Disk Sector Status

Pixel Local Supports

Conceptual Design Review

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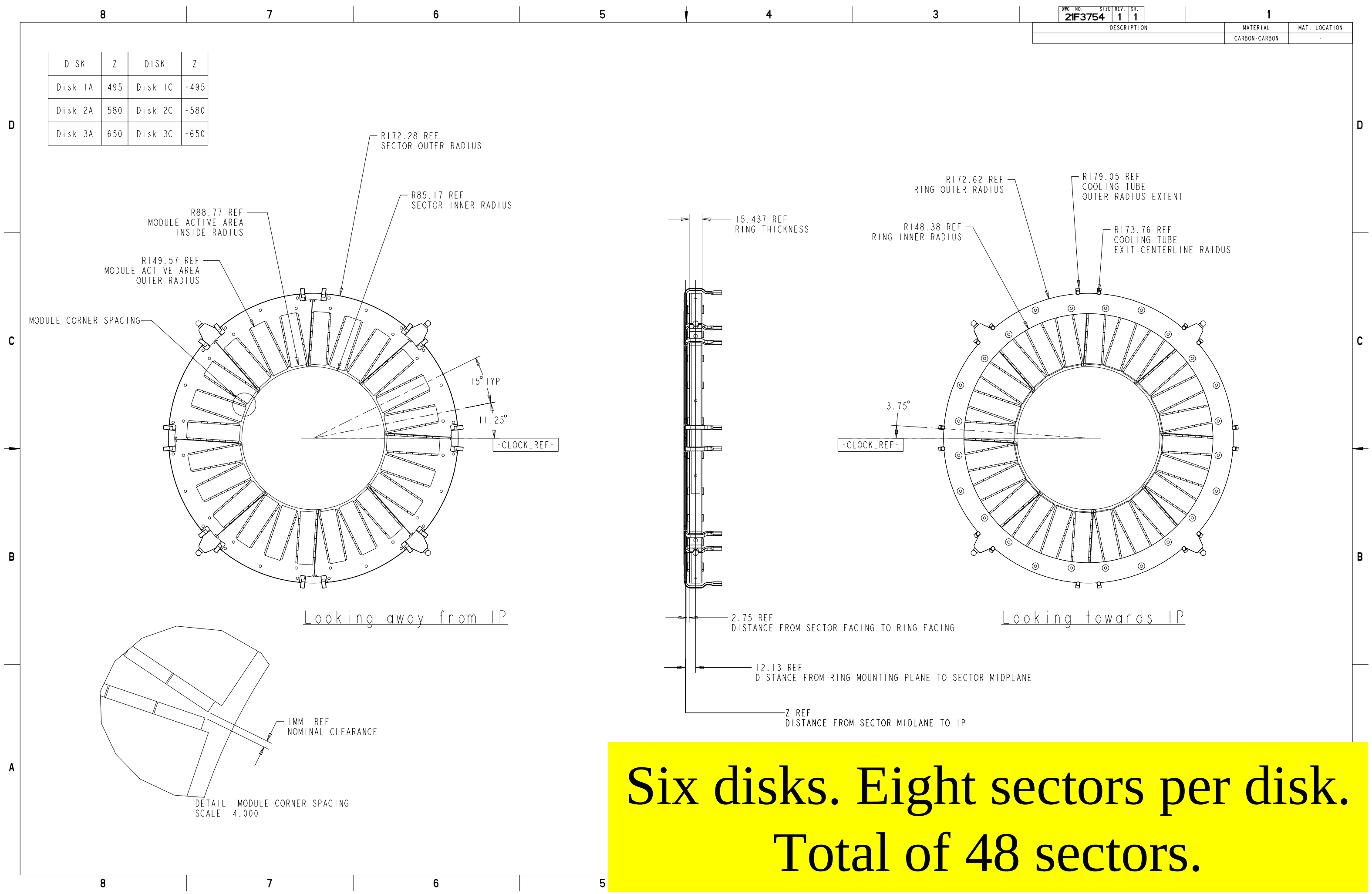
Overview

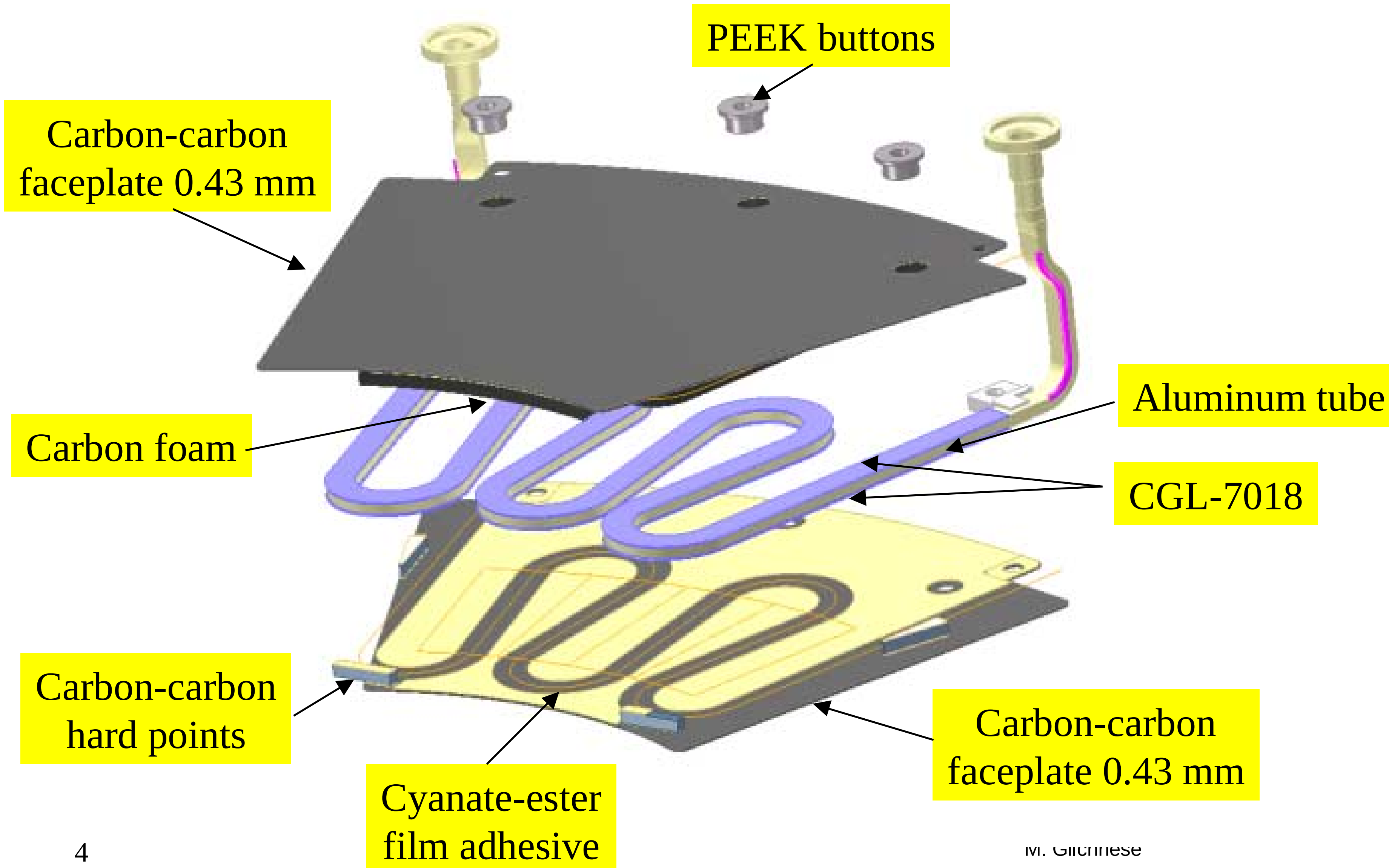
- The pixel layout has been changed substantially since the Local Support FDR last year.
- The sector dimensions have changed correspondingly.
- A baseline design was confirmed after the FDR last year.
- Evaluation of the design against requirements has been completed by testing of prototypes and by (FEA) calculations.

Disks



Six disks. Eight sectors per disk. Total of 48 sectors.

Disk Sector Concept



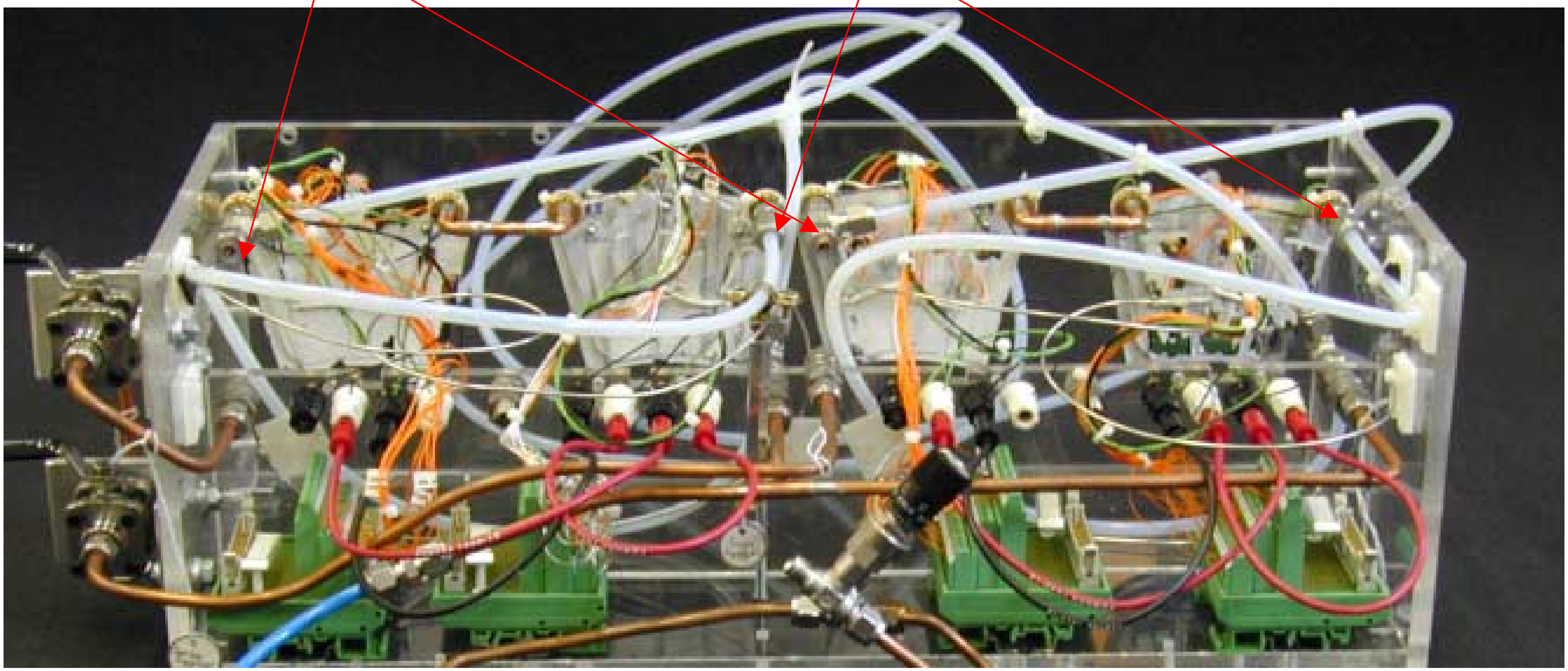
Since the FDR

- Most of the design requirements had been validated by the time of the FDR last year and were summarized in ATL-IP-ER-0004.
- Since the FDR
  - additional prototypes made(to current baseline dimensions)
  - sectors have been run with evaporative C_3F_8 coolant
  - thermal performance has been (re)validated after irradiation, thermal cycling, thermal shock, pressure fault conditions, loss of coolant.
  - stability calculations(FEA) performed, TV holography measurements
  - materials exposed to C_3F_8 vapor without degradation of performance
- Design is robust.
- Requirements met.

Evaporative Cooling Test

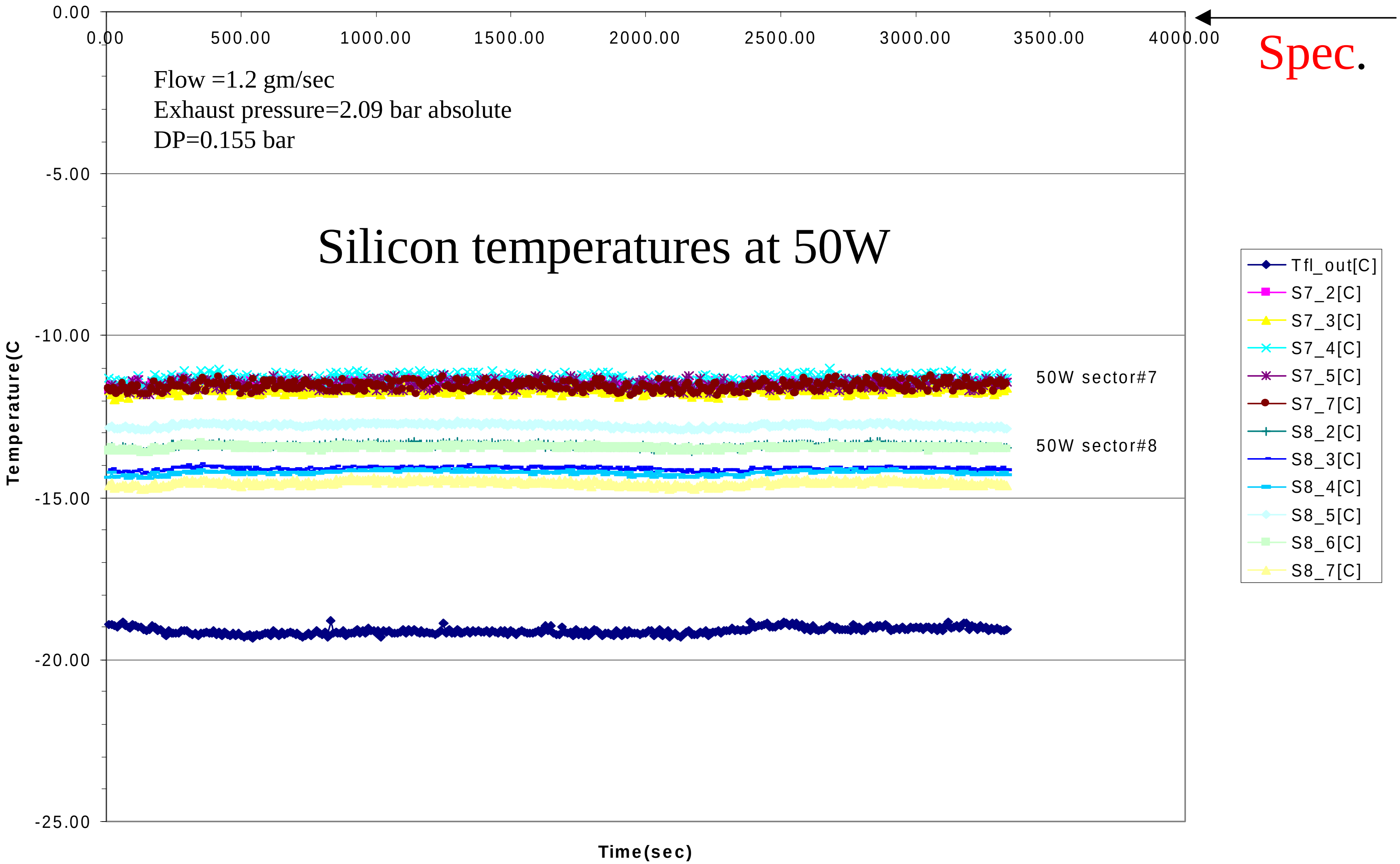
Capillary(0.030" ID
1.2 m long)

Exhaust lines



- This shows four aluminum-tube sectors. There are two pairs, running the pair in series. Two valves allow running each pair separately or running both pairs in parallel.
- Temperature recorded at multiple locations on each sector.
- Results at http://www-physics.lbl.gov/~gilg/Evaporative%20Tests/GIL_0600/ResultsJune00.ppt

Two Sectors in Series - Baseline



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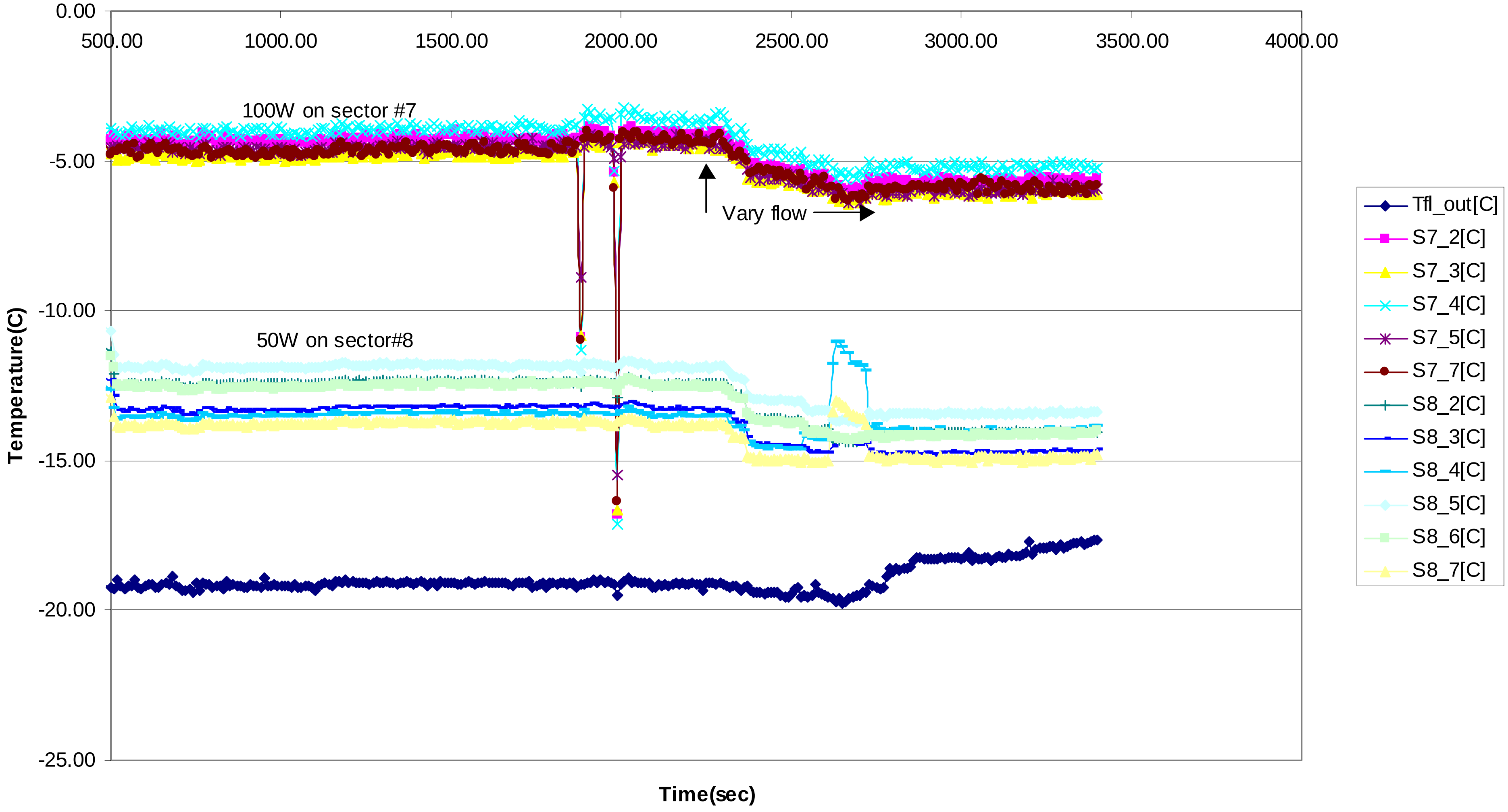
Operating Margin



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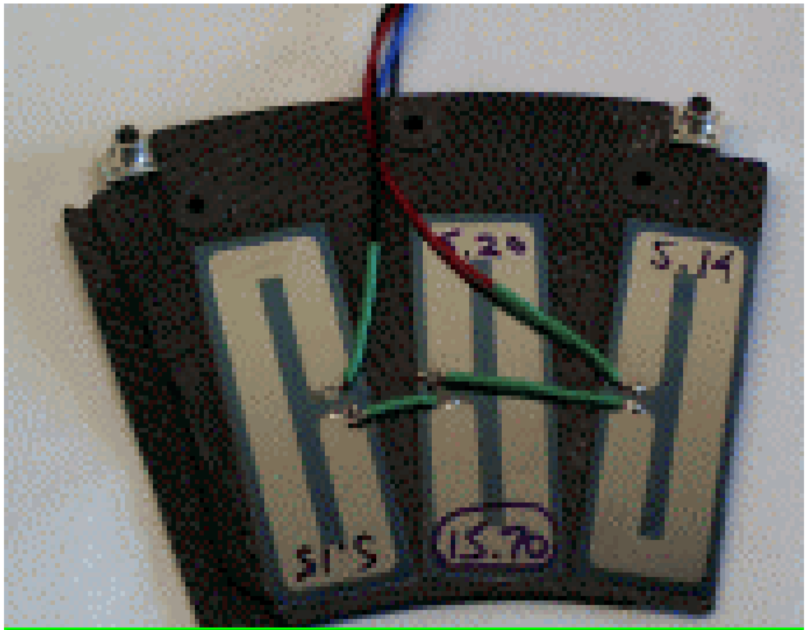
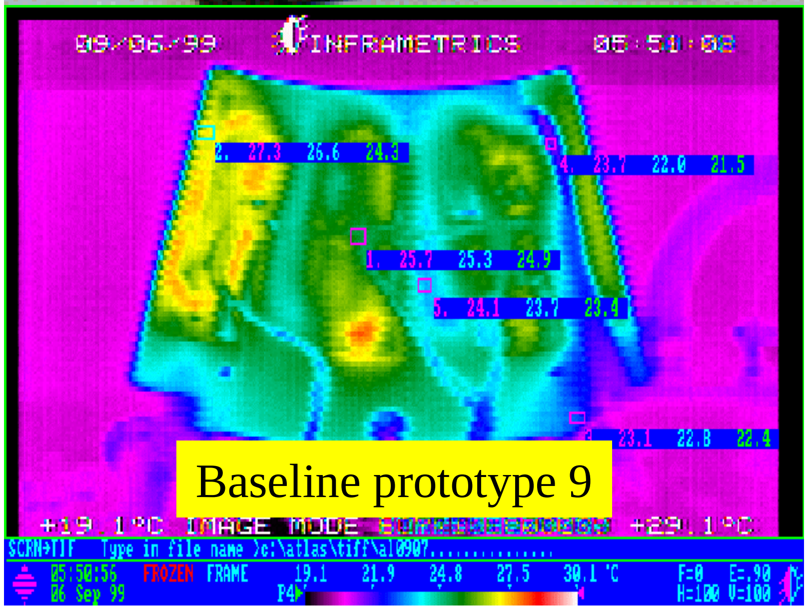
Thermal Performance

- Thermal performance is measured using IR thermography and room temperature water coolant.
- Heat loads are simulated using Pt-on-silicon heaters that replicate distribution of expected heat.
- “Stress” testing has been done on multiple prototypes
  - 50+ thermal cycles 20C<->-35C
  - Thermal shock using LN2 vapor(and also C_3F_8)
  - Pressure to 8 bar absolute
  - Loss of coolant
  - Irradiation up to 50 Mrad(followed by other stress testing).
- Good consistency for different prototypes.





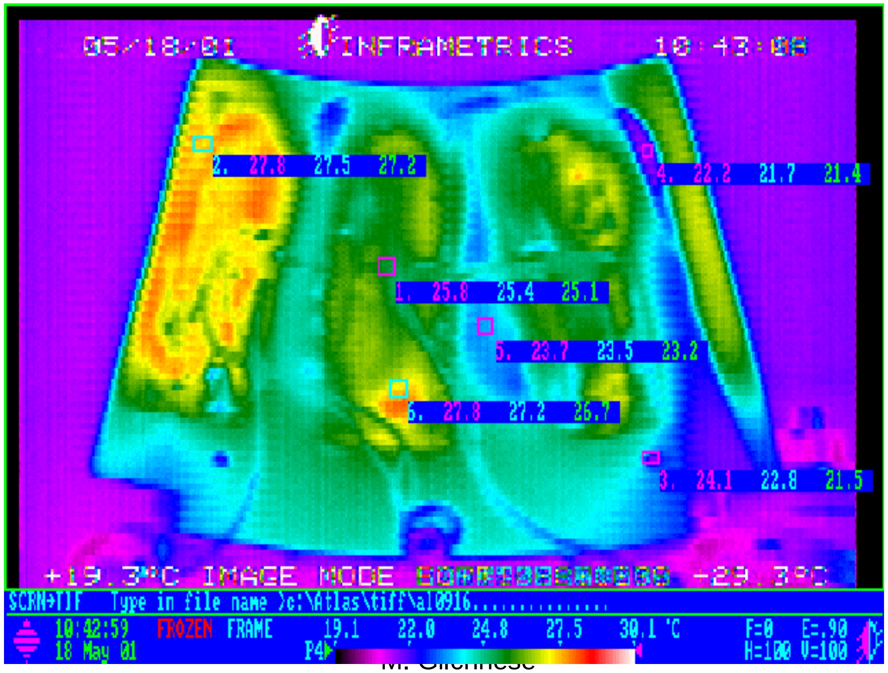
Baseline prototype 9

Thermal Performance Summary

- Example at right of pre-rad, one sector
- Typical values of maximum ΔT from coolant to silicon with room temperature water coolant are 6-8C before stress testing.
- Stress testing gives ΔT increase of <2C(usually less)
- Effects of irradiation are ΔT increase of <2C(usually less).
- Expect total maximum ΔT from coolant to silicon to be <12C.

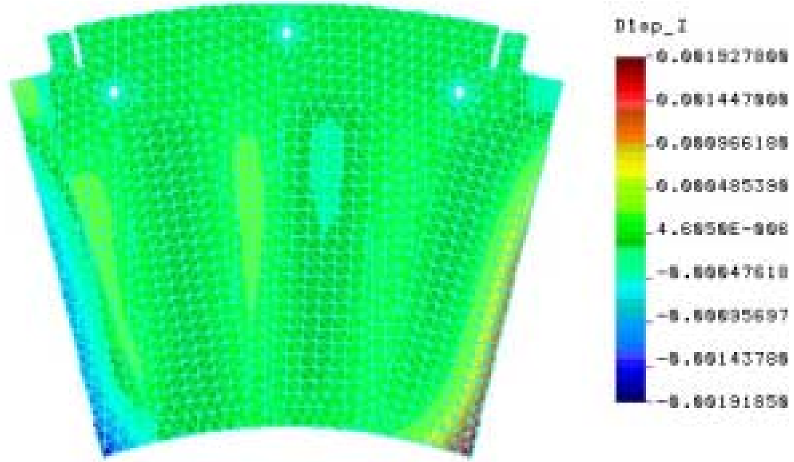
	MAXIMUM ΔT(^{O}C)
Baseline	6.9
50 cycles 20<-> -35C	7.7
LN2 vapor to -35C	7.6
8 bar for 1 hour	7.6
Repeat 50 cycles 20<-> -35C	7.1

Prototype 9 after irradiation(11 Mrads), operation at 150C, thermal shock to -60C

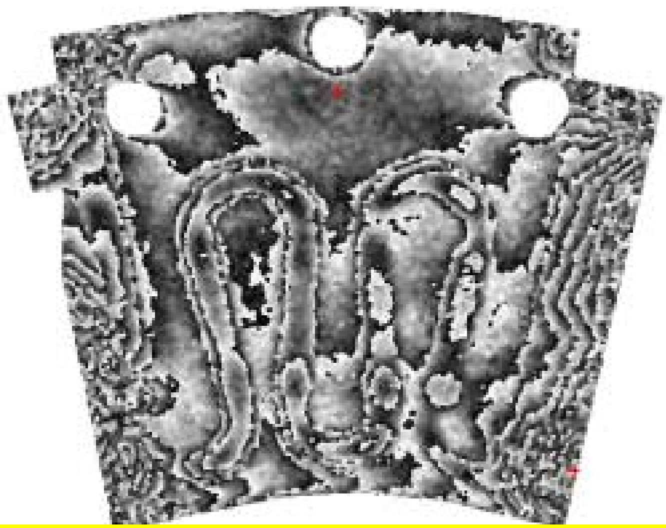


Stability

- Since the FDR, FEA calculations have been done(HTN-106210-0003) to estimate out-of-plane deflections(for which the spec is <30μ(rms))
- Over most of the sector, FEA indicates deflections of much less than 1μ/^{o}C(temperature change), rising to about 1μ/^{o}C only in small regions of the corners.
- TV holographic measurements(and other measurements) confirm the small displacements.



Z distortions for 16^{o}C ΔT in cm



TVH displacement map for 15^{o}C ΔT. Each fringe is 0.26 μ

Other Studies

- A test piece - 1/3 of a sector - that had been tested previously and irradiated to 50MRad was placed in 100% C_3F_8 vapor(the spec is max of 0.1%), along with samples of CGL-7018 for 3 weeks. No effect on thermal performance. No visual change in CGL material.
- Parylene coating (8-12 microns) covers well the sectors, including the foam. Carbon dust or particles well contained.

Risks and Conclusion

- What are the remaining risks?
  - Attachment of coolant fittings by laser welding demonstrated(backup is glue, also demonstrated). However, final fitting(seal) not selected yet => schedule risk.
  - Mitigation: attach fittings after completion of tube bending. Easy with glue. To be demonstrated with laser welding, working with vendors.
  - Module electrical performance on sector => schedule risk. Modules with prototype 0.25 micron electronics not until early 2002 - see figure.
  - Mitigation: mount and test with existing rad-soft modules, in progress.
- Conclusion
  - Risks acceptable
  - Design validation sufficient
  - Ready to begin (pre)production