Solution for
A1 Port Analogue Regulator
Wrong Grounding

RIKEN/RBRC

Itaru Nakagawa

On 2022/03/23 10:40, Brooks, Melynda wrote:

Hi Itaru,

Yes, the grounding is a mistake. The primary result of the mistake is that the non-diagonal wedges needed to be calibrated in pairs so that the grounds got connected correctly when calibrating. Other than that, function was okay.

Melynda

From: Itaru Nakagawa <itaru@riken.jp>
Date: Thursday, March 17, 2022 at 4:53 AM
To: Melynda Brooks <mbrooks@lanl.gov>
Cc: jin huang <jhuang@bnl.gov>
Subject: [EXTERNAL] Column-A Station-1 port of FVTX ROC board

Dear Melynda,

  I know it is getting past for you, but I have to bother you again. I found mysterious circuit design in the ROC and I need to confirm with you. See attached summary file. The issue is in the analogue regulator for the FPHX of the A1 port (Column-A, Station-1). The ground of the regulator suppose to be wired to AGND_4 I believe, but it is actually wired to AGND_2. It is hard to imagine the circuit was designed like this on purpose. As I commented in slide 6, I guess it didn't cause severe effect for FVTX, but I would appreciate if you aware of any misbehavior of wedges connected to the A1 port commonly. I am seeking for any portable solution to fix this because I am afraid our condition can be different from FVTX. If you have any suggestion or idea, I also appreciate.
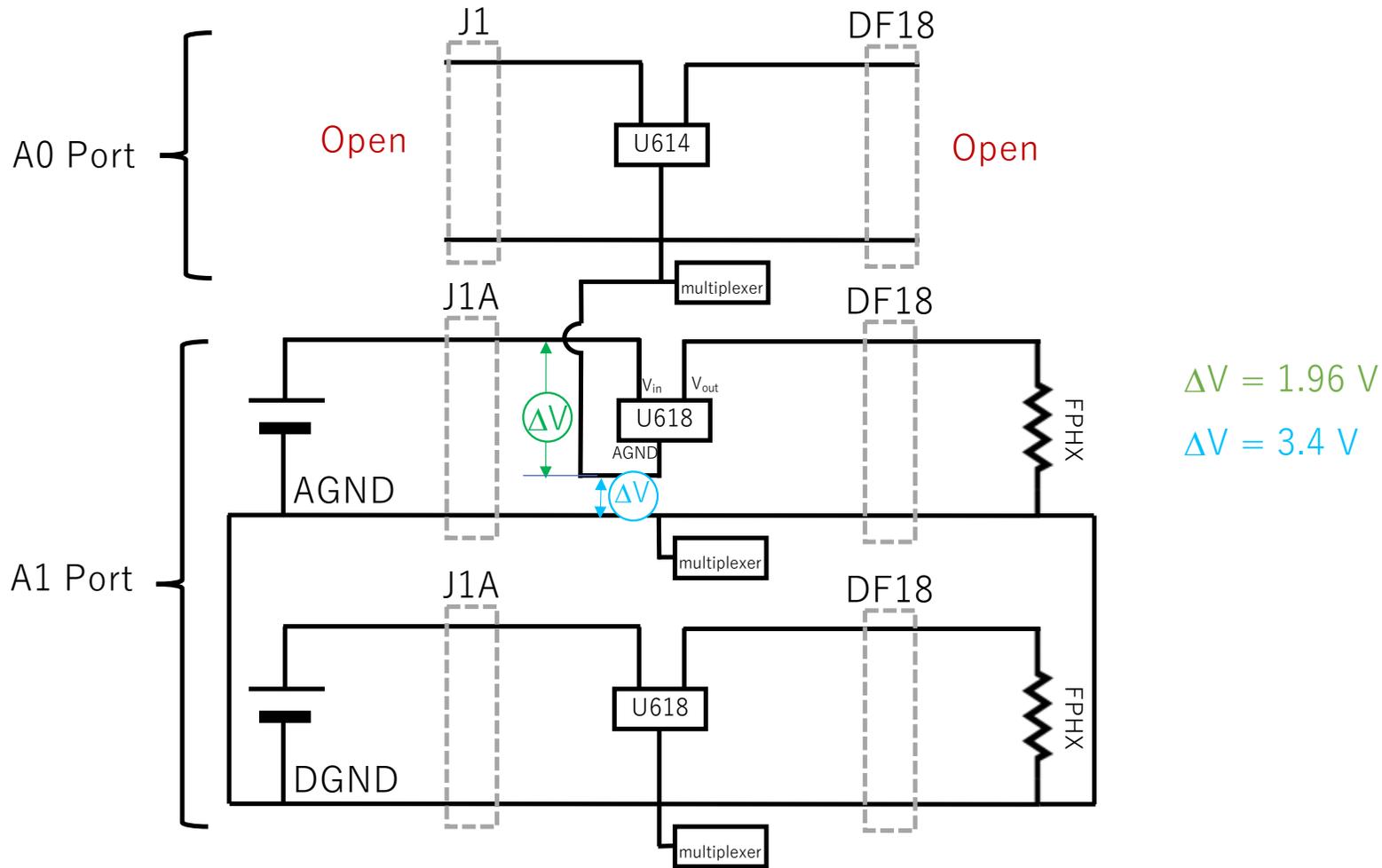
Best regards,

-itaru

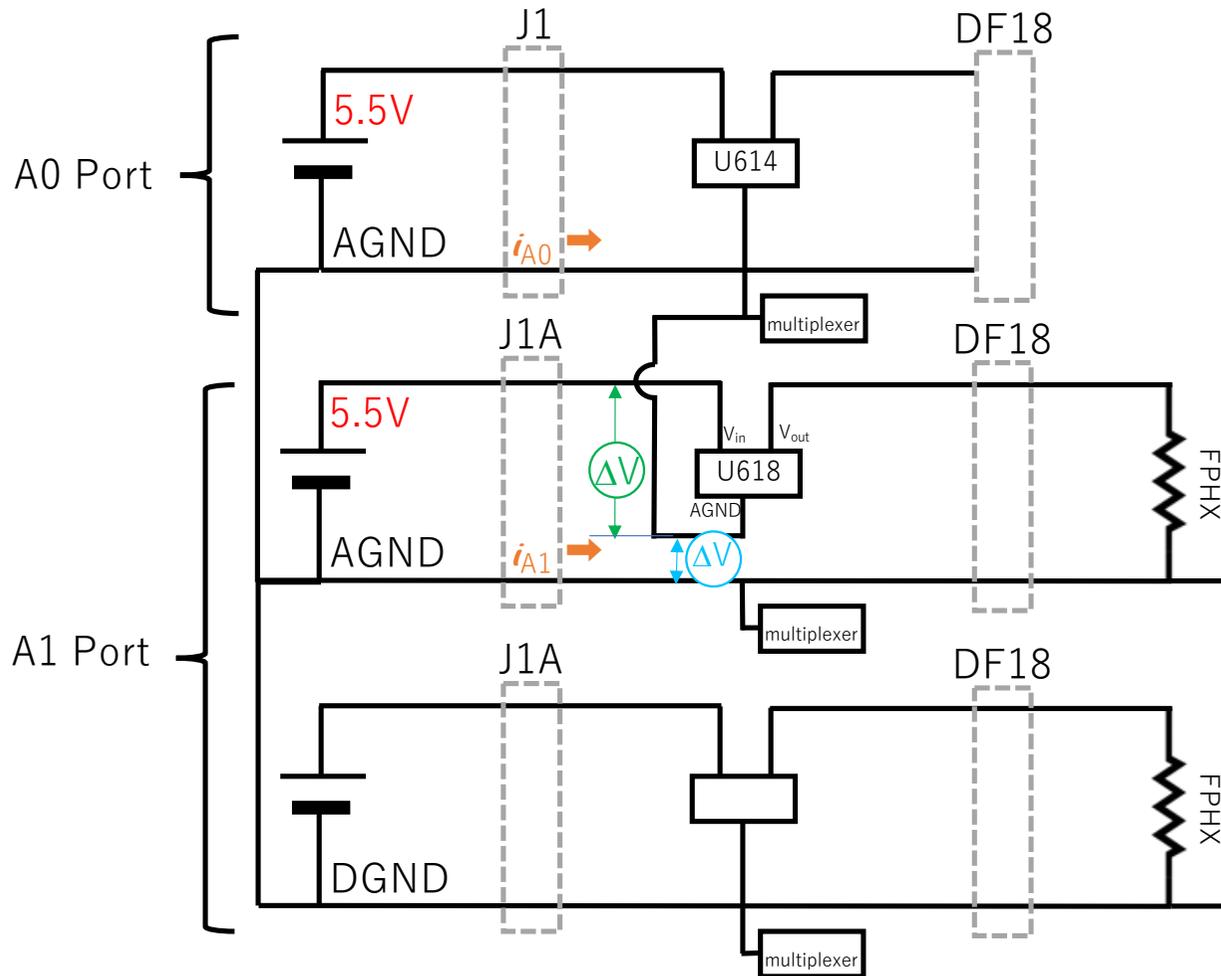# Voltage Gap Measurement with Small Wedge

FVTX Small Wedge

Present Circuit Diagram
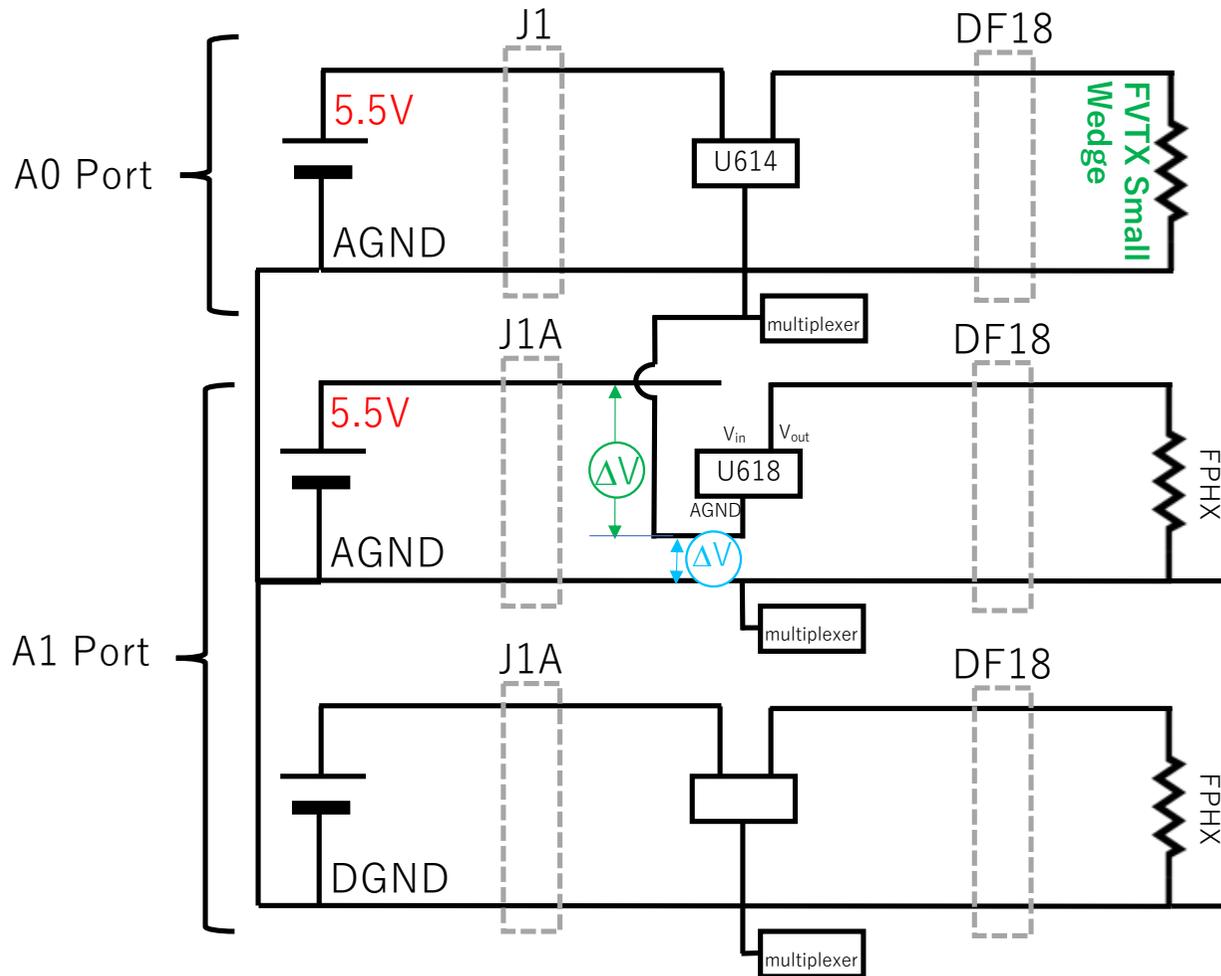
FVTX Case Circuit Diagram

$i_{A0} \neq i_{A1}$

The voltage drop between PS and the regulator is not necessarily same between A0 and A1.

$\Delta V = 5.406 \text{ V}$

$\Delta V = 0.0001 \text{ V}$

This is acceptable.

FVTX Case Circuit Diagram

The drawing current can be different with/without **FVTX Small Wedge** though, turns out the voltage drop different between A0 and A1 ports are negligibly small. Presumably because the analogue current draw is relatively small compared to digital to begin with.
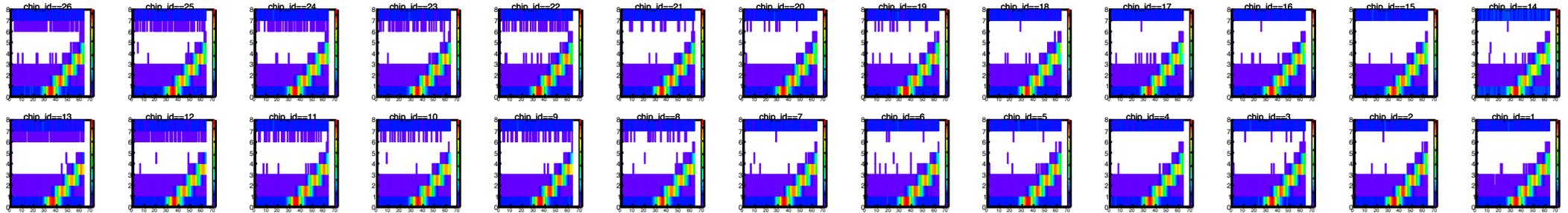
$\Delta V = 5.413$ V

$\Delta V = 0.0001$ V

Implementation of FVTX small wedge may not be crucial to operate A1 port.

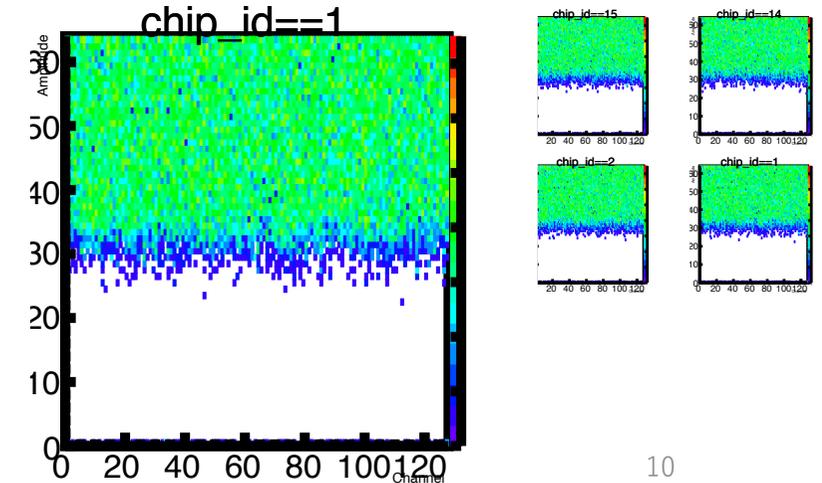# Calibration

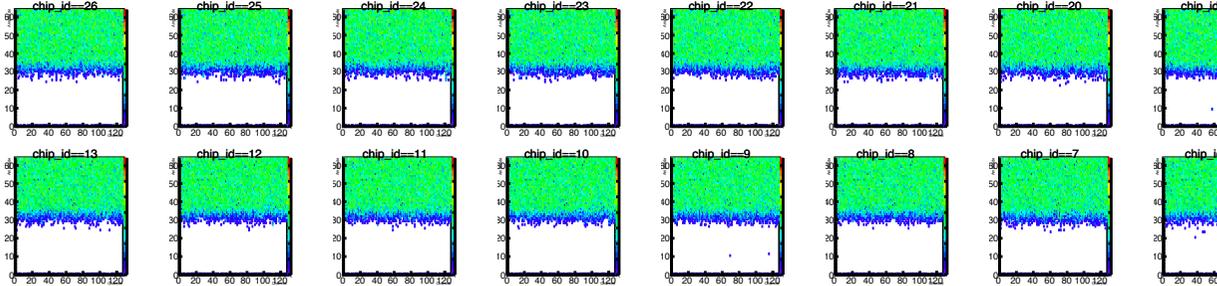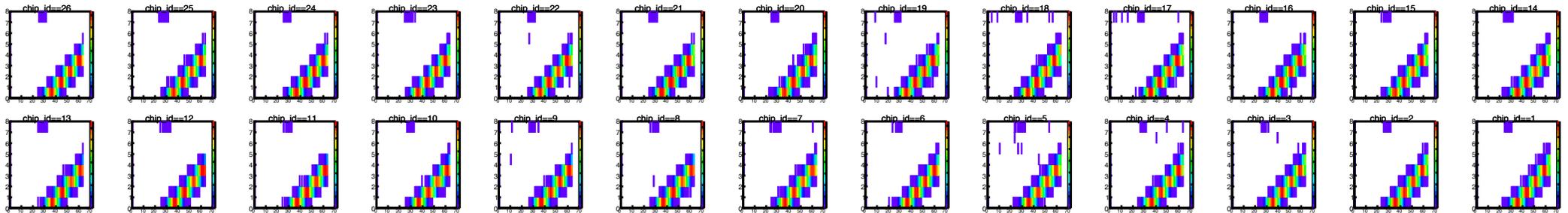# Without J1 power cable Without small wedge
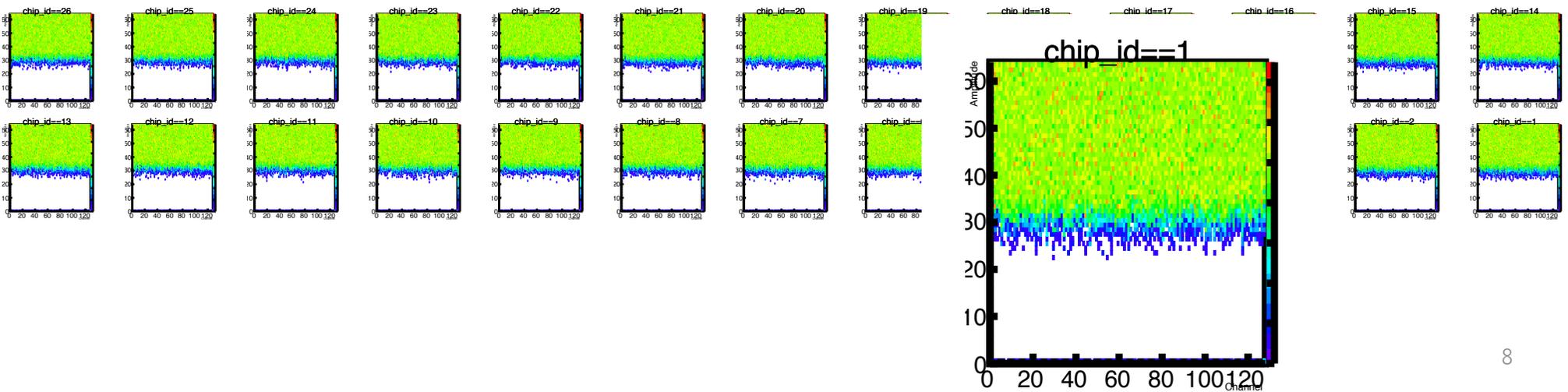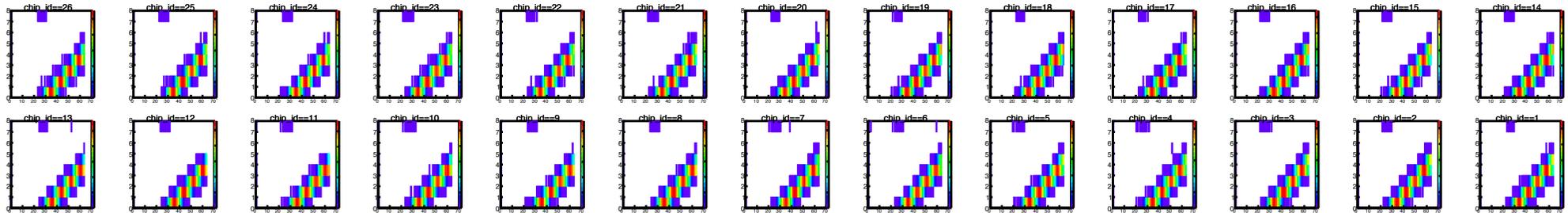
Without J1 power cable Without small wedge
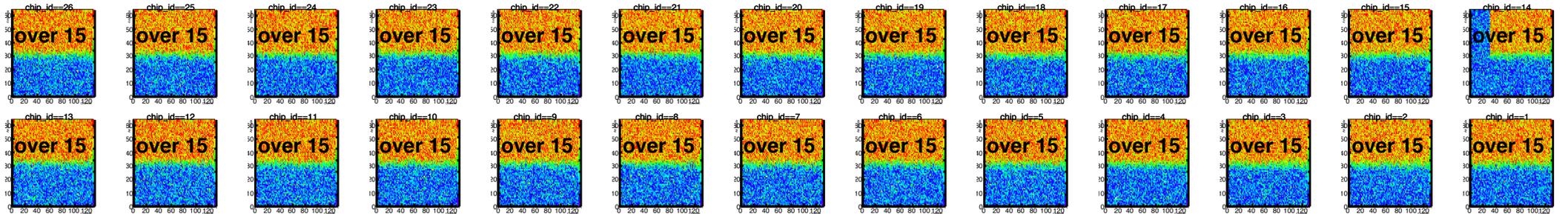
Same condition, but different take.
Thus floating analogue ground doesn't secure stability.

# With J1 power cable With small wedge

Observed something similar without small wedge.

Next Step

- A1 port operation together with J1 power cable seems to work regardless of small wedge plugged in or not.

- We only need to connect analogue ground cable of A0's U614 regulator. No need to power other regulators in B0, C0, D0 . Better to make dedicated cable.

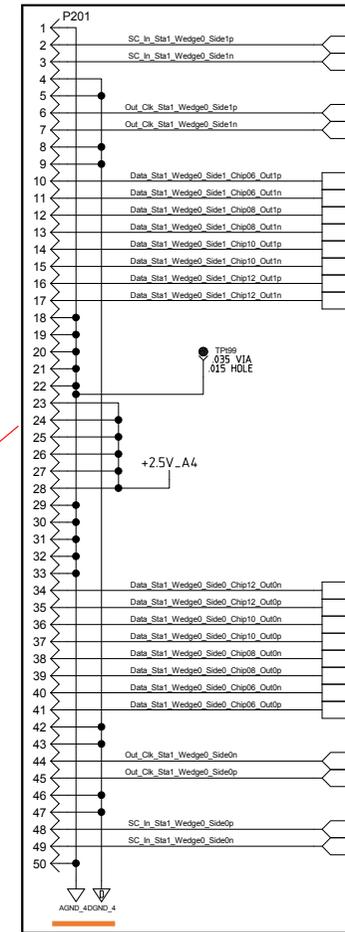- Better to confirm the silicon response with source.
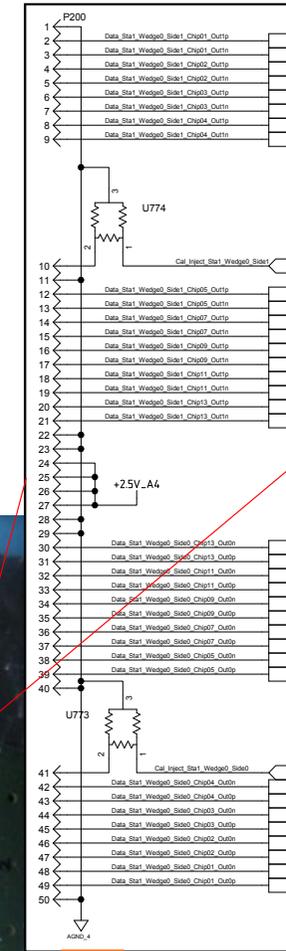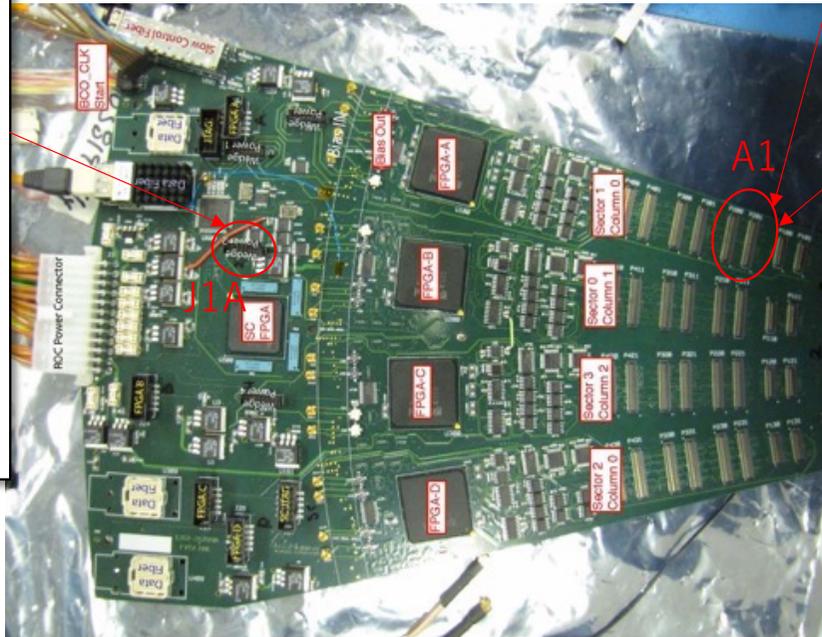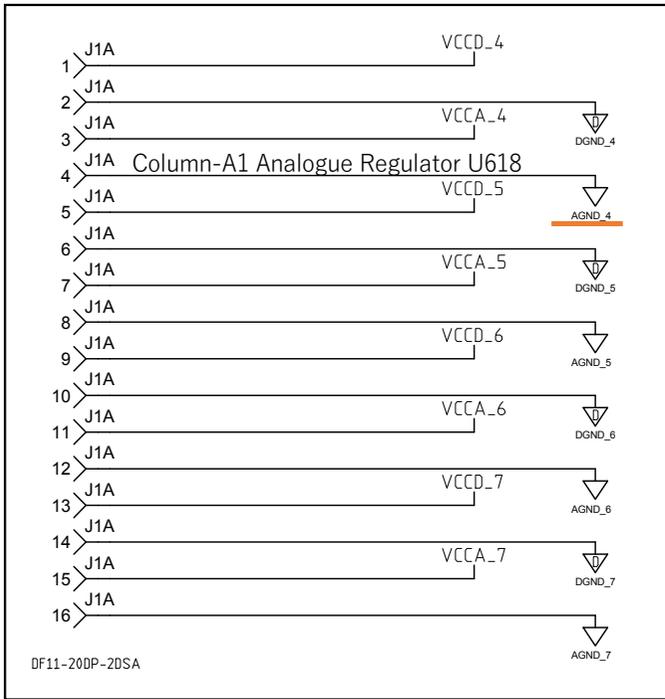
Input Voltage Anomaly for A1 Analogue Regulator

Voltage scan of the input/output voltage of analogue power regulators for FPHX at ROC

Only A1 regulator behaves differently from others.
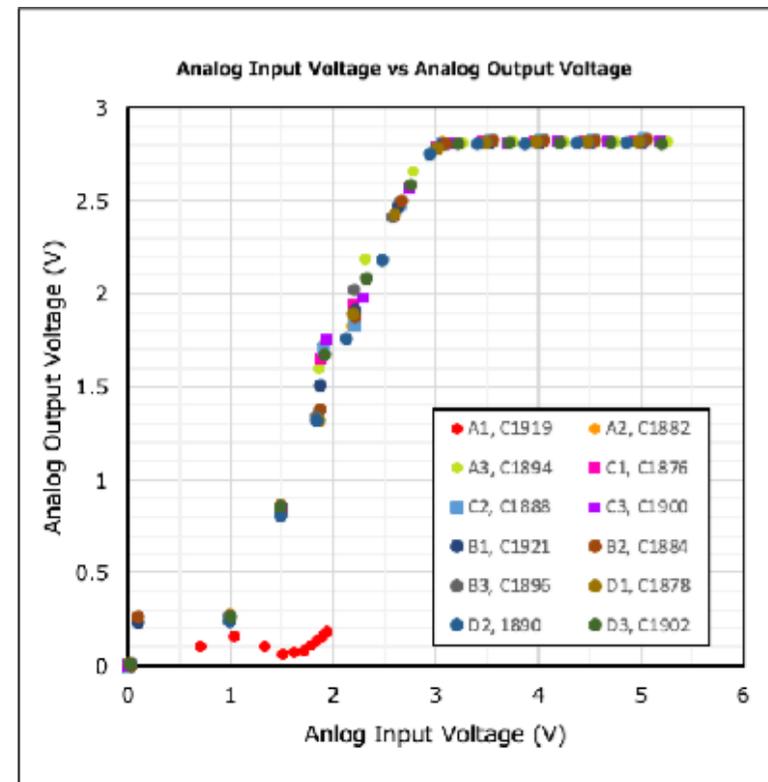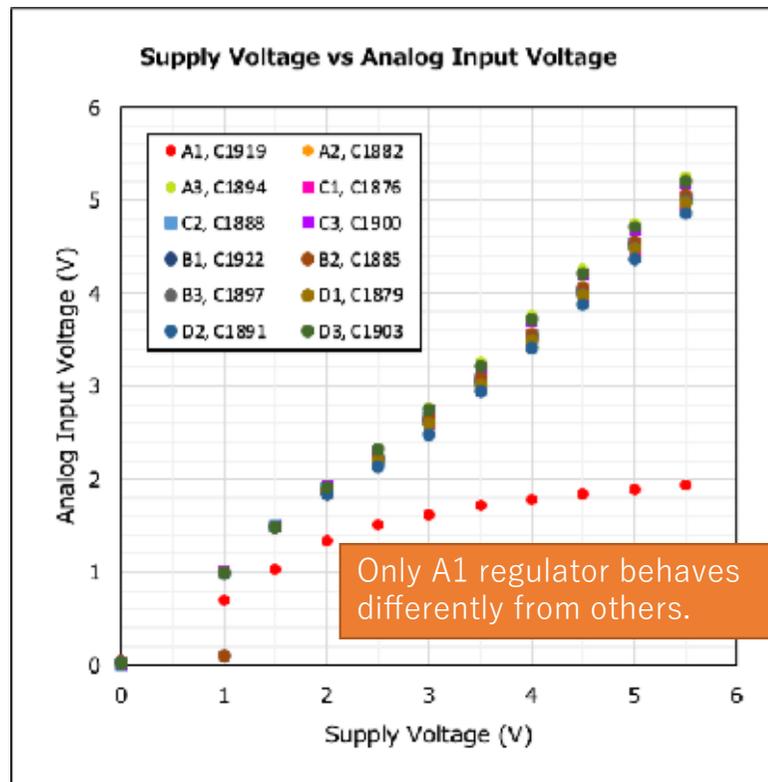
NW4

Circuit Design

Traced back circuit for the
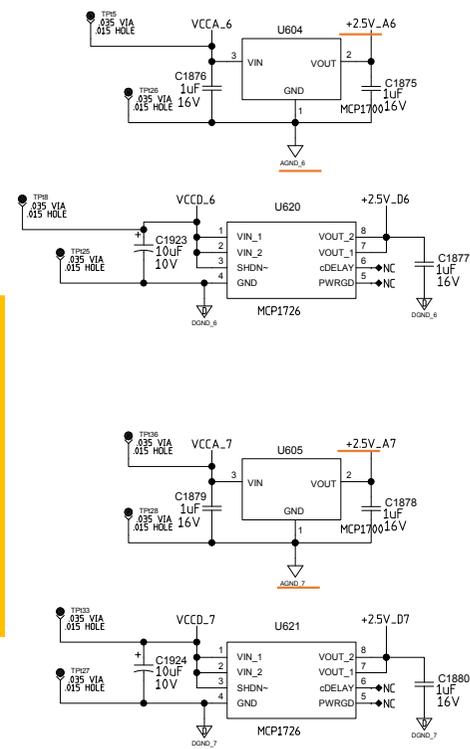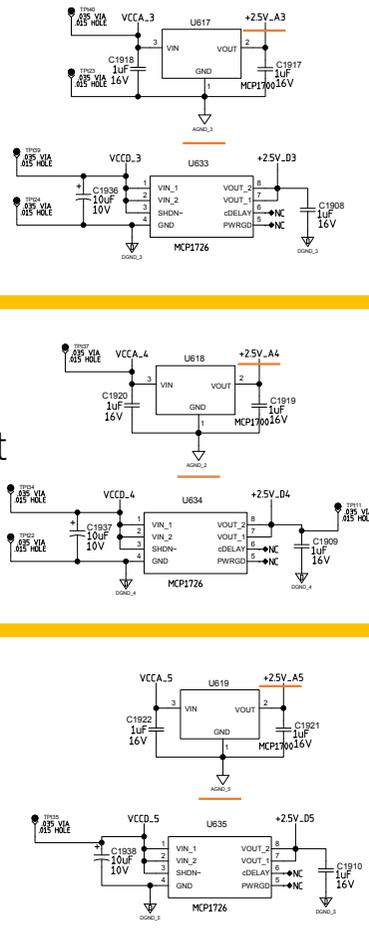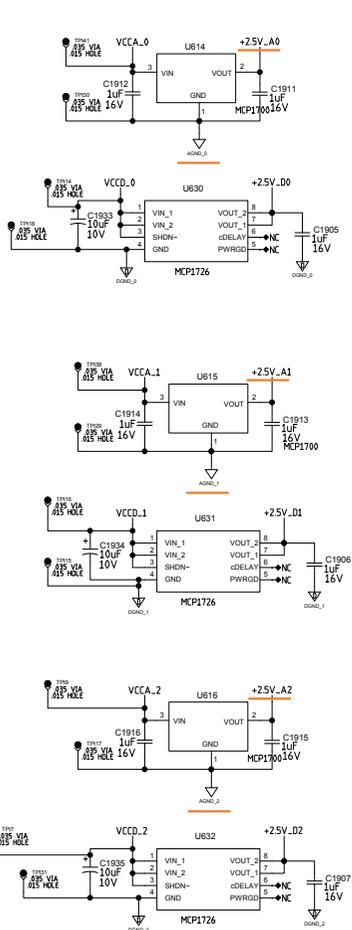analogue regulator for A1 port in
the ROC circuit drawing.

+2.5V V$_{out}$ and AGND

Analogue

Digital
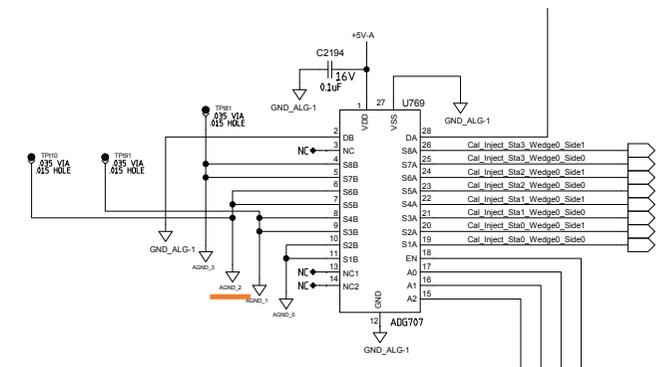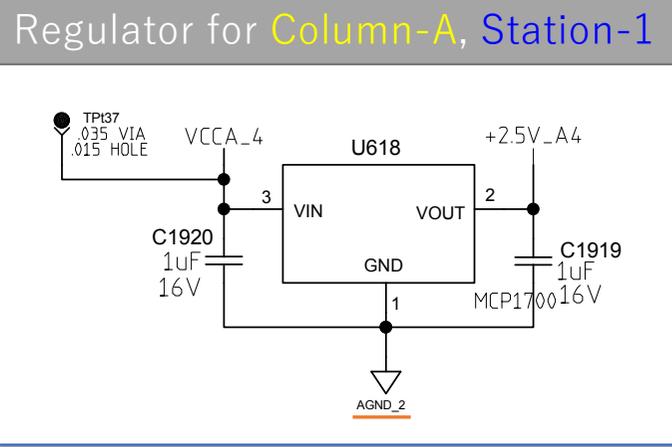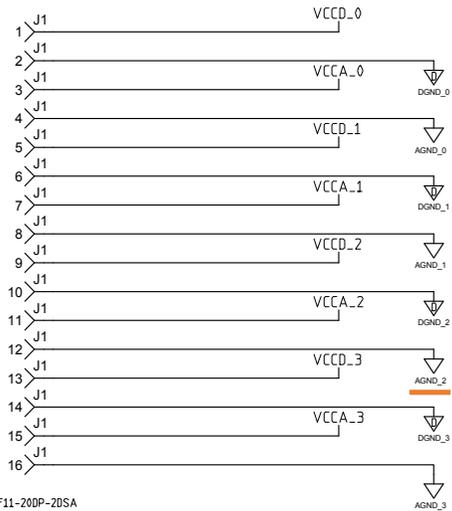
A1 port

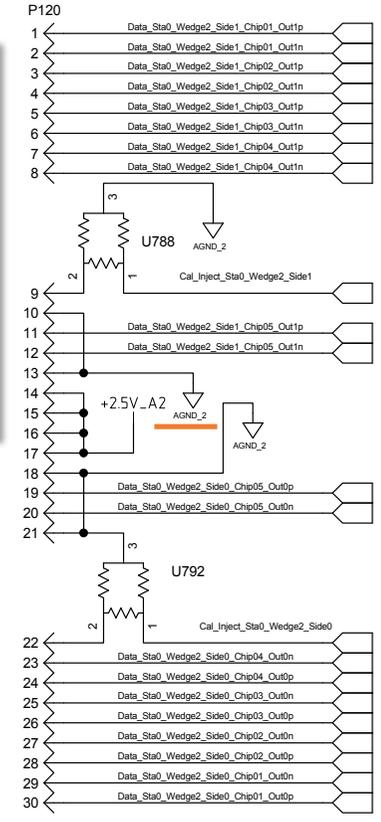| Regulator	+2.5V_AX	AGND_X
U614	0	0
U615	1	1
U616	2	2
U617	3	3
U618	4	2
U619	5	5
U604	6	6
U605	7	7

AGND_2 is wired to U616 as well

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AGND_2 Trace on ROC
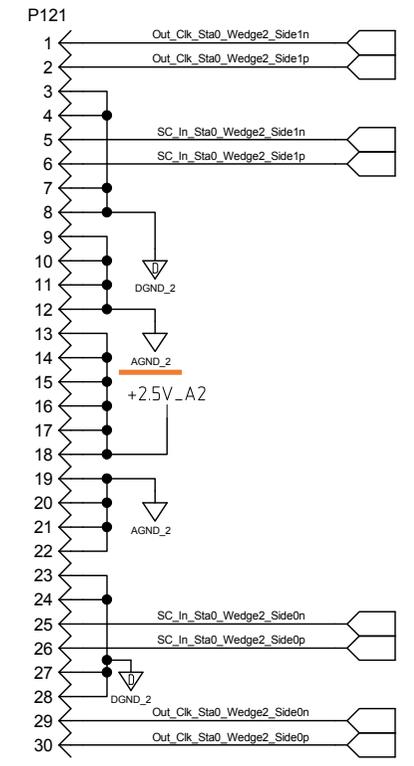

Regulator for Column-A, Station-1

J1 port (FPHX Power for Station-0)
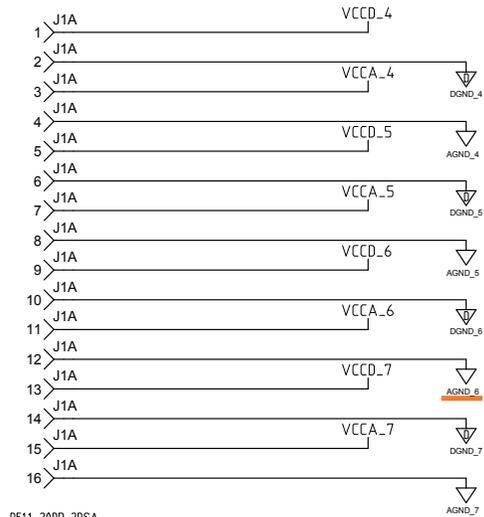
Calib-Multiplexer for Column-A

DF18 for Column-A, Station-0

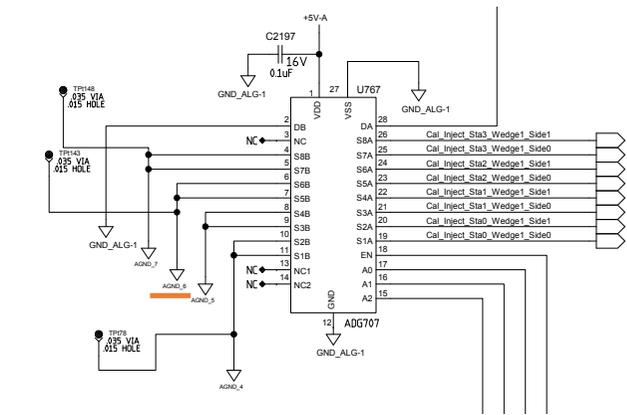Evidently, there is mis-match in the analogue GND. Station-0 and Station-1 are mixed.

AGND_6 Trace on ROC

Regulator for Column-C, Station-1

J1A port
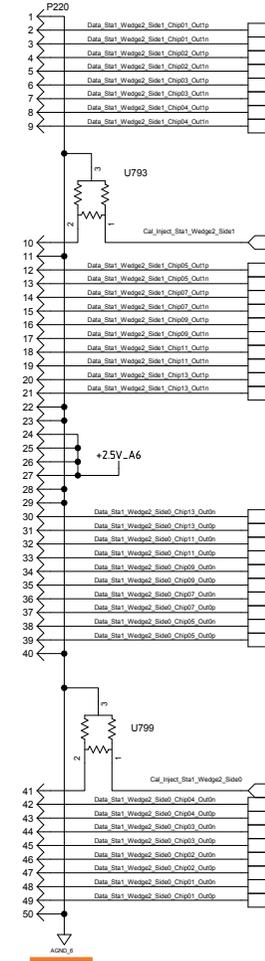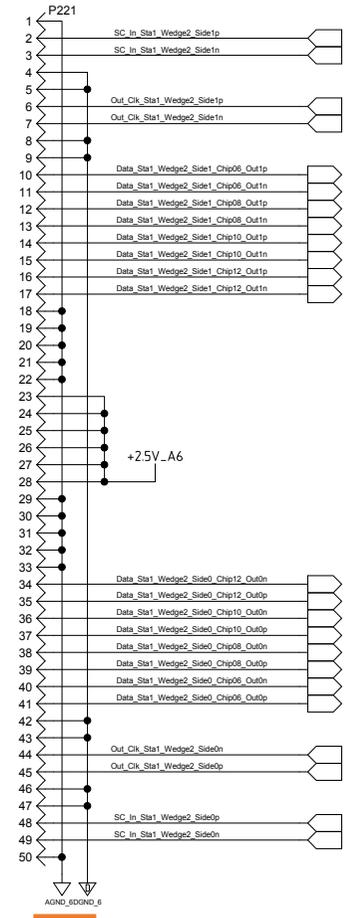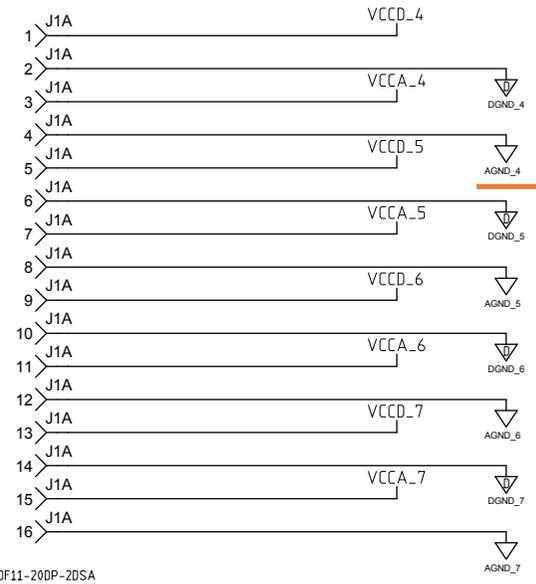**(FPHX Power for Station-1)**
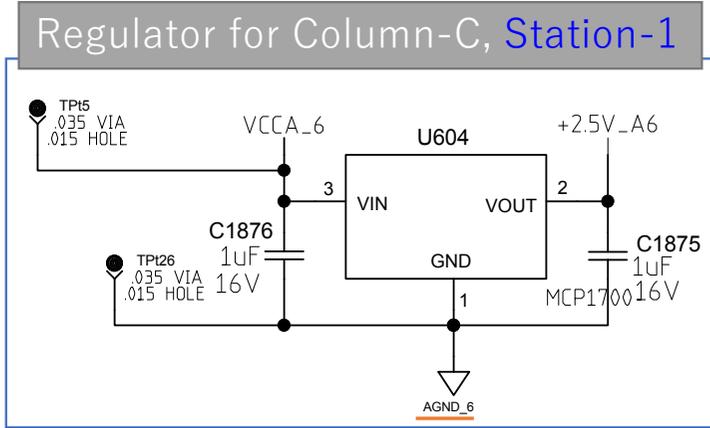
Calib-Multiplexer for Column-C

DF18 for Column-C Station-1

AGND is wired within Column-C, Station-1 throughout ROC trace as expected.

AGND_4 Trace on ROC

No regulator is wired from
AGND_4

J1A port
（FPHX Power for Station-1）
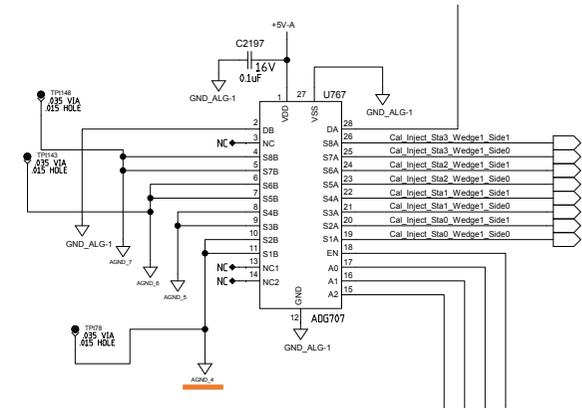
Calib-Multiplexer for Column-B
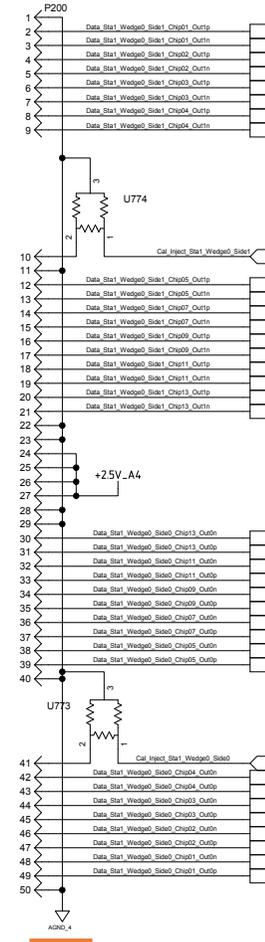
DF18 for Column-A Station-1
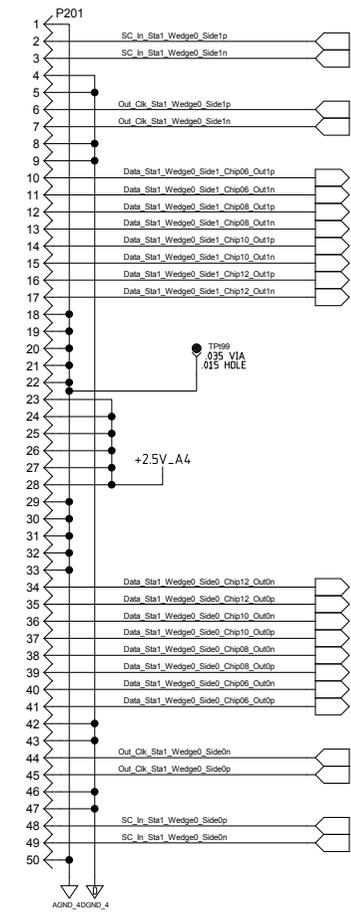
The AGND_4 analogue ground is not wired to any regulators.

AGND_2 Trace on ROC

Regulator for Column-A, Station-1

Regulator for Column-A, Station-0
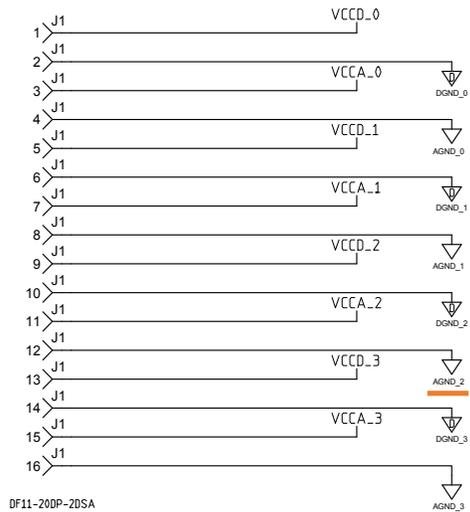
J1 port (FPHX Power for Station-0)
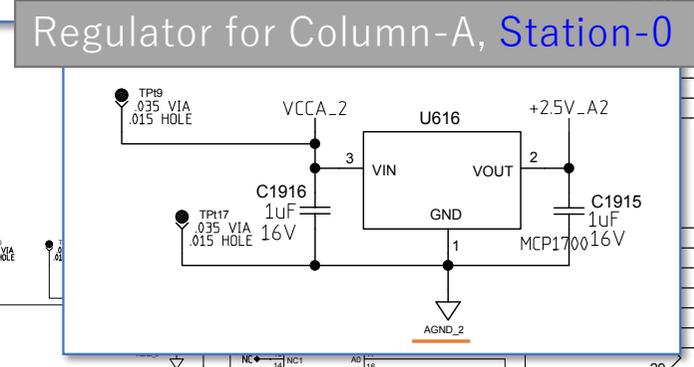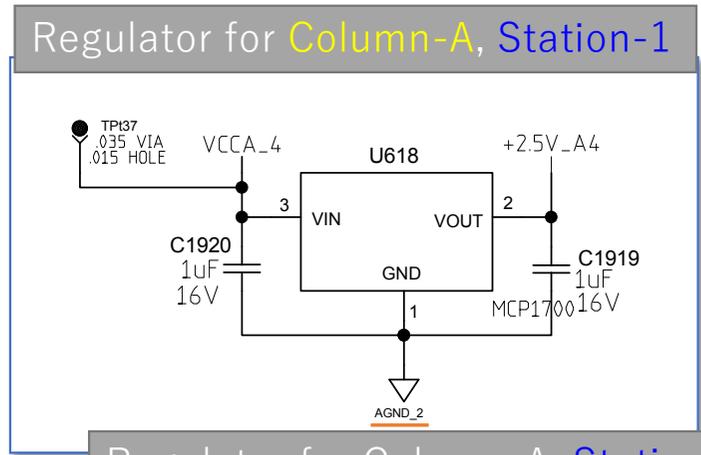
Calib-Multiplexer for Column-A
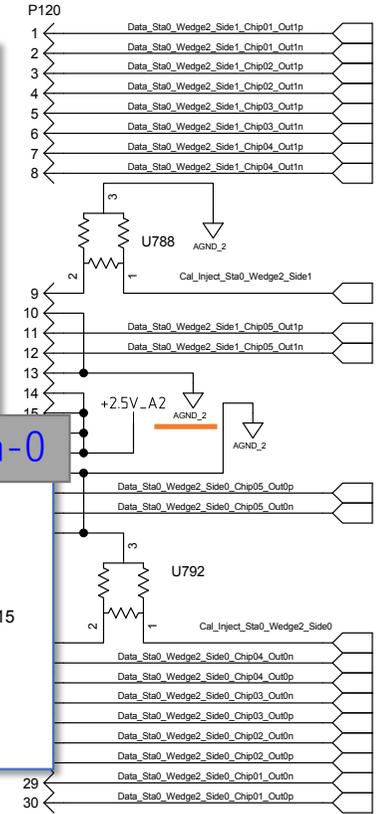
DF18 for Column-A, Station-0
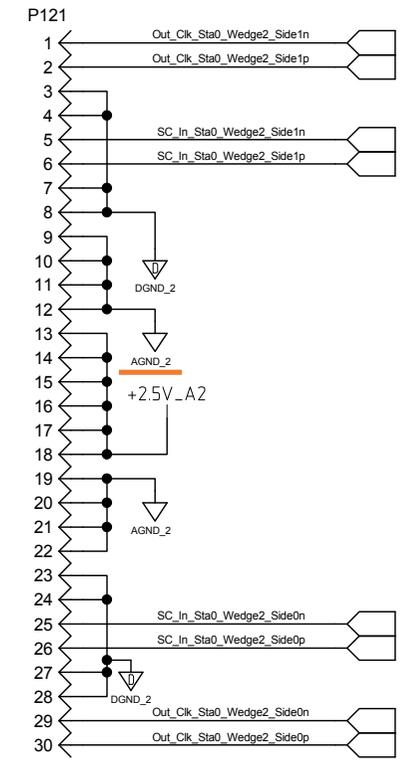
AGND_2 is shared with Column-A, Station-0 and Station-1 analogue regulators.

Correct Circuit Configuration

AGND and DGND are shorted at the wedge.

FVTX Case Circuit Diagram
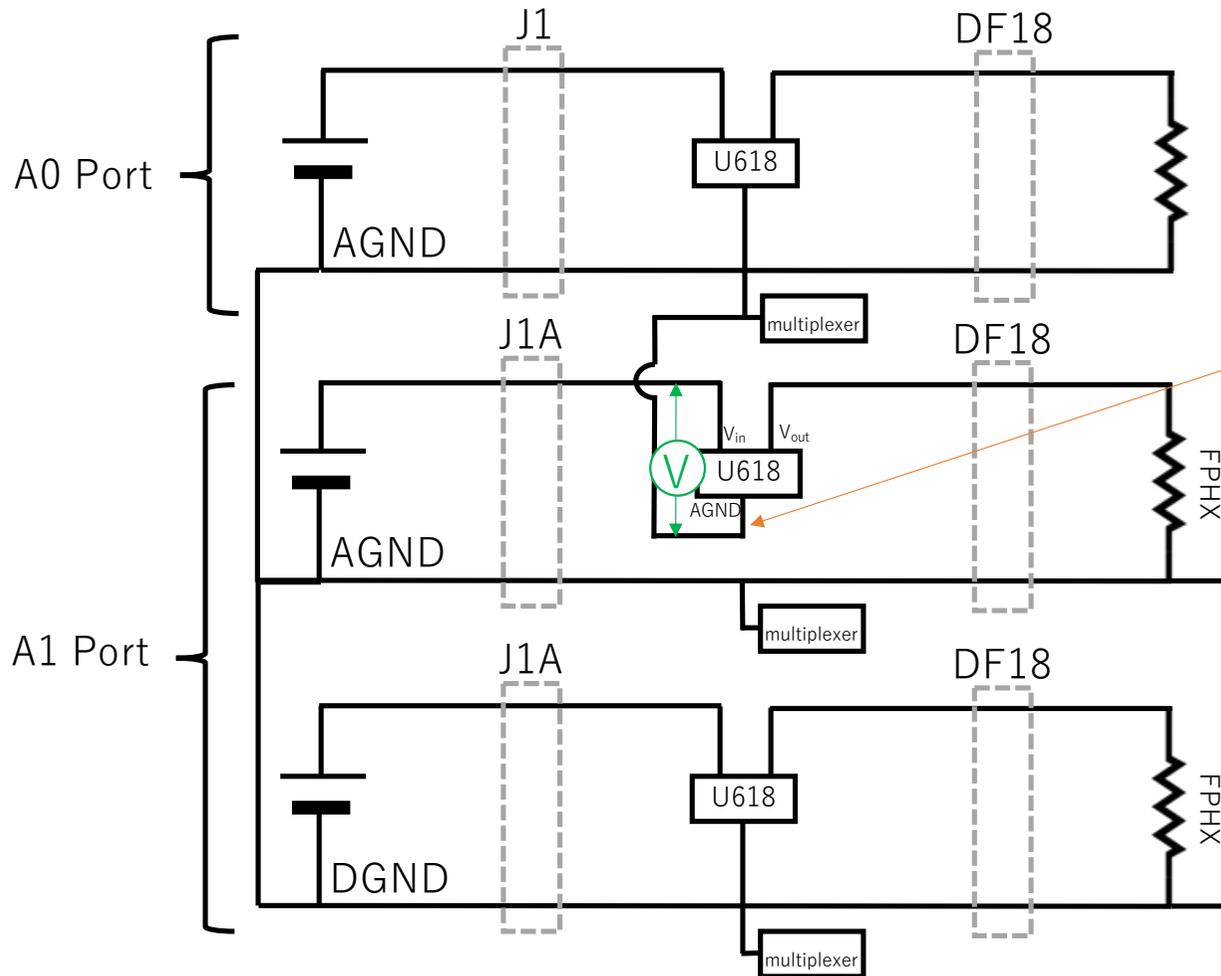
AGND is provided by A0 power supply which is likely to be shared with the GND of A1 analogue power supply. This circuit effectively secures stable operation of U618 regulator presumably.

Not sure how stable U618 regulator output is with the floating ground with open J1 and DF18（P100,P101） for INTT case. It is not guaranteed INTT works as well as FVTX.

How can we recover?

A0 Port

J1

Open

U618

DF18

Open

A1 Port

J1A

AGND

V_{in} V_{out}

U618

AGND

multiplexer

DF18

FPHX

J1A

DGND

U618

multiplexer

DF18

FPHX

multiplexer
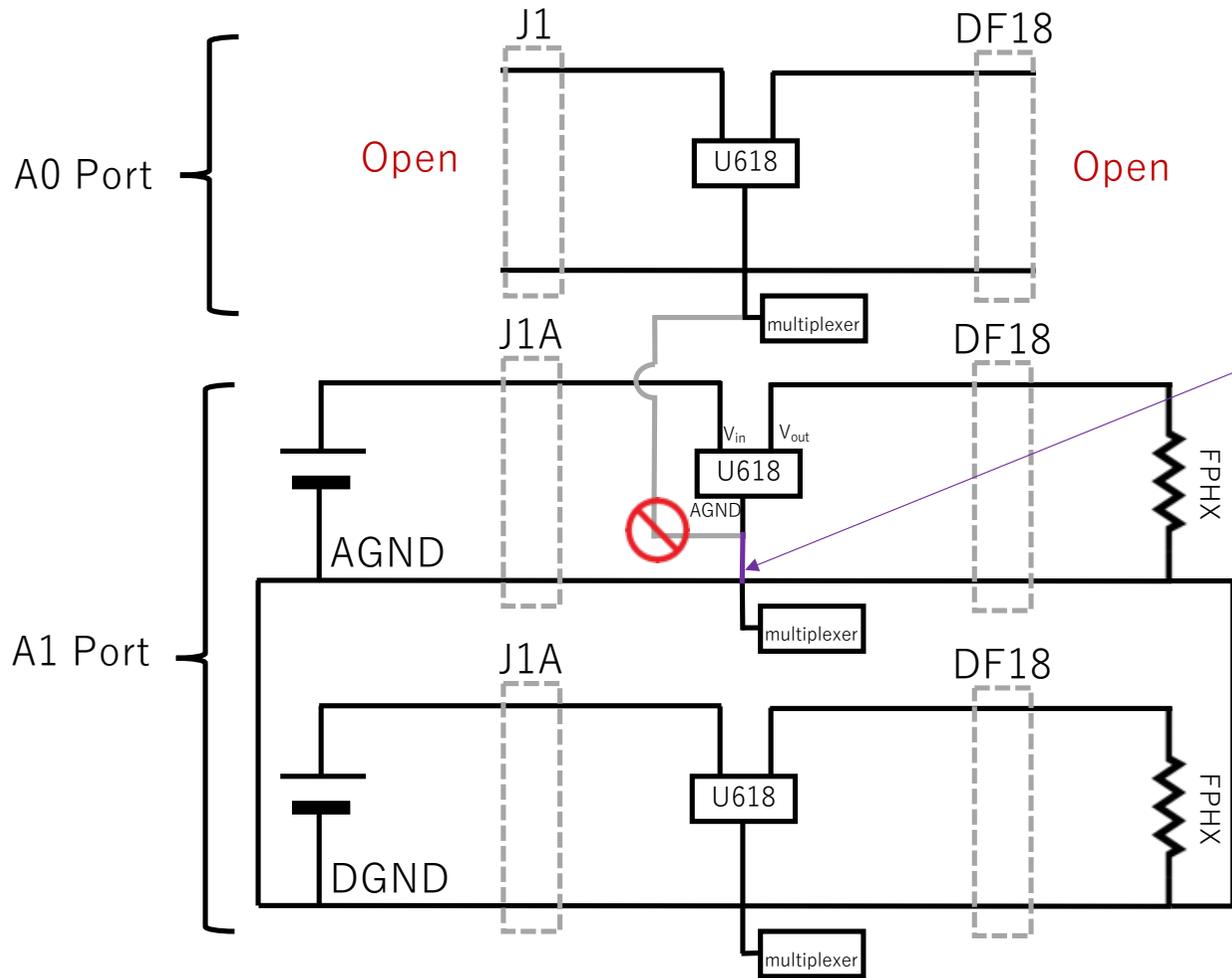
Disable AGND_2 connection and Install new jumper cable.

Need to bridge between primary side and back side of the ROC boards. This is not trivial recovery. Keep searching for more portable solution.

Jumper Cable Route

It is not impossible, but this is ugly cabling.

Actual voltage measurements

Column-C1 Analogue Regulator Measurement

Interception Board

Interception Board と V_{out}

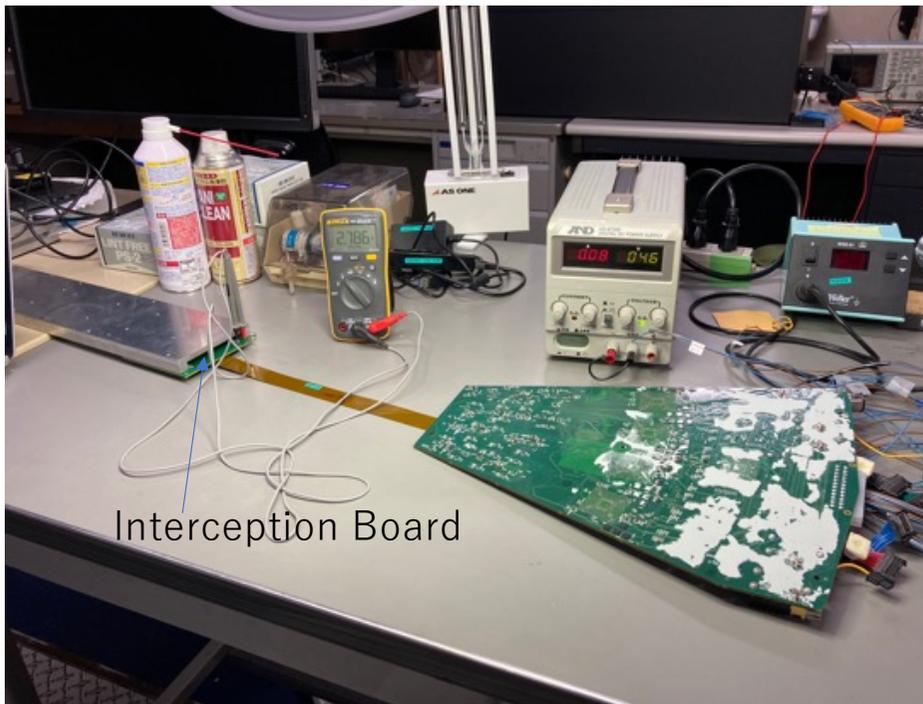| PS [V]	Current [A]	C1876 [V]	C1875 [V]	Intcpt Bd. [V]
1.5	0.00	1.5	0.8	0.8
2.0	0.05	1.9	1.8	1.8
2.5	0.07	2.3	2.2	2.2
3.0	0.09	2.9	2.8	2.8
3.5	0.09	3.2	2.8	2.8
4.0	0.09	3.8	2.8	2.8
4.5	0.09	4.5	2.8	2.8

- Connected only J1A Channel 11,12
- Ladder + 40cm conversion cable on C1 port
- Voltage meas. at U604 & Interception Board
- Observed 0V for digital power at Interception Board

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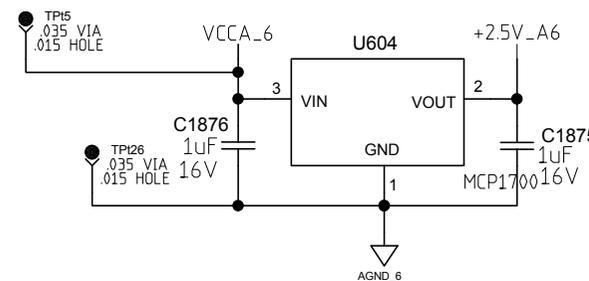
Column-A1 Analogue Regulator Measurement

The output voltage at analogue regulator is 2.8V.
Observed +0.4V higher voltage at the interception board.
Presumably it is caused by the ground level difference.
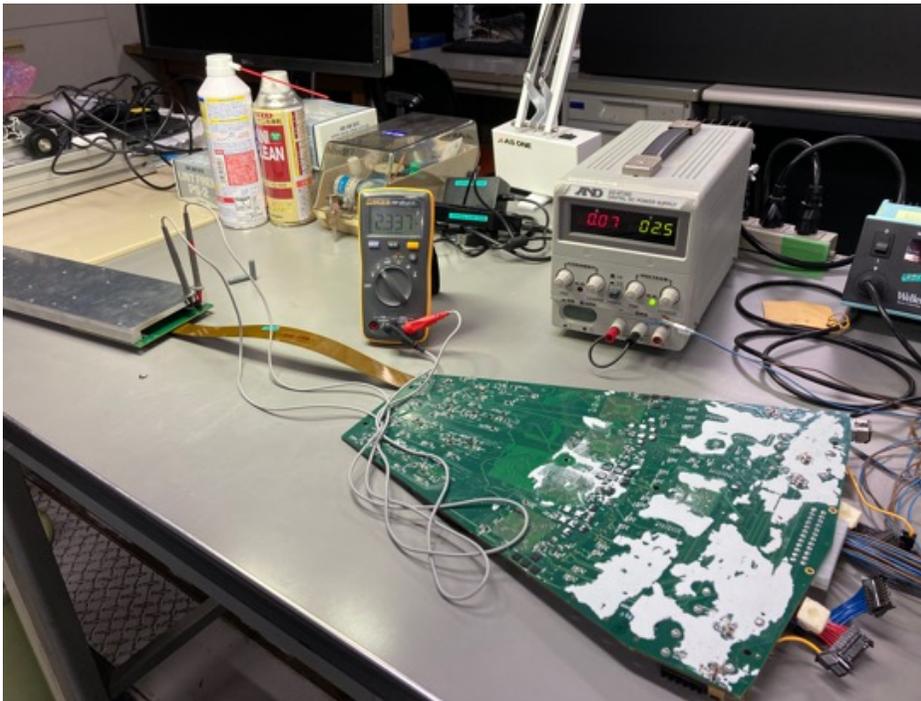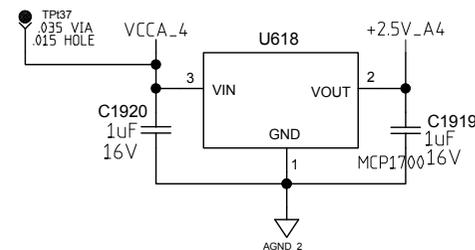
PS [V]	Current [A]	C1920 [V]	C1919 [V]	Intcpt Bd. [V]
1.5	0.00	1.3	0.44	0.58
2.0	0.03	2.0	1.2	1.3
2.5	0.06	2.2	1.9	2.2
3.0	0.09	2.5	2.4	2.7
3.5	0.10	3.1	2.8	3.2
3.9	0.11	3.4	2.8	3.2
4.5	0.11	4.0	2.8	3.2

- Connected only J1A Channel 3,4
- Ladder + 40cm conversion cable on A1 port
- Voltage meas. at U618 & Interception Board
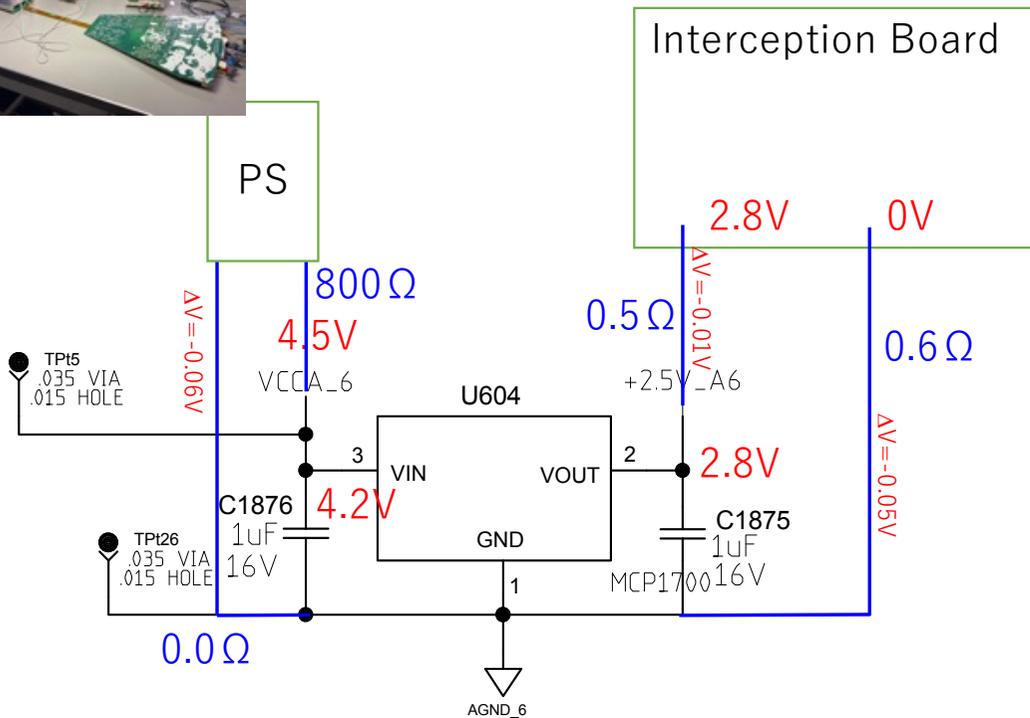- Observed 0V for digital power at Interception Board

NE3 Analogue Power Trace Resistance
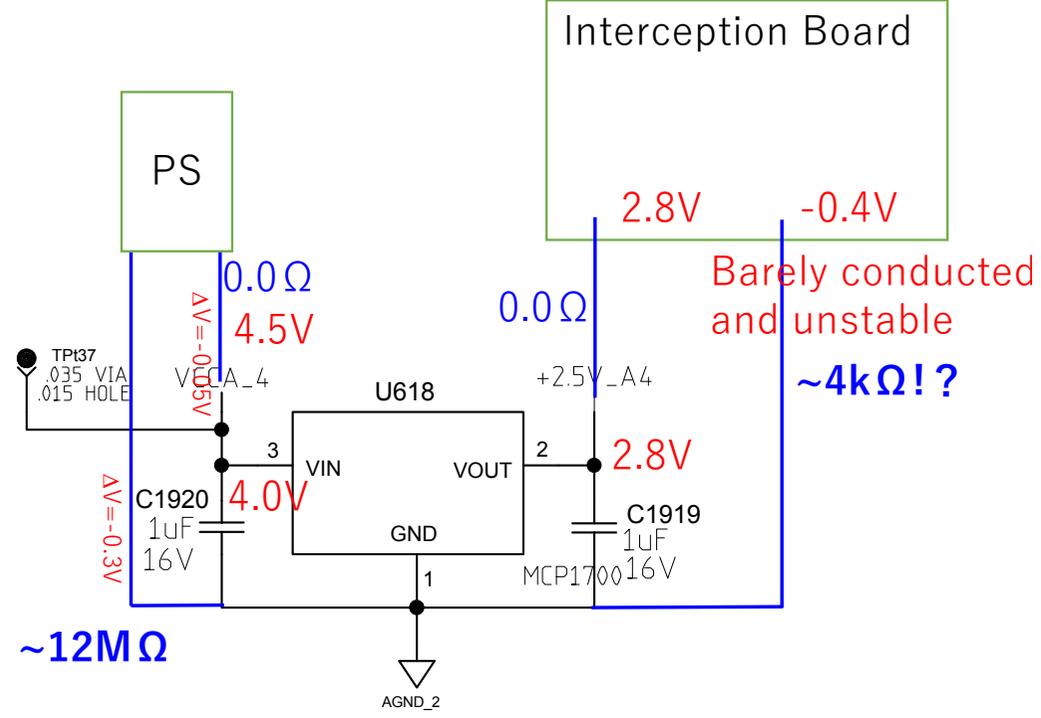
Only J1A Ch-3,4 cables are connected to PS

C1

A1

Interception Board

PS

2.8V   0V

800Ω
4.5V

ΔV=-0.90V

0.5Ω
ΔV=-0.01V

0.6Ω
ΔV=-0.05V

TPt5
.035 VIA
.015 HOLE

VCCA_6

+2.5V_A6

U604

3 VIN   VOUT 2   2.8V

C1876
1uF
16V

4.2V

TPt26
.035 VIA
.015 HOLE

GND

C1875
1uF
16V

MCP1700

1

0.0Ω

AGND_6

Analogue GND Line is directly connected
to AGND of Interception board

Interception Board

PS

2.8V   -0.4V

Barely conducted
and unstable
~4kΩ!?

0.0Ω
4.5V

ΔV=-0.05V

0.0Ω

ΔV=-0.3V

TPt37
.035 VIA
.015 HOLE

VCCA_4

+2.5V_A4

U618

3 VIN   VOUT 2   2.8V

C1920
1uF
16V

4.0V

GND

C1919
1uF
16V

MCP1700

1

~12MΩ

AGND_2

Analogue GND Line is *not* directly
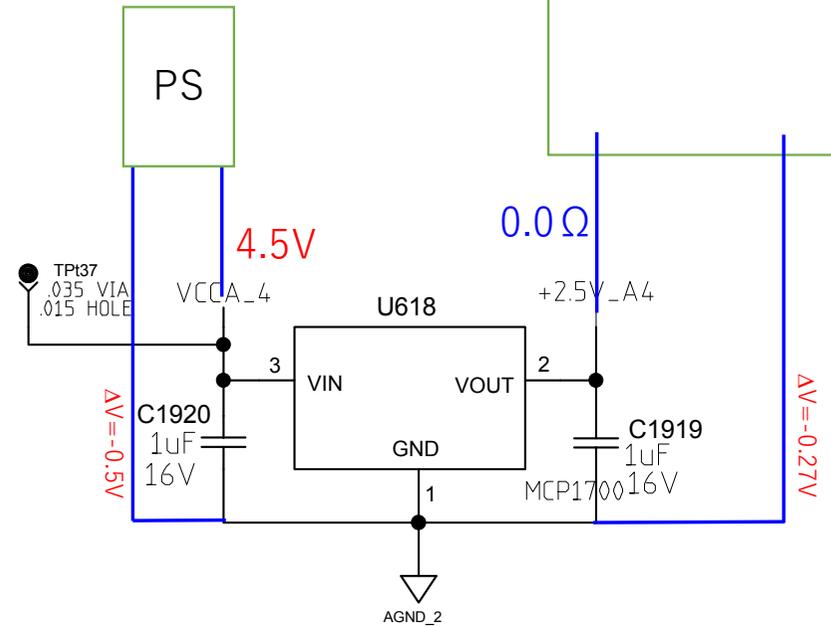connected to AGND of Interception board

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NE3 Analogue Power Trace Resistance
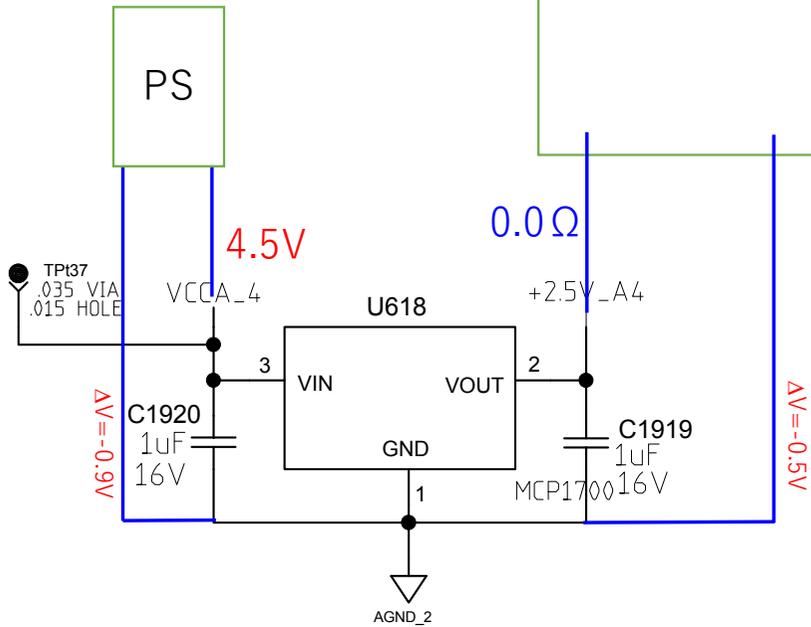
No ROC Power Cable Plugged in
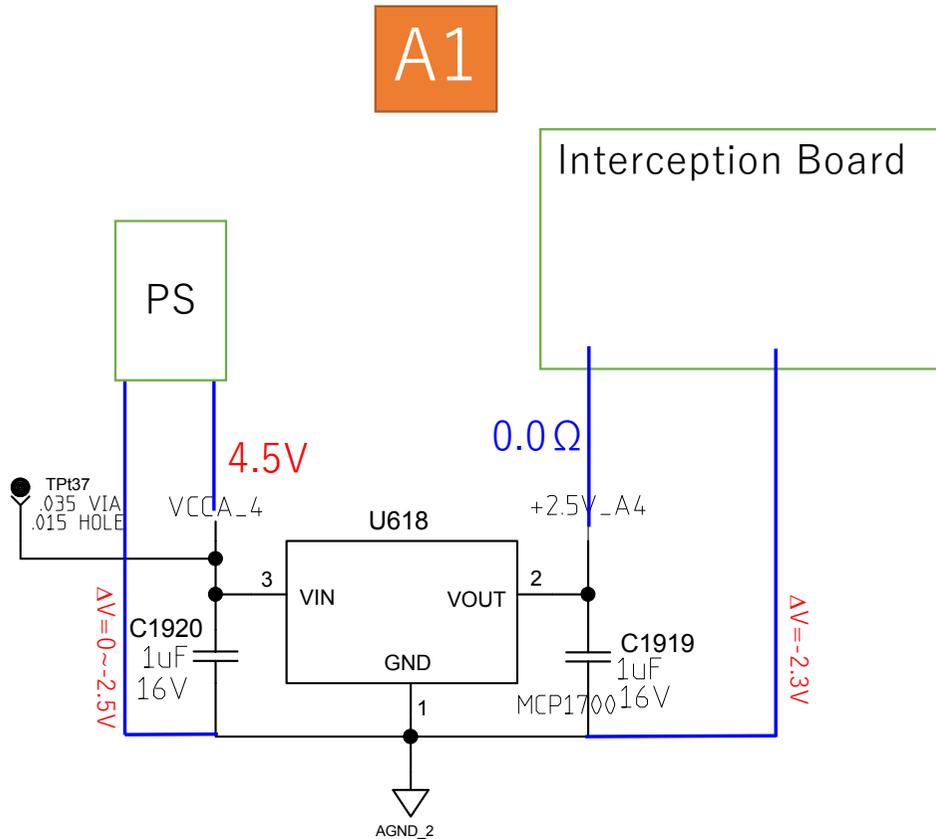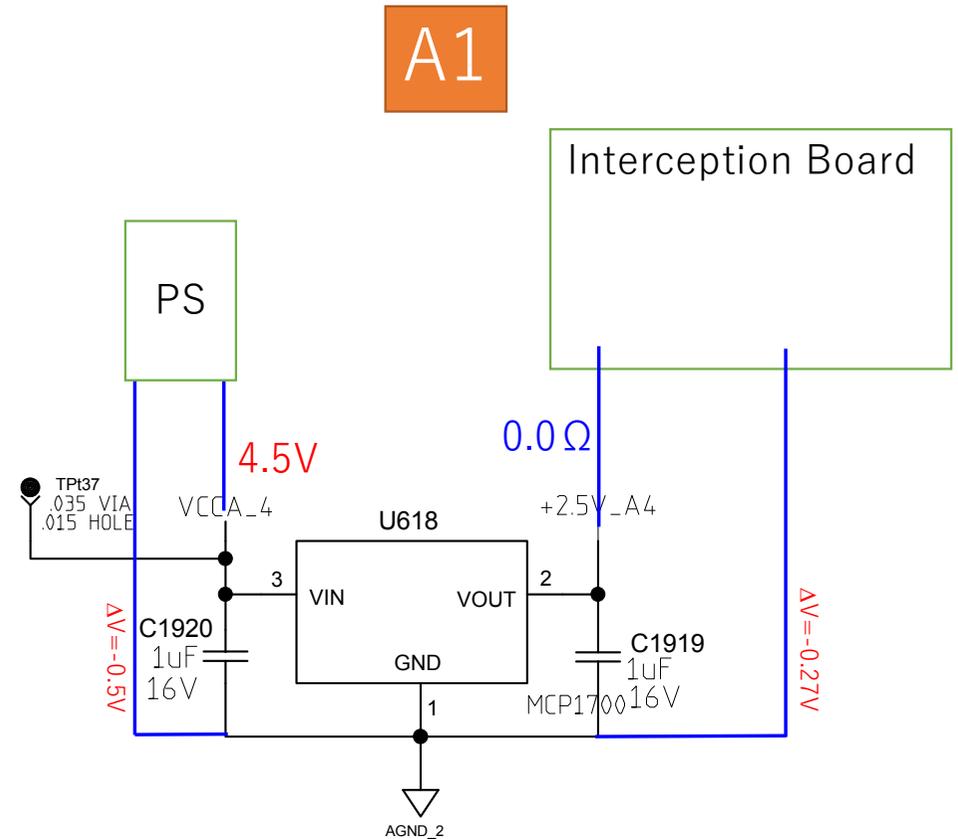
ROC Power Cable Plugged in, but not powered

NE3 Analogue Power Trace Resistance

ROC Power Cable Plugged in, Power On

ROC Power Cable Plugged in, but not powered