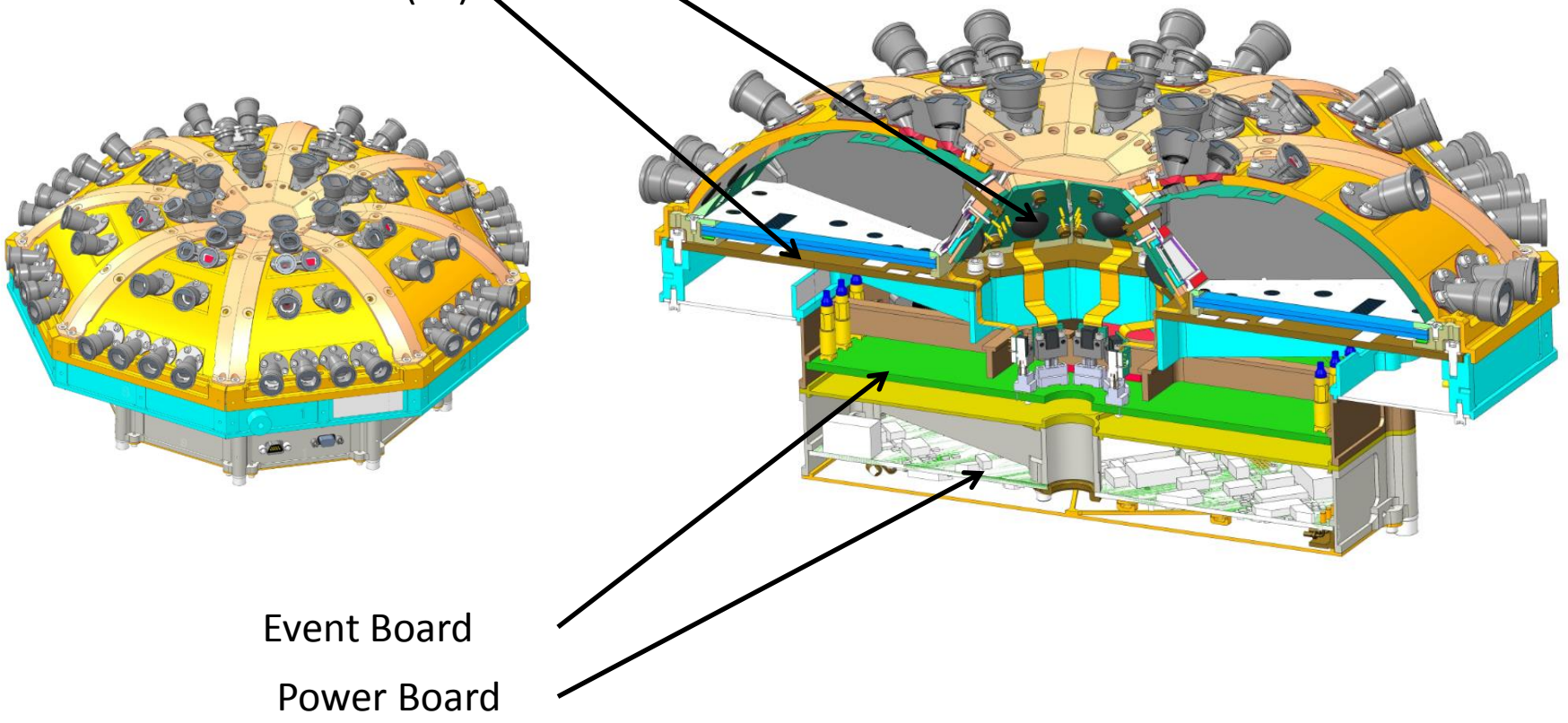
EPI-LO Anode Board Peer Review

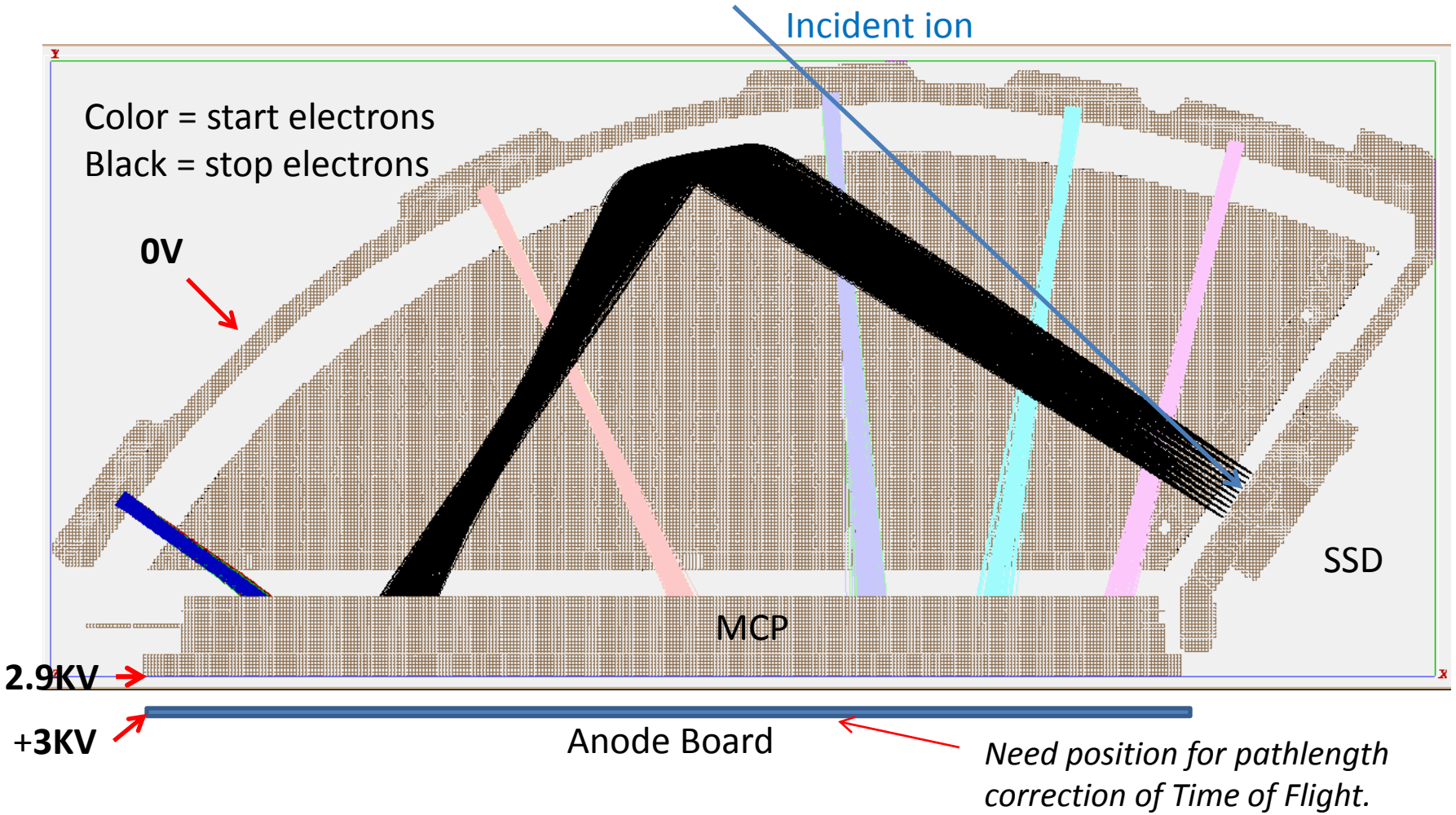
Ken Nelson

Nov 2014


Energy Boards (x8)
Anode Boards (x4)
Event Board
Power Board

Octant Electron Optics

- Each Start foil maps to a distinct region of MCP and anode board.
- Coincident hits in a Start and Stop region define ion direction and $v = \sqrt{2E/m}$.
- Further coincident hit in SSD reduces randoms and determines m.



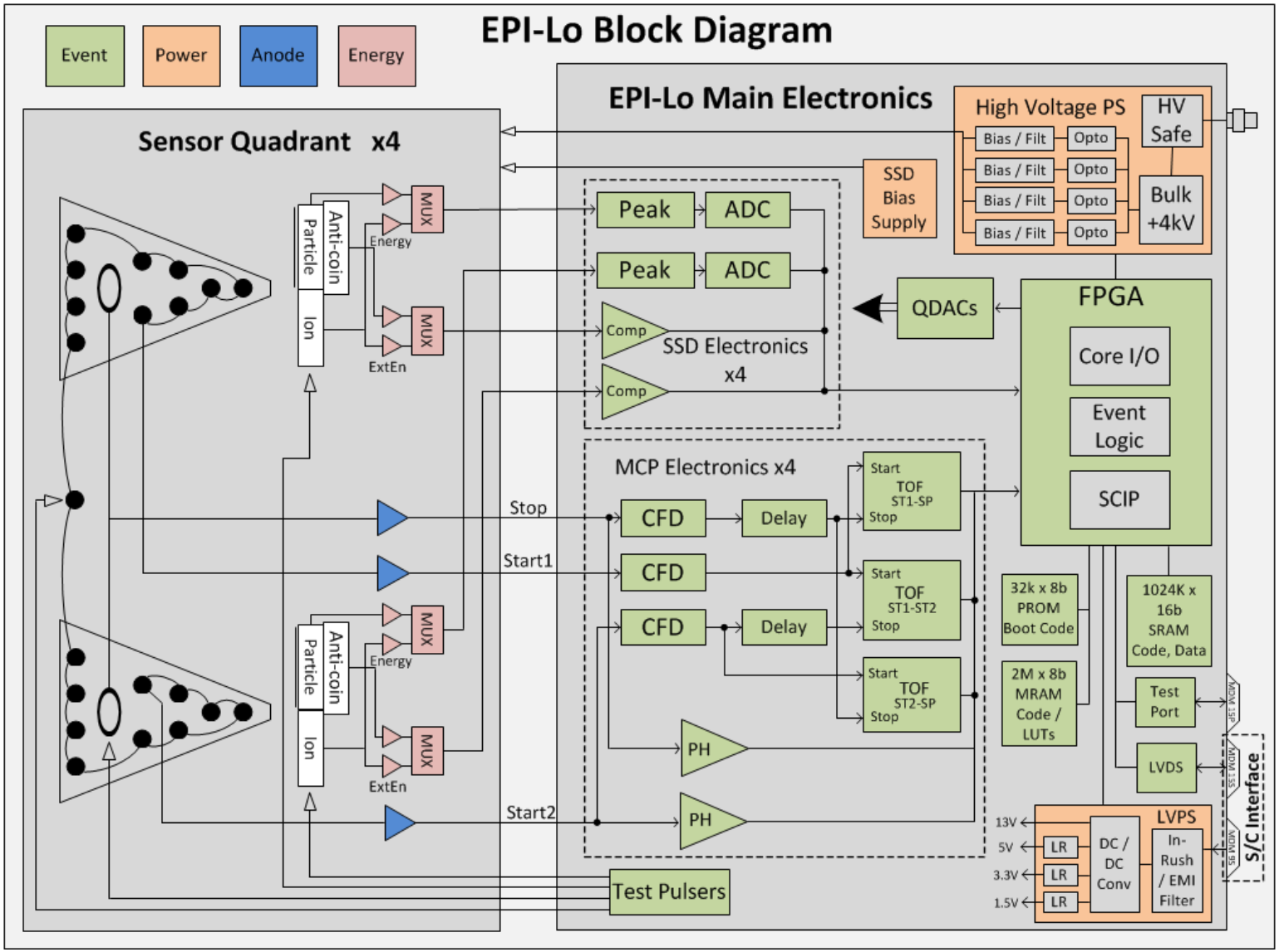
Anode Board Driving Requirements

- Time-of-Flight (system) resolution < 400ps FWHM.
- Amplifier output range to match CFD input (20mV – 1.2V) for anode signals of ~ 0.3 – 20 X 10^6 e^-.
- Anode pads at +HV and amplifiers near 0V.
  - HV isolation
  - Signal coupling
- Anode pad position to be time-encoded
- Temperature range -20C to +20C.
- Radiation, in progress.

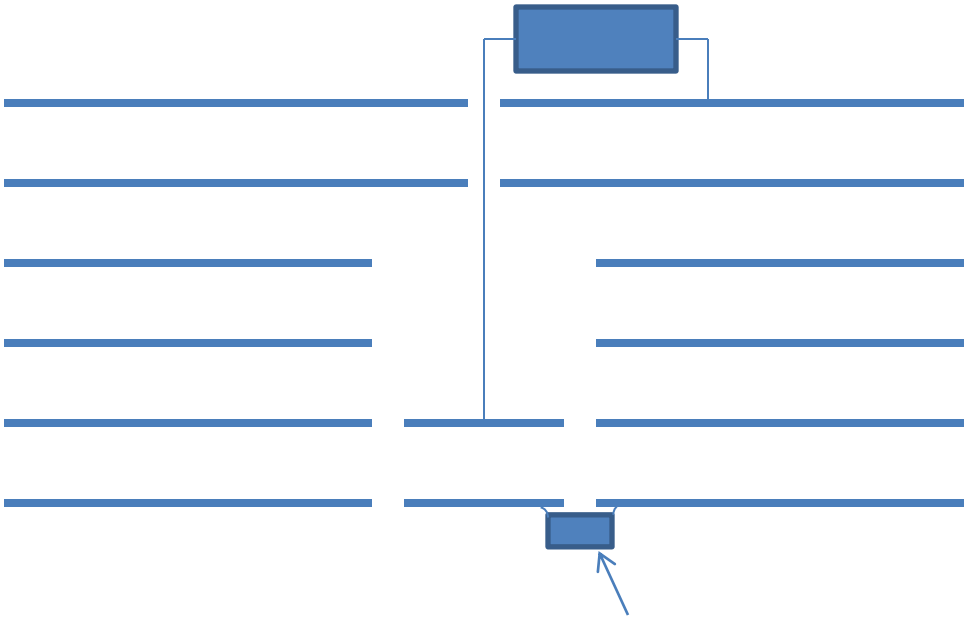
Anode Board Functionality

- Anode board services two wedges (e^- optic & MCP)
- Anode pads at +HV on secondary side with embedded capacitors to couple signals to LV circuitry on primary side.
- Start positions are time-encoded by discrete-tap delay line
- Amplifiers
  - Delay line terminated to two fast amplifiers
  - Stop regions passively combined into a third amplifier.
- Distribute HV to MCP and anode with filtering.
- Test pulse inputs.

Two octants combined into a quadrant => 20 Start regions, 2 Stop regions.
Start regions connected to taps of a delay line terminated in Start1,2 amplifiers.
Stop regions passively combined in Stop amplifier.



Layer Stack-up



Component / outer traces

Ground

+5V / internal traces

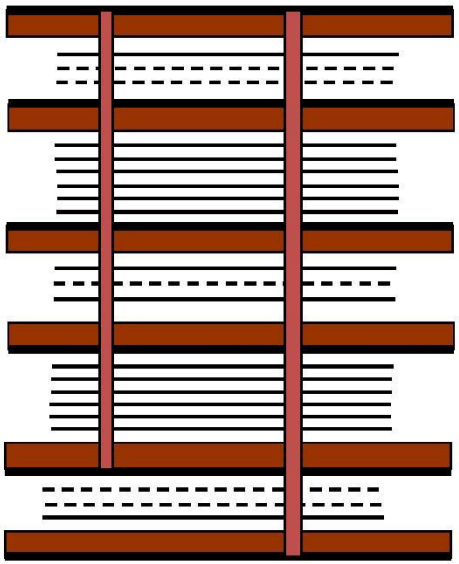
Ground

Induction pads / Ground

Anode pads / +HV plane

Resistor to bias anode pad

REDD 1453 (formerly REDD 1296)
6-layer rigid, blinds 1-5 and 1-6
Arlon 85N core and prepreg, Pyralux AP9121
.093 ± .009



Layer 1 – 1/4 oz
.0025 85N

Layer 2 - 1 oz
.008 85N

Layer 3 - 1 oz
.008 85N

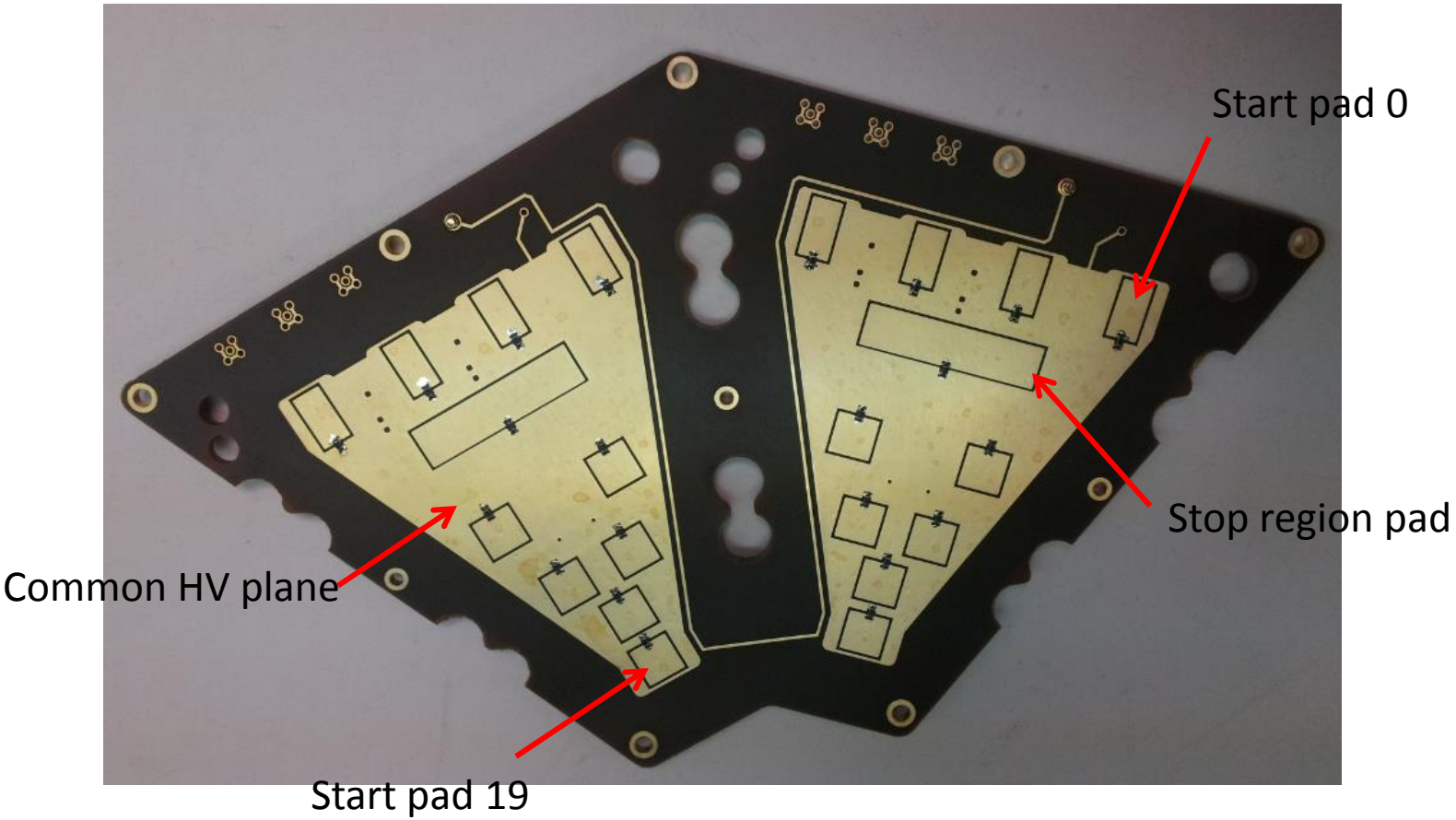
.008 85N
Layer 4 - 1 oz

.008 85N
Layer 5 – 1/2 oz (before plate)

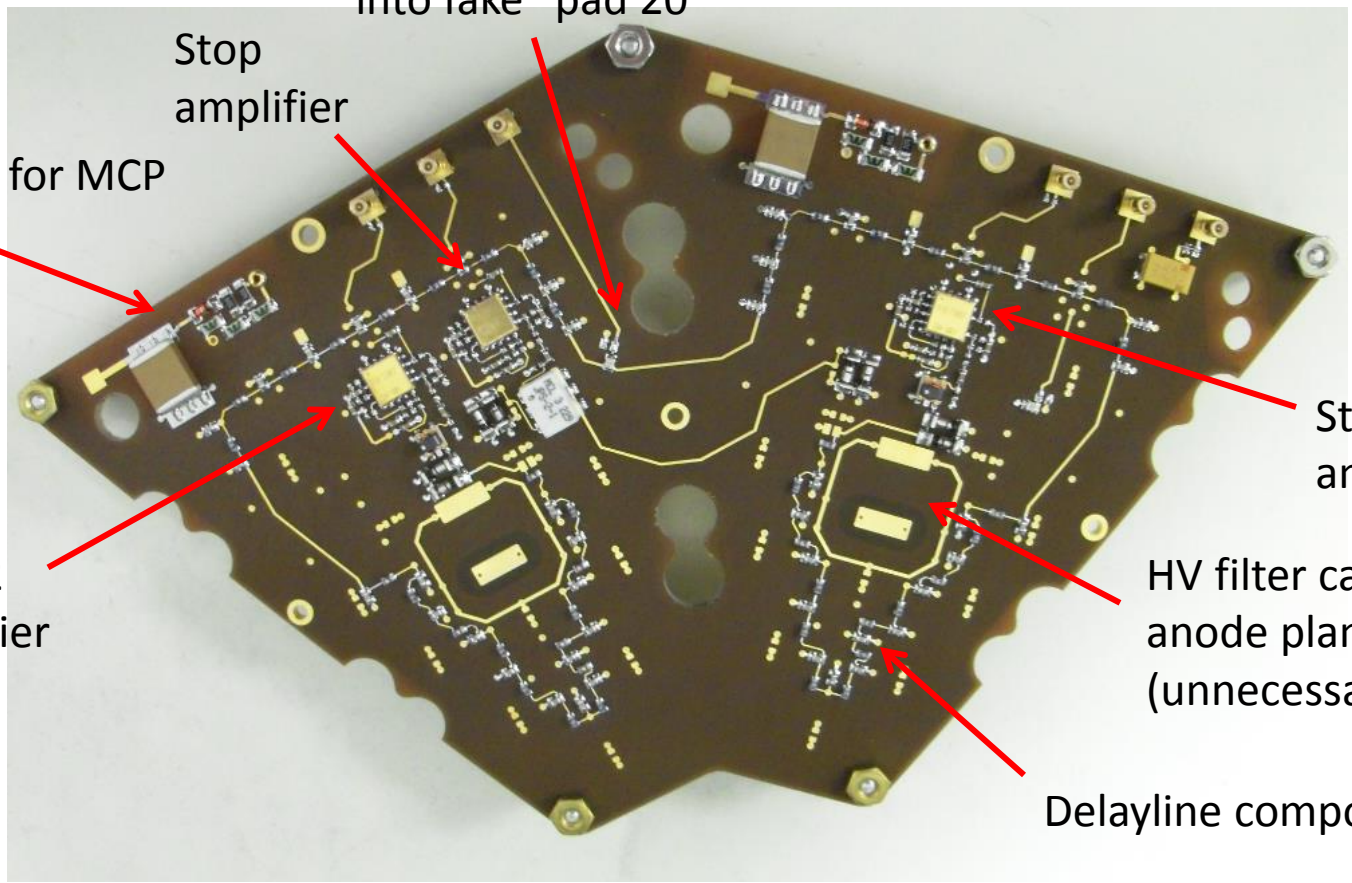
.002 Kapton – (Pyralux AP9121,
Etched one side)
Layer 6 - 1 oz

ENIG finish both primary and secondary sides.

Anode Board HV side – facing towards MCP

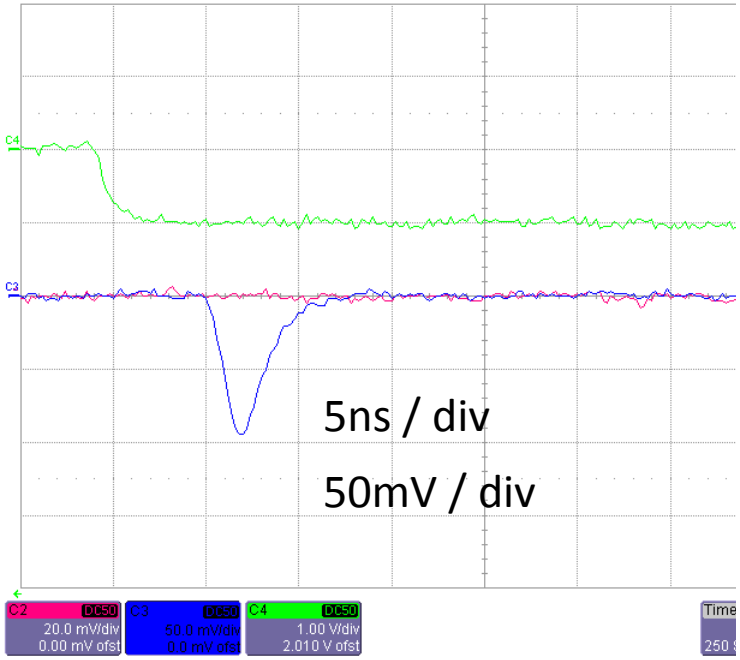


Anode Board LV side – facing Event Board

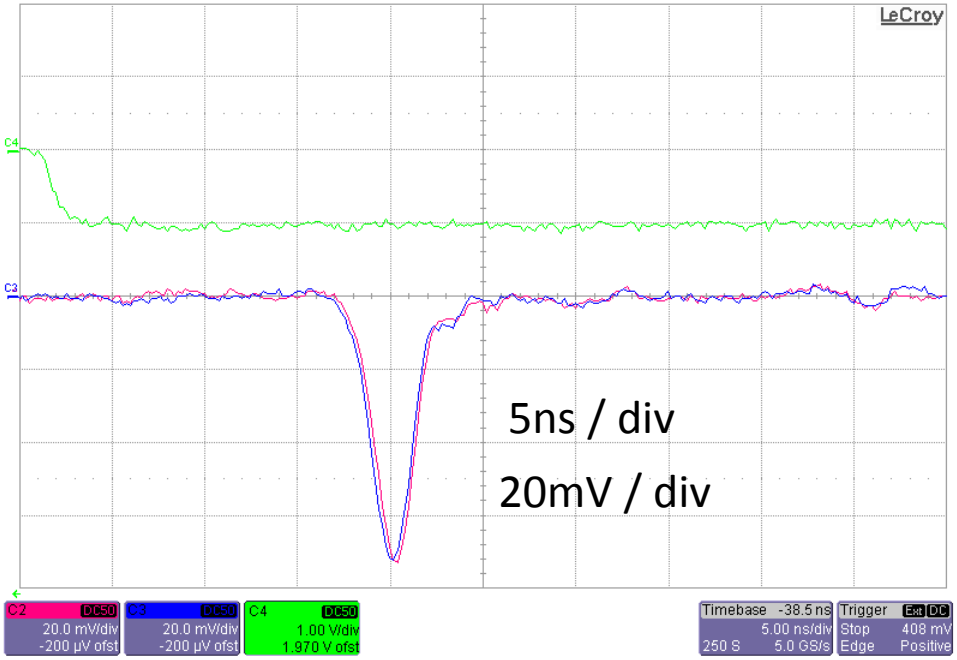


Test signal input (~1.2e6 electrons)

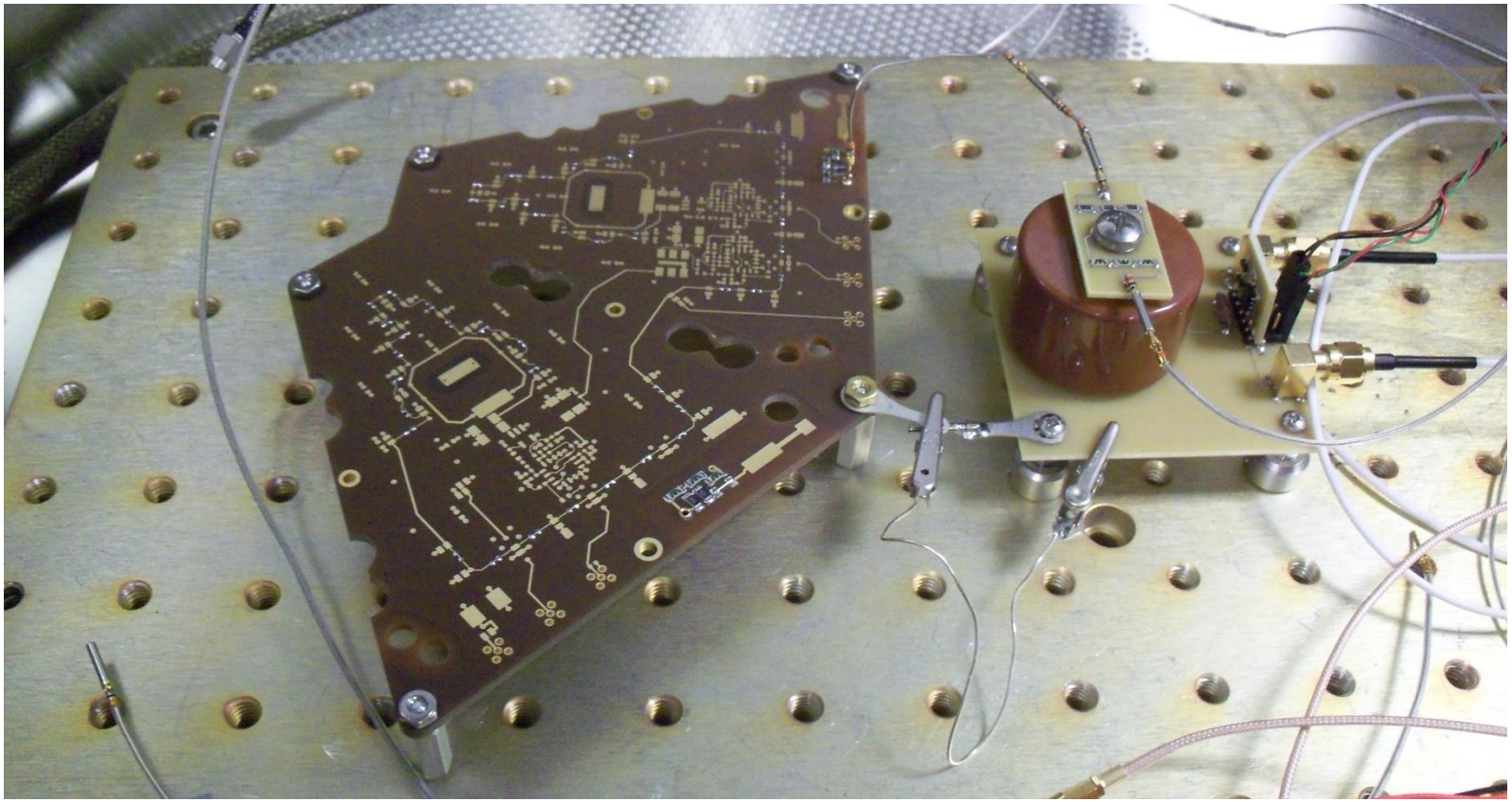
Stop amplifier output



Start1,2 amplifier outputs



Test of HV standoff of Pyralux AP9121

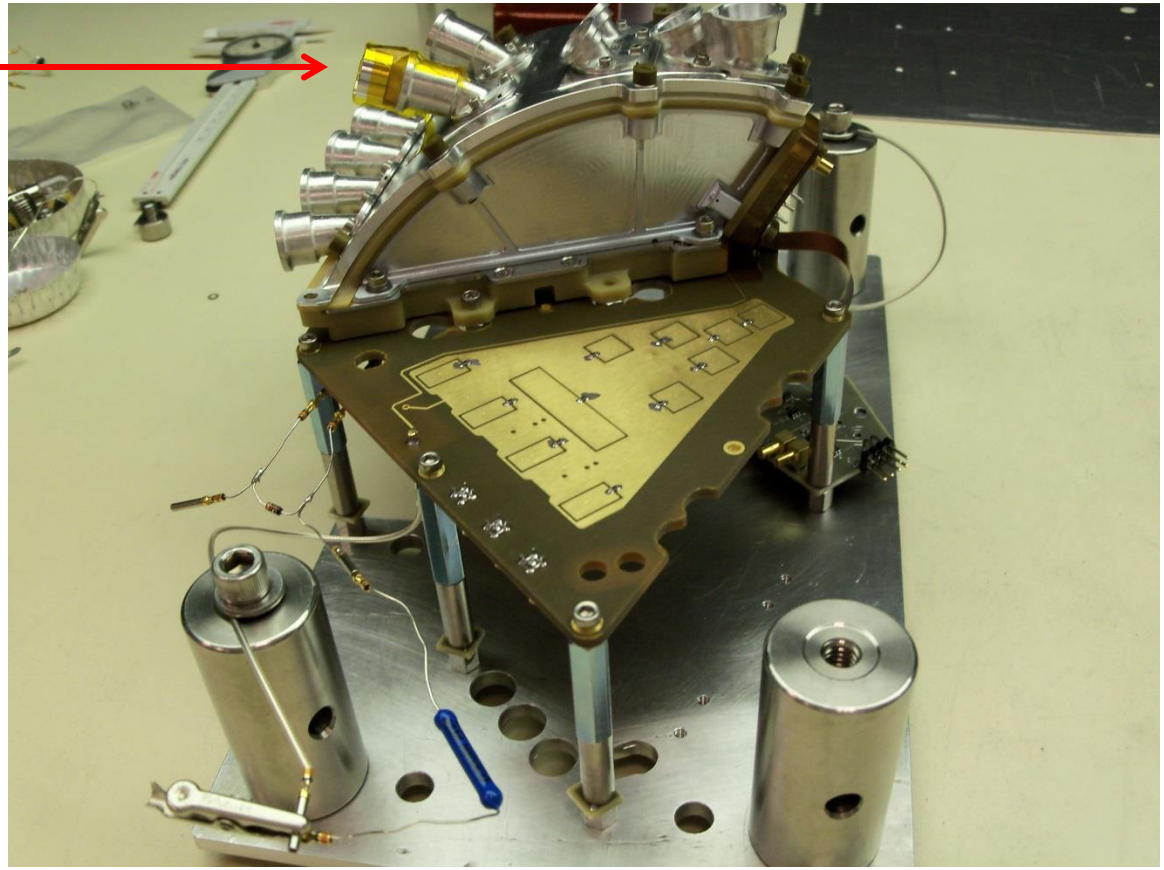


No discharge (5pC threshold) for 72hr @ 6KV (nominal HV ~ 2.9KV)

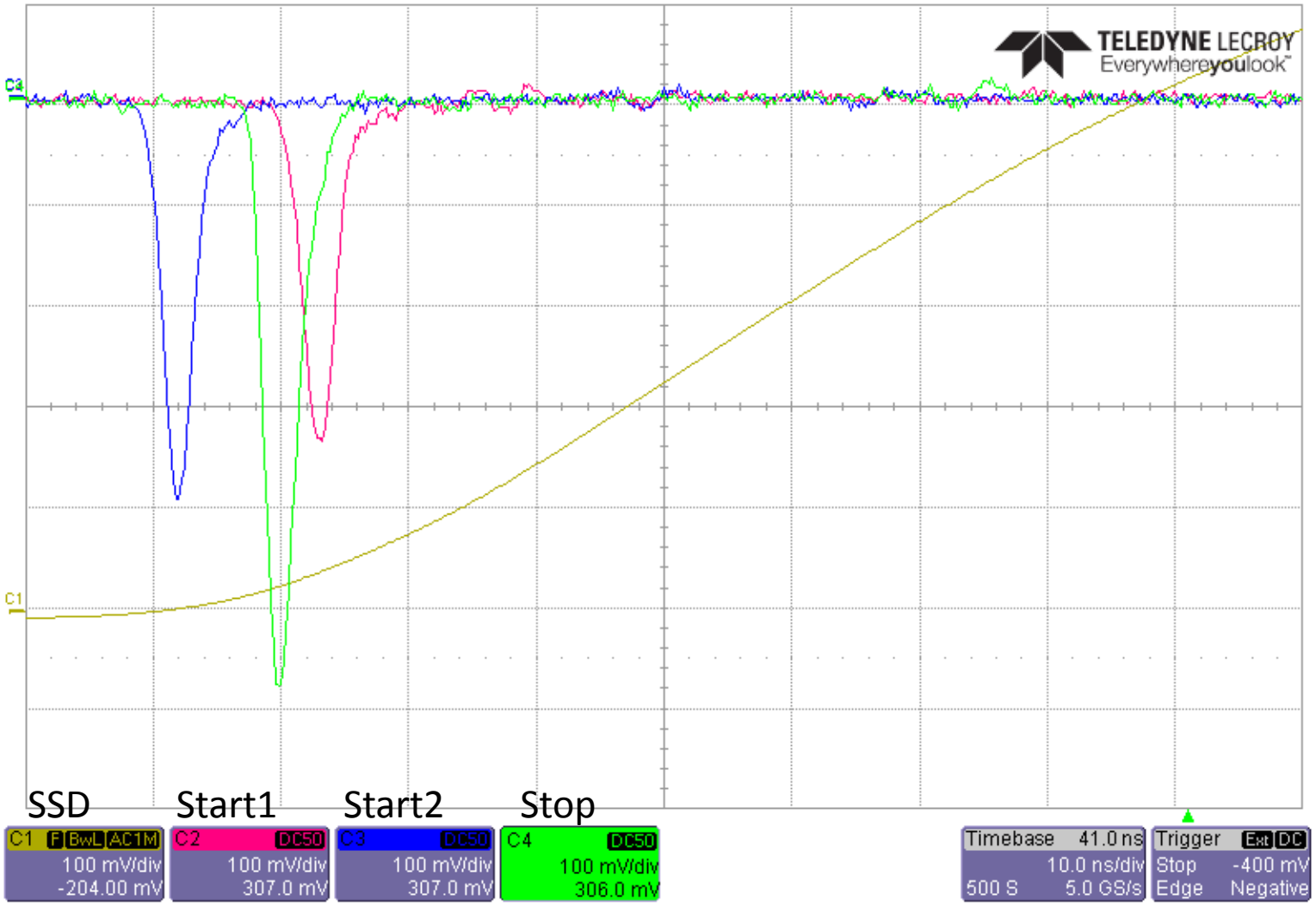
Single Octant on EM anode board

Readout with Lab electronics; NIM modules & DSO

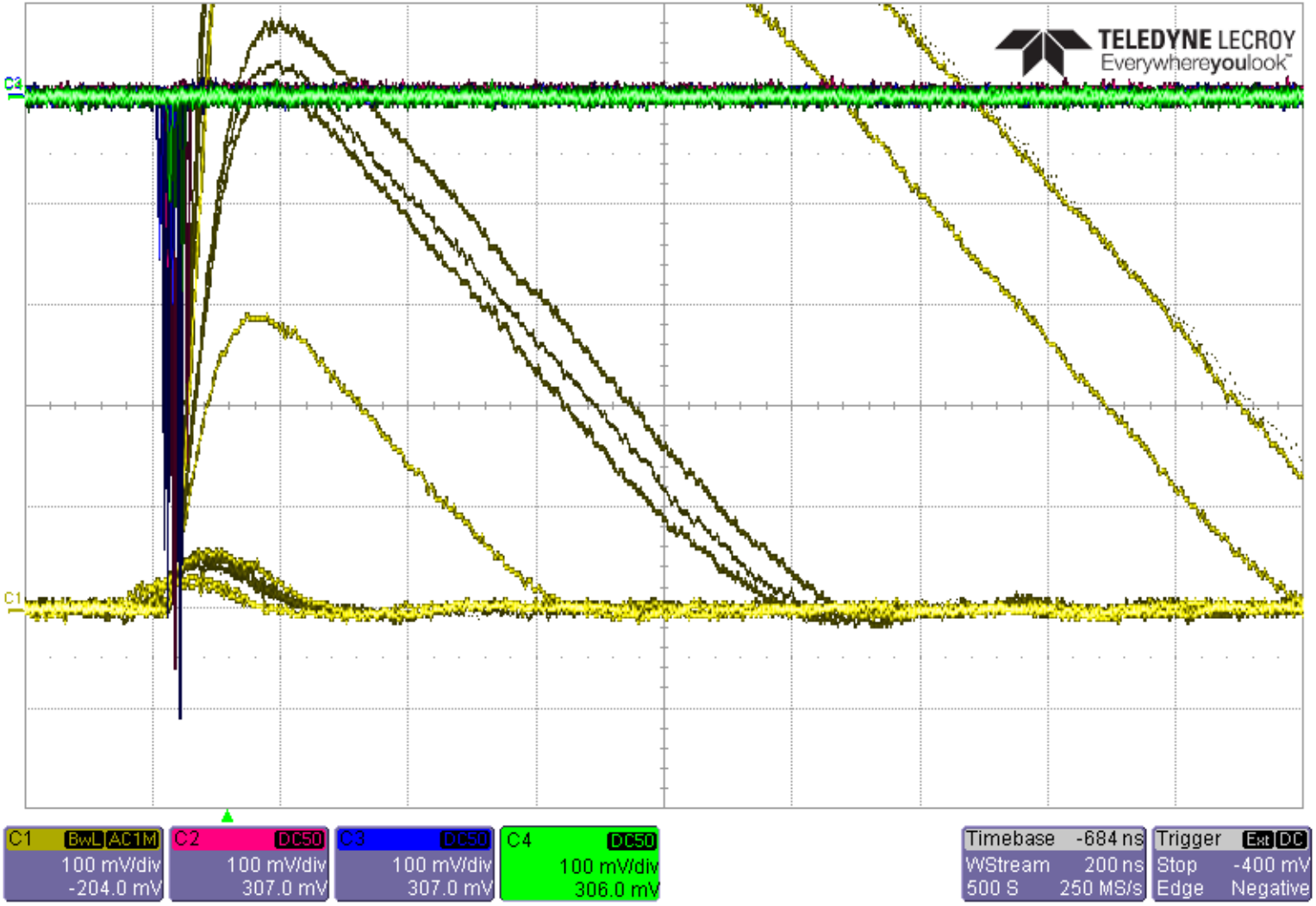
Alpha source



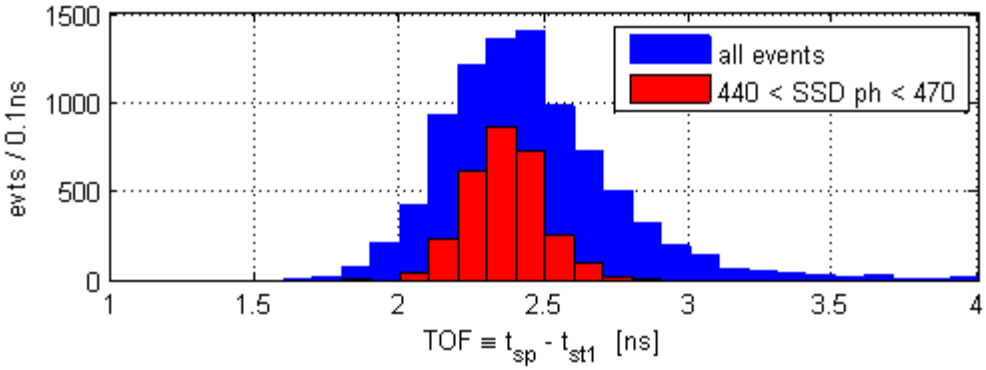
Alpha particle triple coincidence

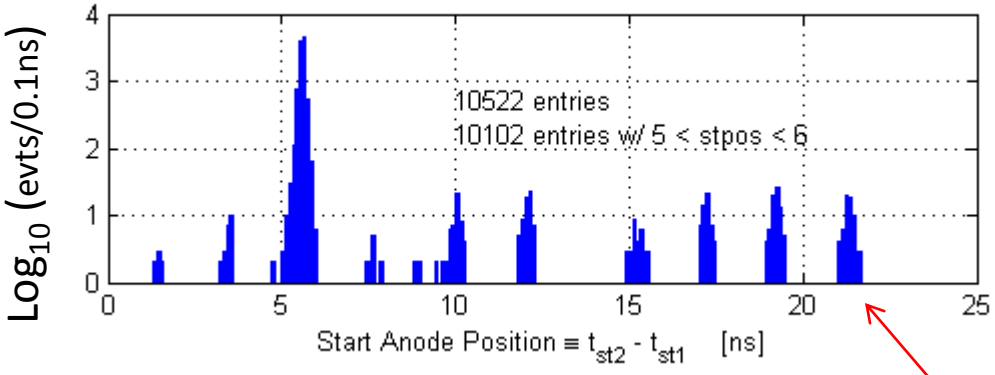


SSD signal slew-rate limiting enables Pulsewidth mode.



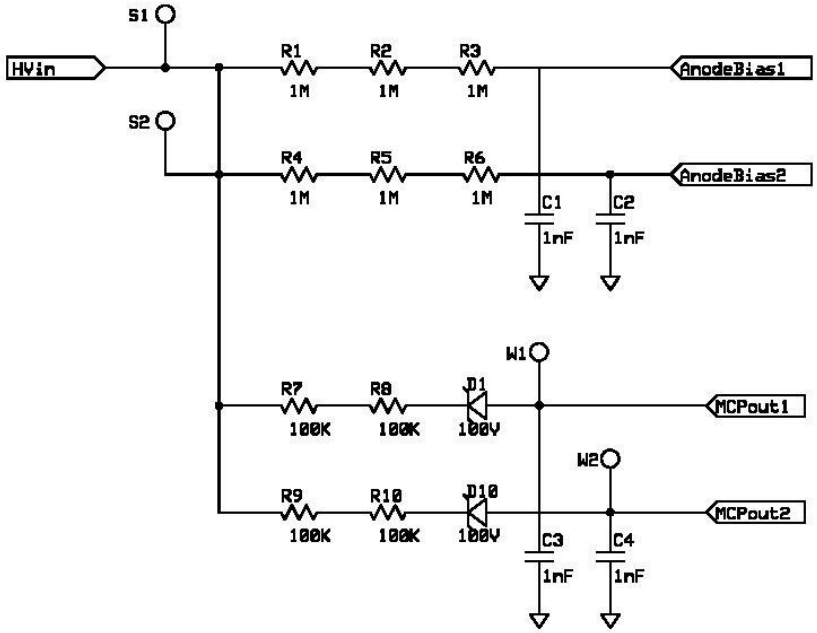
Results from Alpha source located over a single start foil demonstrate that timing requirement can be satisfied.

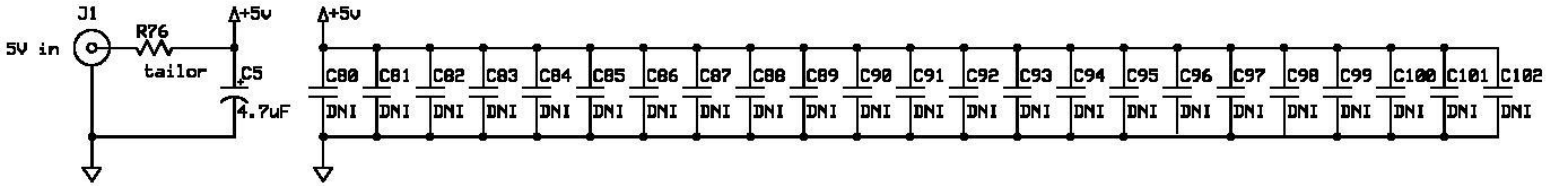




Only one octant
=> 10 pads.

Satellite peaks due to source
X-rays and/or electrons





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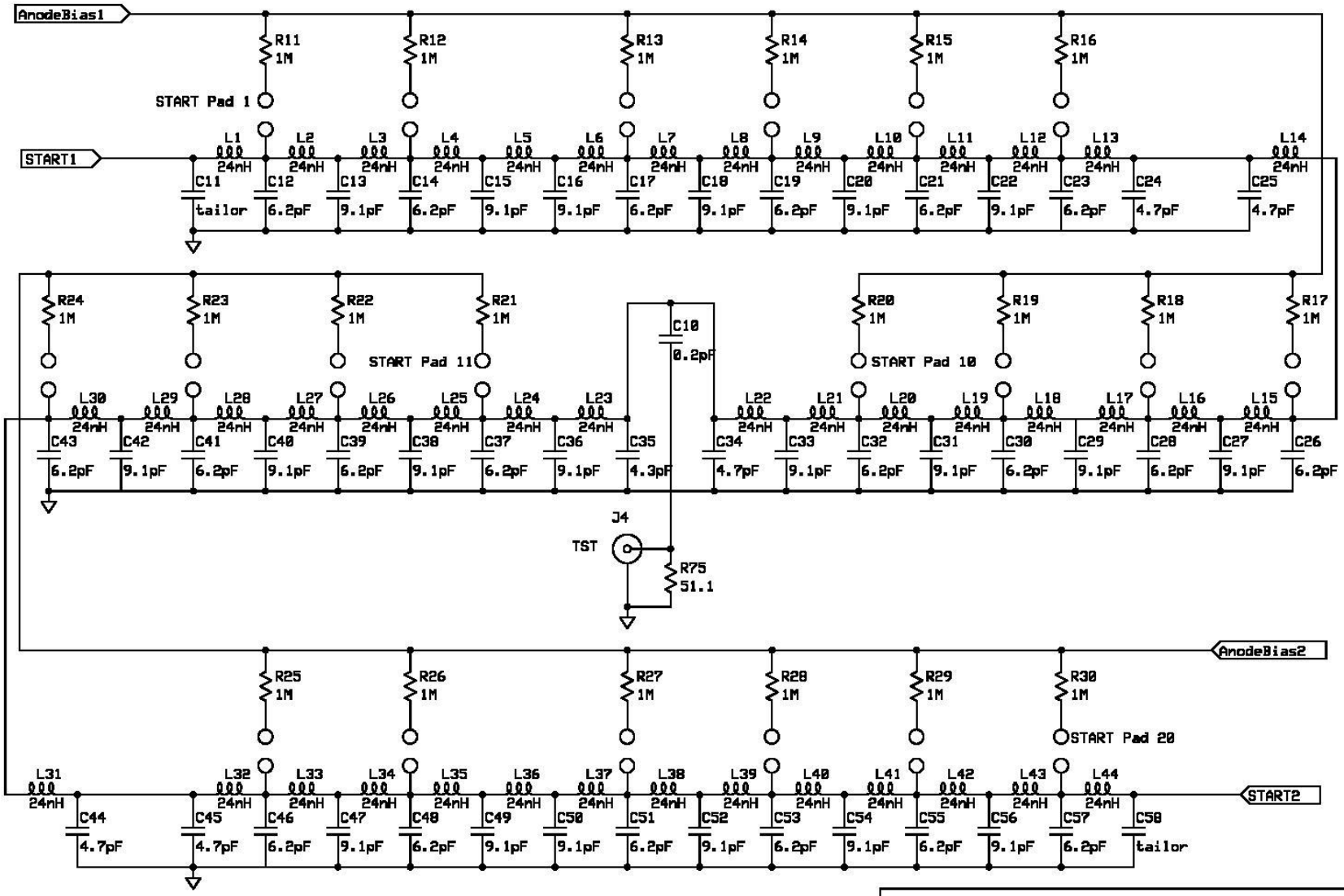
START anode delay line



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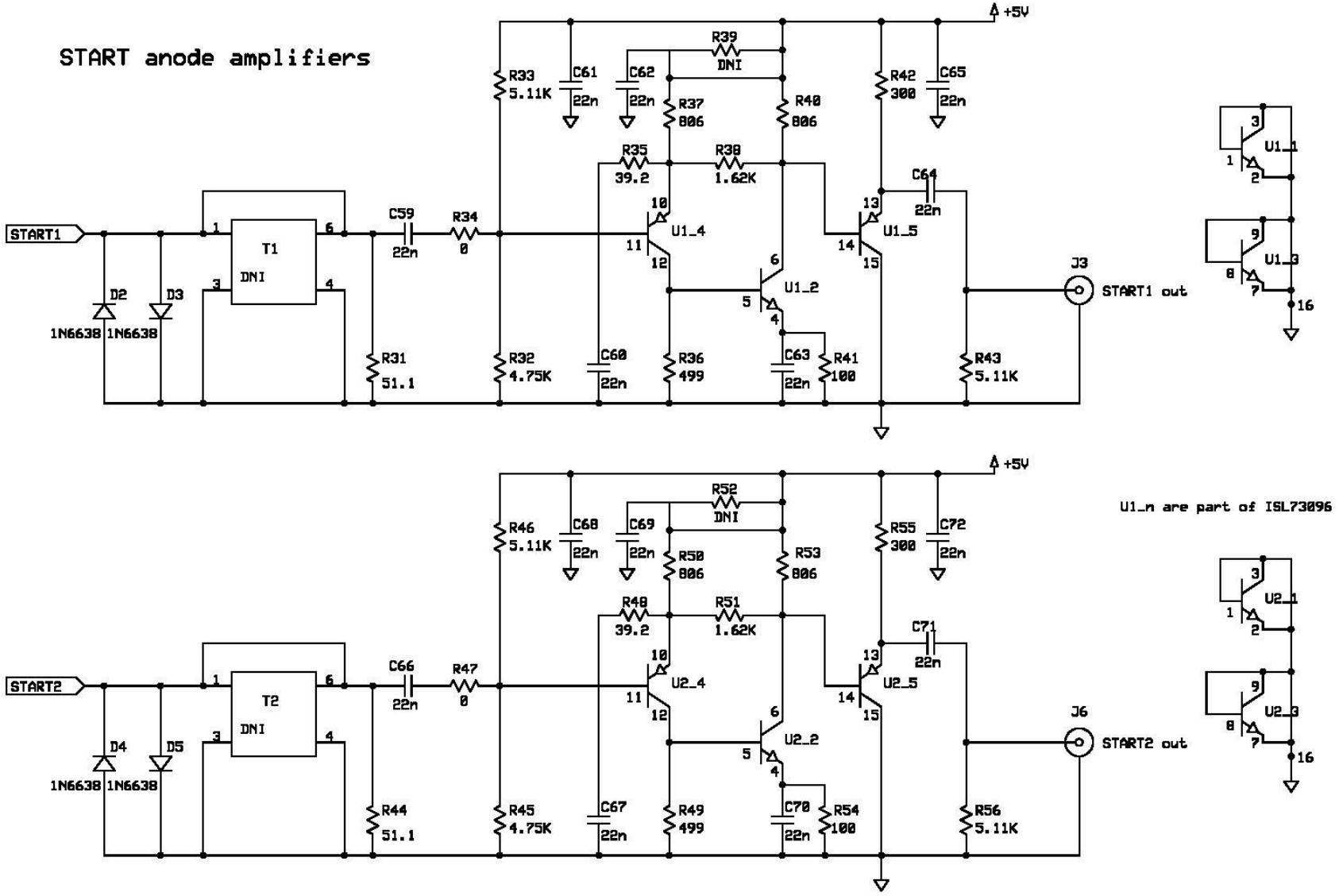
START anode amplifiers
+5V
START1
T1
DNI
D2
D3
1N6638
1N6638
C59
22n
R34
0
R31
51.1
R33
5.11K
C61
22n
C62
22n
R39
DNI
R37
806
R40
806
R35
39.2
R38
1.62K
R32
4.75K
C60
22n
R36
499
C63
22n
R41
100
R42
300
C65
22n
C64
22n
U1_4
U1_5
U1_2
J3
START1 out
U1_1
U1_3
U1_n are part of ISL73096
START2
T2
DNI
D4
D5
1N6638
1N6638
C66
22n
R47
0
R44
51.1
R46
5.11K
C68
22n
C69
22n
R52
DNI
R50
806
R53
806
R48
39.2
R51
1.62K
R45
4.75K
C67
22n
R49
499
C70
22n
R54
100
R55
300
C72
22n
C71
22n
U2_4
U2_5
U2_2
J6
START2 out
U2_1
U2_3
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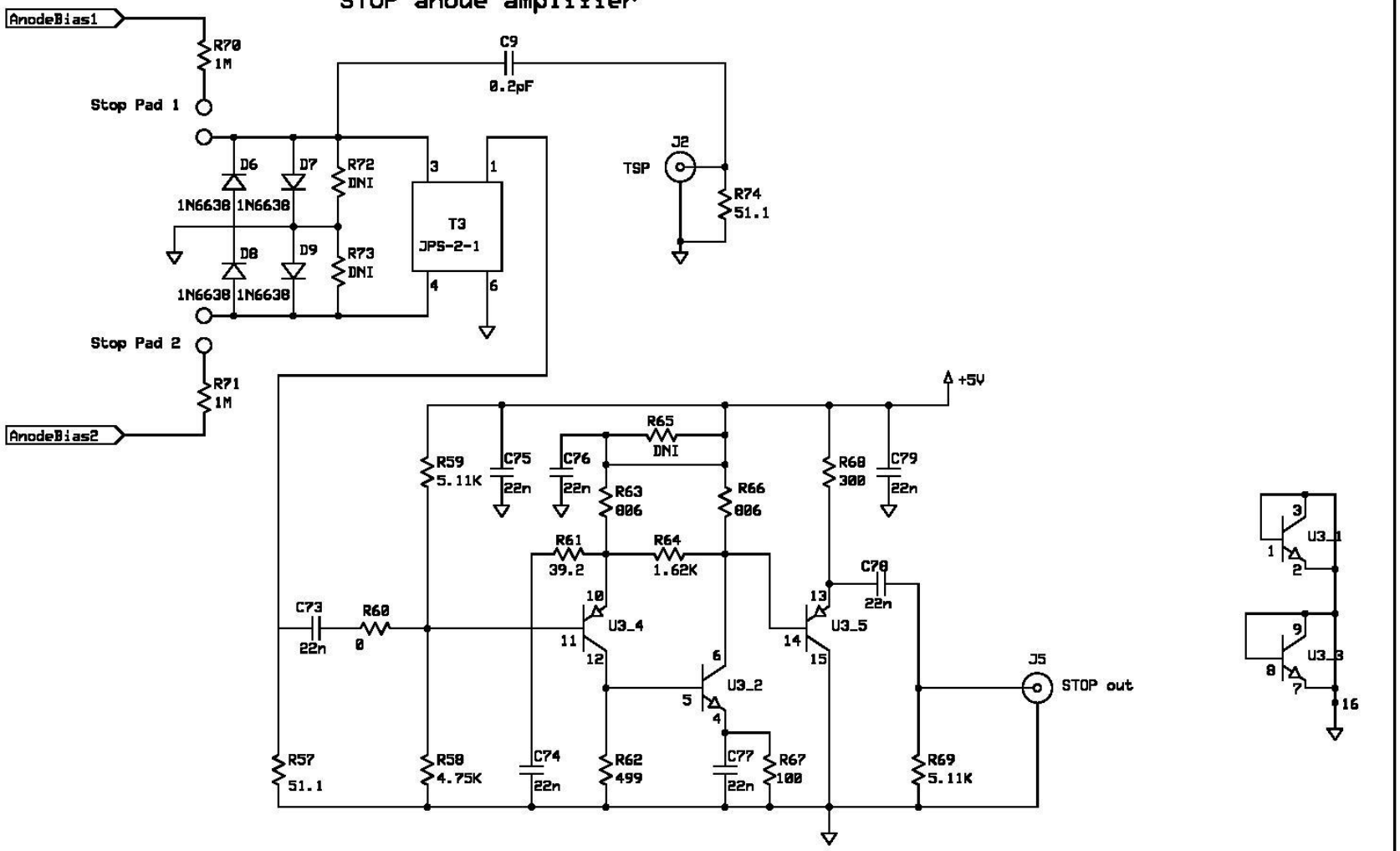
STOP anode amplifier



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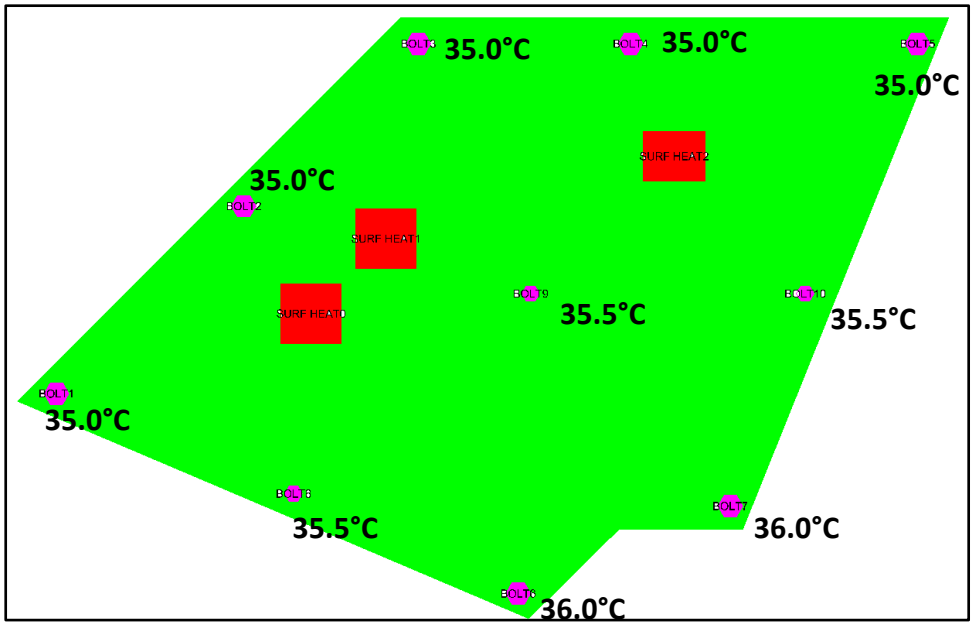
Thermal Modeling

- Box level model temps applied at board mounting bolts
- Power dissipation (0.126W) modeled as local heat sources.
- Max board temp is 40C in area of active components (red).



Other issues….

- Omitted 4:1 transformers on start amplifiers due to reflections
- Omitted HV anode filter cap.
- No changes from EM to FM.