

Challenges of Constructing a 17 Magnetron Transmitter

- ◆ Michael W. Hunter – H6
- ◆ Alan D. Mazuc – NAVAIR
- ◆ Dr. Marcel P.J. Gaudreau - DTI

H6 SYSTEMS INC.



H6 Systems Inc.

- Manufacturer of tube based high power transmitters
 - Used in the susceptibility testing of military aircraft and ordinance.
- Also rack mount pulsed signal source
 - 220-5000 Mhz
 - 5000 watts

Narrow Pulse Magnetron System At H6 Systems Before Shipping



Customer:

Patuxent River Navy Air Station

Naval Air Warfare Center under Navair
Naval Electromagnetic Radiation Facility

Location: Lexington Park, Maryland

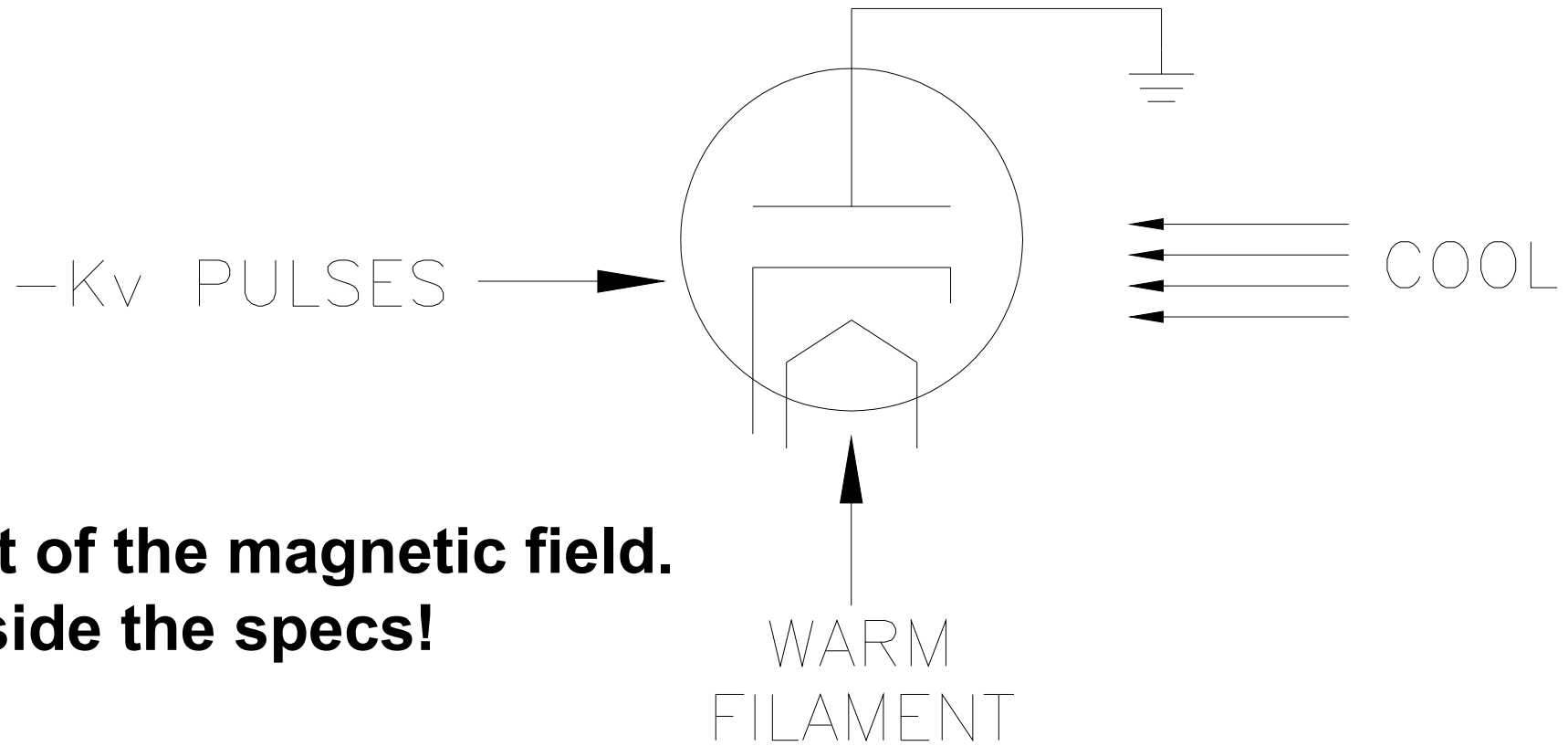
- Susceptibility testing of aircraft
 - Simulate E fields generated by –
 - Shipboard radar
 - Other sources

System Requirements

- Frequency 1 GHz – 24 GHz
- Power .1 MW – 4.5 MW
- Pulse Width .5 μs – 5 μs
- This can be done with 17 magnetrons

Running a magnetron

MAGNETRON



- **Stay out of the magnetic field.**
- **Stay inside the specs!**

Challenges

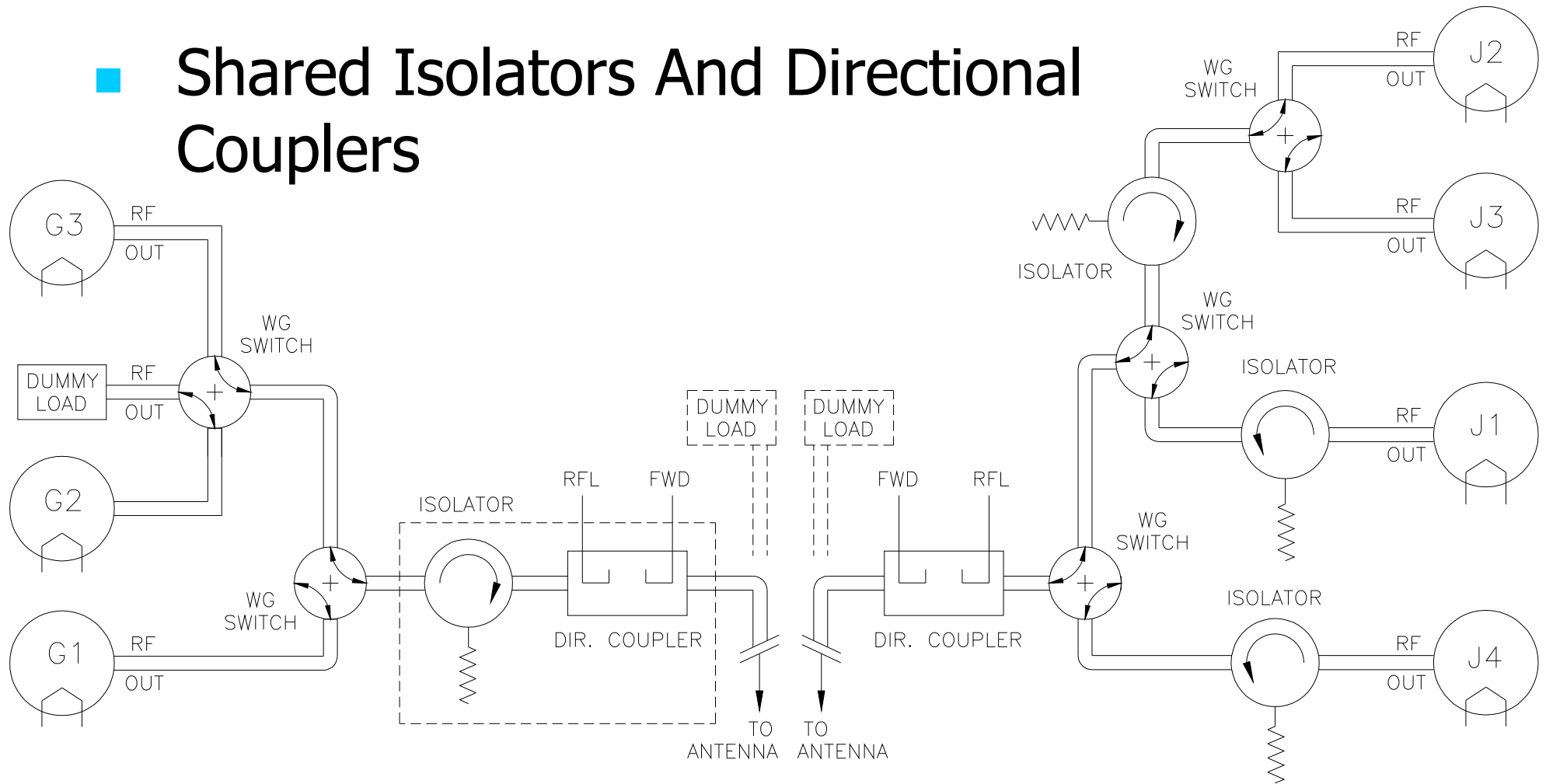
- Modulator Requirements
 - Voltage: 15 kV – 70 kV
 - Peak Current: 18 A – 130 A
 - Pulse Rise Times: 10 – 130 kV/ μ s
- HV Cable Routing:
 - Furthest Magnetron 19.5 Feet Away.
 - Minimize Capacitance and Inductance.
 - Avoid Corona on High Voltage Magnetrons.
 - Switch Voltage Between Magnetrons.

More Challenges . . .

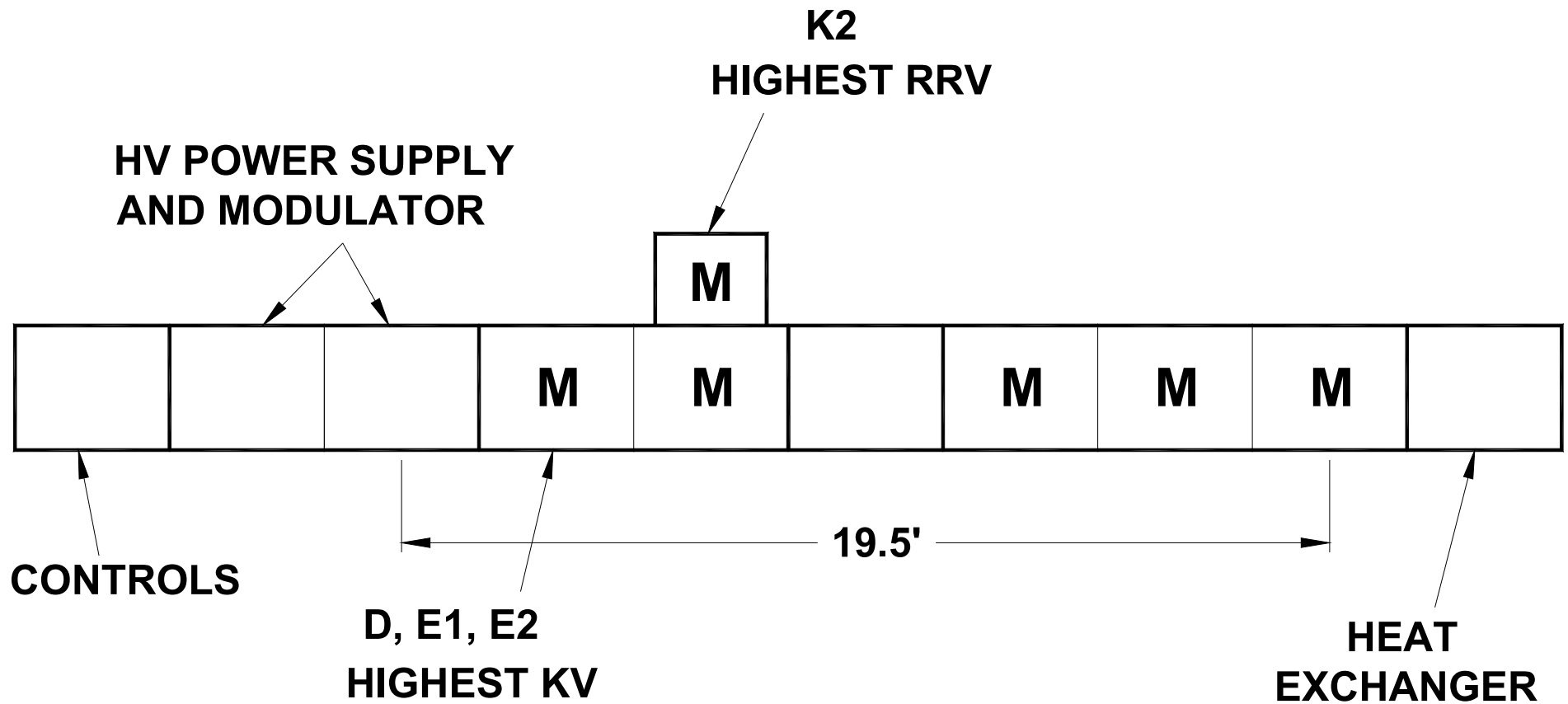
- Filament:
 - Unique Voltages
 - Warm-up Times
 - Cut-back Voltages
 - Simultaneous Warm-ups
- Mechanical Layout of Components
- RF Monitoring
- Controls

Fit: Waveguide Arrangement

■ Shared Isolators And Directional Couplers

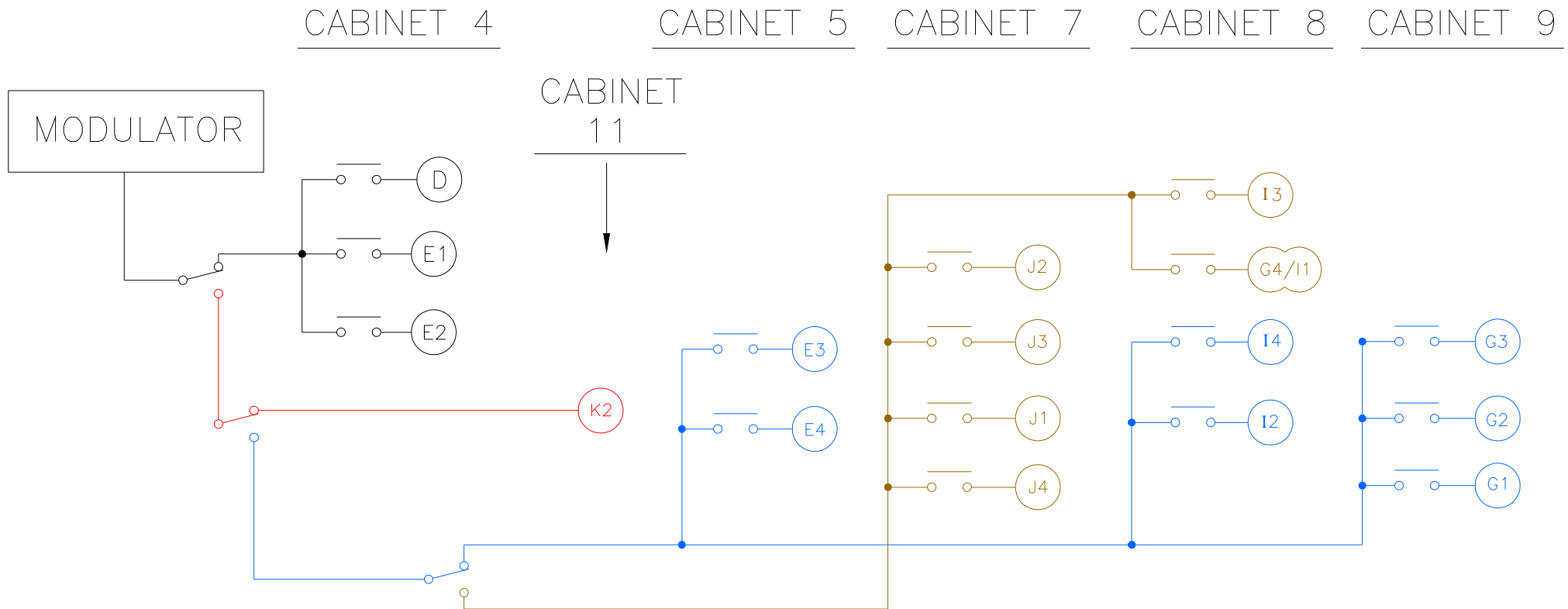


Physical layout of NPMS



TOP VIEW OF CABINETS

Routing HV to magnetrons



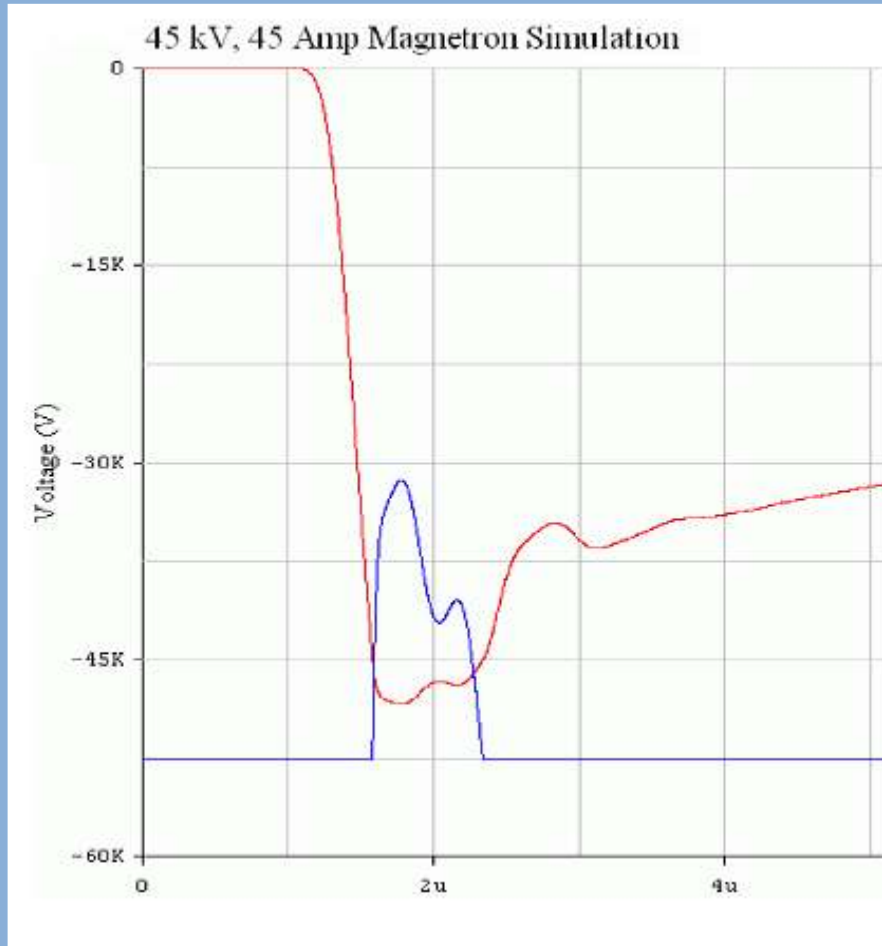
Modulator

- Requirements
 - 15 - 70 kV
 - 18 - 130 A
 - Pulse Width .5 – 5 μ s
 - PRF 200 – 2000 Hz
 - Open During Magnetron Arc
- Diversified Technologies, Inc. (DTI)
 - High Voltage Series Modulator
 - Peak Current Protection
 - Max Repetition Rate

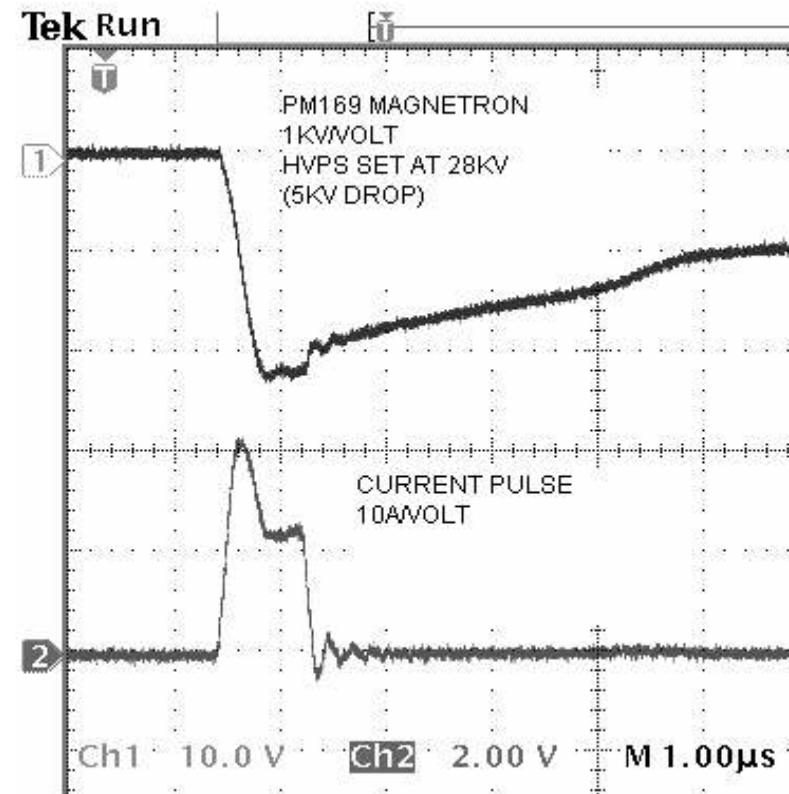


Typical Solid State Switch Assembly and Gate Drive Controller

Voltage & Current Waveform



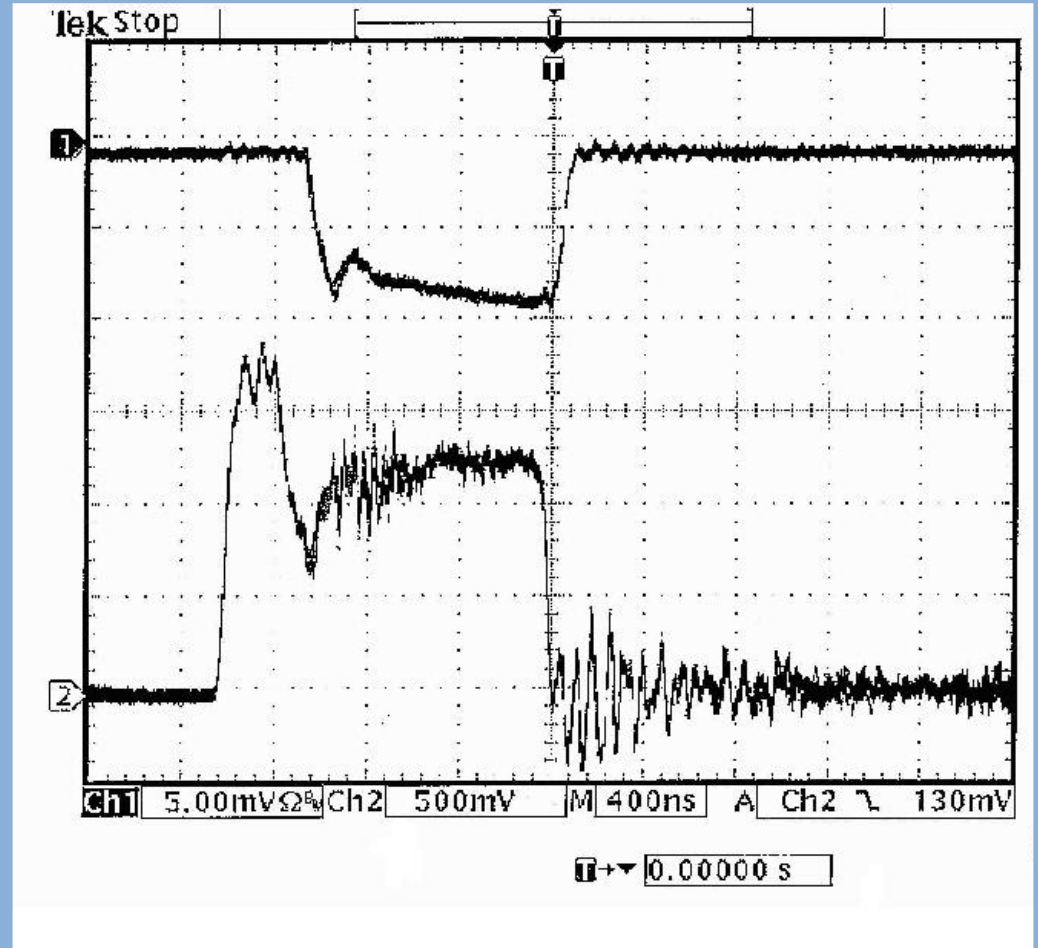
Spice Model



G4/I1 Magnetron

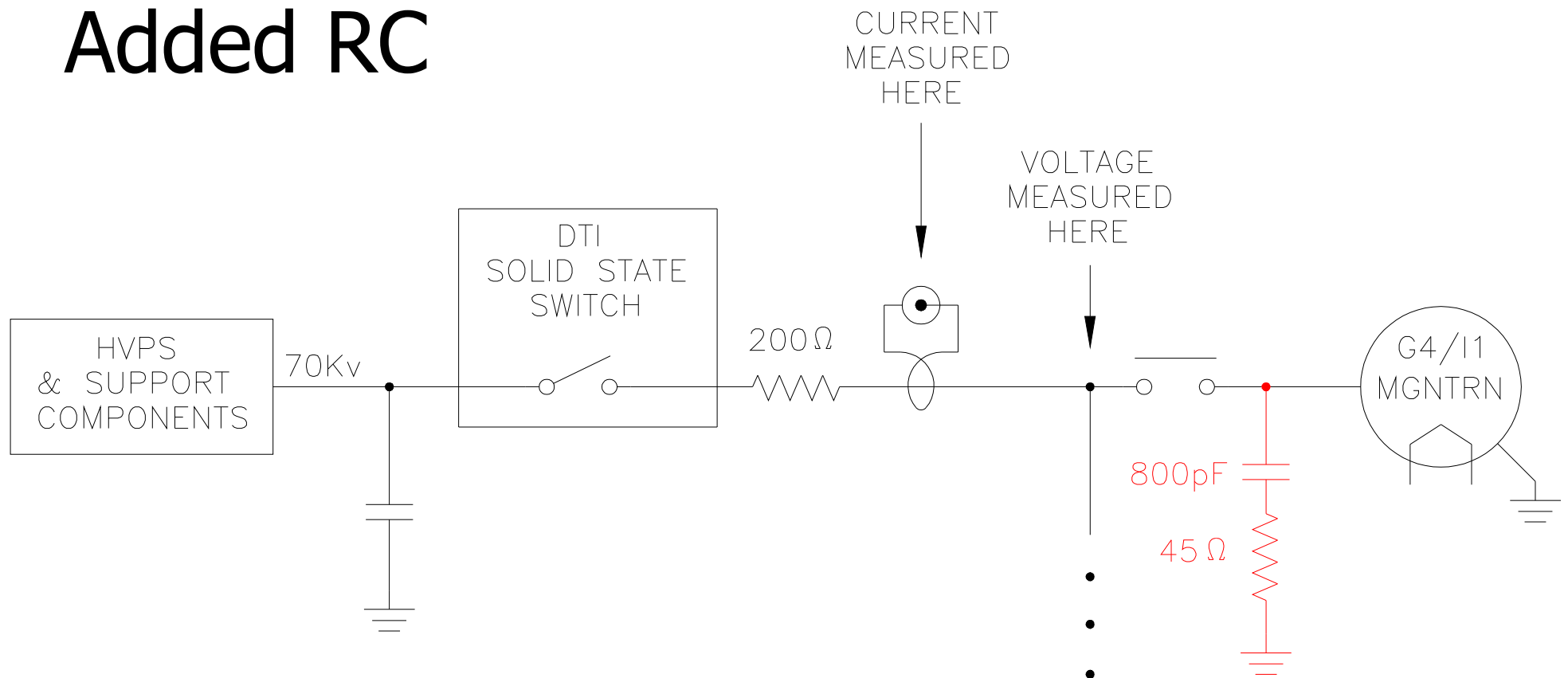
Typical Waveforms

- Trace 1 – RF Output Power
- Trace 2 – Magnetron Current
 - Note Initial Cable Charging Current

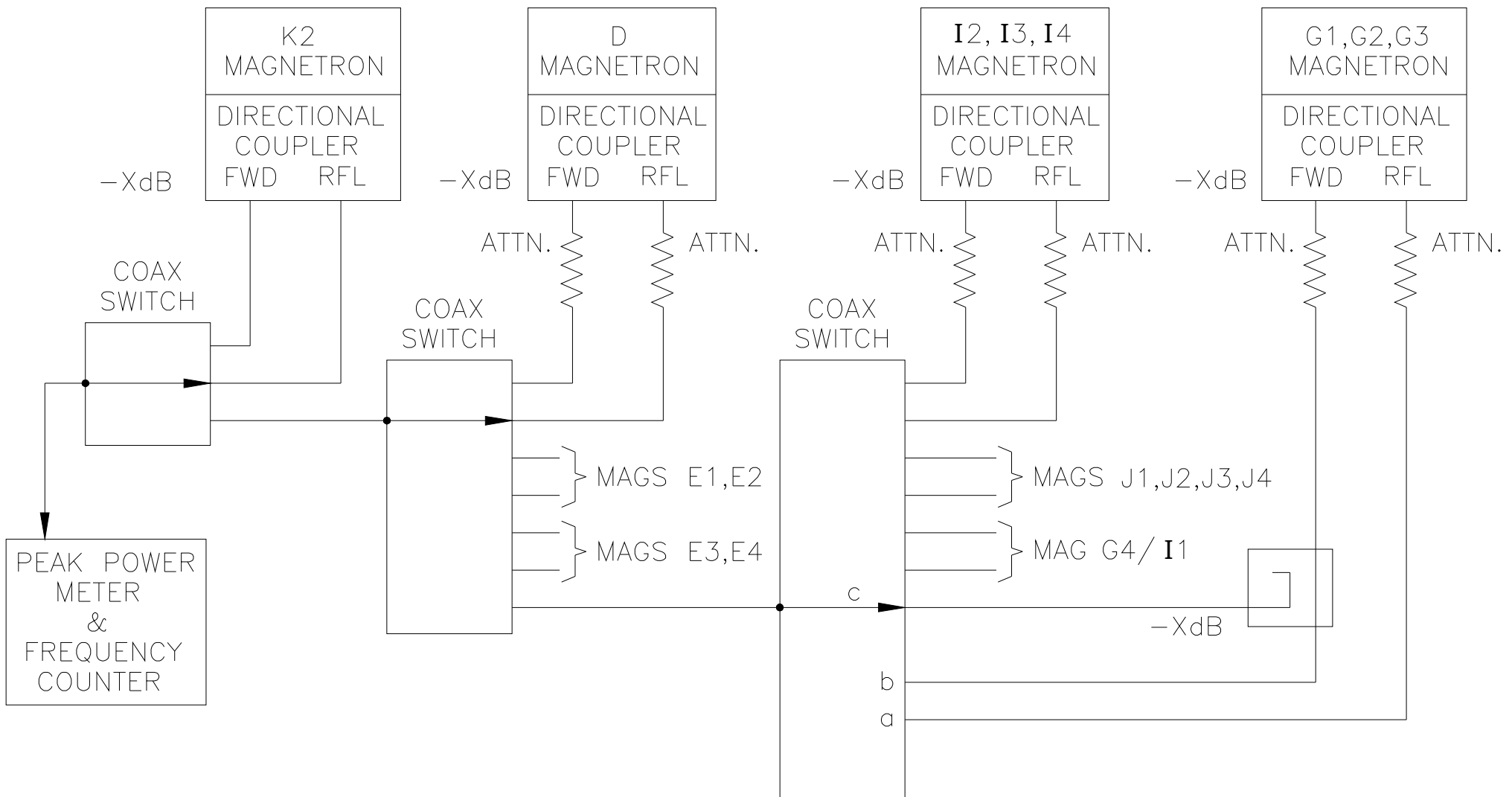


Some magnetrons needed slower pulses

Added RC

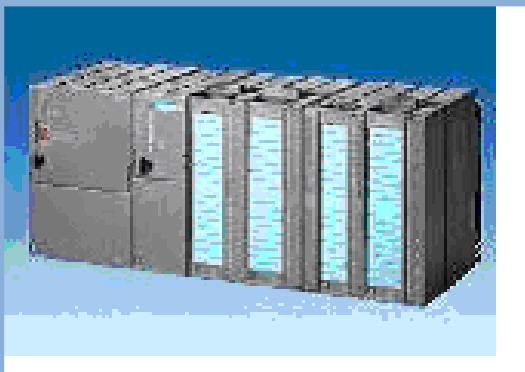


RF Monitoring

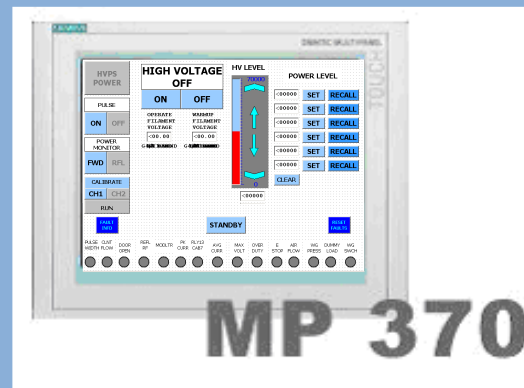


PLC Controls & Operator Interface

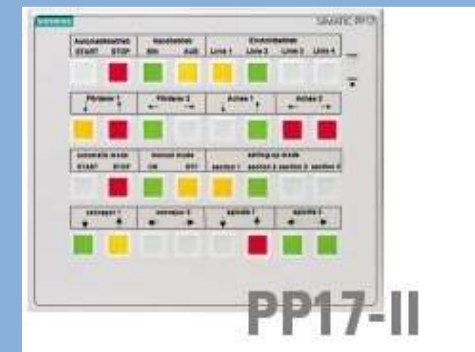
- Flexible and Configurable
 - Analog I/O
 - 24 VDC I/O
 - Easy to Program: Timers, Math functions



Siemens
PLC



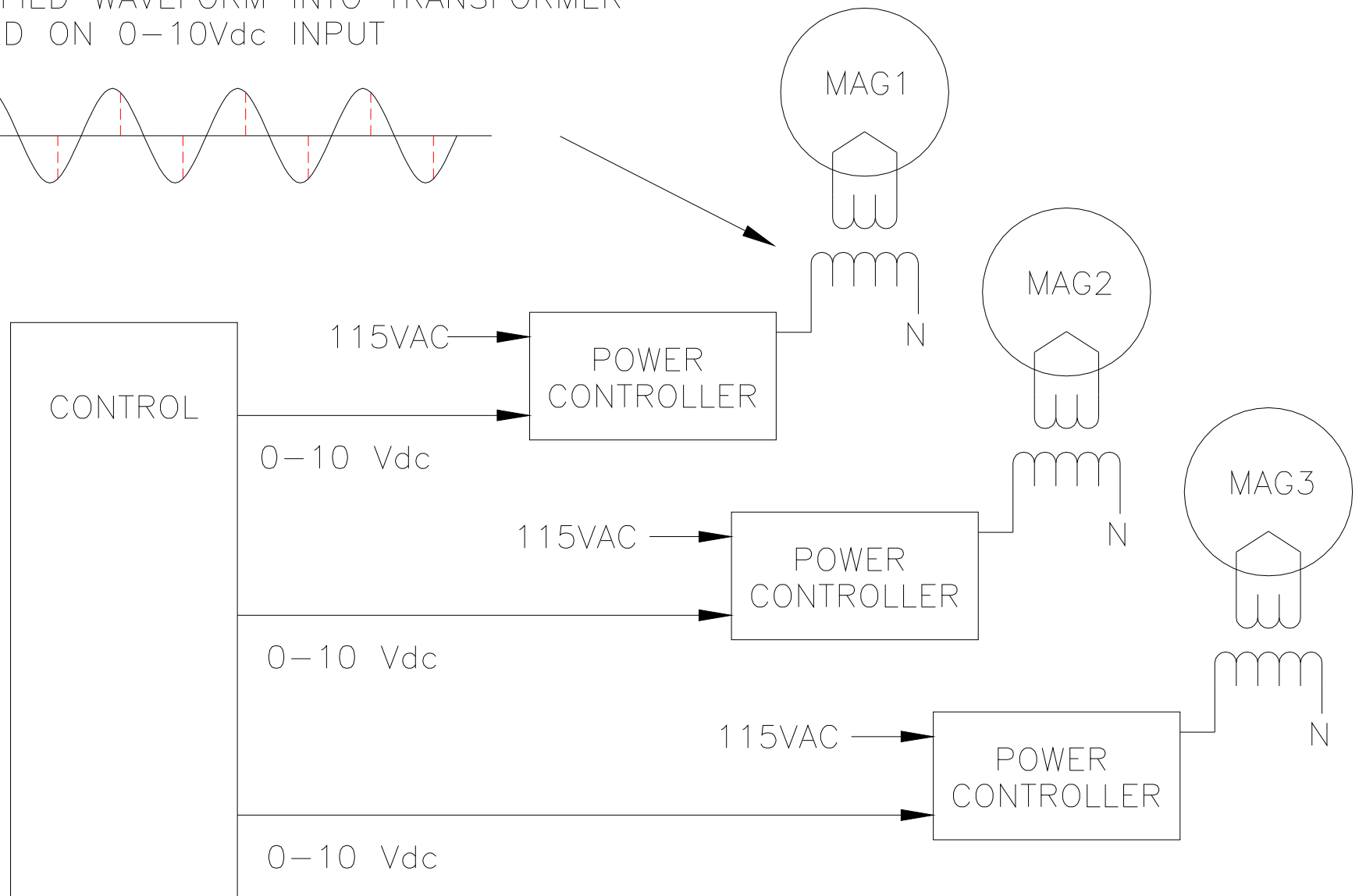
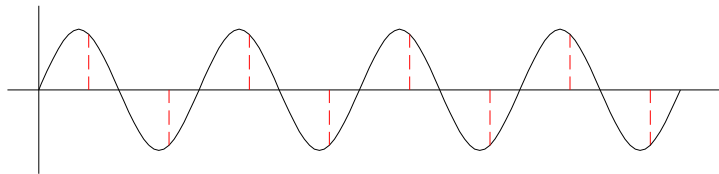
Touch Screen



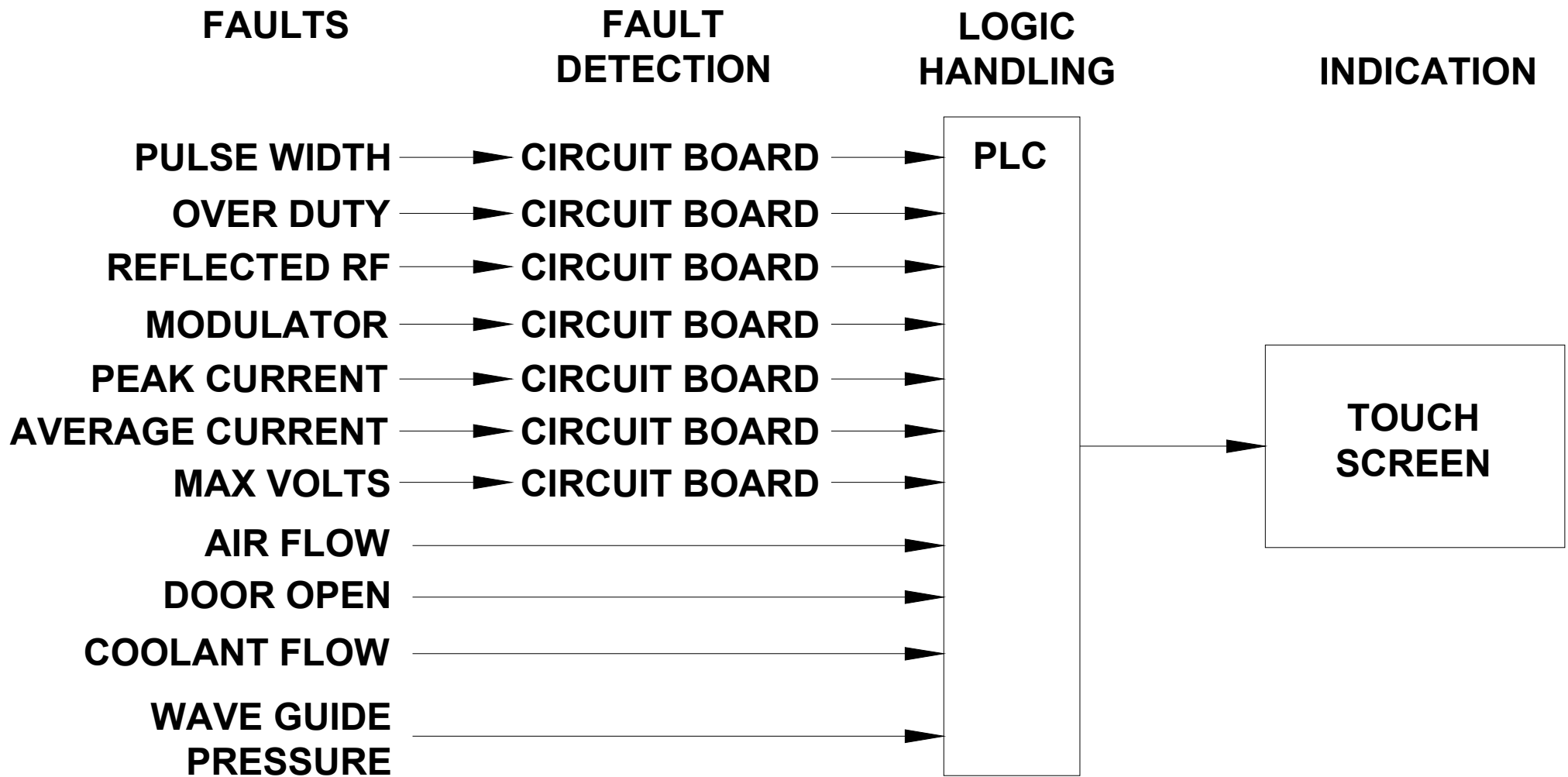
Membrane Button
Panel

PLC Filament Control

MODIFIED WAVEFORM INTO TRANSFORMER
BASED ON 0-10Vdc INPUT



NPMS Fault Handling



Narrow Pulse Magnetron System

Naval
Electromagnetic
Radiation
Facility



Narrow Pulse Magnetron System

Naval Electromagnetic Radiation Facility



Conclusion

- With proper design and component selection, the challenges of transmitter design can met.

Thank You

Michael Hunter
H6 Systems
55 Lake Street
Nashua, NH 03060
(603) 880-4190
kinotec@compuserve.com

Alan D. Mazuc
NAVAIR
(301) 757-3605
alan.mazuc@navy.mil

Dr. Marcel P.J. Gaudreau
Diversified Technologies, Inc.
35 Wiggins Avenue
Bedford, MA 01730
www.divtecs.com
(781) 275-9444

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