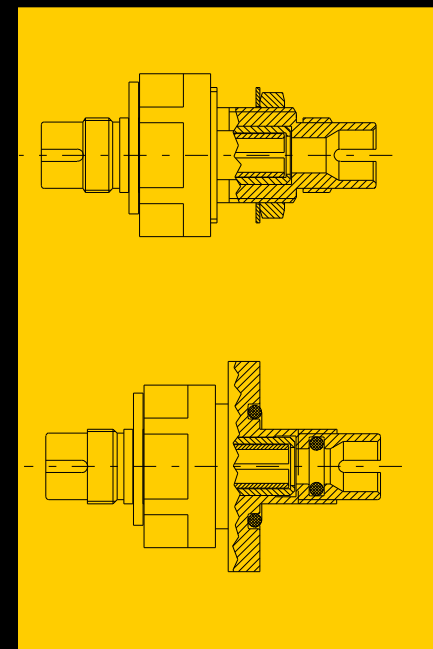
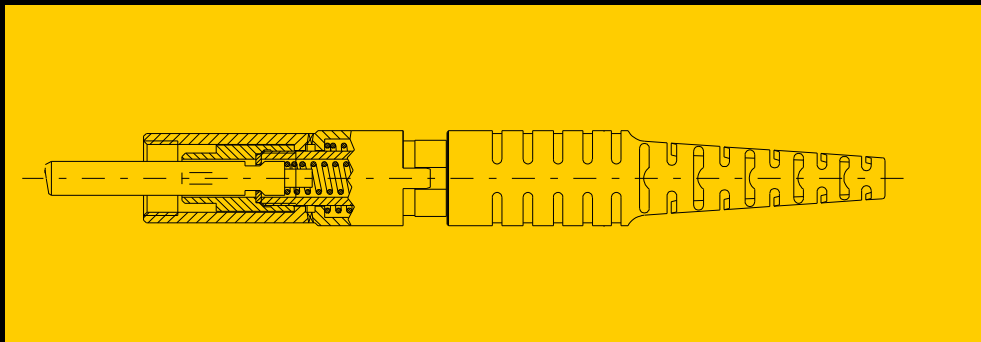
DIAMOND AVIM Connector

Fiber optic connector for space applications

AVIM Connector



→ The AVIM connector family, is designed to be used in high reliability space and aerospace programs. These connectors are designed as Single Terminus, Fiber Optic Connectors applicable for Single mode, Multimode and PM Fibers.





Product Features

- Single mode / Multimode / PM Fiber Compatible
 - Active aligned core for lowest insertion loss
 - Unique AVIM 2-piece cleanable Adapter for black box applications
 - Environmentally robust, survives vibration, shock, thermal cycling and repeated mating.
 - Wide temperature operating range: -55°C to $+125^{\circ}\text{C}$
 - Low out gassing materials applied conform to space applications
 - Sealed, flange mounted bulkhead allows pressure feed through
 - Diamond has produced and sold over 10'000 pieces since 1996.
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Specifications



Fiber

- Single Mode 1550/1625, 1310, 980nm
- Multimode
- Polarization maintaining

Optical Requirements

- IL max. 0.5dB
- RL PC >45dB
- APC >70dB
- ER (PM fibers): min. 20 dB

Thermal Cycling

- Temperature range -55°C (+0, -5°C) to +125°C (+5, -0°C)

Ferrules - Active Alignment

- The active alignment ferrule

Shock

- The adapter shall be capable of surviving a shock of 2000g over a frequency range of 100 - 10,000 Hz.

Vibration

- Samples shall be subjected to vibration at 46.4G_{rms} Random for 3 minutes in each axes.

Temperature Life

- Test condition 240 hours test, temperature 100°C.

Mating Durability

- Connector pairs (plug-adapter-plug) shall be tested for mating durability for total of 500 mating cycles.

Bulkhead Adapter

- The bulkhead adapter shall be designed such that the fiber interface of the internal connector plug can be cleaned conventionally without disconnecting the plug. It's a 2-piece cleanable adapter.

Alignment Sleeve

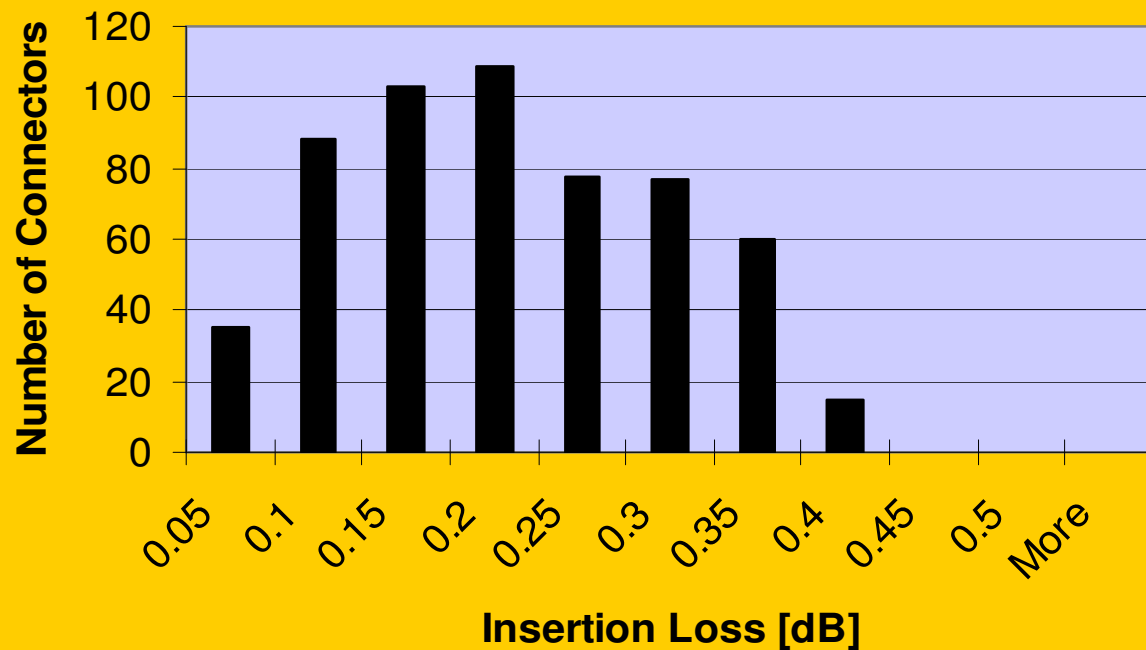
- The alignment sleeve shall be a split-sleeve configuration made from ceramic zirconia.

AVIM Performance

Insertion Loss

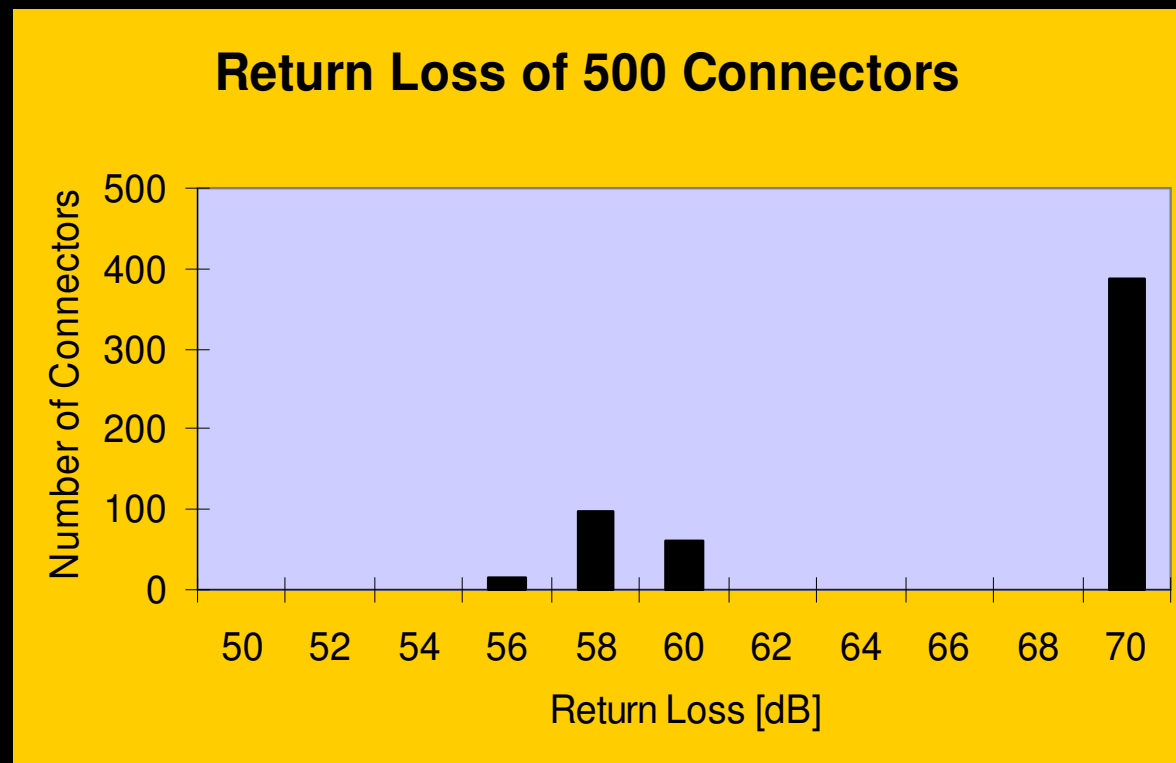


Loss Results for 500 Connectors

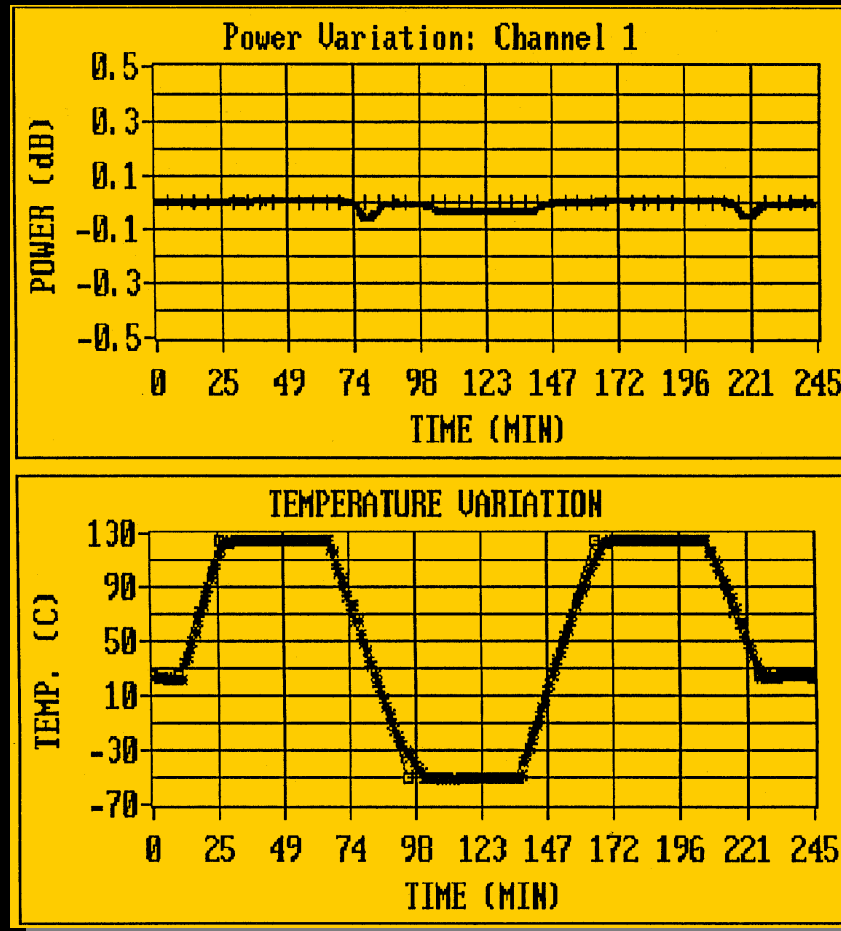


AVIM Performance

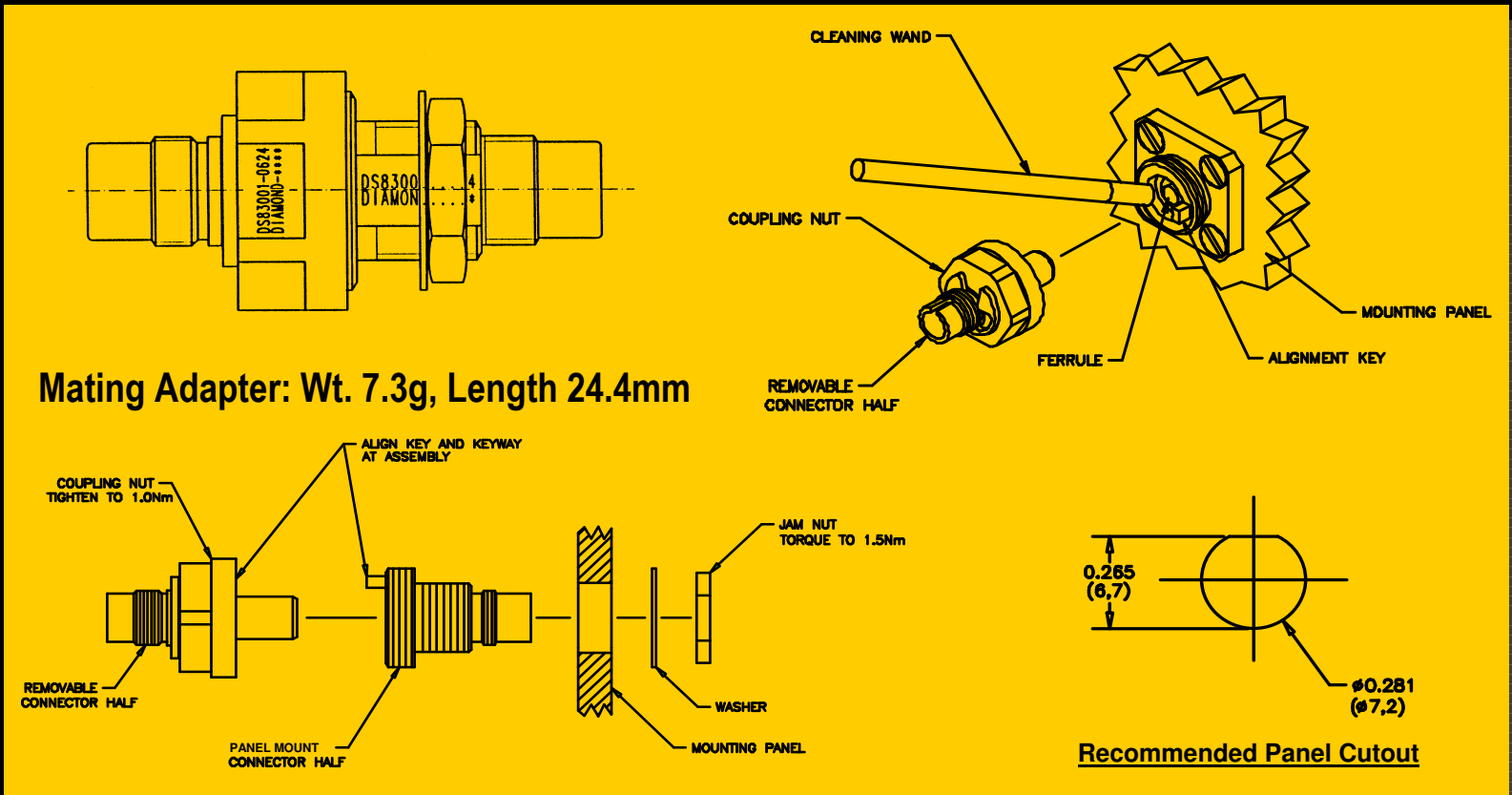
Return Loss



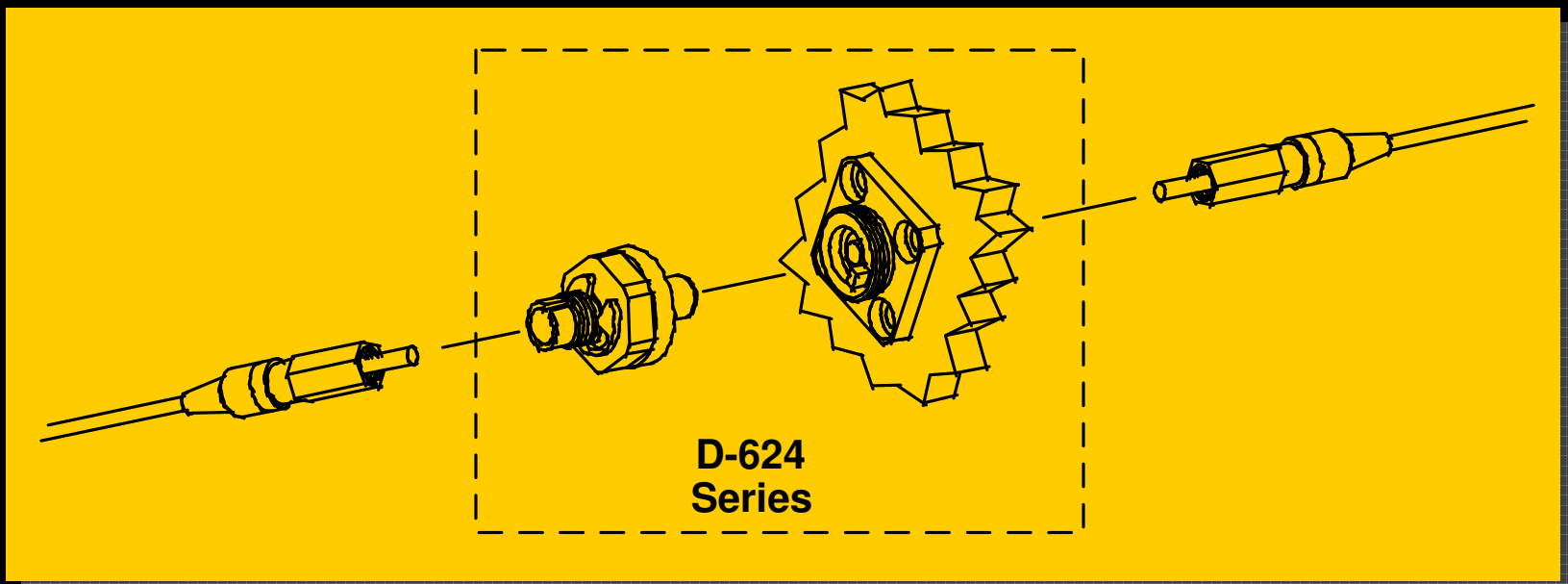
AVIM Performance Thermal Cycling



Cleanable Bulkhead

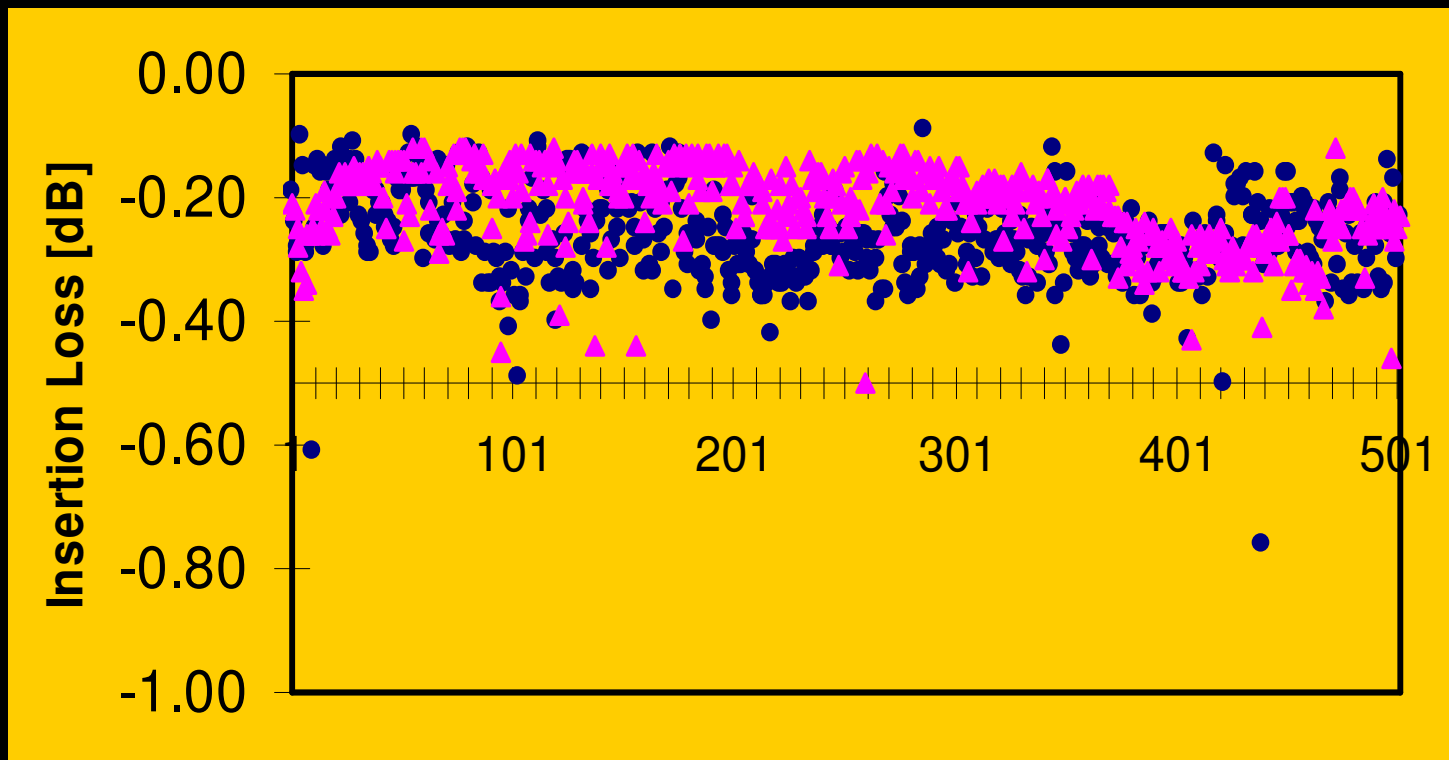


Sealed Cleanable Bulkhead

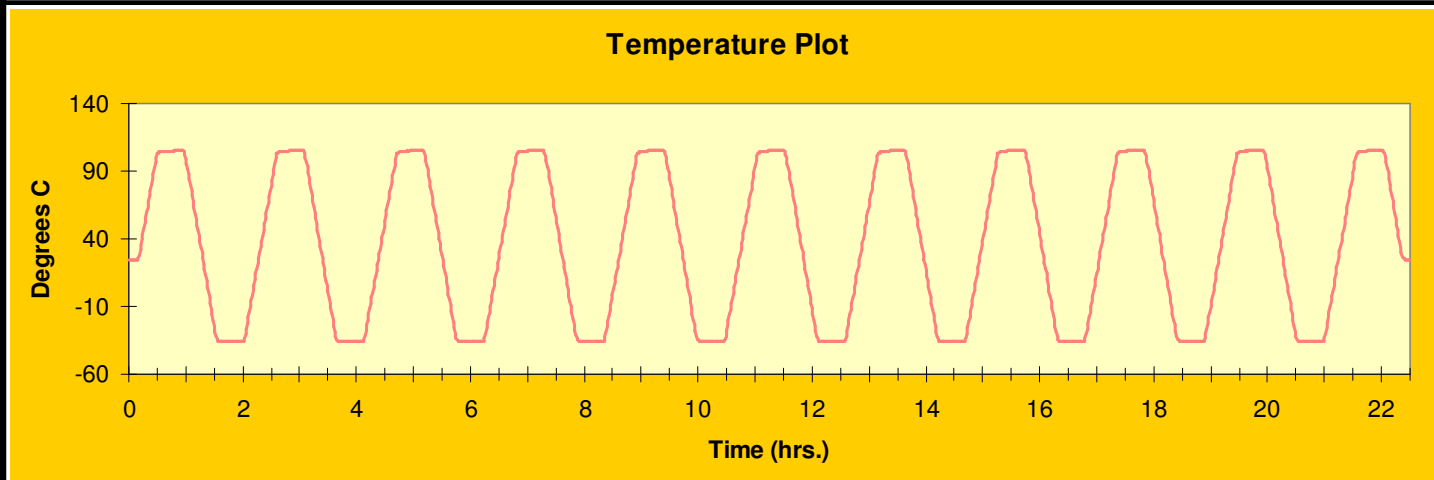
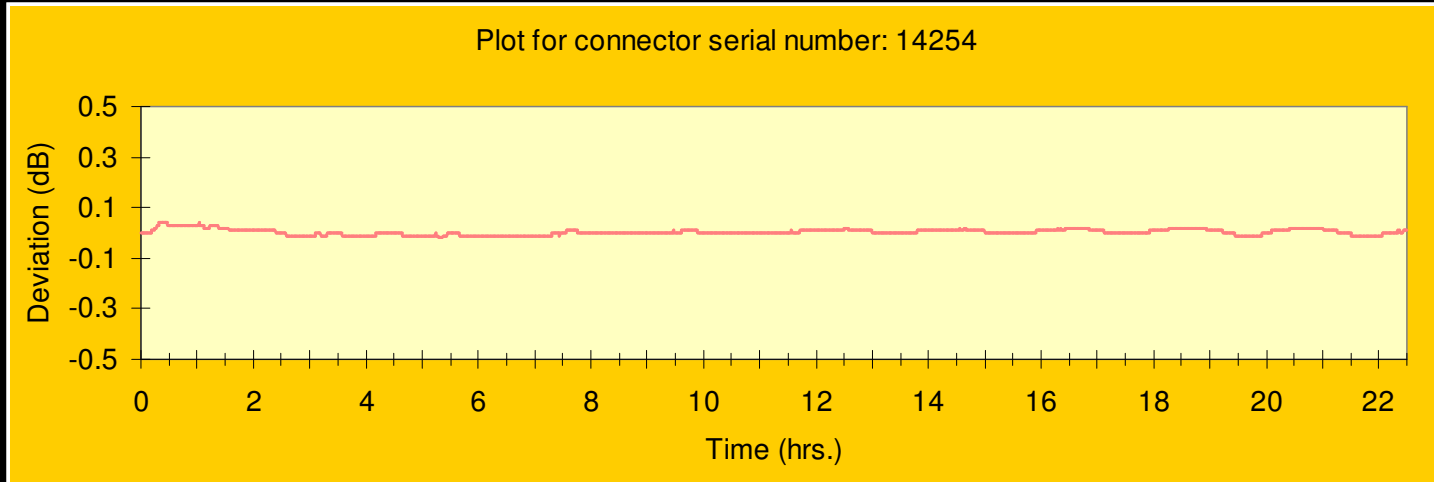


AVIM Performance

Durability Test for 500 Matings



AVIM Performance Temperature Cycling

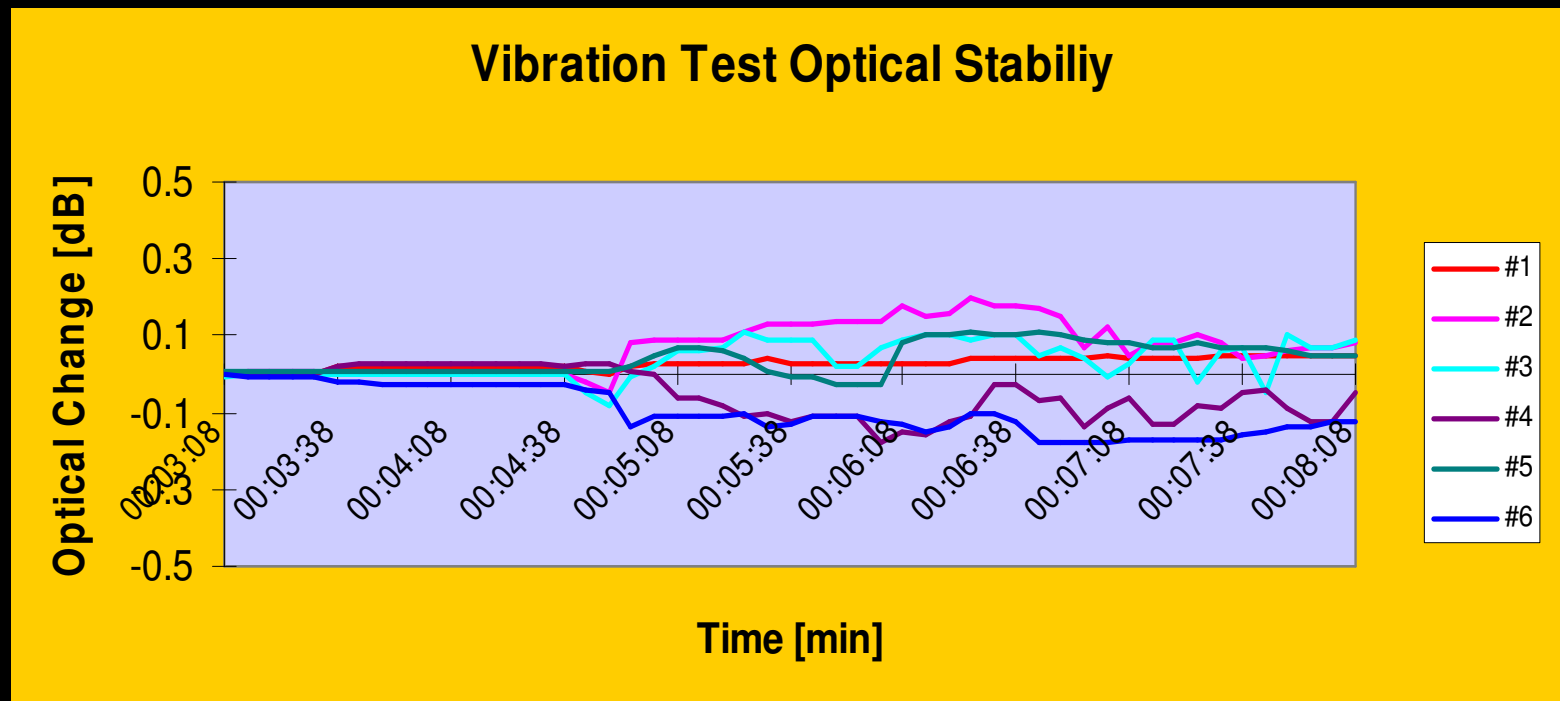


AVIM Performance

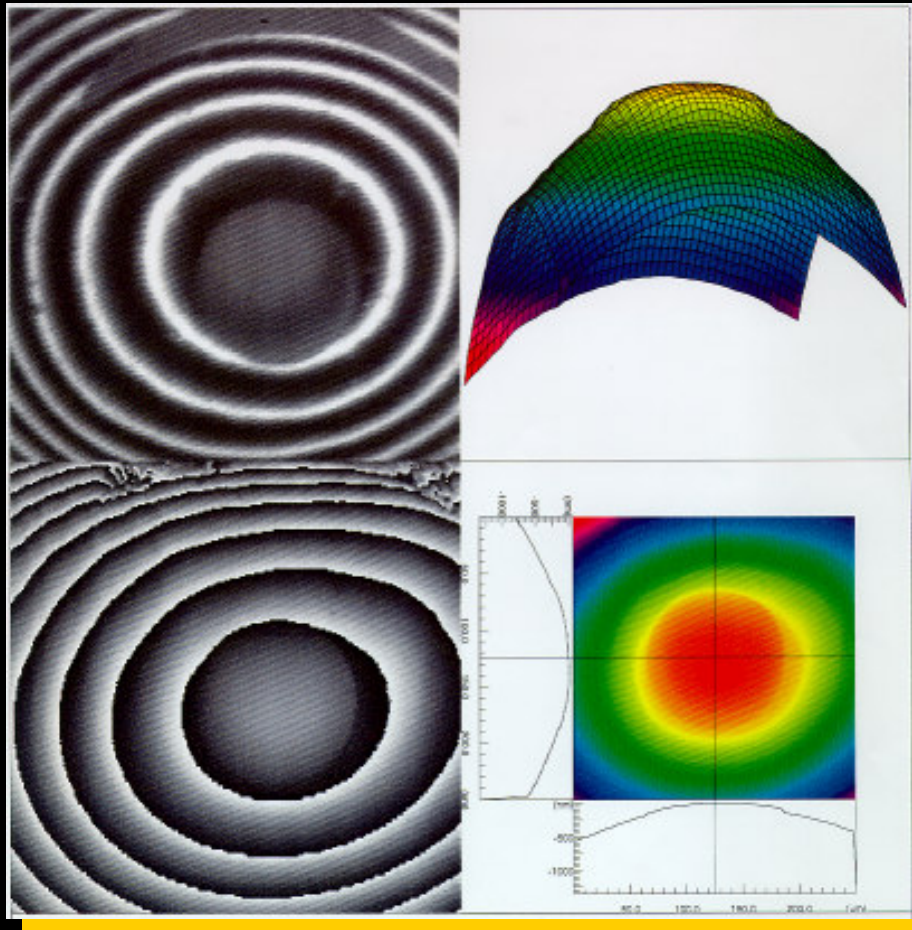
Vibration Tested to $46.4G_{rms}$



→ Random Frequency from 20Hz to 2'000Hz



Polish Analysis on all Flight Critical Connectors



Radius of Curvature: 13.85mm
Fiber Spherical Height: 0.047 μ m
Linear Offset (μ m) 17.1 μ m
APC Polish Angle: 7.988 $^{\circ}$

AVIM Connector

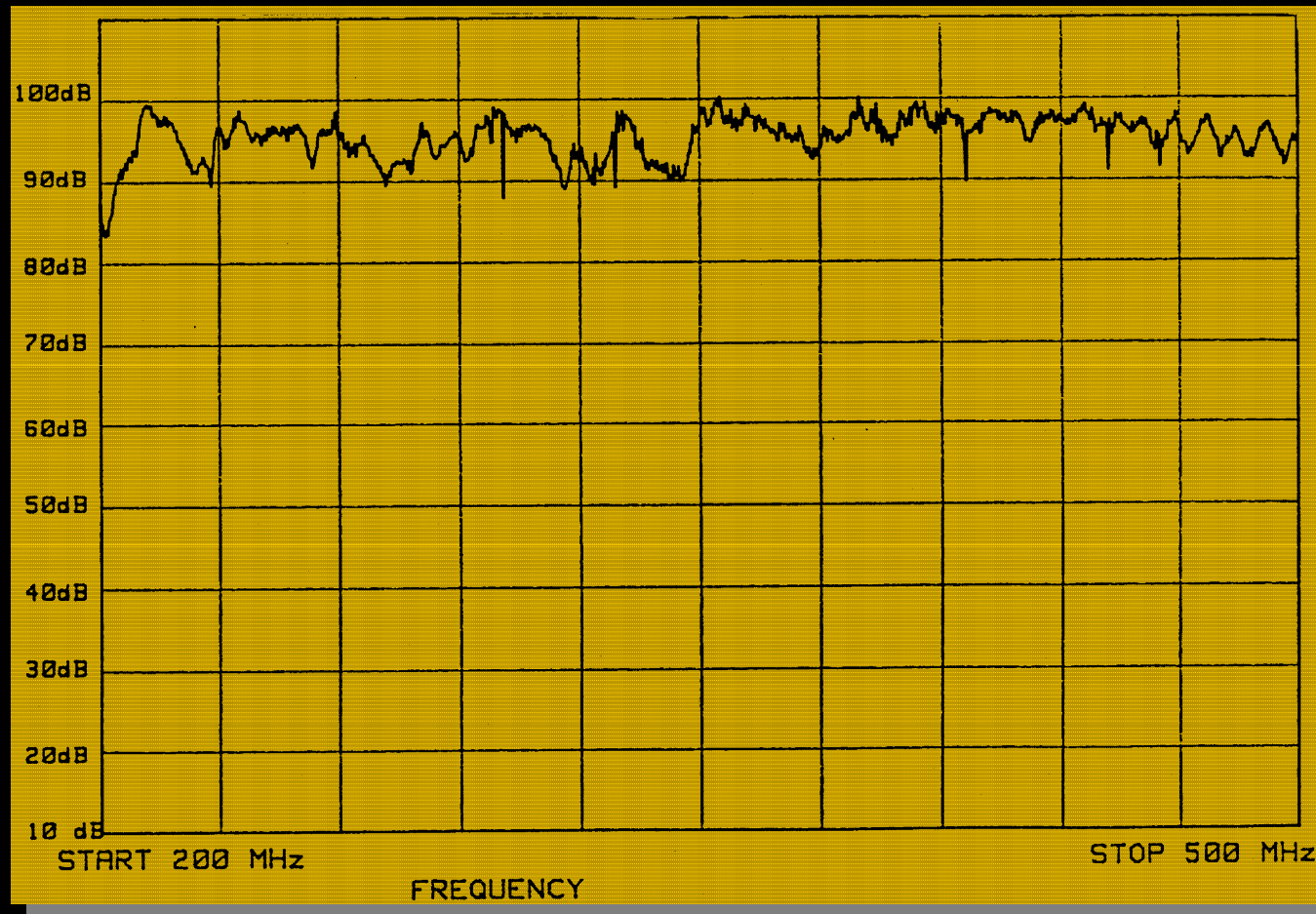
RF Shielding Test Results



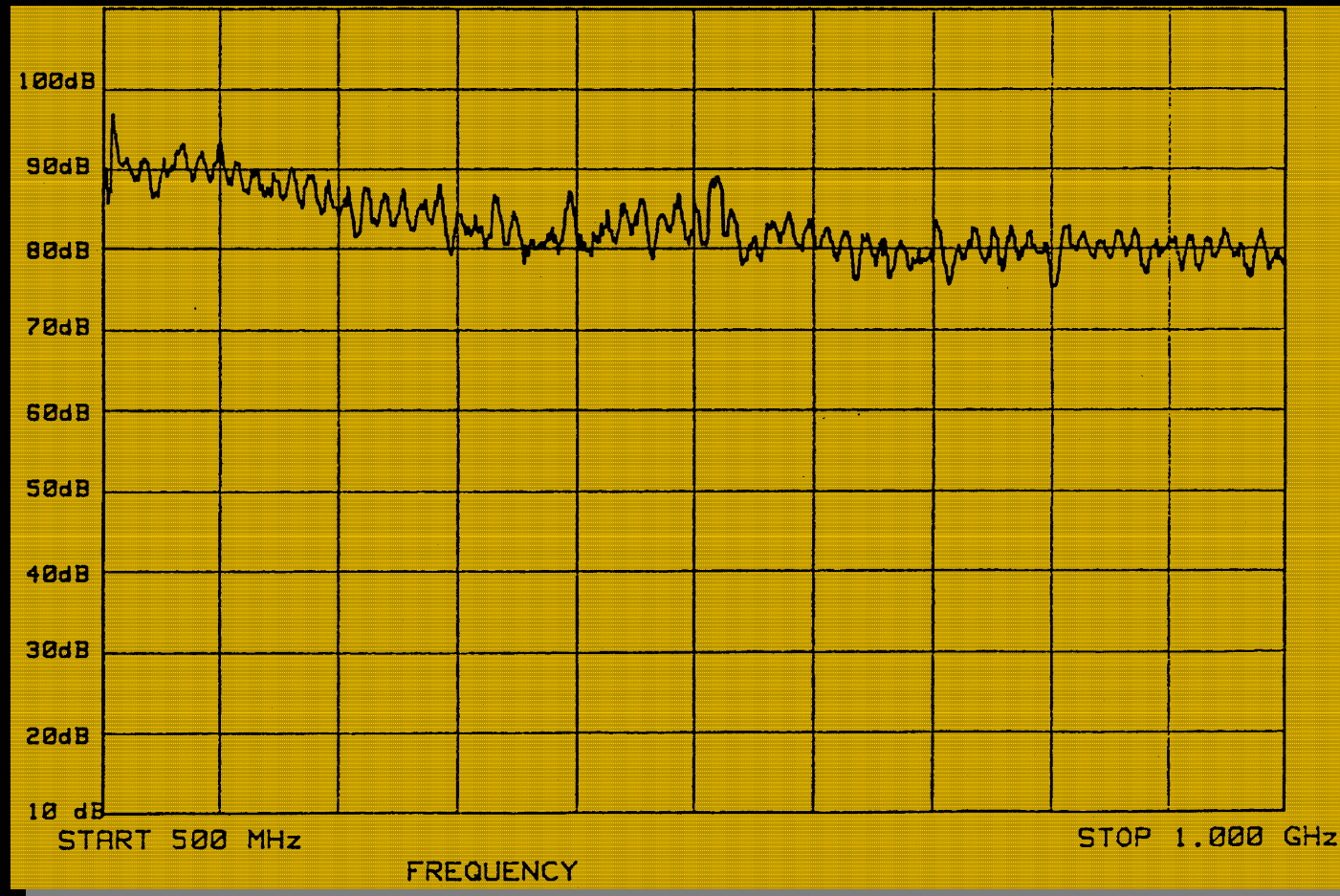
- Test performed from 200MHz to 18GHz
- Test determines the RF attenuation through the Bulkhead
- Shielding is better than 60dB from 200MHz to 5.8GHz
- Shielding from 5.8GHz to 18GHz was measured at better than 30dB but Test Equipment limited.

The Cleanable Bulkhead Adapter is specifically designed to provide excellent RF attenuation.

RF Shielding Effectiveness Test



RF Shielding Effectiveness Test



Helium Leakage

Test on Bulkhead Adapter



- Test Bulkhead Feed through for pressure leakage
- 5 Connector Samples tested
- Tested into 1.0×10^{-3} TORR

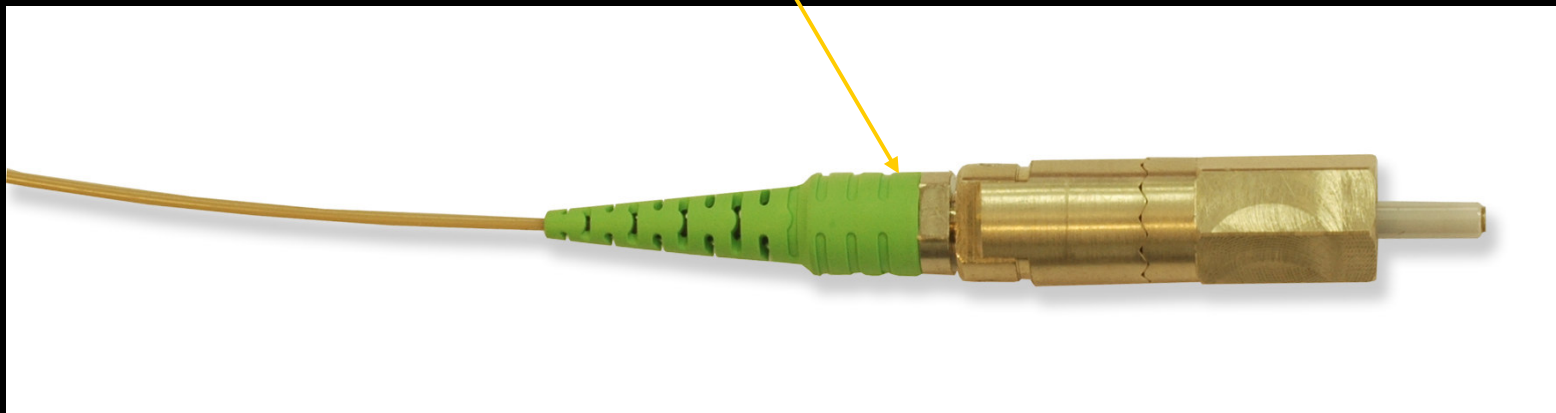
Typical leakage rate: $< 5 \times 10^{-3}$ cc/min. Helium

The bulkhead adapter is suitable for pressurized hull penetration!

On PM fibers



PM tuning system. Jointed to Diamond's active core alignment, is the guaranty for outstanding ER between fast & slow axis



AVIM Performance On PM fibers



IL (Insertion Loss) Performed @ at 980 nm

Test performed for TESAT-Spacecom GmbH & Co. KG

Before thermal cycling

Ca 23° C

[dB]

0.19

0.08

0.15

After thermal cycling

+ 80° C /- 40° C; 20 cycles

[dB]

0.36

0.12

0.23

Fibre type 6L.4944.038.00

PM 6 / 125 / 400

AVIM Performance On PM fibers



ER (Extinction Ratio) @ 980 nm

Test performed for TESAT-Spacecom GmbH & Co. KG

@ +20°C	+80°C	-40°C	+20°C	maximum variation
[dB]	[dB]	[dB]	[dB]	[dB]
26.7	28.6	28.3	28.7	2.0
25.8	21.6	22.6	26.1	4.5

Fibre type 6L.4944.038.00
PM 6 / 125 / 400

AVIM Performance On PM fibers



Mechanical vibration

IL @ 980 nm

Test performed for TeSat-Spacecom GmbH & Co. KG

Vibration axis	Min. value [dB]	Max. value [dB]	maximum variation [dB]
transversal (X/Y)	0.21	0.21	0.00
longitudinal (Z)	0.32	0.33	0.01
transversal (X/Y)	0.15	0.15	0.00
longitudinal (Z)	0.05	0.06	0.01

Fibre type 6L.4944.038.00
PM 6 / 125 / 400

Influence of the cable



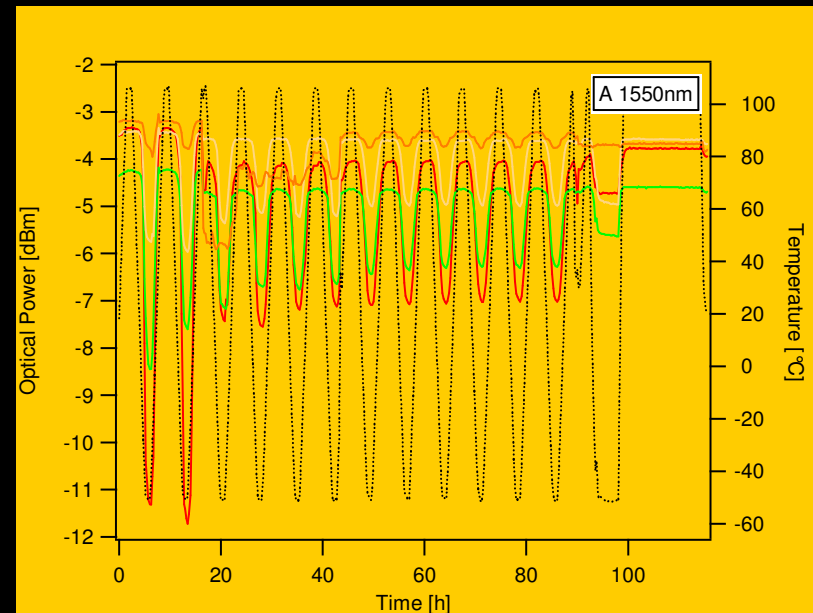
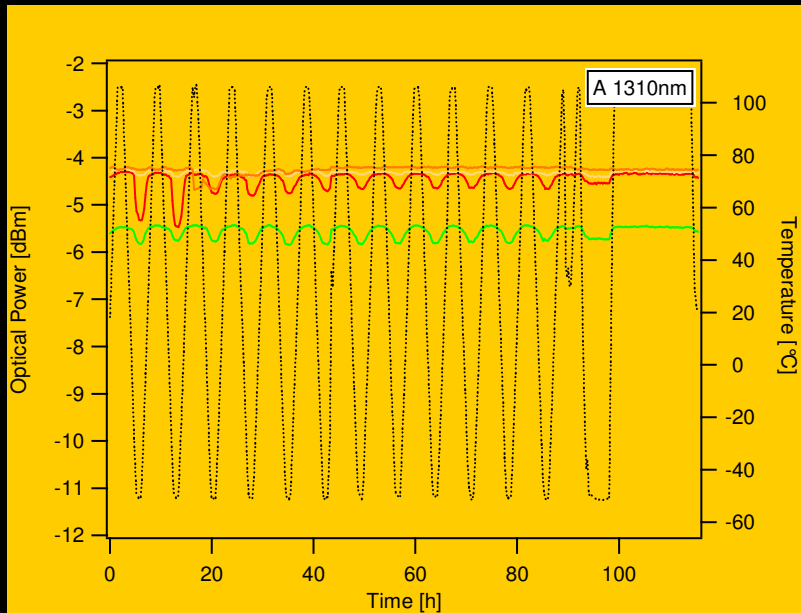
- The features of the fiber cable is a relevant aspect in relation to the global performance of fiber optic patch cords.
 - To prevent that influence, most of the previously presented tests were performed on secondary coated fiber.
 - The features of the materials used for their sheath layers (mainly extensional & retraction properties) are of capital importance.
 - The level of fiber's micro movement permitted in the cable might prejudice good behaviors of the whole assembly
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AVIM Performance

Influence of the cable



Result of unproper matching connector - cable

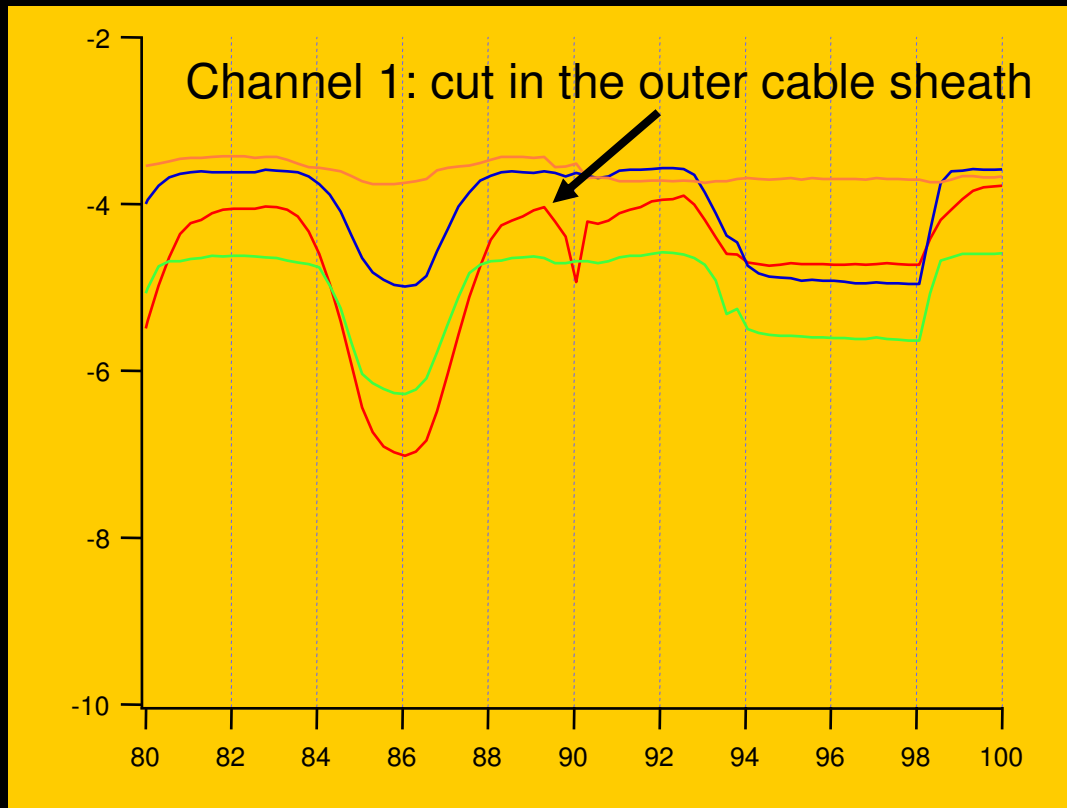


AVIM Performance

Influence of the cable



Restoring



Measurement @ 1550nm

AVIM Performance

Influence of the cable

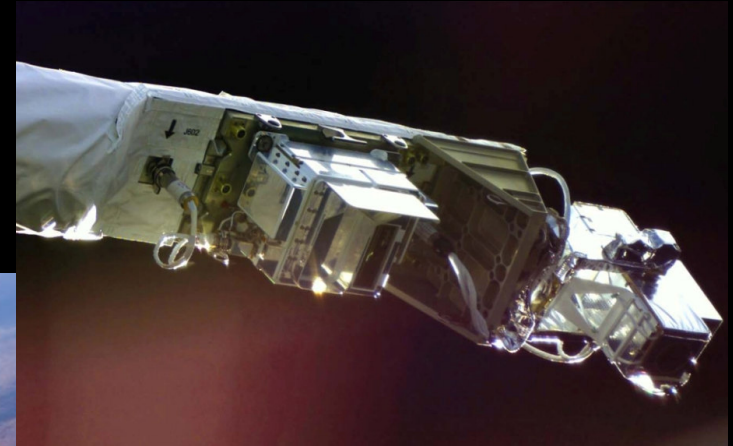


- Diamond has already several solution for a good matching between connector and fiber/fiber cable. Pretreating of the cable, expansion chambers in the connector
 - Only a good collaboration between the connector manufacturer, the cable manufacturer, the user and the termination facility guaranties good results & performances.
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Applications



Sensor package
on the Space Shuttle



Applications



- Intersatellit Links in the Terasar mission
TeSat-Spacecom GmbH & Co. KG
AVIM - PM
 - ESA SMOS mission
Contraves Space
AVIM SM
 - Other qualified projects and tests were realised.
-

On the track



ESA qualification

Activities are in process to define applicable specifications for a full qualification at the ESA.

EVALUATION TEST PROGRAMM
FOR
SIMPLEX OPTICAL FIBER CONNECTOR
SET
ESA/SSC Basic specification Nr. 33
Draft A
0402

On the track

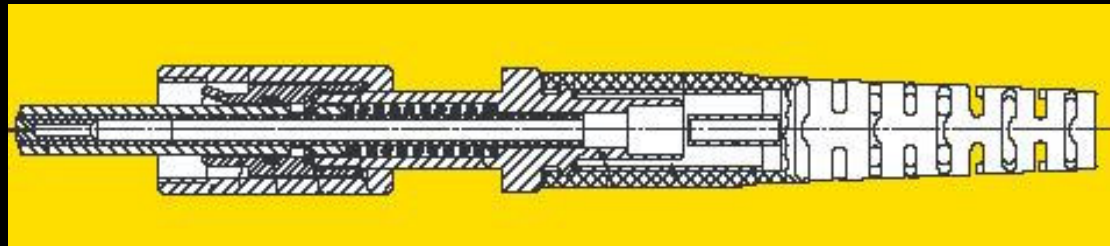
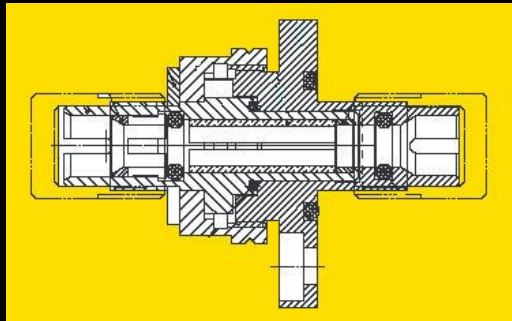


IP67 Sealed connection



On the track

IP67 Sealed connection



Additional advantages:

- Protection of the full connector against humid environment, prevention of failures due to humidity, salt water, corrosive environment in the inside of the plug.
- Prevention of ice building within the connector and the mating surface.

On the track



IP67 Sealed connection

Now under test!

Test procedure:

Immersion in Sweet water at:

- Ca. 23° C
- Depth: 1m
- Time: 30 min

Results:

- ✓ IL (on 9 μ m fibre core) <0.2 dB (@1310 & 1550 nm)
 - ✓ Variation in IL (before/after) <0.02 dB
-

AVIM in the future



😊 Thank you for your kind attention

- ▶ The discussion is open
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