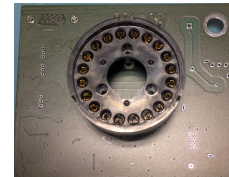
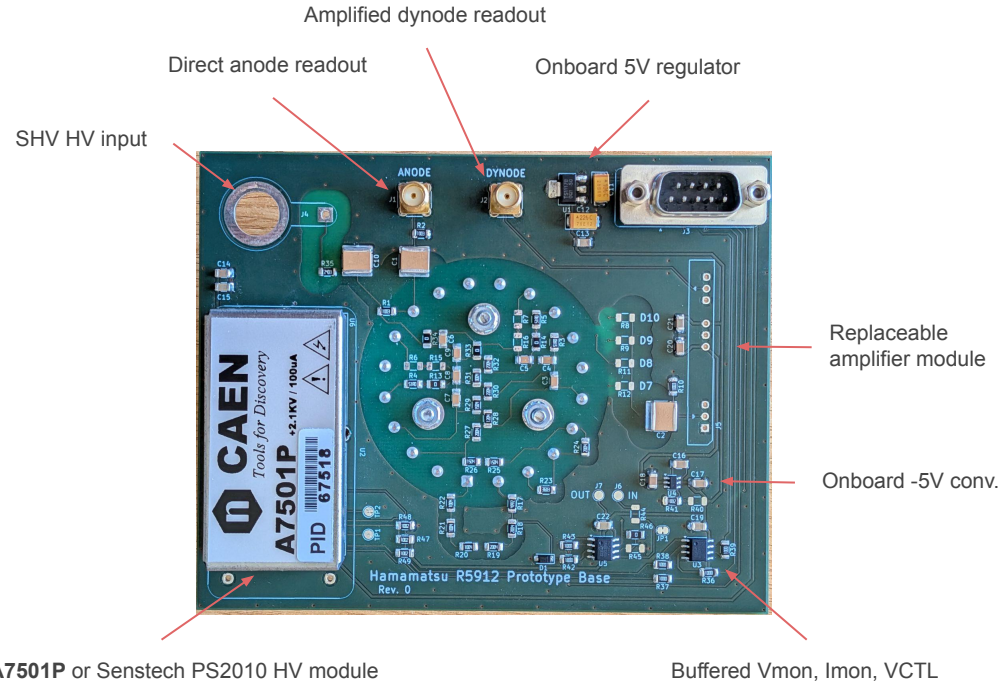


# Passive base for Hamamatsu R5912

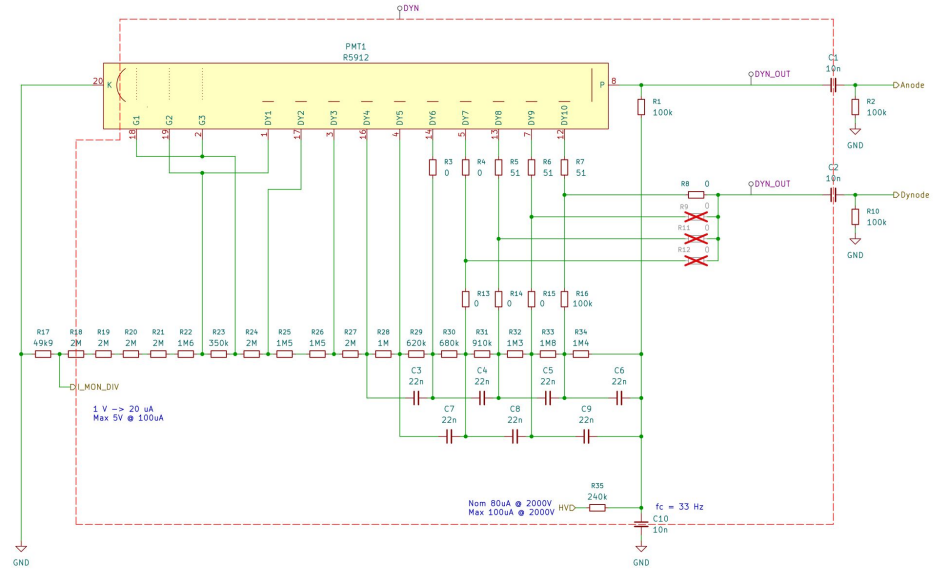
# R5912 Prototype Base

- *Prototype for the possible new Auger PMT*
- Works with **R5912** / R5912-03
- E678-20B socket
- Compatible with UB / UUB (tested)
- BoM cost
  - 280 EUR - HV module
  - 20 EUR - Socket
  - 10 EUR - amplifier module
  - 15 EUR - PCB
  - 35 EUR - rest
- Power: 1.5 W stby, 4.5 W @ 2000V
- Optimization still ongoing



# Divider

- Adapted from Auger Photonis base
- Simple passive design
- Start with suggested dynode ratios
  - $R_{DIV} \approx 25 \text{ MOhm}$
  - Hamamatsu E7694-03 has 4 MOhm
- Taper on last stages
- Backed by capacitors on last stages
- Dynode pickup



Divider schematic.

|            |      | K  | Dy1 | G2  | G1 | G3  | Dy2 | Dy3  | Dy4  | Dy5 | Dy6 | Dy7 | Dy8 | Dy9 | Dy10 | P |
|------------|------|--|-----|-----|----|-----|-----|------|------|-----|-----|-----|-----|-----|------|---|
| R5912/-100 | 1500 | 16.8   | 0   | 0.6 | 0  | 3.4 | 5   | 3.33 | 1.67 | 1   | 1.2 | 1.5 | 2.2 | 3   | 2.4  |   |
| R7081/-100 |      | Capacitors in $\mu\text{F}$   0.01 0.01 0.01 |     |     |    |     |     |      |      |     |     |     |     |     |      |   |

Divider ratios specified by Hamamatsu.

# HV Modules

- Auger tank: Senstech PS2010
  - Reliability problems @ Auger
- Auger SPMT: CAEN A7501
- Auger SSD: iseg base + HV conv.
- Other suggestions?

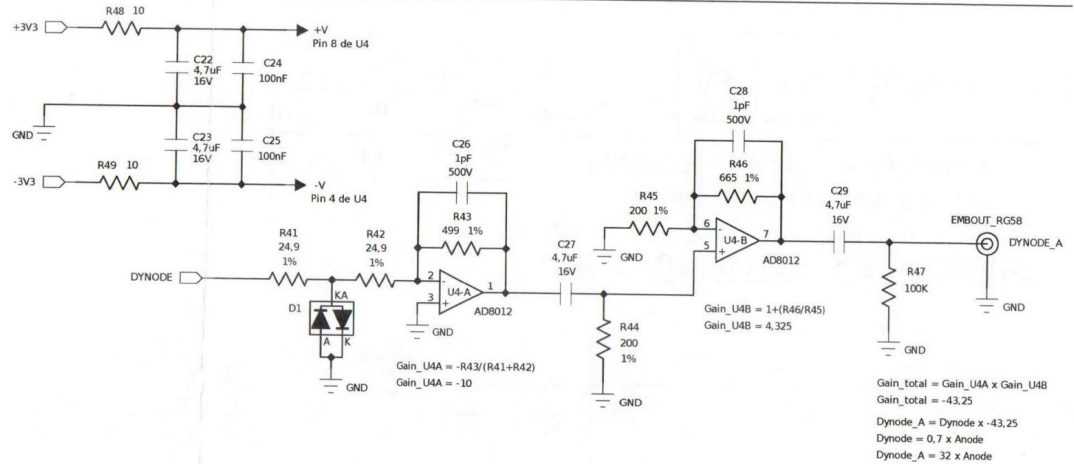
## CAEN A7501

- + Low power consumption
- + Used at Auger (1600+ units)
- Costly

| Module               | Max current | Max voltage | Max. Ripple | Input current stby / full | Price / 1pc |
|----------------------|-------------|-------------|-------------|---------------------------|-------------|
| Senstech PS2010/12   | 100uA       | +2000V      | 40mV        | ?/27 mA                   | 300 EUR     |
| Hamamatsu C9619-51   | 2mA         | +2000V      | 60mV        | 100 / 460 mA              | 240 EUR     |
| Hamamatsu C11152-51  | 1mA         | +1500V      | 1mV         | 50 / 220 mA               | 200 EUR     |
| CAEN A7501           | 100uA       | +2100V      | 5mV         | ?/33 mA                   | 280 EUR     |
| CAEN A7520           | 700uA       | +2000V      | 8mV         | ?/210 mA                  | ?           |
| XP A20P-12           | 500uA       | +2000V      | 6V          | 100/185 mA                | 226 EUR     |
| XP AG20P-5           | 500uA       | +2000V      | 6V          | 300/500 mA                | 224 EUR     |
| XP C20               | 500uA       | +2000V      | 40mV        | 100/250 mA                | 332 EUR     |
| XP CA20P             | 500uA       | +2000V      | 20mV        | 100/550 mA                | 392 EUR     |
| XP CA20P-T           | 500uA       | +2000V      | 20mV        | 100/220 mA                | ?           |
| TDK CHVM2-12-2000PW  | 1mA         | +2000V      | 50mV        | ?/340 mA                  | 325 EUR     |
| Ultravolt 2A12-P4    | 2mA         | +2000V      | 200mV?      | 100 / 400 mA              | 469 EUR     |
| Ultravolt 2AA12-N4   | 2mA         | +2000V      | 200mV?      | 100 / 450 mA              | 577 EUR     |
| SDS WRM12N2-1-C2.5.* | 0.5mA       | +2000V      | 40mV        | 50/180 mA                 | 310 EUR     |
| HVM SMHV0520         | 0.5mA       | +2000V      | 200mV       | 35/350 mA                 | 273 EUR     |
| HVM SK1230           | 0.5mA       | +2000V      | 200mV       | 35/350 mA                 | 260 EUR     |
| HVM RK1220           | 0.5mA       | +200V       | 200mV       | 35/350 mA                 | 220 EUR     |
| HVM UMHV1220         | 250uA       | +2000V      | 2V          | 10/100 mA                 | 190 EUR     |

# Dynode amplifier

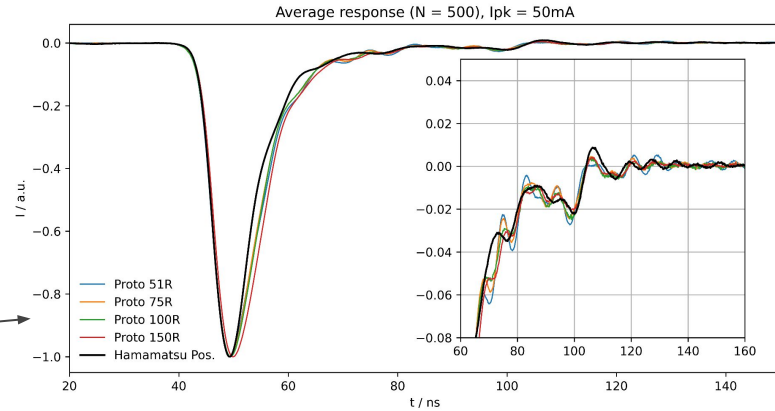
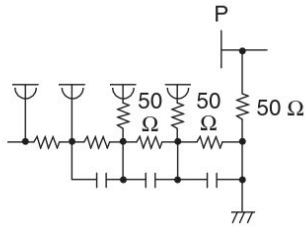
- Increase SNR of small signals
- Requirements
  - Gain:  $\sim -45$
  - BW:  $> 30\text{MHz}$
  - Power:  $\pm 3\text{V3}$
- Auger design with dual stage **AD8012**



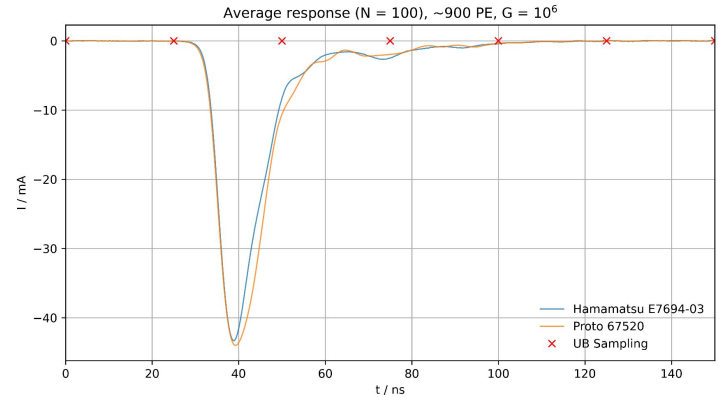
Auger LPMT base dynode amplifier.

# Ringng

- Resonance in parasitic LC circuit
  - Dyn - A capacitance
  - Lead inductance
- Increase damping resistors
- Effect of isolation capacitor ESR?



Anode ringing for different damping resistors.



Comparison of Hamatsu and Prototype base.

# Adaptation for PEPS

- *Design requirements?*
- *PMT performance?*

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# Adaptation for PEPS

- Flying leads
- Temperature sensor
- Increase margin on some components
- Testpoints & jig

## TBD - Other modifications

- Amplified anode or dynode?
- Is buffered IO necessary?
- Connectors or direct solder cables?
- Ferrites on IO?
- Other ideas?



Auger XP1805 base.

# Mechanics

- PCB conformal coating
- Flying leads
  - Spot welding
- Potting silicone
- Mechanical interface



Auger XP1805 with potting silicone and nick

# Conclusion

- ✓ Auger base adapted for Hamamatsu R5912
- ✓ Proven robust design
- ✓ Interfaces with UB
  - Some changes required for production version
  - Optimize PMT performance and other base tweaks
  - Define mechanical assembly
- × High cost (280 EUR for HV module)

**Prototype base assembled and working in Prague and soon in Brussels.**



# Questions?