Special Missions

M197
Weapon Command/Control System
MH-60S

Rapid Response
Proven Solutions
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

- Ammo Handling
- Gun, Laser, and Mount
- Weapon Control Panel
- Fire Control
- Power Supply
- Weapon Control Unit
System Communication

- WOW/MA
- Safety Pins
- Weapon Control Panel
- Fire Weapon
- Fire Laser
- Safe Command Interface To Weapon
- Store Mounted Weapon
- Weapon Control Unit
- Cabin Mounted Ammunition Supply
- System Can Break Loop to Signal Error
- Continuity Loop
- Safety Critical Command Interface
- Simple Interface For Error Feedback
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

- Master Arm
- CoPilot Laser Trigger
- Left Cont Continuity
- Pilot Laser Trigger
- CoPilot Weapon Trigger
- Right Cont Continuity
- Pilot Weapon Trigger
### Weapon Control Panel

**System Fault Handling**

<table>
<thead>
<tr>
<th>System Fault Description</th>
<th>When Detected?</th>
<th>Reset Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCP FPGA Weapon States Differ</td>
<td>Whenever Powered</td>
<td>Cycle System Power</td>
</tr>
<tr>
<td>Weapon Trigger without Laser Trigger</td>
<td>When Weapon trigger is operated</td>
<td>Press System Fault Indicator</td>
</tr>
<tr>
<td>Loss of Continuity Loop</td>
<td>When GCP is Powered and GCU is Powered by either Laser or Weapon Power</td>
<td>Press System Fault Indicator</td>
</tr>
</tbody>
</table>
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
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

![Diagram of Weapon Control Unit]$
## Weapon Control Unit System Fault Handling

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<tr>
<td>GCU Loss of Power</td>
<td>When GCP is Powered and GCU is Powered by either Laser or Weapon Power</td>
<td>Press System Fault Indicator</td>
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<tr>
<td>Excessive Gun Motor Drive</td>
<td>When Gun Motor is being Run</td>
<td>Cycle GCU Power and then Press System Fault Indicator</td>
</tr>
<tr>
<td>Erroneous Arm or Fire Commands</td>
<td>Shorts to ground or Power whenever the System is Powered; Shorts to other signal lines only when firing</td>
<td>Cycle GCU Power and then Press System Fault Indicator</td>
</tr>
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Questions
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