



Vehicle Control Unit (VCU) for the HMMWV





Background of HMMWV Starting Problems

- **Protective Control Box (PCB)**
 - **25,000** Units Fail **Every Year**
- **Glow Plug Failures Due to Stacking**
 - Repeatedly Turning Starter Switch Lengthens Pre-Glow Time –
This Burns out Glow Plugs
- **Results:**
 - **Truck Doesn't Start**
 - **1/3 of Fleet Down at any Given Time!!**



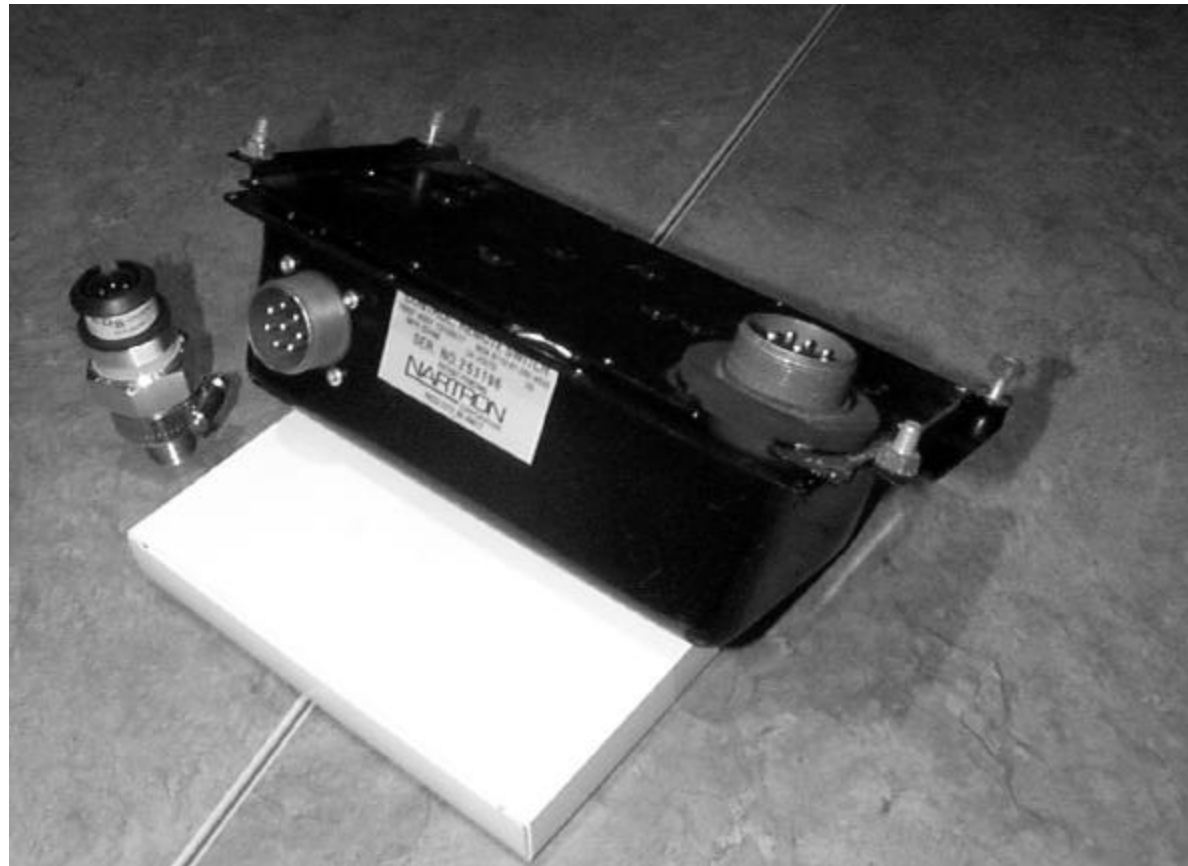
Protective Control Box (PCB) : The Main Problem

- **Most Failed Item** in the Army's Inventory:
 - **25,000 PCBs Failed** Every Year (\$150/Box)
- **PCB Failures Caused:**
 - **480,000 Glow Plugs** to Fail Every Year (\$4.50/Plug)
 - **72,000 Glow Plug Controllers (GPC)** to be Replaced Every Year (\$45/Controller)





Obsolete PCB & GPC





Failure Causes Identified

- **Some PCB Versions Not Properly Water-Sealed, Nor EMI-RFI Tested**
- **Relays NOT Military Rated – Per Manufacturer**
- **Results:**
 - **Relay Coils Burn out Much too Quickly**
 - **Relay Contacts Weld Shut – Causes Glow Plug Burn-out and Phantom Cranking Leading to Vehicle Fires**



HMMWV Fire at Ft. Stewart, GA.





PCB - Interior View



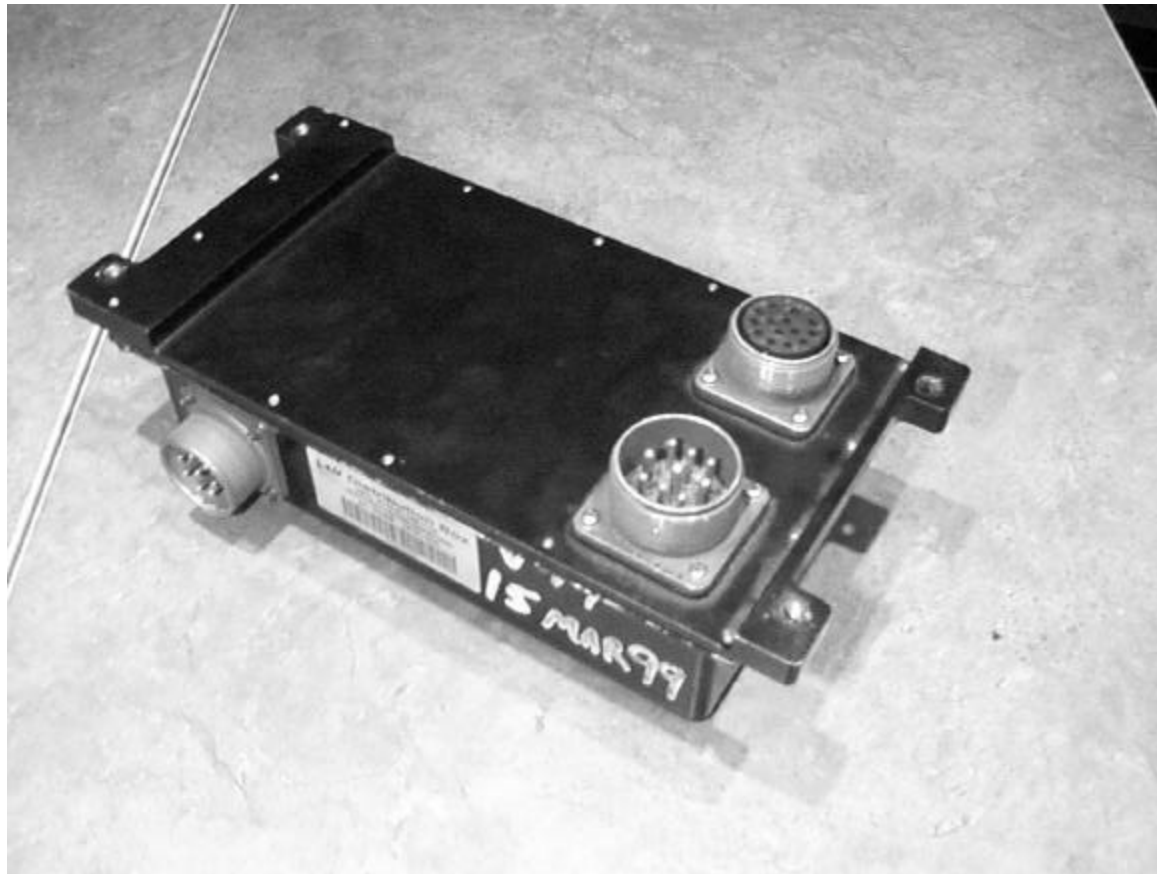


Approach Taken to Solve the Problem

- **Design Team Takes an “Outside the Box” to Approach to Solving the Problem By:**
 - **Leveraging Commercially Available, Off-The-Shelf (COTS) Technology**
 - **Eliminating all Relays to Increase System Reliability**



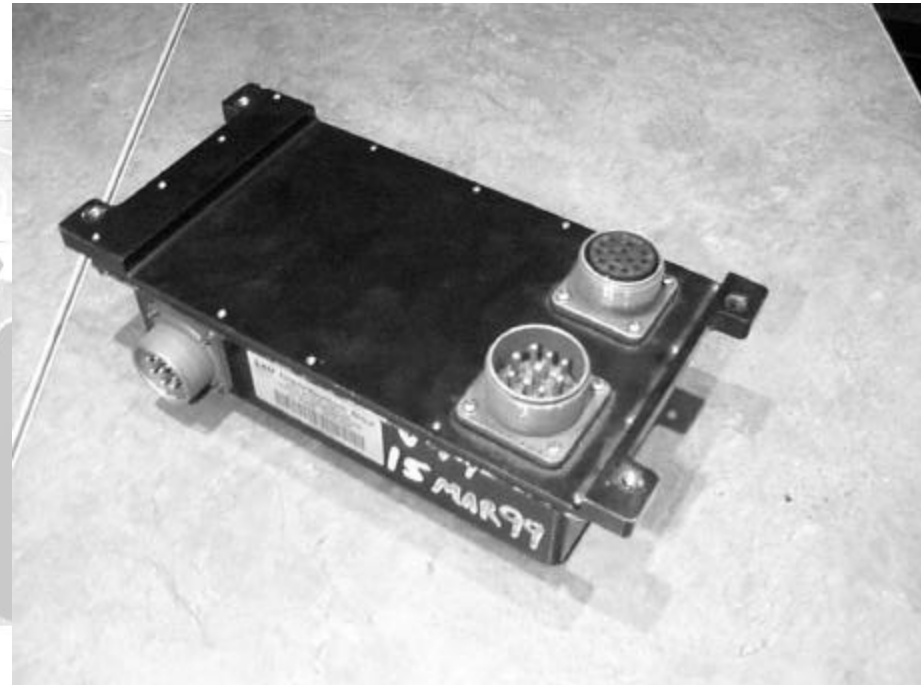
Enter The VCU





Vehicle Control Unit (VCU) for the HMMWV

- **VCU Upgrades Improve Fleet Readiness by +25%:**
 - **Increase in Starting System Reliability**
 - **Reduced Maintenance Costs**
 - **Reduced Spare Parts Costs: \$9.54M over 3 Years**





VCU Innovations

- **GPC and PCB Functions Integrated Into one Box.**
- **True Microprocessor Control of all Functions Enables:**
 - **Precise Control of Power to Glow Plugs**
- **All PCB Relays Eliminated - Replaced by Ultra-High-Current Power MOSFETs.**
- **Multi-Channel Glow Plug Operation Enables:**
 - **Starting with Multiple Glow Plug Failures (Previously Impossible with old PCB System).**
 - **Simplified Glow Plug Troubleshooting/Diagnostics.**



VCU - Interior View





VCU Results

- **Successful Completion of 200,000+ Test Starts. (Roughly 4 Starts per Day for 137 Years!!)**
- **Major Increase in System Reliability**
- **Cold-Starting and Stacking Problems Resolved**
- **Fleet Glow Plug Usage Down +25%, First Year**
- **Reduced Maintenance/Spare Parts Costs**
- **HMMWV Fleet Readiness Increased by This Effort.**



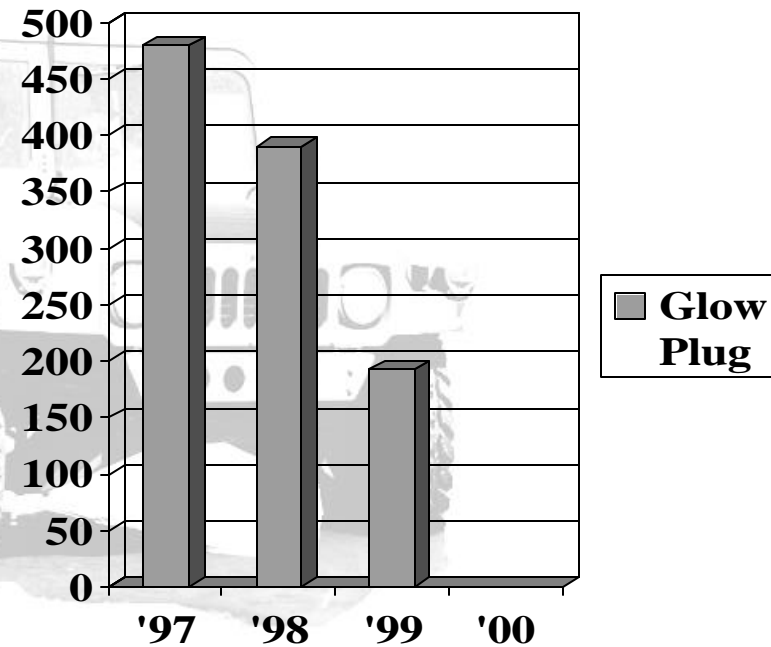
Ver. 14.0a VCU Improvements

- **Software and Hardware Upgrades From v.10 Unit:**
 - **Improve Performance and Reliability**
 - **Eliminate Self-Starting Problems Encountered in v.10 VCU**
- **Failure Rate (All Versions): 0.02% v. 28% for PCB**



Glow Plug Usage (Thousands) 1997 – 2000

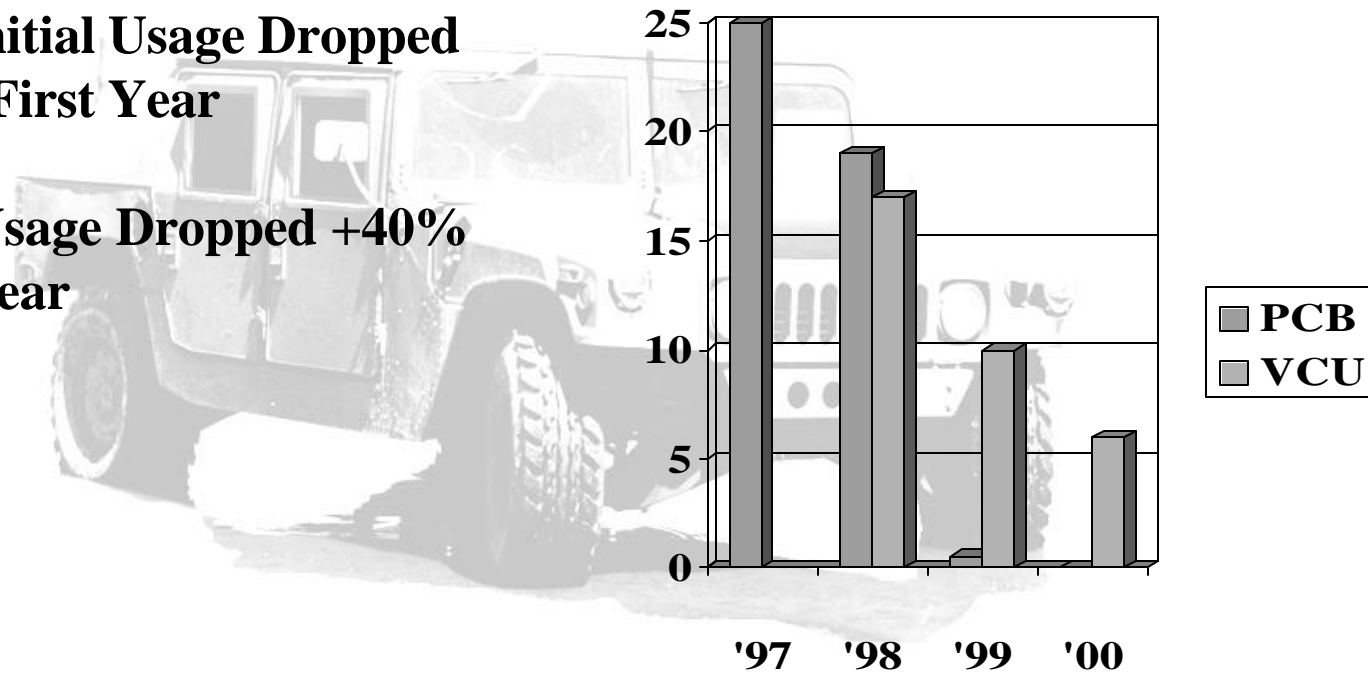
- Usage in VCU-Equipped Vehicles Fell to Virtually Zero in Four Years
- \$9.54 Million Spare Parts Savings over 3 Years
- Additional Savings of 50,000 hrs. Annual Maintenance





PCB Usage (Thousands) 1997 – 2000

- **PCB Initial Usage Dropped +25% First Year**
- **VCU Usage Dropped +40% First Year**





Program Results

- **NAC Embraces This as Initial Step Toward the Next-Generation of Vehicle-Electrical Architecture Implementation in HMMWV**
- **Leveraging COTS Technology for Innovative Solutions to Serious Readiness Issues**
- **\$9.54 Million Spare Parts Savings From 1997 to 2000**

