ASD Scorpius

Marx Source

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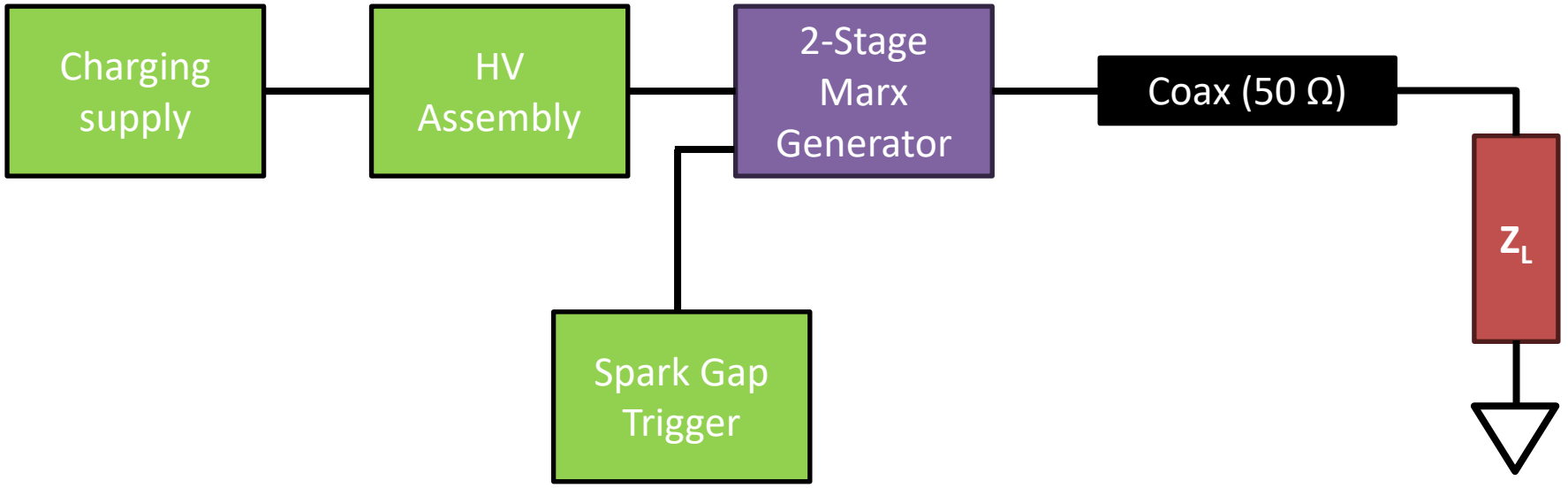
Why a Marx?

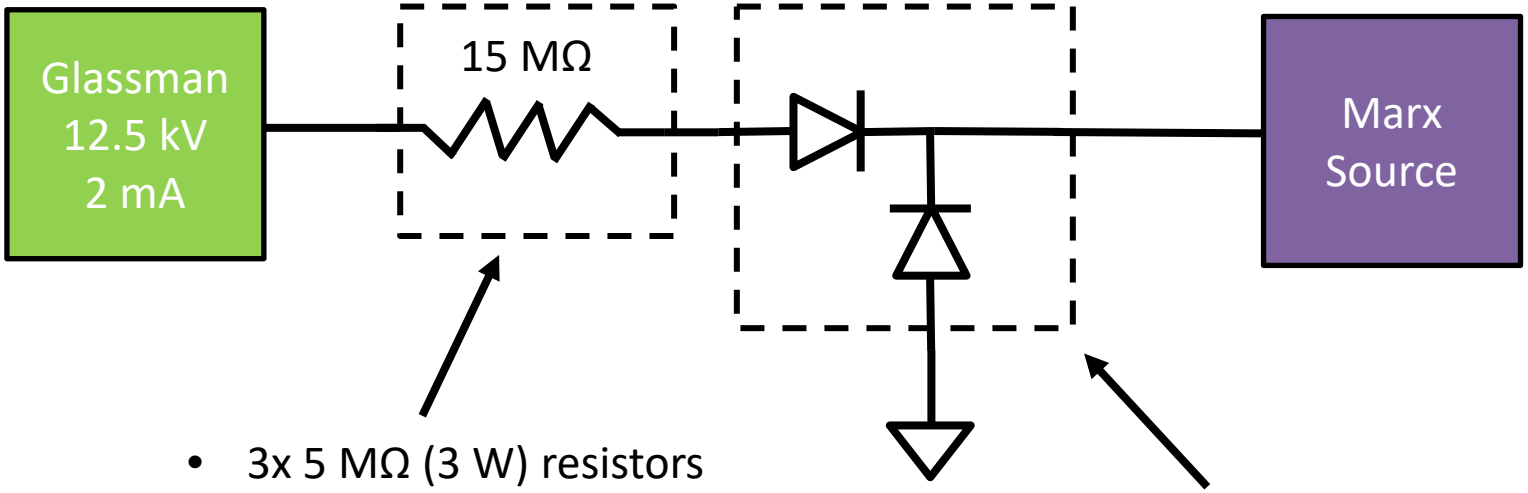
- Need a permanent pulsed power source to use for diagnostic experiments
- Most of the parts are readily available
  - Ceramic capacitors, spark gaps, power supply, coaxial cable, etc.
- Easy to design and test
  - Important considering time constraints

System Overview



- Charging supply: Glassman HV supply (12.5 kV charge voltage, 2 mA)
- HV assembly: charging resistor & diode stack (for supply protection)
- 2 stage resistively charge Marx generator
- Coax: RG-217 or RG-8
- Load also interchangeable

Charging & High Voltage Assembly



- 3x 5 MΩ (3 W) resistors
- Enclosed in heat shrink (2000 V/mil)
- Serves as current limit for extra protection of HV supply

- 10 kV, 20 mA diodes
- 4 stacked in forward bias,
- 3 stacked in reverse bias
- Diodes potted in 832C epoxy
  - 60.4 kV breakdown voltage
  - 480 V/mil dielectric strength

Marx Circuit

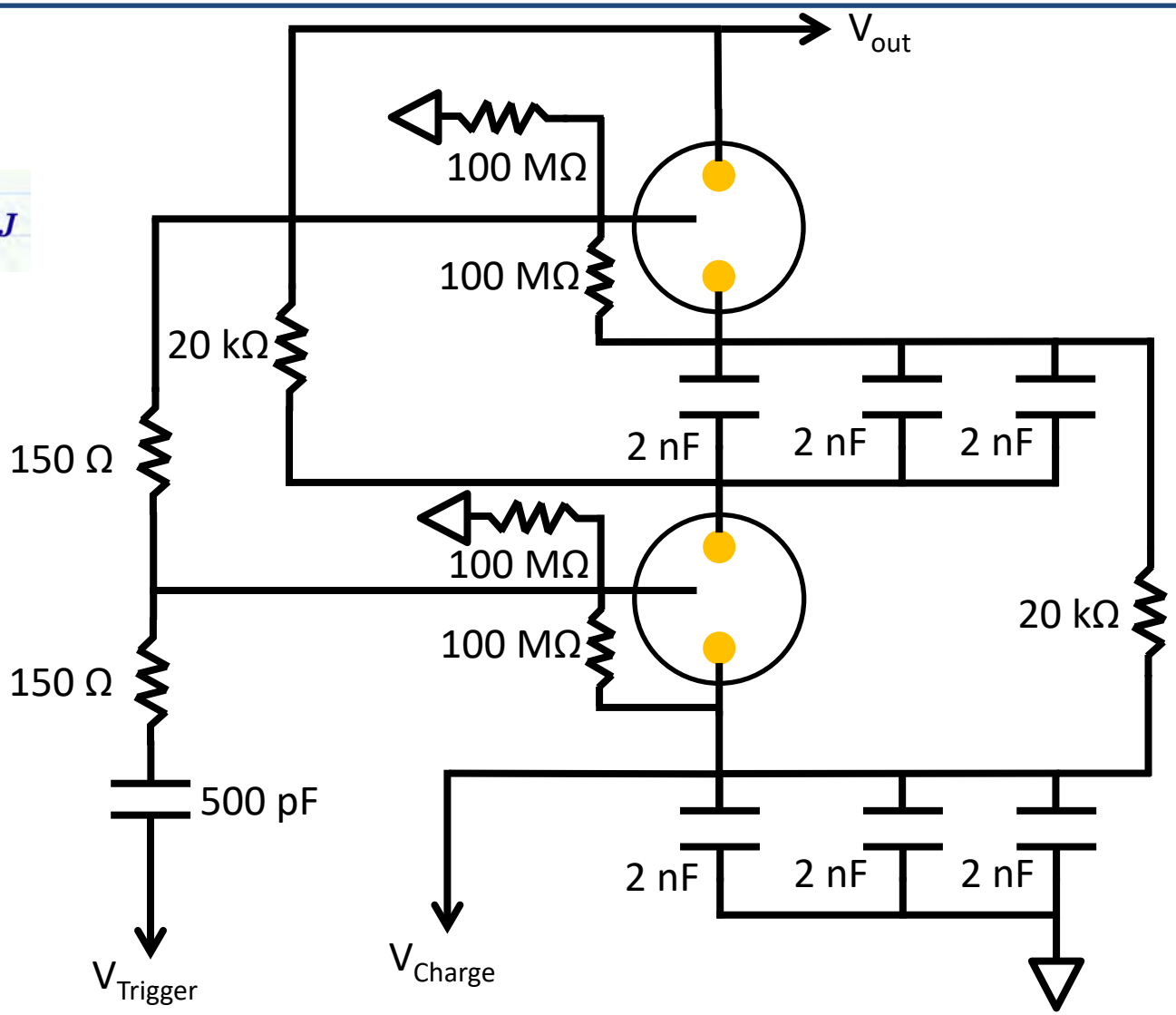
Each stage uses 3, 2 nF door knob capacitors (40 kV rated)

$$W_{marx} := \frac{1}{2} \cdot N_{stage} \cdot C_{total} \cdot V_c^{\,2} = 0.469\ J$$

Charging time:

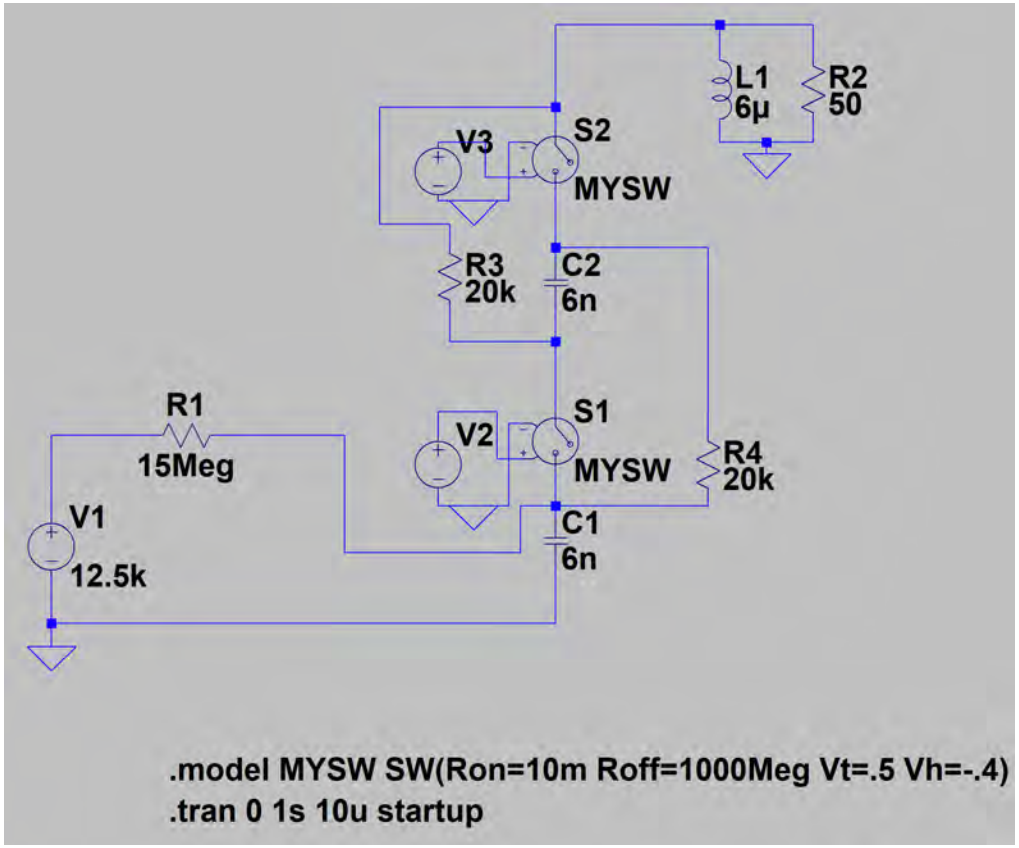
$$t_c := 2 \cdot R_c \cdot C_{total} \cdot N_{stage}^{\,2} = 360\ ms$$

- Output of Marx ~25 kV peak
- Midplane field distortion spark gaps as switches
- Triggered using -17.5 kV pulse

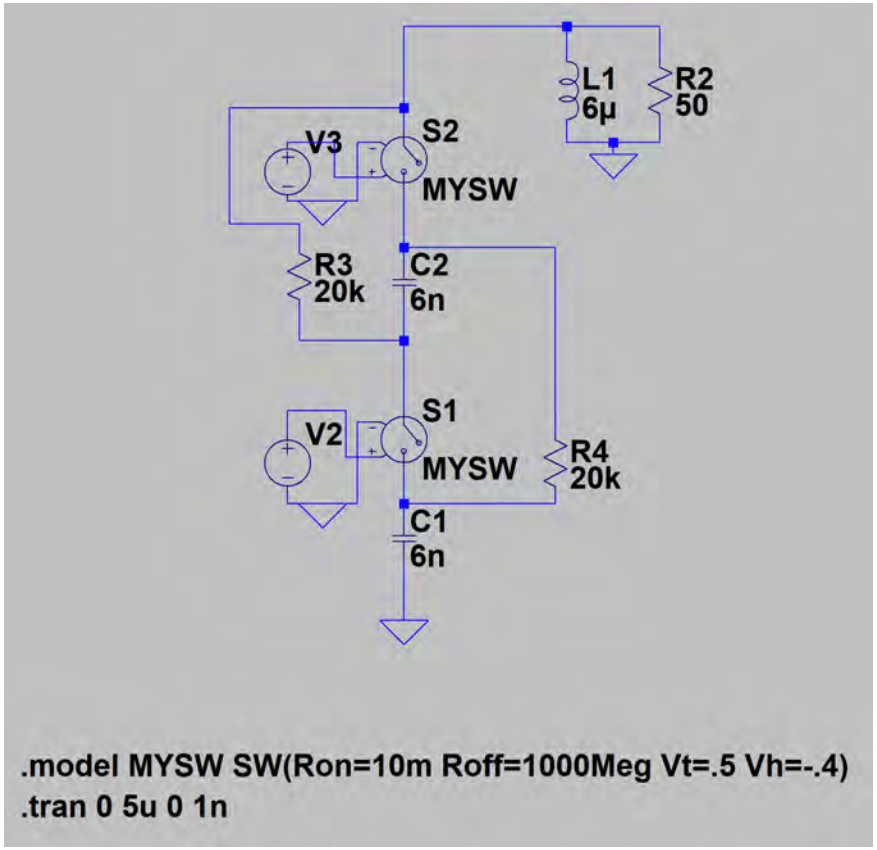


Charge and Discharge Circuits

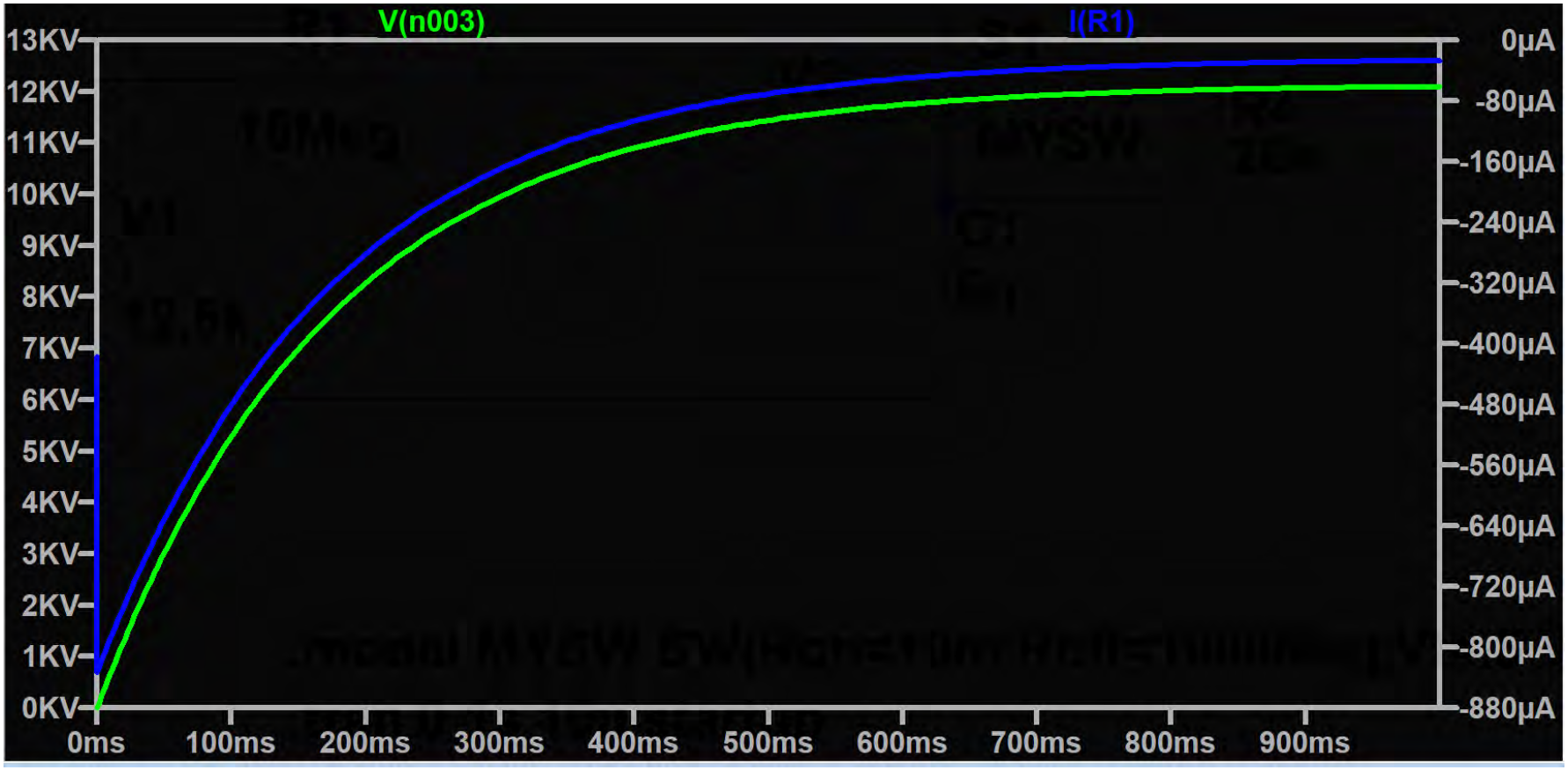
Charge Circuit



Discharge Circuit

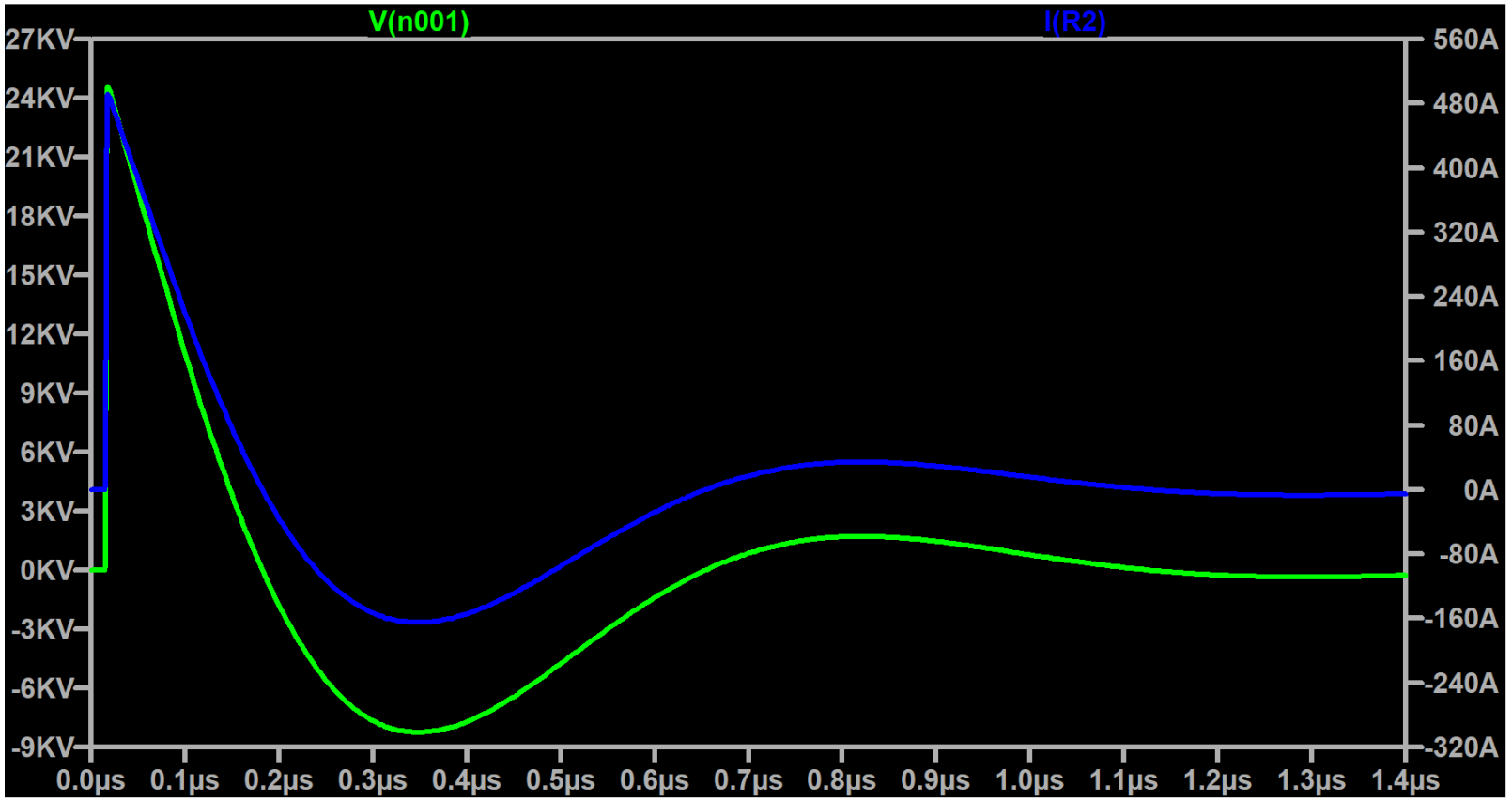


Charging Circuit Waveforms



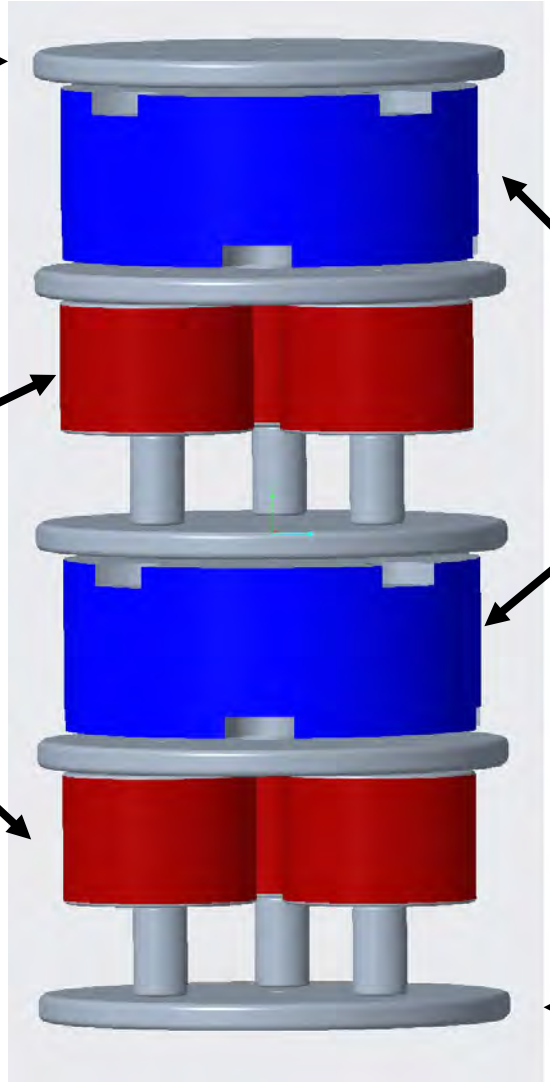
- Charge voltage – green trace
- Charging resistor current draw – blue trace
- Complete charging ~1 second, current draw peak 880 µA, within Glassman current limit

Discharging Circuit

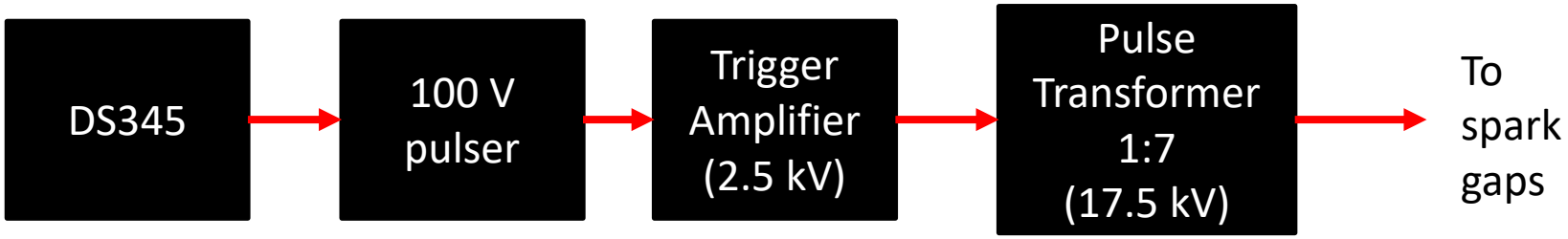


- Load voltage – green trace
- Load current – blue trace
- 24 kV peak voltage (~77 ns pulse width), 480 A peak current.
- Voltage and current backswing: 33.8%

Marx Rendering

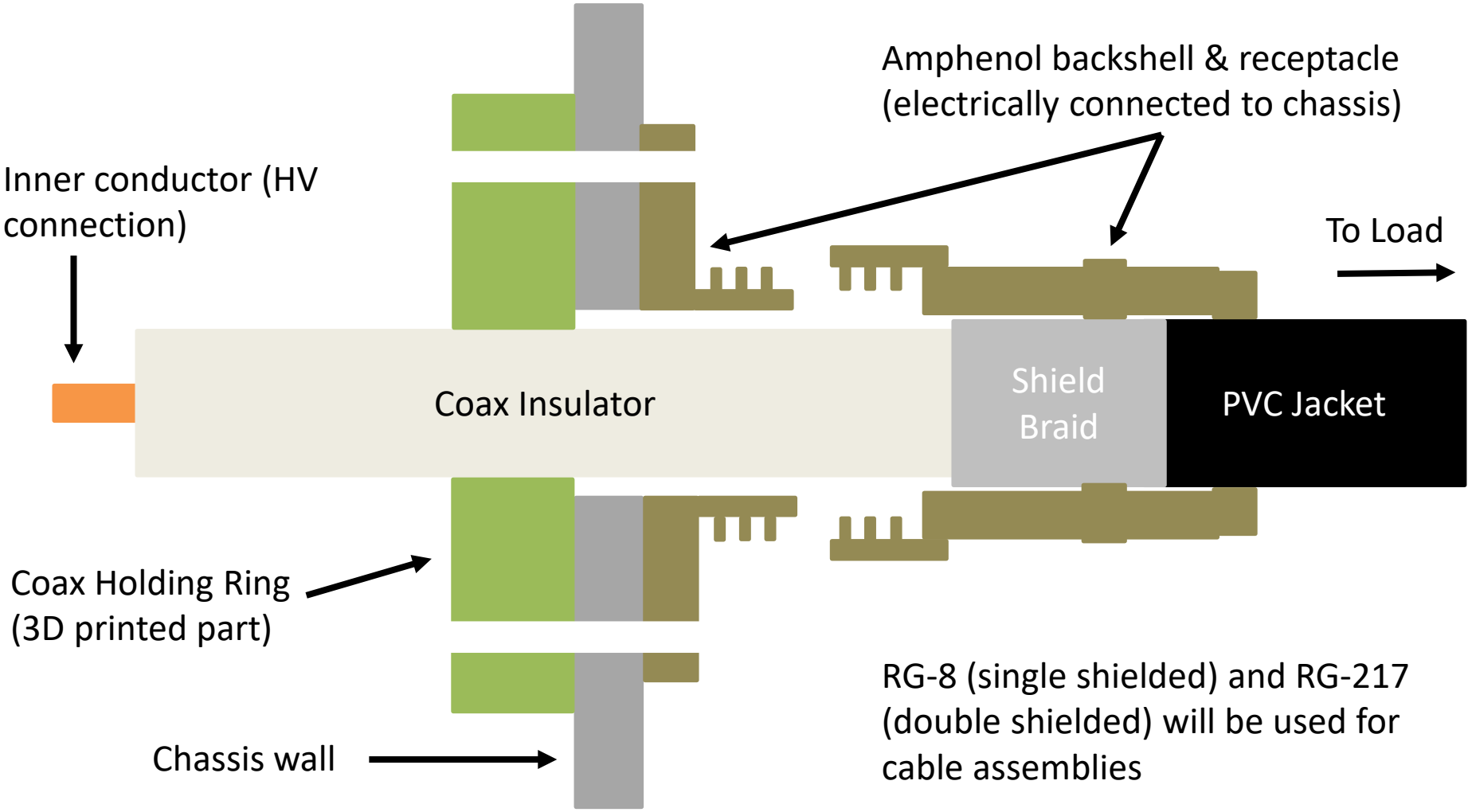


Spark Gap Trigger Overview



Many components are involved, but readily available!

Cable Assembly (Cross-section)



RG-8 (single shielded) and RG-217 (double shielded) will be used for cable assemblies

Summary & Future Work

- Parts ordered for Marx source
- Trigger circuit needs to be tested once parts arrive
- Currently setting up experiment with prototype diagnostic and different pulser
- Qualifier exam scheduled for December 11th