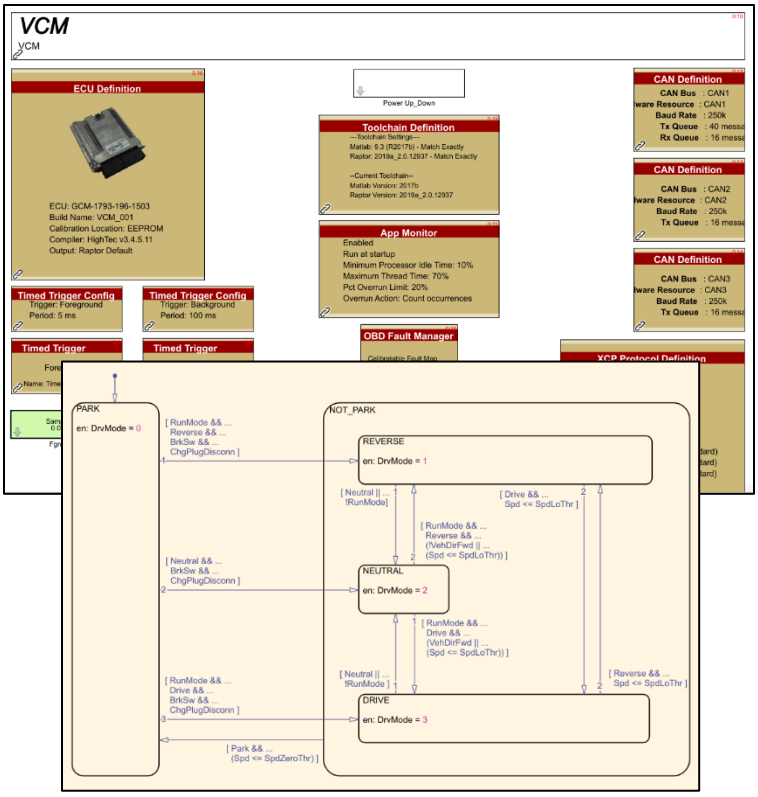
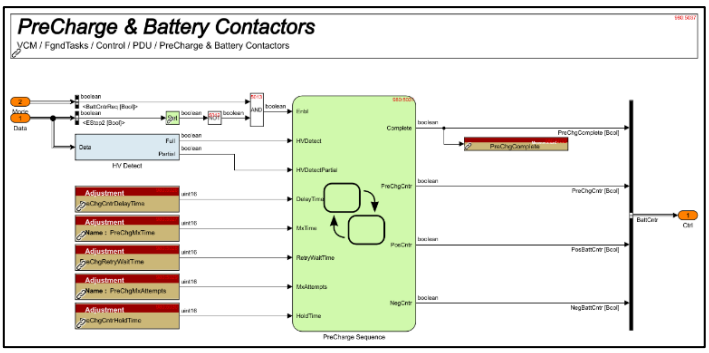
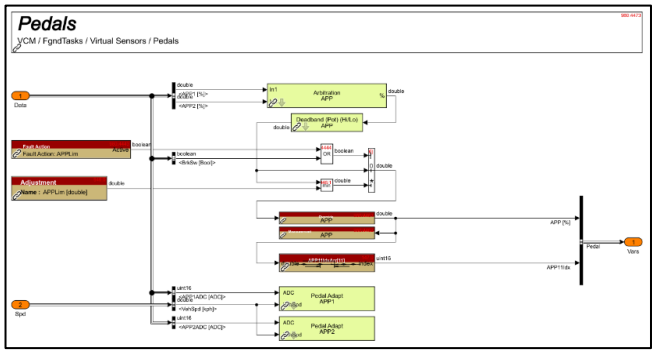
EV SUPERVISOR APPLICATION MODEL



- **Features**
  - Base EV supervisor software developed in MATLAB/ Simulink with Raptor-Dev for the GCM-1793-196-1503
  - Starting with the base model minimizes time to functional EV operation
  - Control strategies validated on numerous R&D and production-intent EV projects
  - Architected for easy I/O, component, and strategy customization
- **Two-Part Offering:**
  - Base EV Supervisor Software
  - Series Hybrid (add-on)





New Eagle's Electric Vehicle (EV) Supervisor Application Model enables rapid electric vehicle development. The software comes initially configured with common I/O and components but is architected for easy customization to customer requirements. This solution prevents a blank-sheet starting point: the model contains control strategies validated over years of projects and represents New Eagle's state-of-the-art EV knowledge.

Overview

The EV Supervisor Application model is comprised of two parts which are each individually described in the remainder of this document. As a summary, the two parts are:

1. **Base EV Supervisor Software**: core startup/shutdown, charging, torque request, etc. control strategies
2. **Series Hybrid (add-on)**: genset control

Base Configuration

The EV Supervisor Application Model as described in this document reflect those component requirements that New Eagle has commonly encountered with production-intent EV projects.

BMS:	Ewert Energy Systems (Orion)
CCS 2.0 / J1772 Interface:	IoTecha (M2iEV)
On-Board Charger:	EDN (EVO11K)
DC/DC Converter:	Bel Power Solutions (DNC series)
Drive Inverter:	John Deere (PD400)
A/C Compressor:	Mitsubishi (EV36BNx)
Heater:	Mitsubishi (EWH40Dx)
Cooling Pump:	EMP (WP29)
Power Steering Pump Inverter:	Sevcon (HVLP-20)
Relay/Fuse Box:	New Eagle MPDM

Custom Configuration

The aim of the EV Supervisor Application Model offering is to provide a significant head-start towards meeting customer's EV control requirements. However, modifications, additions, and/or subtractions may be required to make the code appropriate and complete for each application. These modifications may be related to I/O, components, control strategies, or both. If desired, New Eagle can provide additional development assistance with an engineering contract. Additionally, for MotoHawk applications, all software described in this document can be converted from Raptor code into MotoHawk code through a conversion task.

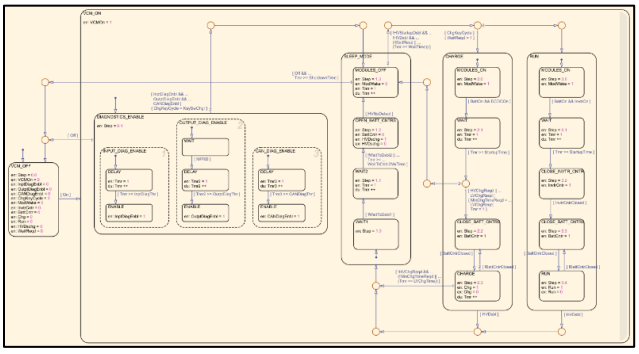
Below is a partial list of manufacturers whose components New Eagle has successfully implemented in the past; with a support contract, New Eagle can substitute these into the application model. New Eagle can also implement new components if an interface control document and/or .dbc file is provided.

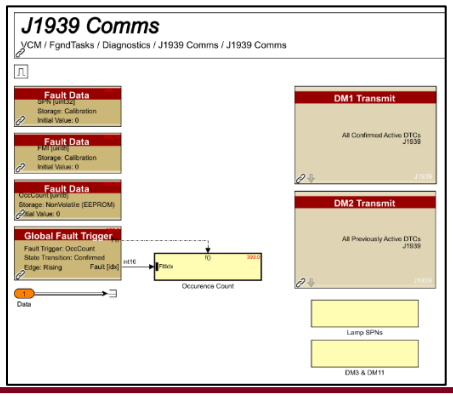
BMS:	A123, eMatrix, Impact Clean Power Technology, Johnson Controls, Lithium Balance, Munich Electrification, Romeo, Stafl Systems, XALT Energy
On-Board Charger:	Brusa, Current Ways, Eltek, Ovartech, Shinry
DC/DC Converter:	Delphi, Ovartech, Sevcon, Shinry
Inverter:	Cascadia Motion, InMotion, Lenze, Protean, Semikron, Sevcon, TM4, UQM
Motor:	AVID, Borg Warner, MAGELEC, Parker, Protean, UQM, Yasa
Electric Axle:	Allison, Meritor
Other:	JTEKT power steering pump, Webasto heater

Base EV Supervisor Software

New Eagle's Base EV Supervisor Software is the starting point for an electric vehicle application. It provides the core startup/shutdown, drive mode, charging, torque request, etc. control strategies that are common for most EV applications. At a high level, the primary functions of the Base EV Supervisor Software include:

- Input characterization of sensors: internal voltage readings, accelerator pedal, brake switch, PRND switches, cruise control switches, E-stop buttons, contactor state feedback, brake vacuum pressure, HVIL input, and HVAC-related inputs
- CAN message inputs from the BMS, CCS interface, on-board charger, DC/DC converter, drive inverter, power steering pump inverter, A/C compressor inverter, heater, cooling pump, and MPDM
- Virtual sensor tasks, including vehicle speed calculation, odometer calculation, dual pedal arbitration, pedal adaption, high-voltage bus voltage arbitration
- Startup/shutdown sequencing of high-voltage components to ensure safety and integrity, including pre-charge and battery contactor control on startup and high-voltage bus discharge on shutdown
- Drive mode determination through state of PRND switches, vehicle speed, charge plug, brake switch, etc.
- On-board charger and DC fast charger control through voltage setpoint and current limit
- DC/DC converter control through voltage setpoint and current limit
- Arbitration between drive requestors: pedal and cruise control
- Arbitration between drive limiters: CAN-based, current limit-based, vehicle state-based, and derate multipliers
- Arbitration between requestors and limiters to result in drive motor torque request
- Accessory control of park pawl, brake vacuum pump, power steering pump, A/C compressor, heater, cooling pump, cooling fan, and lights/lamps
- Discrete output control to close contactors and turn on accessories
- CAN message outputs to wake components (though MPDM) and communicate requests
- OBD fault manager with drive cycle and warm-up cycle logic
- Diagnostics, including physical I/O circuit diagnostics, CAN message timeouts, battery isolation and cell voltage/temperature diagnostics, contactor cross checks, HVIL cross check, DC/DC converter cross check, drive motor torque cross check, sensor/system/HV voltage diagnostics, and component fault diagnostics
- J1939 scan-tool communications: DM1, DM2, DM3, and DM11; note that a license for New Eagle's J1939 Diagnostics Toolbox for EMD (P/N RAP-SW-J1939-EMD-LIB) is required for these functions

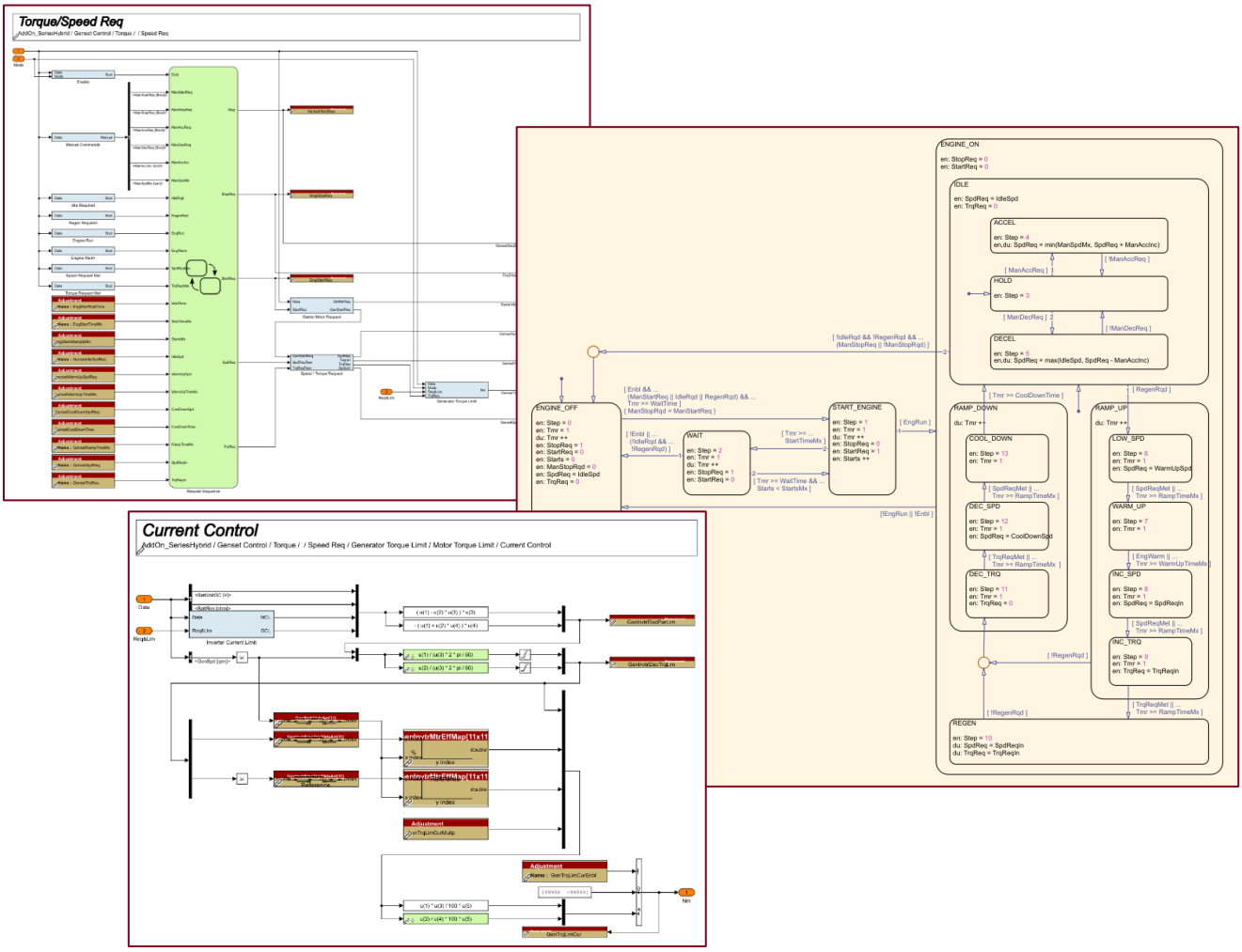




Series Hybrid (add-on)

New Eagle's Series Hybrid is an optional software add-on for EV supervisor applications. It is designed to be integrated with the Base EV Supervisor Software with minimal effort. Specifically, the Series Hybrid add-on software includes:

- Clean interface to Base EV Supervisor Software with simple integration instructions
- Wake and enabling sequencing tied in to startup/shutdown sequence from Base EV Supervisor software
- Regeneration criteria based on battery SOC
- Engine start control through generator or starter motor
- Genset speed/torque control sequencing that includes warm-up and cool-down periods and ramping in desired speed and torque (commonly, engine in speed control and generator in torque control)
- Torque limiting of generator, including current limit-based to obey overall current limits of battery
- Manual idle control option that could be tied to manual button inputs (e.g., from engine bay)



Frequently Asked Questions

1. What hardware targets are available?

The GCM196 is the most capable module in our lineup in terms of I/O, CPU power, and memory; further, it is suitable for safety-critical applications (ASIL B capable) and has attractive high-volume pricing. However, other modules are options as well so long as they meet the application I/O and resource requirements. For instance, the GCM70 module is compatible with 24V systems, and the GCM80 has 4 CAN busses that may be useful.

2. Exactly what EV configurations are possible with New Eagle's offering?

New Eagle supports a wide variety of EV architectures. The best approach is to engage with the New Eagle sales team to see if we may have a possible solution for your application needs. Over the years, New Eagle has supported EV projects that have collectively used a variety of I/O, components, external power distribution modules, external gateway modules, and stock vehicle architectures (light, medium, and heavy-duty), among many other configuration variations. Additionally, we have encountered many EV projects with multiple drive inverter/motors, and the EV supervisor software is well architected to handle those configurations. New Eagle has also been the system integrators on numerous different series and parallel hybrid system architectures. In summary, we have shown a consistent ability to provide creative solutions that leverage our off-the-shelf, proven, and production-ready hardware options.

3. How production-ready is New Eagle's EV Supervisor code?

The current EV supervisor software is New Eagle's latest/greatest that has been tweaked and improved over the years with lessons-learned from a variety of projects. Variations of the code have been successful in several R&D and production-intent projects since New Eagle's inception in 2009.

4. What are the purchase options?

There are a variety of options when it comes to software ownership and accompanying New Eagle support. Some customers prefer New Eagle to own the software development and supply the software builds for calibration and validation after working through change requests. Some customers prefer to purchase the full source code and only engage New Eagle for support when required. Please inquire with the New Eagle sales team to determine the arrangement that works both commercially and technically best for your project.