Birds webinar Lesson learned from manufacturing of 1st to 3rd CIT Birds satellite

Tetsuro Harada
Chiba Institute of Technology
2023/11/08

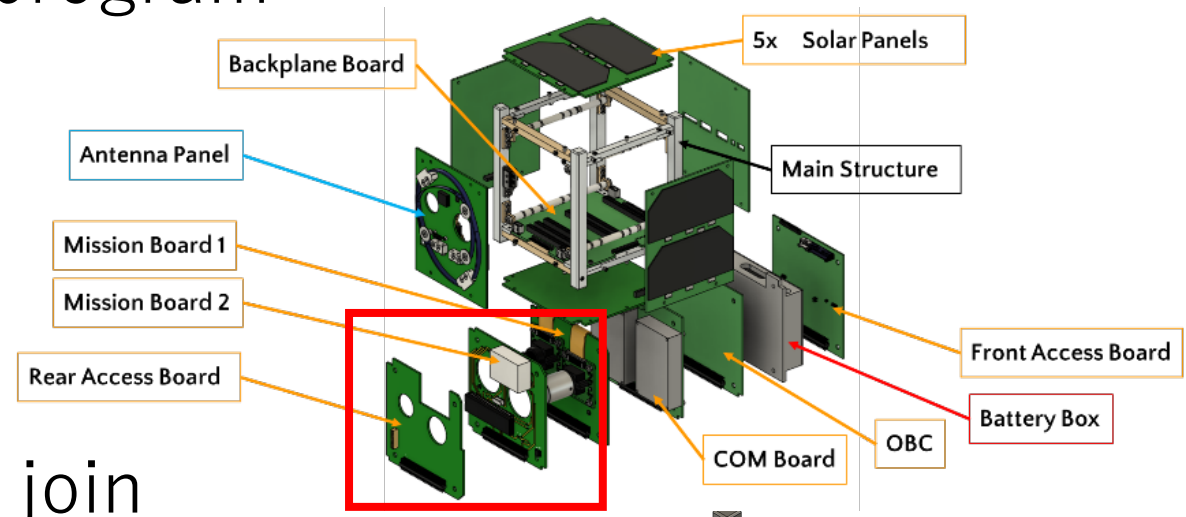
※暫定版
Growing
Advanced and
Refined space
Development
E
Ngineers in
succession and under the
satellite
GARDENs-01

Scope

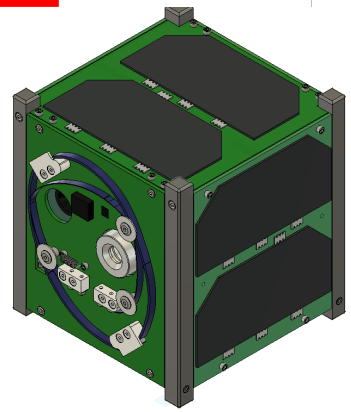
- This document addresses Lesson learned note for CIT's 1st to 3rd satellite especially JAXA and frequency coordination

Program summary

- Starting in 2021, This is educational program that develops up to 9 cubesats
- ISS JSSOD is applicable
- **Bus bus is** applicable
- **From sophomore**
- **Students all department** are able to join
- Mission plan, design, manufacturing, test, operation
- Goal「**Must Work Cubesat**」

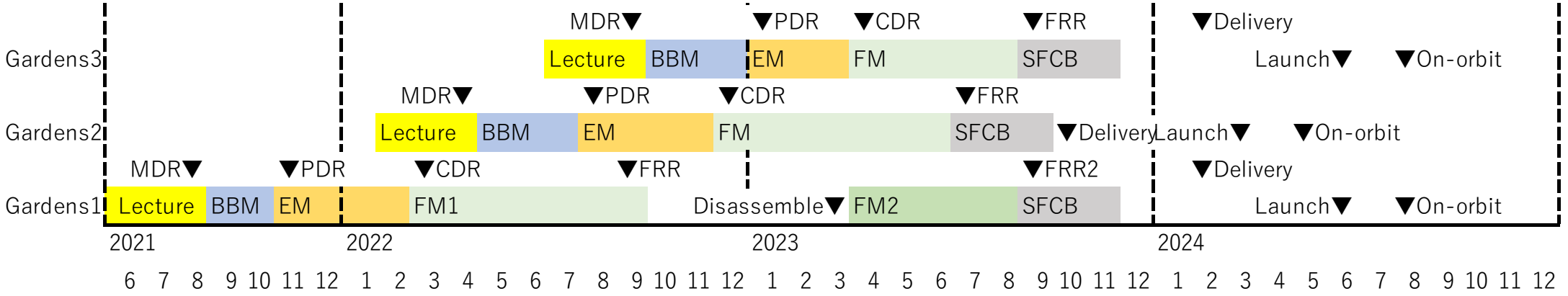


ミッション部



Schedule control

- Gardens1 took for **2 years and 3 month** for development.
  - Delay by frequency coordination, JAXA SFCB, birds bus improvement, and graduation
- Gardens2 took for **1 year and 5 month**
  - 4 month delay by frequency coordination
- Gardens3 took for **1 year and 2 month.**
  - No delay



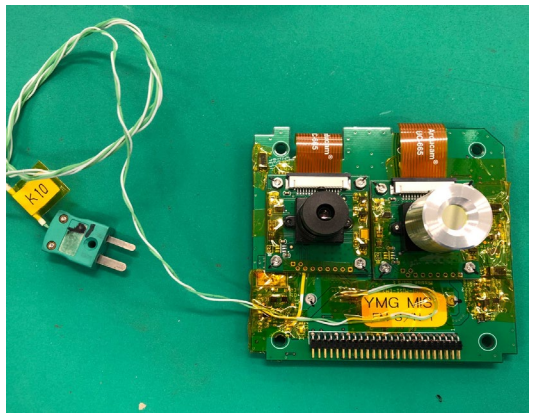
Technical summary

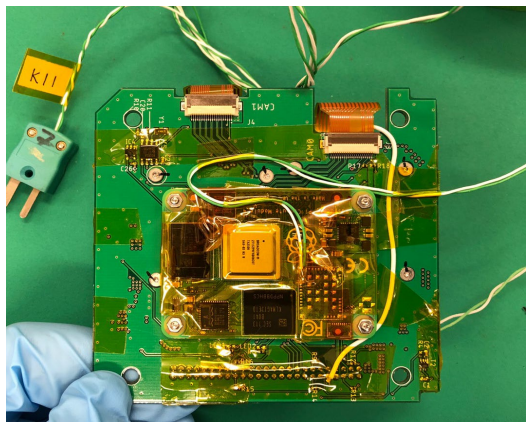
	Camera	APRS	Other missions
Gardens1	Rpi CM4 Dual camera	TT4 (APRS TNC) BIM1H	
Gardens2	Two Rpi Zero2 Two camera		FM audio
Gardens3	One Rpi Zero2 Two camera		Sun sensor

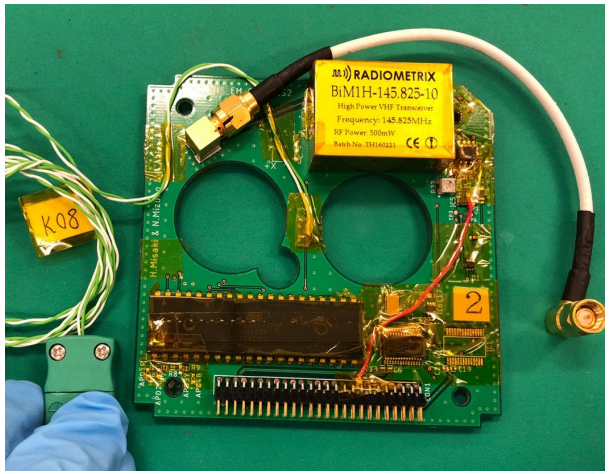
- Through 1 to 3 has camera and APRS mission.
- Different mission but

Gardens 1st

- Based on Birds4 and STR is identical to EM Birds5
- Rpi cm4 and dual camera
- TT4 is DIP package
- 2 mission board

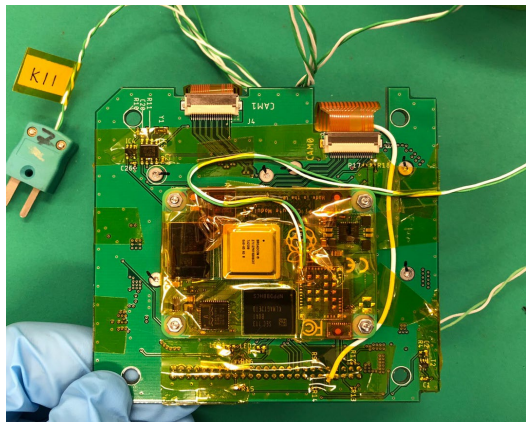


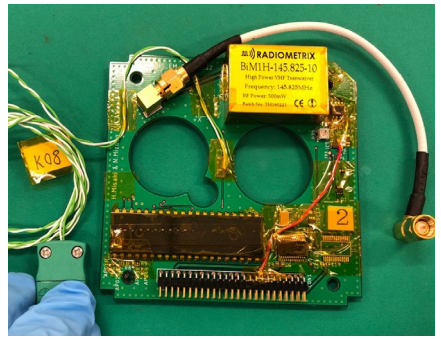


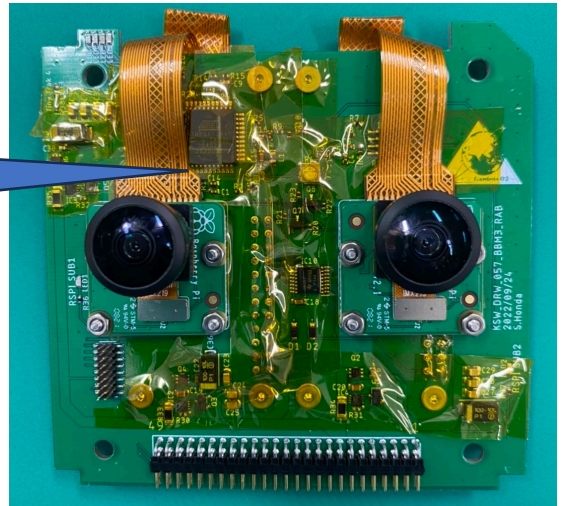


Changes Gardens 1st to 2nd

- Rpi cm4 to two zero 2
  - Added mission boss
- SMA connector to SMPM connector
- ANT deploy inihibit RBF pin
- ANT RF Switch
- TT4 package change from DIP to QSMT

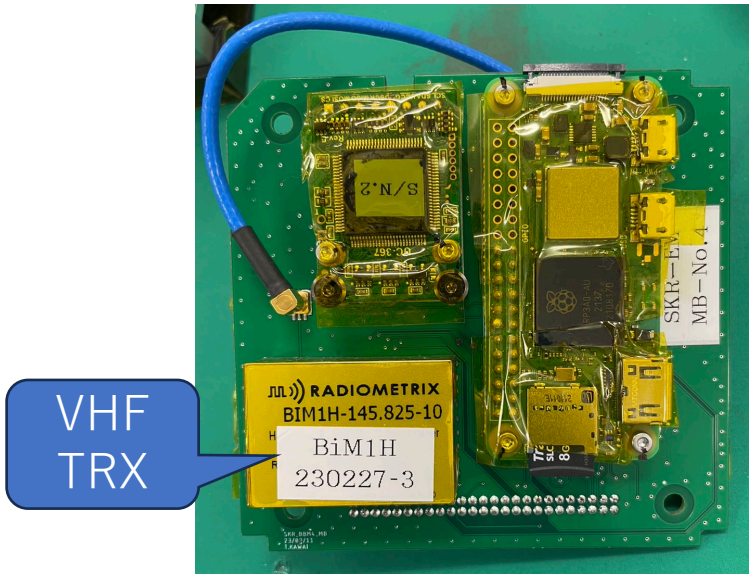


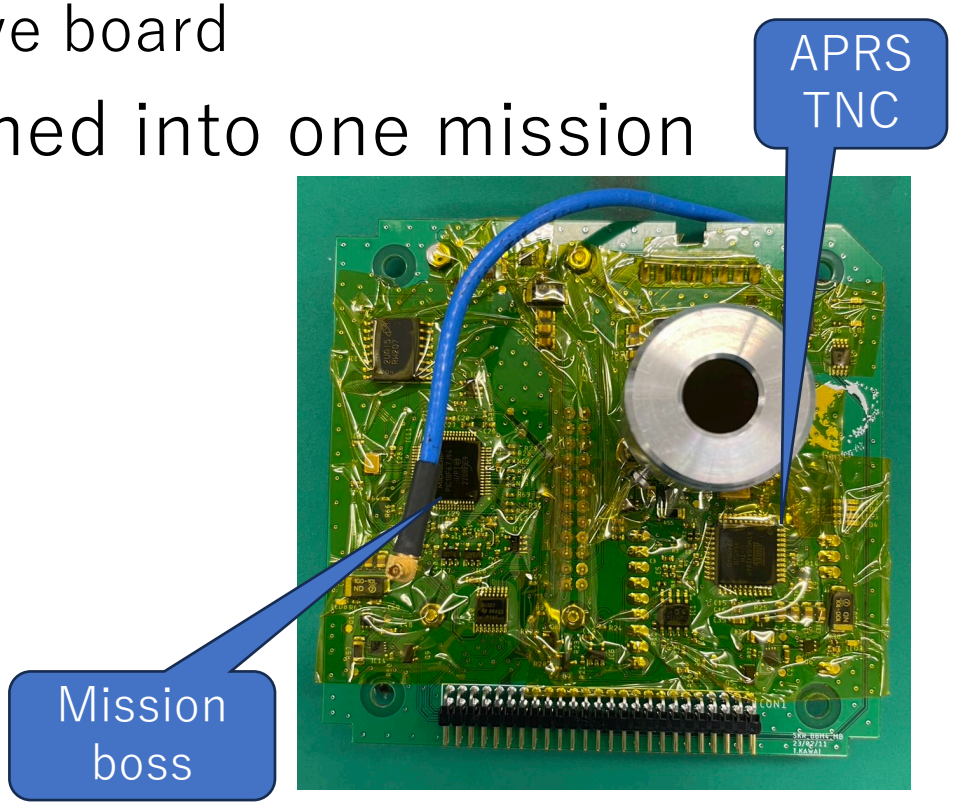




Changes Gardens 2 to 3

- Two raspi camera to one raspi camera and one arducam
- Replacement mission boss from BPB to mission board
  - Very good change. BPB should be passive board
- mission boss, CAM and APRS combined into one mission board





Hardware non conformance
Main PIC stop at High temp.

- In the Gardens3 FM, ANT did not deploy at high temperature .
- For further investigation
  - COM pic stopped when main pic stopped and COM PIC wait for command from MAIN PIC.
  - Decreeing temperature, then work again.

- Same non conformance occur 2Birds-5 OBC

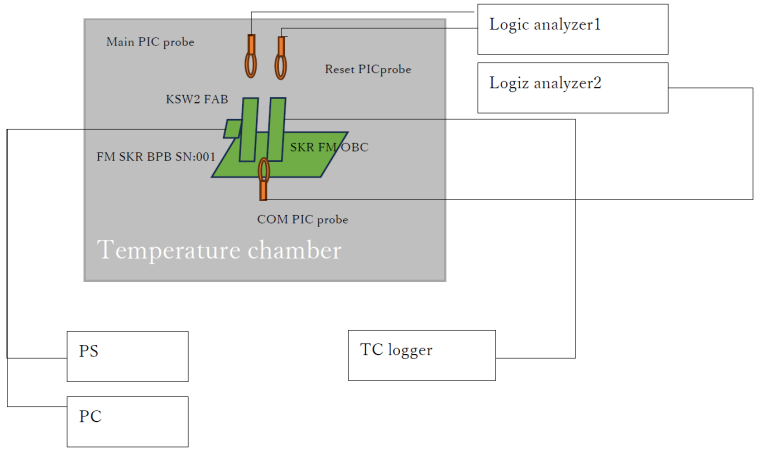
Table1 FM OBC SN001 temperature data

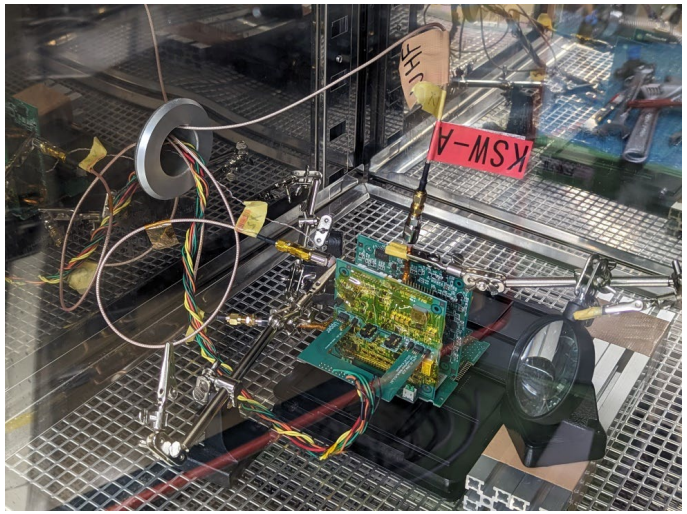
	External monitor	No monitor
FM OBC	36°C	42°C
sagami 2 OBC	41°C	49°C

- The temperature which Main PIC stop at depends on serial number.

Investigation1 OSC

- Right figure is configuration
  - Right bottom is configuration photo
- OSC frequency is measured by loop ant if OSC is work or not





Investigation1 OSC

- Data Confirms Main PIC OSC does not work indicated by orange at high temp (Blue is compic)
- One of root cause of frequency margin.
- In any case, frequency margin is not taken into consideration. The margin need to be measured.
- For detail report, refer to SKR_PKG_104. only Japanese, no English.

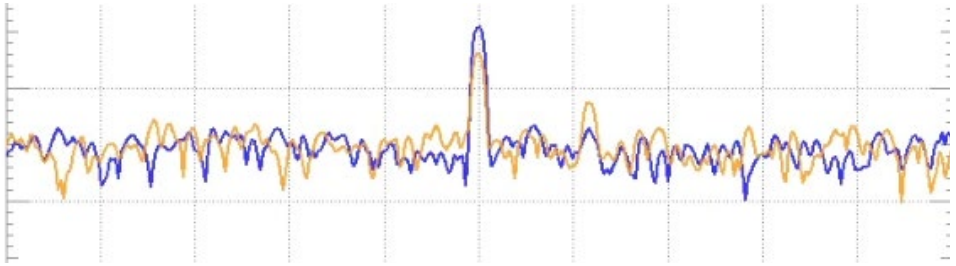


fig1　nominal

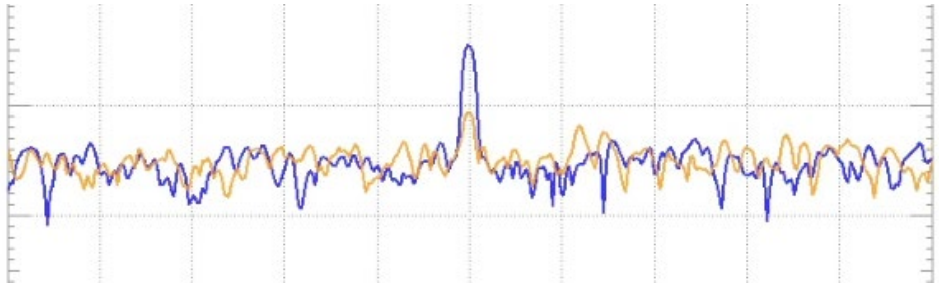
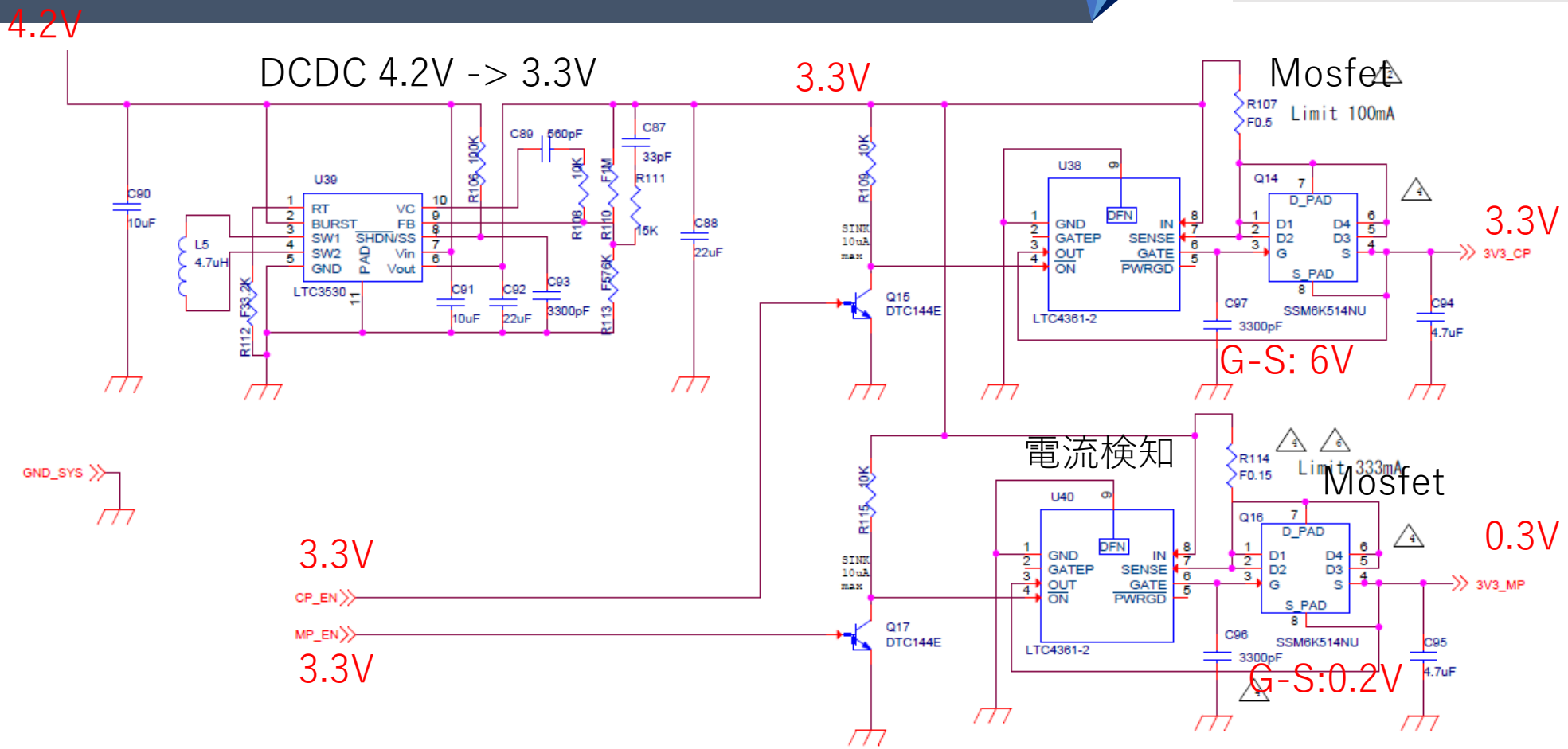


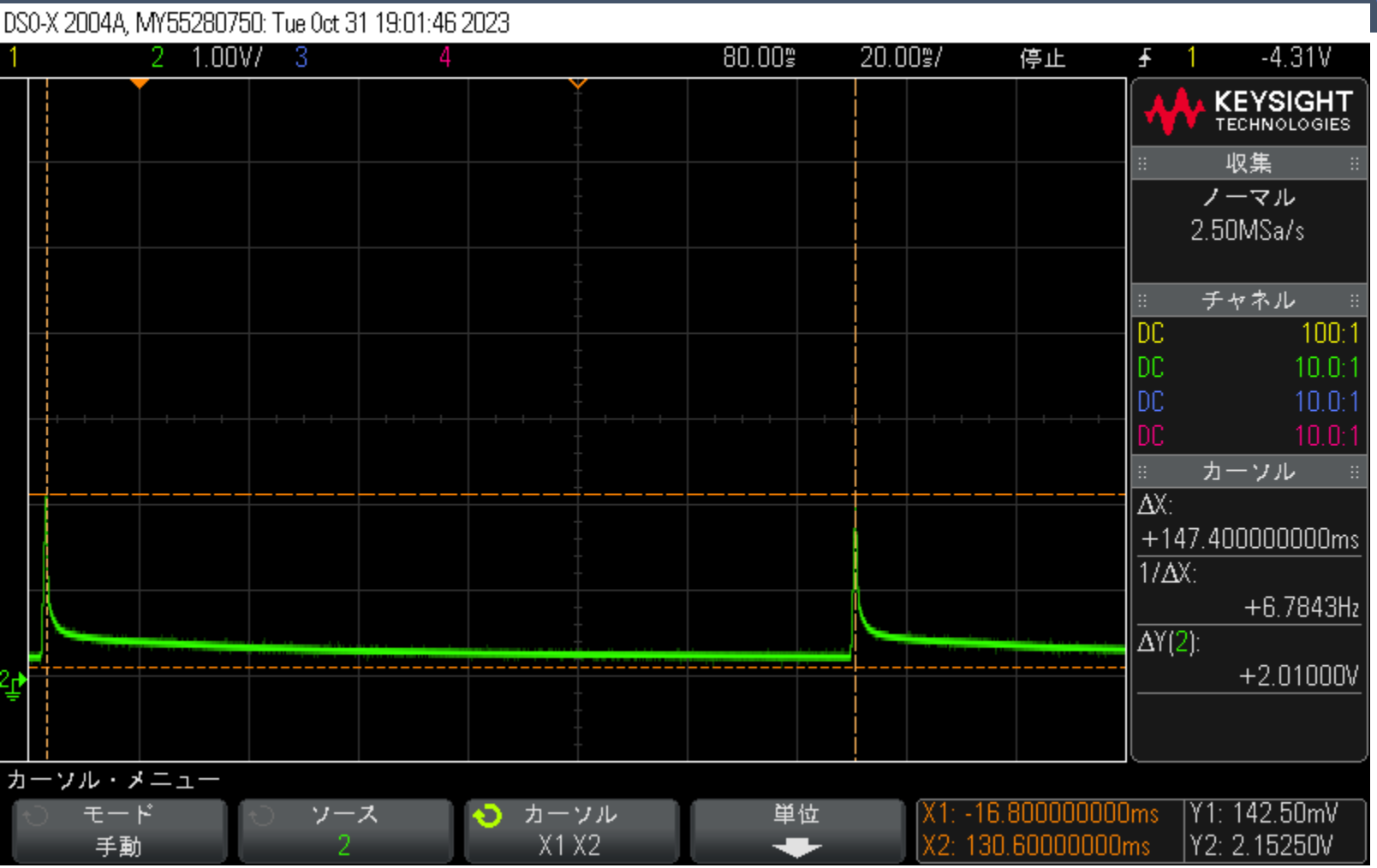
fig2　high temp 47degC

Voltage Measurement at high temp



3V3_MPのLCL and following circuit will be root cause

3V3_MP　@50°C



After 2.1V then drop voltage.

After 147ms, then same issue happed.

According to datasheet, OCP will cut mosfet after 130ms.
It is consistent to this issue.

OCP worked.

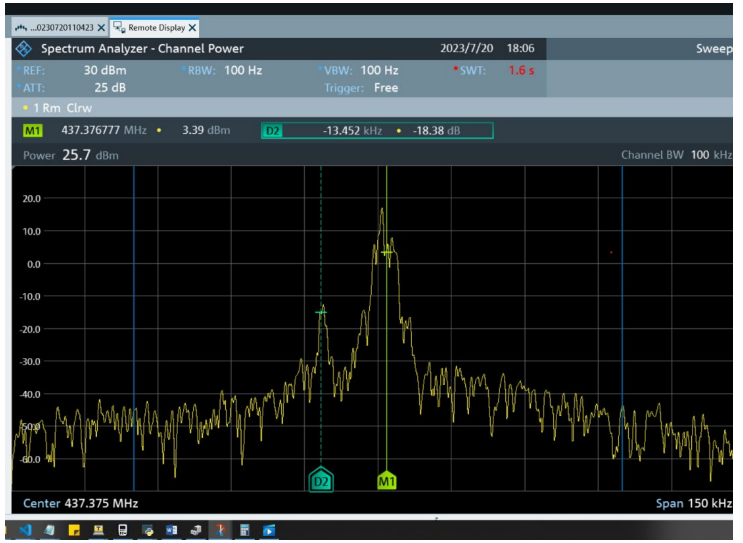
For further investigation, remove RS-232 Chip then test again.

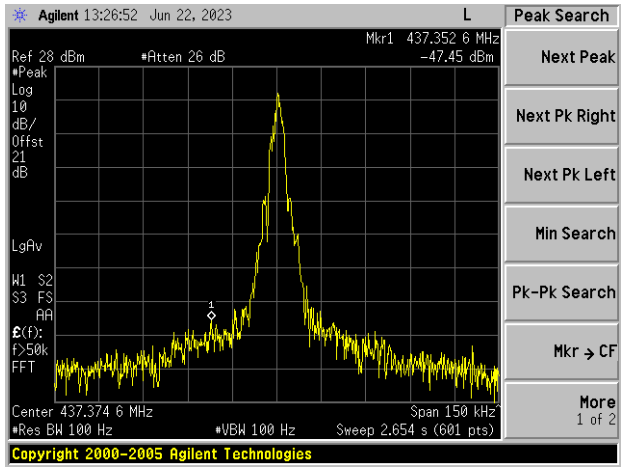
Frequency coordination

- AT vibration test for Gardens1 performed before frequency inspection accordance with KIT
- So-tu-kyoku (inspector) does not allow inspection with satellite configuration.
- FM1 Gardens was disassembled.
- For future: Inspection will be done before AT vibration.

Frequency coordination

- Inspection by So-tu-kyoku found spurious in spectrum analyzer(FPC1000) in the upper photo.
  - Agilent spectrum analyzer was okay.
- Rohde & schwarz confirmed that this issue occurred due to software bug.
  - To be updated for future software update.
- Spectrum analyzer over 3MYen will be fine or Use Inspection company 200k yen per satellite.



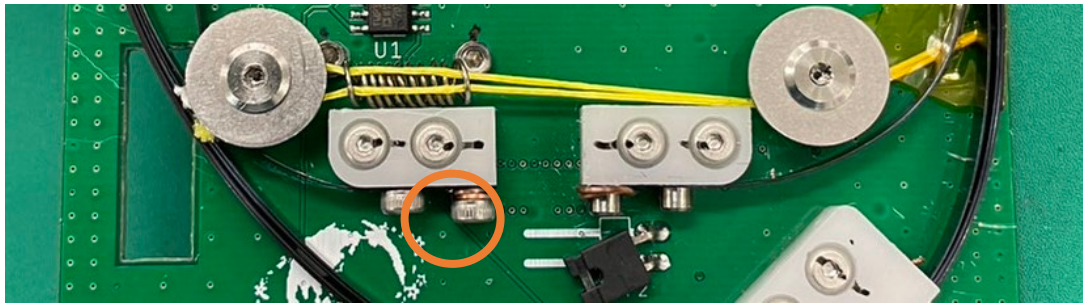


JAXA SFCB

- JAXA commented on VT requirement
  - VT level was too strong due to CTB bug.
  - Can be calculated
    - JDX-2013237B section 6
    - SSP50835E Appendx-I vibration attenuation rate
  - In conclusion JAXA confirmed updating JPAH for future.

Frequency coordination (MIUL)

- JAXA pointed out that electrical wire connecting ant element and boar is not in the MIUL
- For further, discussion, JAXA required us whisker evaluation and corrosion evaluation. Actually we did not do
- In conclusion, added following comment on MIUL
  - The satellite contain tin. Applicable part is tin plated copper wire for a terminal of antenna element. But this part is acceptable due to MUA evidence code 705.



JAXA SFCB

- Applicable JPAH changed from Rev.D to Rev.E during Phase012 after AT
- JAXA insist Spec is down grade so it is easy.
  - For example 1st frequency for VT spec from 60Hz to 30Hz
- It took many time consumption changing document format.
- For future lesion: discuss with JAXA for total cost.

Conclusion

- This document addressed Lesson learned note for CIT's 1st to 3rd satellite.