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
- Power Supply
- Weapon Control Unit
- Weapon Control Panel
- Fire Control
System Communication

Weapon Control Panel

Safe Command Interface To Weapon

Fire Weapon

Fire Laser

Store Mounted Weapon

Weapon Control Unit

Cabin Mounted Ammunition Supply

Simple Interface For Error Feedback

Safety Critical Command Interface

Saftey Pins

Continuity Loop

WOW/MA

System Can Break Loop to Signal Error
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

- Pilot Laser Trigger
  - Left Cont Continuity
  - Master Arm
    - CoPilot 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</td>
<td>When Weapon trigger is operated</td>
<td>Press System Fault Indicator</td>
</tr>
<tr>
<td>Trigger</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loss of Continuity Loop</td>
<td>When GCP is Powered and GCU is Powered by either</td>
<td>Press System Fault Indicator</td>
</tr>
<tr>
<td></td>
<td>Laser or Weapon Power</td>
<td></td>
</tr>
</tbody>
</table>

[NAVSEA Logo]  

Harnessing the Power of Technology for the Warfighter
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

![Diagram](image_url)
## 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>
</tr>
<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>
</tbody>
</table>
Questions