

# Qualification and flight of a cutting edge Sunsensor for constellation applications

**LENS** R&D

FOCUS ON INNOVATION





# The team

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# Cutting edge Sunsensors for constellation applications

- Right performance
  - 3 to 5 degrees is enough for LEOP and Safe mode operation
- Right reliability
  - 5 to 7 years in (higher) LEO
    - >36.000 thermal cycles
    - Radiation hardened
- Lowest possible total cost of ownership
  - Low recurring price (at high volume)
  - Easy mounting
  - Guaranteed performance without calibration
  - No delta qualifications required

# BiSon64-ET(-B)

64° field of view (in diagonal) analogue fine Sunsensor with or without baffle

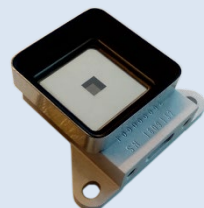
- Accurate (3.5° without and 0.5° with calibration)
- Envelope qualification fit for all known missions
  - -125°C..+125°C temperature range
  - 40g sine, 41.6g random, 3.000g shock
- Radiation hardened
  - $4 \cdot 10^{14}$  1MeV electrons tested (equivalent to 9.2Mrad and  $12.56 \text{E}9 \text{ MeV.cm}^2/\text{g}$ )
- 100% EAR/ITAR free
- ESA qualified
- Batch manufacturing including standard TVAC and random vibration acceptance test.



# Sunsensors timeline



2012



2013  
**esa**  
ARTES21  
(ESAIL)



**esa**  
ARTES 3.4  
2015

Vesta  
ELSA-D  
LISA-B  
Earth-I  
...  
OTB-2  
OTB-3



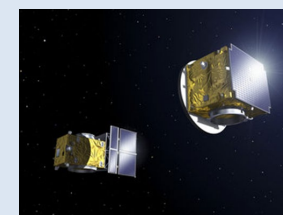
2015  
**esa**  
ARTES 5.2



2017  
**esa**  
GSTP 6.2



Falcon  
Q3/2020



ESA Proba-3  
Q3/2021



Phobos  
rover



Triton-X



Micro



Mini

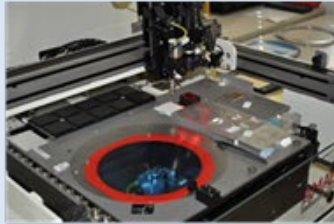
high volume sunsensors

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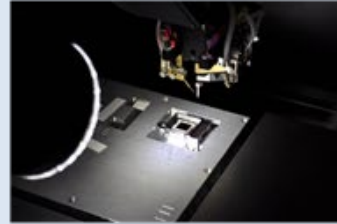
# Production optimised for volume manufacturing



Wire-bondable  
integrated  
connector



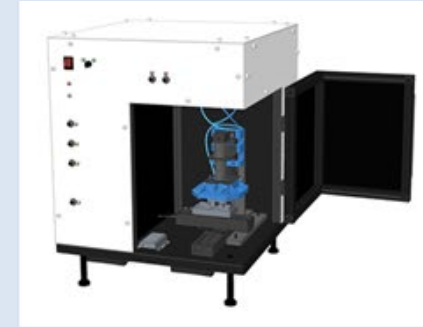
Vision based  
Pick and place  
assembly



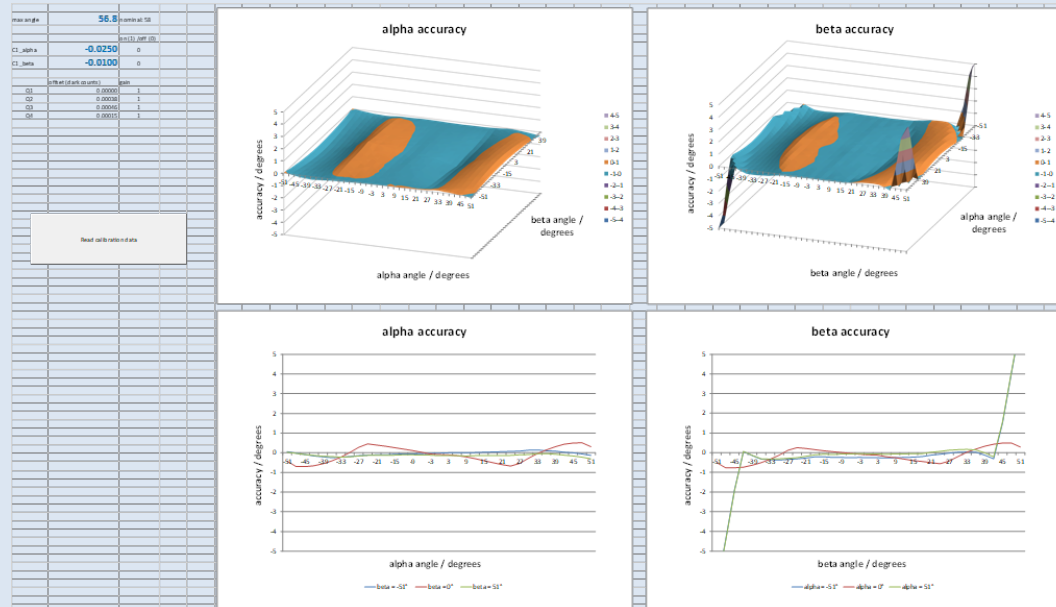
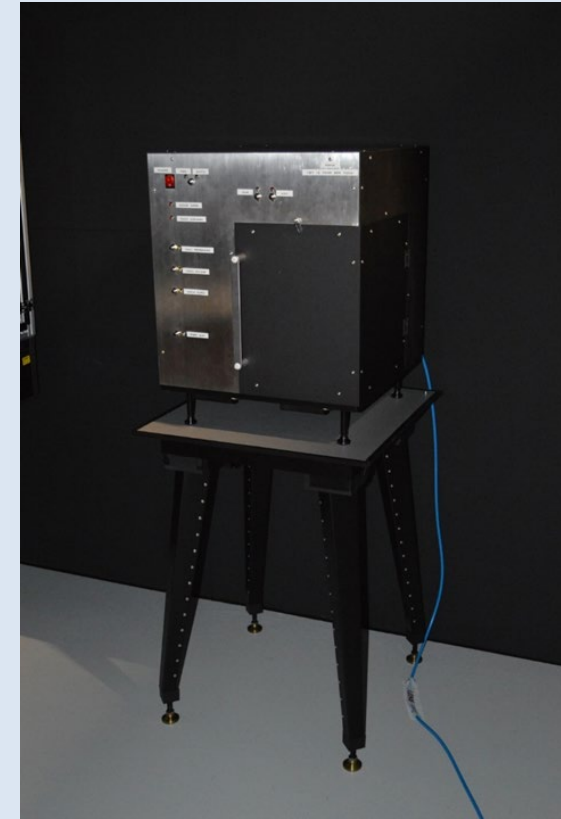
Automated  
Wire-bonding



Wafer-scale  
Membrane  
Production



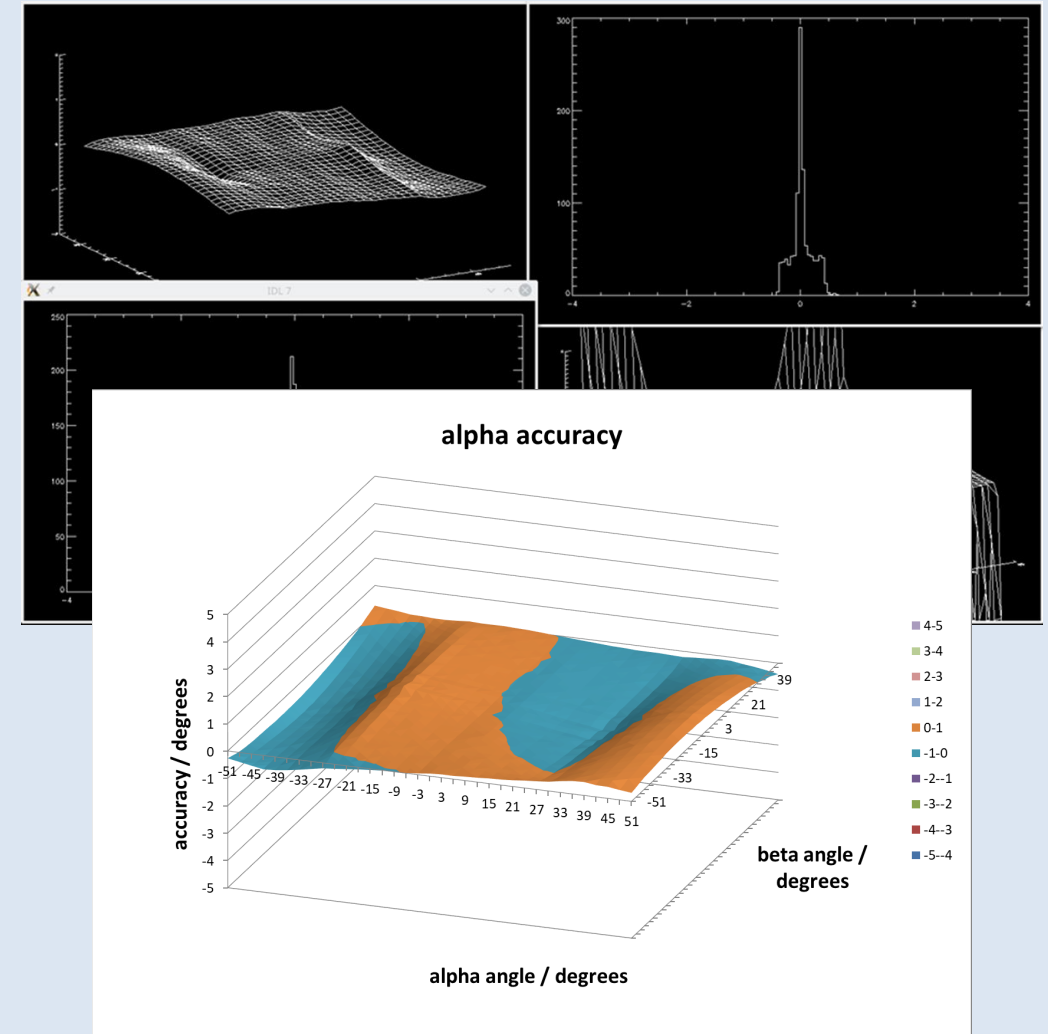
Automated  
final assembly



Guaranteed accuracy  
through automated membrane assembly

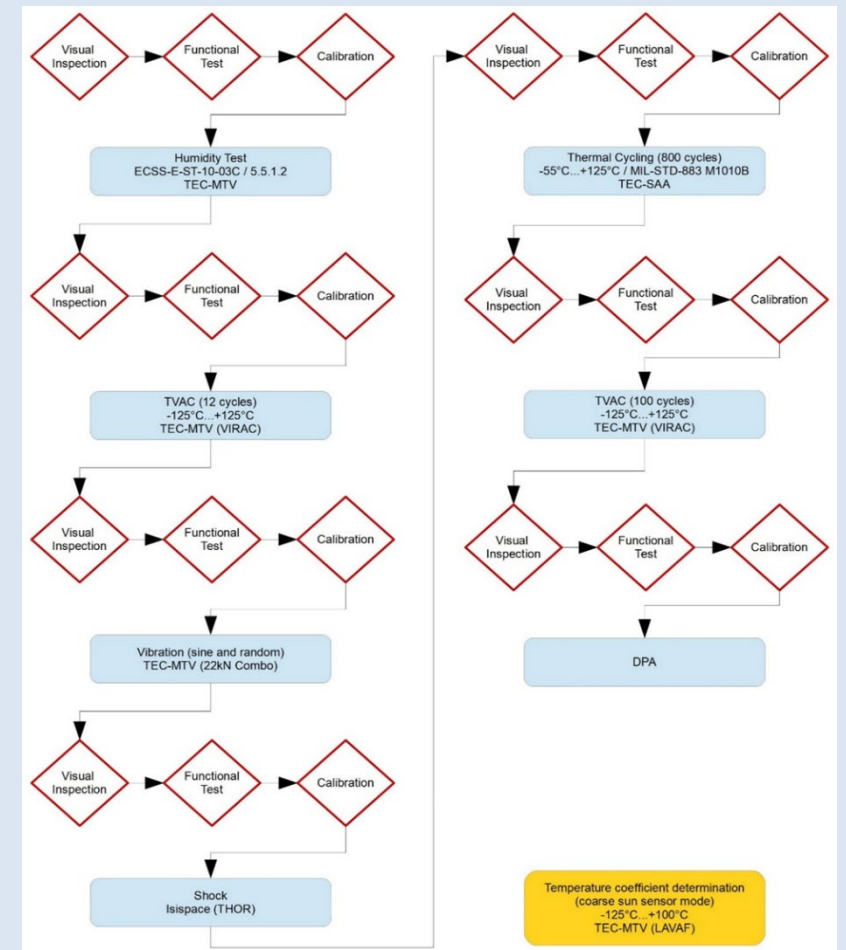
# Reproducible performance

- Simple optical configuration
  - photodiode
  - Single sapphire membrane
- Straight forward model
- Very good match with real measurement data
- High repeatability through MAMA tool and process control



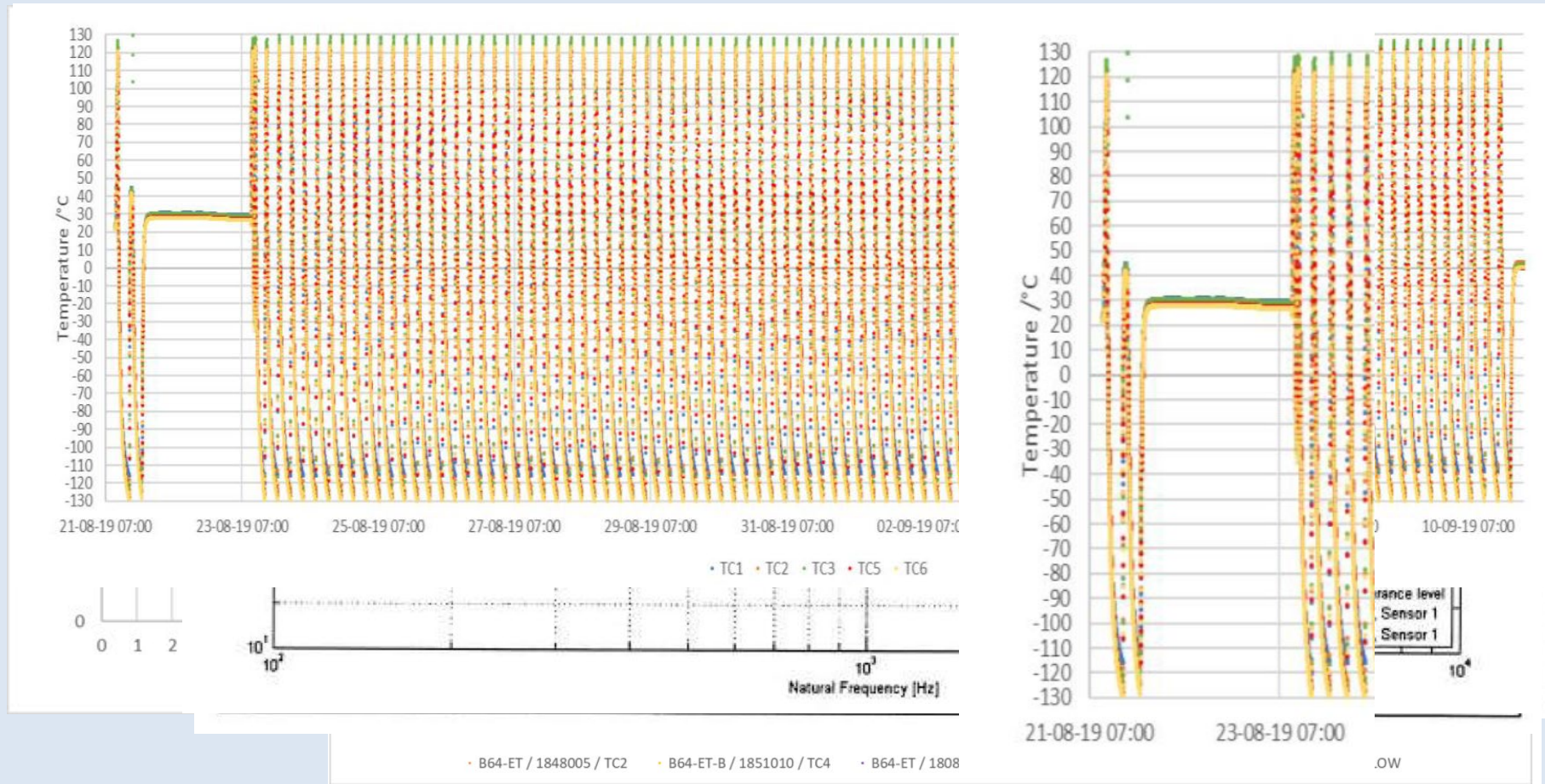
# Full ESA qualification

- Humidity
- 12 TVAC cycles -125°C..+125°C
- 40g Sinus vibration
- 41.6g Random vibration
- 10.000g Pyro shock
- 800 Thermal shock cycles -55°C..+125°C
- 100 TVAC cycles -125°C..+125°C



# Full ESA qualification

- Humidity
- TVAC
- Sinus
- Random
- Shock
- TC
- TVAC



# Lowest total cost of ownership

- Select and fly
  - no delta qualifications required due to envelope qualification
- Plug and fly
  - no alignment at spacecraft level
  - No uploading of calibration data required
  - No fixed pigtail but a real high reliability connector
- Lowest overhead
  - basic formula only
  - No temperature or radiation degradation compensation
  - No memory or processing required for calibration correction

# Conclusions

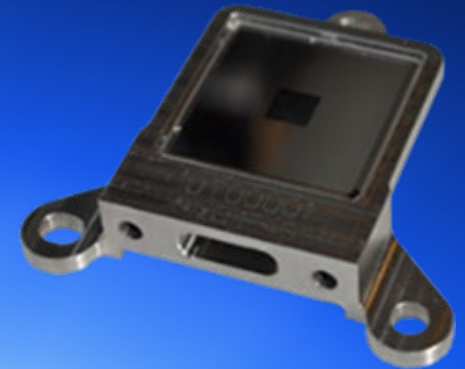
- Cutting edge Sun sensors for constellation applications should:
  - Be good enough
  - Have a verified reliability
  - Provide the lowest total cost of ownership
- The BiSon Sun sensors fit those descriptions as the most affordable Sun sensors in their reliability class.



# Cutting edge Sunsensors For constellation applications



When quality counts  
and budgets matter



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