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SPECIAL MISSIONS

M197
Weapon Command/Control System
MH-60S

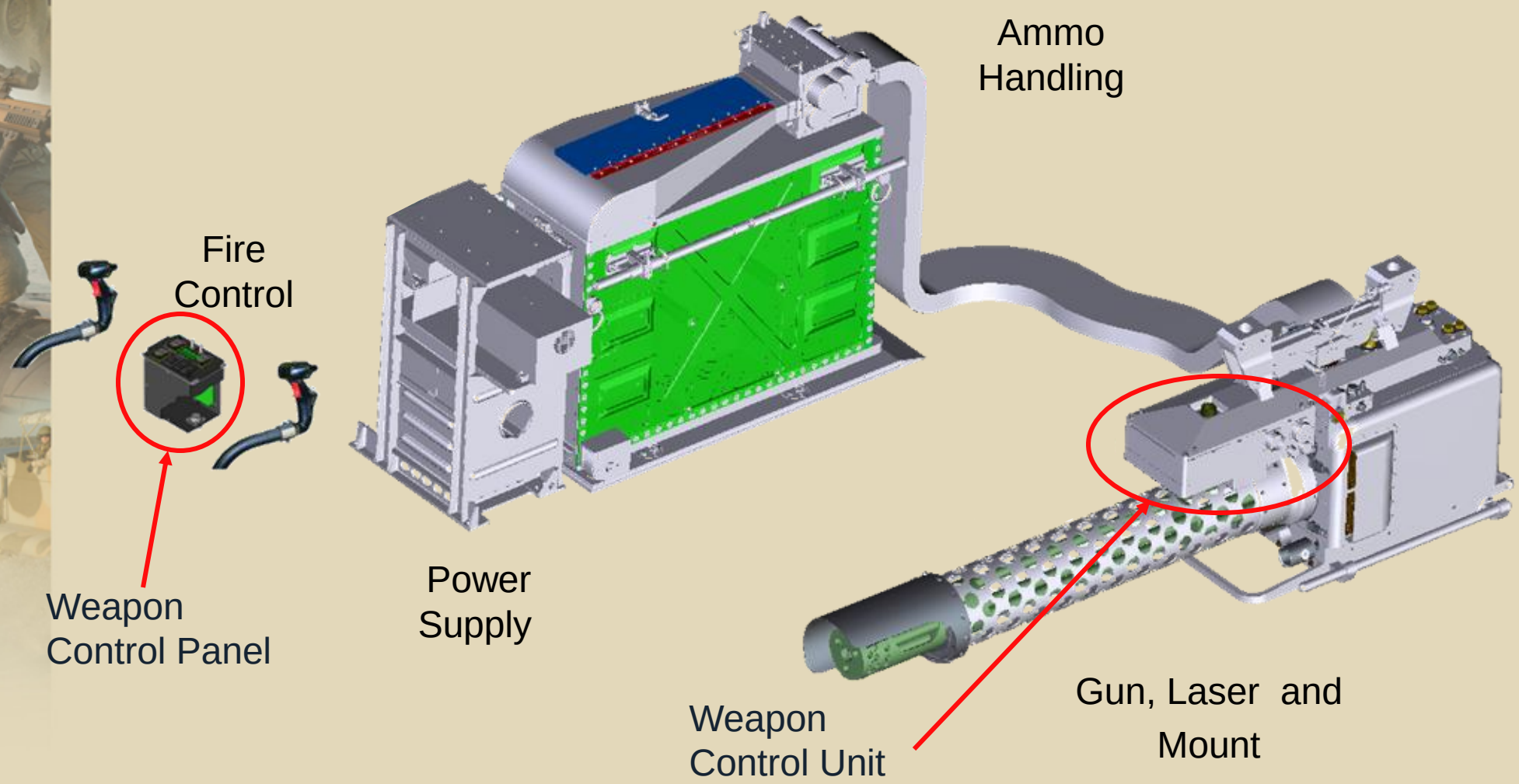
Agenda

- Design objectives
- System Overview
- System Communication
- Weapon Control Panel
- Weapon Control Unit

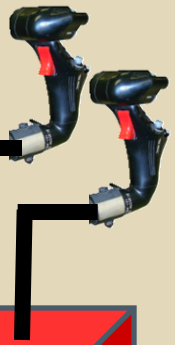
Design Objectives

- Isolate system from aircraft systems except for power, safety interlocks, and weapon triggers
- No microcontroller or embedded software
- Make the system as safe as possible in the presence of electrical interference, mechanical failure, human induced faults
- Minimize system weight
- Minimize cost
- Maximize reliability
- Rapid development schedule

M197 20 mm Gun System Overview



System Communication



WOW/MA

Safety Pins

Safe Command Interface To Weapon

Store Mounted Weapon

Weapon Control Panel

Fire Weapon

Fire Laser

Weapon Control Unit

Simple Interface For Error Feedback

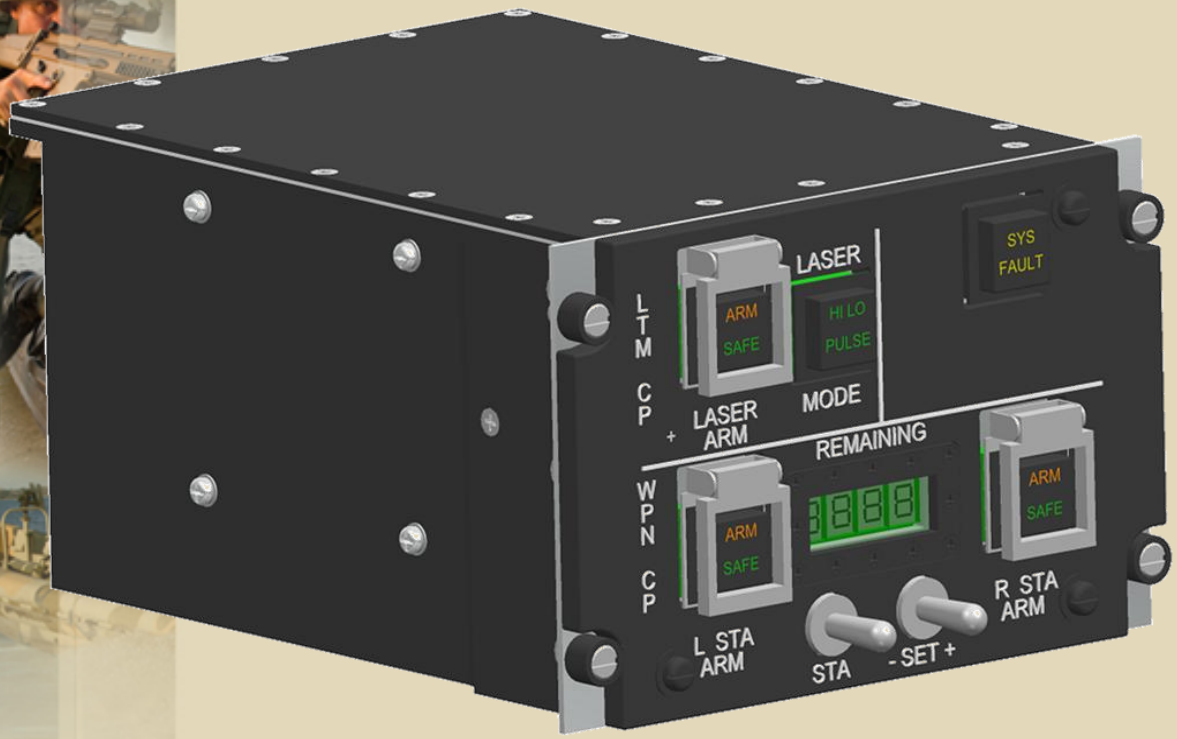
System Can Break Loop to Signal Error

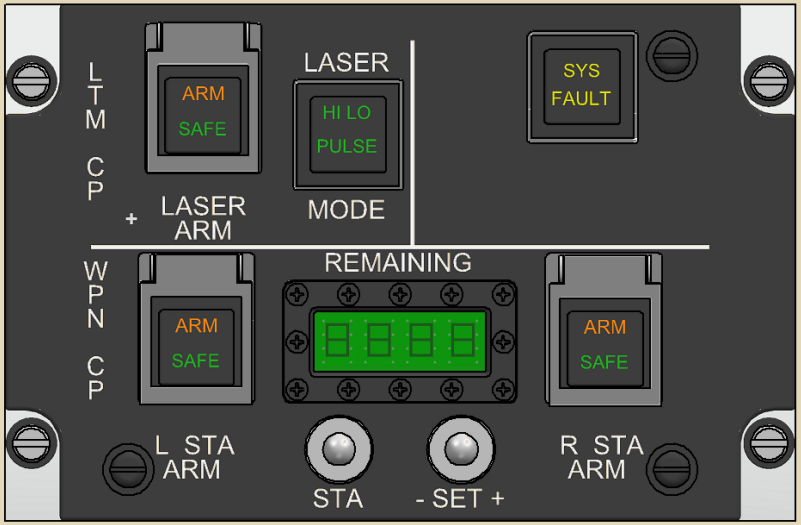
Cabin Mounted Ammunition Supply

Continuity Loop

Safety Critical Command Interface

Weapon Control Panel





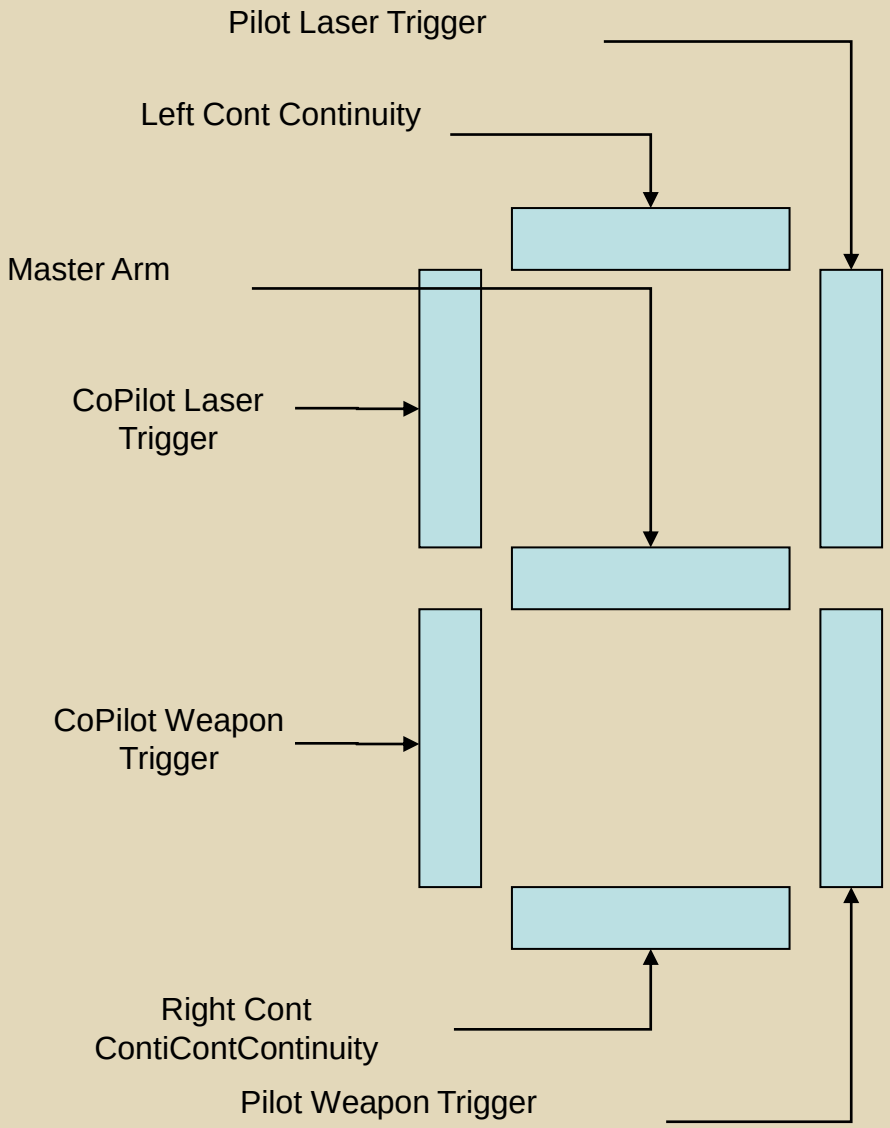
Weapon Control Panel

- Provides four state machines to maintain safe/arm states for one or two weapons and one or two laser target markers
  - State machines are implemented with Dual Field Programmable Gate Arrays for safety critical operations
- Utilizes a proprietary multi-wire connection to each weapon and laser installation.
  - Safety critical protection is provided by sensing shorts to ground, power and each other
- Maintains ammunition count

Weapon Control Panel

- Prevents arming if required interlocks are not detected or if a wiring/component error is detected on inputs
  - Other system components may communicate their non-readiness/fault by interrupting the continuity loop
  - Fault lock-out is enabled upon detection of system fault, preventing arming and enabling fault light
  - Troubleshooting mode integrated to aid diagnosis

Input Troubleshooting Mode Operation



Weapon Control Panel System Fault Handling

System Fault Description	When Detected?	Reset Method
GCP FPGA Weapon States Differ	Whenever Powered	Cycle System Power
Weapon Trigger without Laser Trigger	When Weapon trigger is operated	Press System Fault Indicator
Loss of Continuity Loop	When GCP is Powered and GCU is Powered by either Laser or Weapon Power	Press System Fault Indicator

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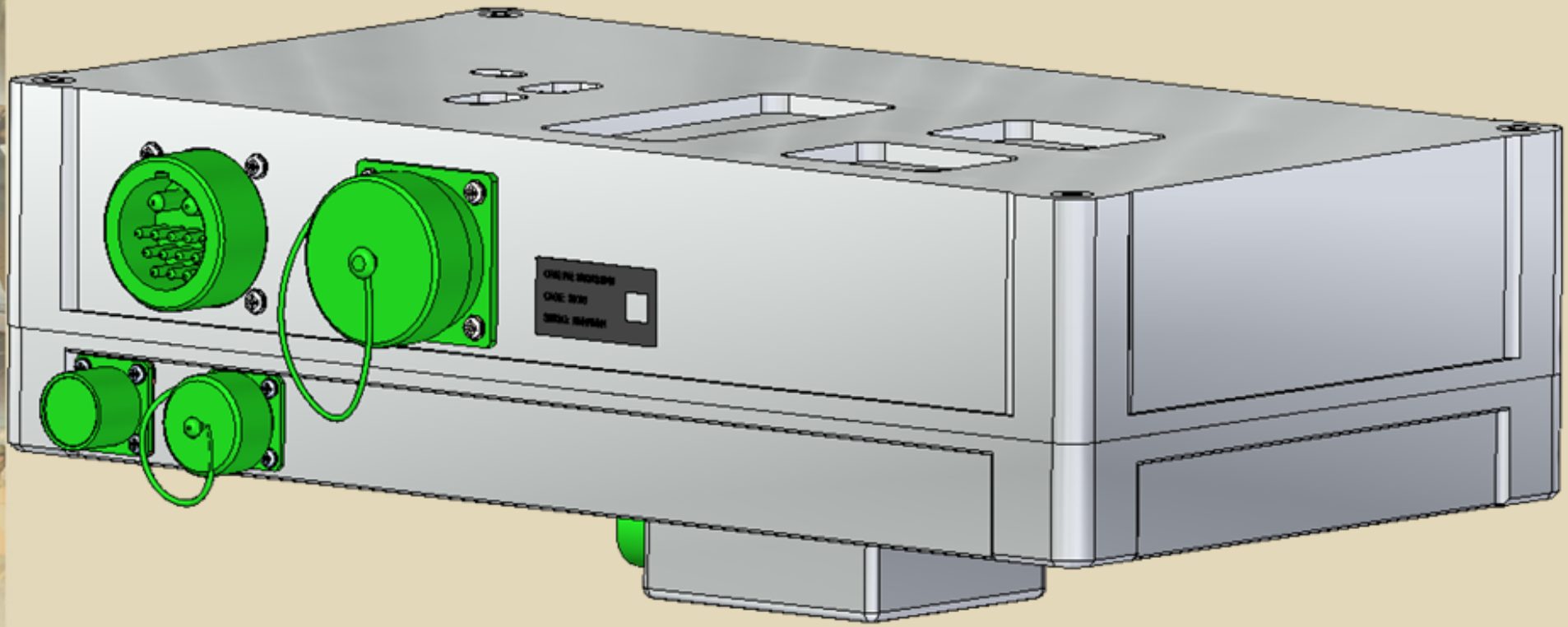
Weapon Control Unit



Weapon Control Unit

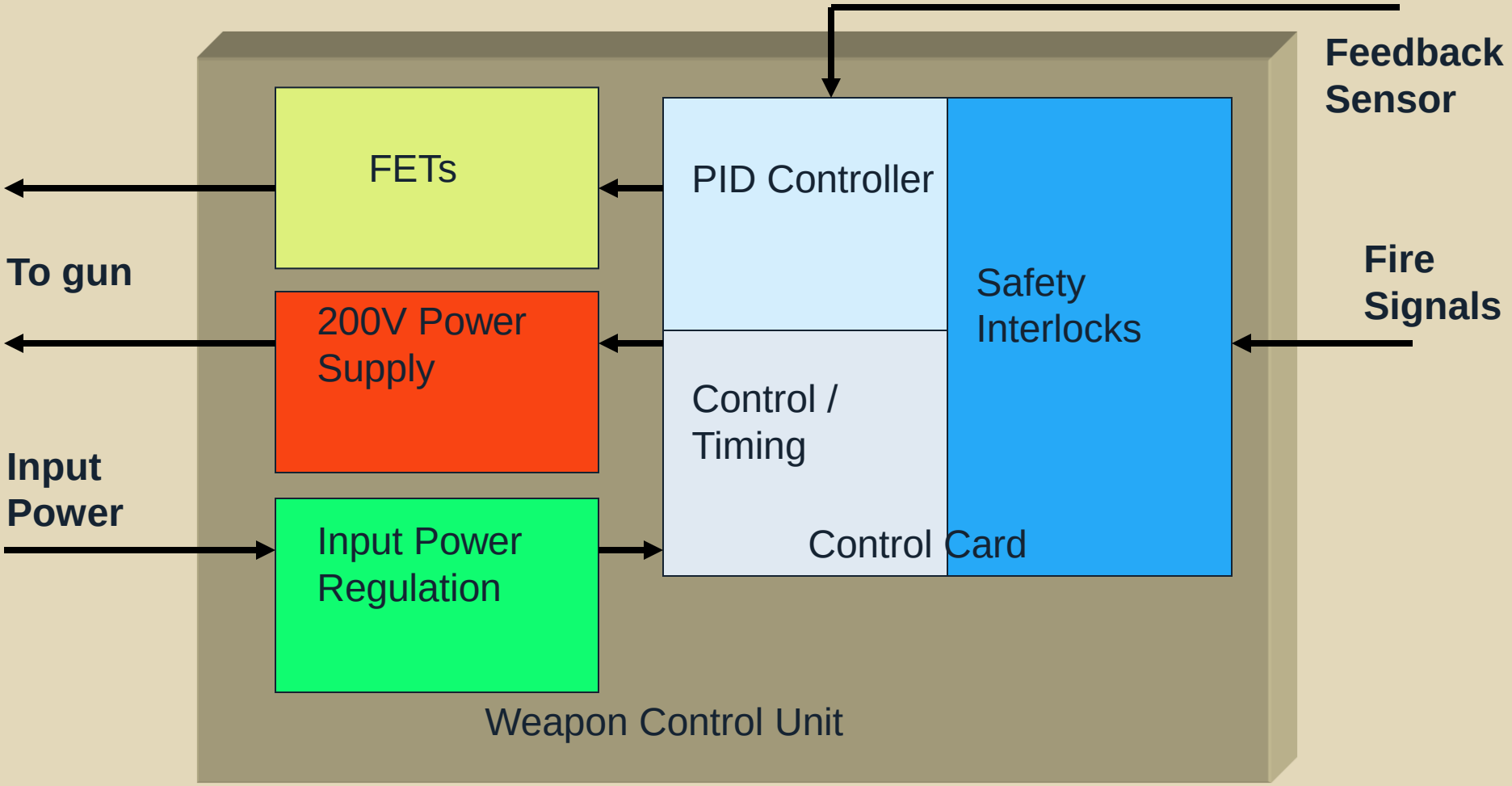
- Responds to commands received over safety critical interfaces from the WCP
- WCU utilizes state machines to verify correct operating sequence steps are received
- If faulty sequence is detected, the WCP opens the continuity loop to communicate fault to the WCP and safes the associated weapon or laser system
- System clearing procedures are provided to allow operators to correct and clear faults which may be corrected in flight

Weapon Control Unit
20mm gun integration

- 20mm gun integration required:
  - Speed Control of gun system via feedback loop, PID controller, and high current pulse width modulated output
  - 200V output for priming of ammunition
  - Output for activation of Feeder
  - Robust Input Power Circuit Regulation (MIL-STD-704A and additional capacitance for excessive current draw)

Weapon Control Unit
20mm gun integration

- **Modular Circuit Cards utilized for flexibility**



Weapon Control Unit System Fault Handling

System Fault Description	When Detected?	Reset Method
GCU Loss of Power	When GCP is Powered and GCU is Powered by either Laser or Weapon Power	Press System Fault Indicator
Excessive Gun Motor Drive	When Gun Motor is being Run	Cycle GCU Power and then Press System Fault Indicator
Erroneous Arm or Fire Commands	Shorts to ground or Power whenever the System is Powered; Shorts to other signal lines only when firing	Cycle GCU Power and then Press System Fault Indicator

Questions