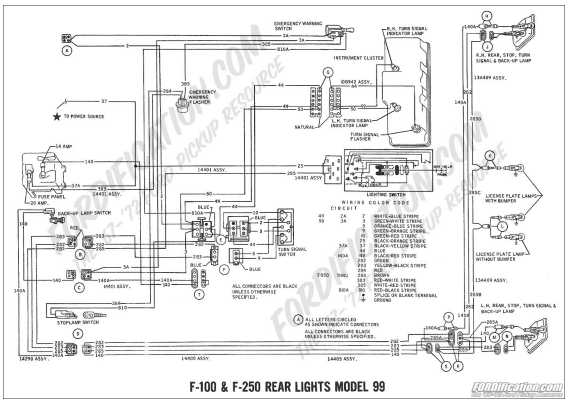
ENGINEERING SPECIFICATION DOCUMENT

K-Series Wiring, ECU Integration and F1-Style Start System



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Contents

1 Purpose

This document defines the **wiring architecture, ECU integration, and F1-style start system** for the K-series AWD Civic project using a **Hondata K-Pro** based ECU and a **keyless, switch-based start system**.

The goals of this specification are to:

- Define how battery, fuses, relays, and switch panel distribute power to the ECU and engine.
- Document the F1-style start system (ignition, fuel, start button) wiring logic.
- Provide a clear interface between the K-series engine harness and the chassis harness.
- Specify relay and fuse sizing for critical electrical subsystems.
- Provide a baseline wiring diagram and test procedure to bring the engine to first start.

This document does **not** attempt to cover every OEM chassis circuit (lights, HVAC, etc.); it focuses on **engine, ECU, fuel, ignition, and starting systems** required to run the K-series drivetrain reliably in a track environment.

2 System Overview

2.1 Target Electrical Configuration

- **ECU:** Hondata K-Pro (K-series ECU with programmable maps).
- **Engine:** K24/K20 Frankenstein hybrid, as defined in engine specification.
- **Chassis:** EF/EK Civic platform with modified harness.
- **Starting Method:** F1-style panel:
  - IGN switch (master engine power),
  - FUEL switch (fuel pump enable),
  - AUX switch (optional accessories),
  - START push button (starter relay control).
- **Power Distribution:** Battery → master fuses → relays → subsystems.

2.2 High-Level Architecture

At a high level, the electrical system is divided into:

- **High-current side:** battery, starter motor, alternator, fuel pump, radiator fan(s).
- **Low-current control side:** ECU, sensors, switch panel, relay coils.
- **Signal side:** crank and cam sensors, MAP, TPS, IAT, ECT, knock, O2, VTEC control.

3 Power Distribution Architecture

3.1 Battery and Main Protection

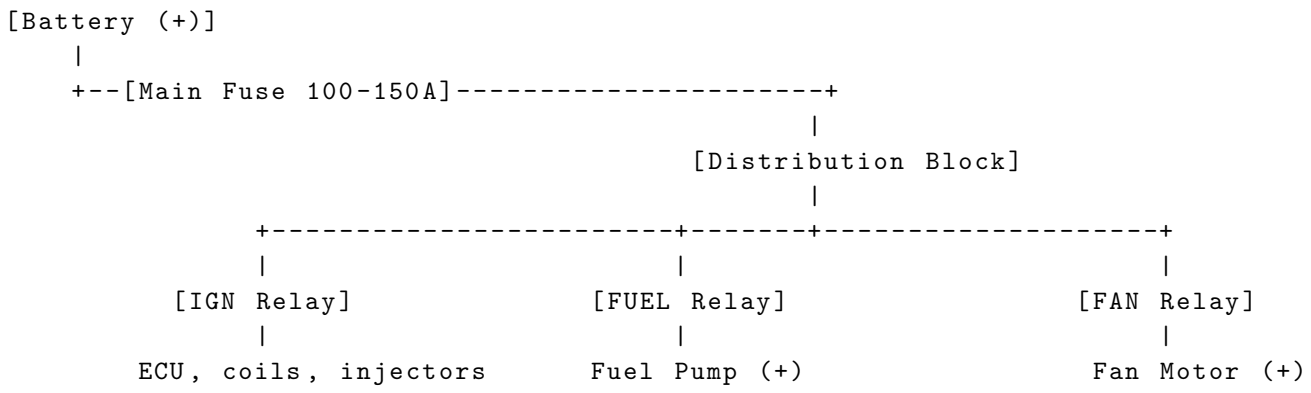
- Battery may remain in OEM location or be relocated (e.g., to trunk) with:
  - Appropriately sized cable (e.g., 1/0 AWG or 2 AWG for main run),
  - Main fuse or breaker near the battery (100–150 A typical).
- All downstream circuits must be fused near their feed point.

3.2 Relay Groups

Recommended relay grouping:

- **IGN Relay:** ECU, coils, injectors, essential engine power.
- **FUEL Relay:** Fuel pump.
- **FAN Relay:** Radiator fan(s).
- **START Relay:** Starter solenoid control (triggered by START button).
- **AUX Relay (Optional):** Cluster, wideband, extra electronics.

3.3 Text-Based Power Diagram



4 ECU Overview (Hondata K-Pro)

4.1 Core ECU Functions

The Hondata K-Pro (or similar K-series programmable ECU) will provide:

- Control of fuel injection and ignition timing.
- VTEC engagement control.
- Fuel pump control output (optional, via FUEL relay).
- Cooling fan output (optional, via FAN relay).
- Sensor power (5 V reference) and grounds.
- Data logging and diagnostics.

4.2 Key ECU Power Inputs

- **Battery feed (BATT):** Constant 12 V, fused (e.g., 15–20 A).
- **Ignition feed (IG_SW):** Switched 12 V from IGN relay.
- **Grounds:** Multiple ground wires to chassis and engine.

4.3 Critical ECU Outputs (Engine Control)

- Coil drivers (one per COP).
- Injector drivers (one per cylinder).
- Fuel pump relay control (optional).

- Fan relay control (optional).
- VTEC solenoid output.

5 F1-Style Start System

5.1 Functional Description

The F1-style start system replaces the OEM key barrel with a **switch panel**:

- **IGN Switch (ON/OFF):** Enables IGN relay which powers ECU, coils, injectors, and other engine-critical circuits.
- **FUEL Switch (ON/OFF):** Enables fuel pump via FUEL relay (either directly or via ECU control).
- **AUX Switch (ON/OFF, optional):** Powers non-critical accessories (cluster, wideband, etc.).
- **START Button:** Momentary push button that energizes the START relay, which in turn powers the starter solenoid.

5.2 Switch Logic and Interlocks

- The **IGN switch** must be ON before pressing the START button.
- The **FUEL switch** should be ON to allow engine start (unless purposely disabled for testing).
- A **clutch switch** can be wired in series with the START button to prevent starting in gear.

5.3 Start System Diagram (Text)

```
[Battery (+)]
    |
    +--[Main Fuse]------------------------+
                                          |
                                   [IGN Switch]
                                          |
                                   [IGN Relay Coil]
                                          |
                                       Ground

IGN Relay Contacts:
    12V OUT --> ECU IGN, Coils, Injectors, etc.

[FUEL Switch] --+--> [Fuel Relay Coil] --> Ground
                |
               (Option: ECU FP output in parallel or series)

[START Button] --(in series with clutch switch if used)--> [START Relay Coil] --> Grou

START Relay Contacts:
    12V from Battery (fused 30-40A) --> Starter Solenoid
```

6 Starter Circuit Specification

6.1 High-Current Path

- Battery positive → dedicated starter fuse or fusible link (e.g., 80–100 A).
- From fuse to starter motor main terminal with large gauge cable.

6.2 Control Path

- START button (momentary) receives IGN-switched 12 V.
- Output of START button passes through optional clutch switch.
- Signal energizes START relay coil.
- START relay contacts connect fused 12 V to starter solenoid terminal.

6.3 Wire Gauge Recommendations

- Starter main cable: 1/0–4 AWG depending on length and routing.
- Starter solenoid wire: 14–16 AWG.
- START button wiring: 16–18 AWG (relay coil current only).

7 Fuel Pump Control

7.1 Control Strategy

The fuel pump is controlled via a relay:

- **Power side:** Battery → fuse (15–30 A) → FUEL relay contacts → fuel pump (+).
- **Control side:** FUEL switch and/or ECU fuel pump output energize the relay coil.

7.2 Recommended Hybrid Control

- FUEL switch provides 12 V to ECU fuel pump control input or directly to relay coil supply.
- ECU then controls relay ground (or positive, depending on strategy) to:
  - Prime pump on key-on,
  - Shut off pump if engine stalls.

7.3 Fuel Pump Diagram (Text)

```
[Battery (+)]
    |
    +--[Fuel Pump Fuse 15-30A]---> [Fuel Pump Relay Contacts] ---> [Fuel Pump (+)]
                                                                        |
                                                                  [Pump (-) to chassis]

Fuel Pump Relay Coil:
    +12V from FUEL Switch  --->(coil)--- ECU FP Output (grounded when ON)
```

8 Sensor and Actuator Wiring

8.1 Critical Engine Sensors

The following sensors must be wired according to Hondata / K-series ECU pinouts:

- Crank Position Sensor (CKP).
- Cam Position Sensor(s) (CMP).
- Throttle Position Sensor (TPS).
- Manifold Absolute Pressure (MAP) sensor.
- Intake Air Temperature (IAT) sensor.
- Engine Coolant Temperature (ECT) sensor.
- Knock Sensor.
- Primary O2 Sensor (wideband or narrowband as per ECU configuration).

8.2 Actuators

- Fuel injectors (1–4).
- Coil-on-plug ignition coils (1–4).
- VTEC solenoid.
- Idle control (IACV or DBW throttle if applicable).
- Purge solenoid (optional).

8.3 5 V Sensor Reference and Grounds

- TPS, MAP, and some other sensors use a shared 5 V reference from the ECU.
- Sensor grounds should return to ECU sensor ground pins, not directly to chassis, to avoid noise.

9 Relay and Fuse Tables

9.1 Relay Summary

Relay	Loads Powered	Control Source
IGN	ECU, coils, injectors, critical sensors	IGN switch
FUEL	Fuel pump	FUEL switch + ECU fuel pump output
FAN	Radiator fan(s)	ECU fan output (or manual switch)
START	Starter solenoid	START button (+ optional clutch switch)
AUX (opt.)	Cluster, wideband, extras	AUX switch

Table 1: Relay overview and control logic.

9.2 Fuse Summary

Circuit	Fuse Size	Notes
Main battery feed	100–150 A	Near battery, protects distribution
IGN feed	30–40 A	Feeds IGN relay input
Fuel pump	15–30 A	Inline fuse to pump
Fan motor	20–40 A	Depends on fan current draw
ECU constant BATT	15–20 A	ECU memory, K-Pro
Aux/Accessories	10–20 A	Cluster, wideband, etc.

Table 2: Recommended fuse sizes (to be refined after component selection).

10 Grounding Strategy

10.1 Engine and Chassis Grounds

- Heavy ground strap from battery negative to chassis.
- Heavy ground strap from chassis to engine block.
- Additional ground from cylinder head to chassis recommended.

10.2 ECU and Sensor Grounds

- ECU main grounds should be bolted to clean, paint-free chassis and/or engine ground points.
- Sensor grounds should be returned to ECU sensor ground pins when specified (not chassis).

11 Harness Layout and Connectors

11.1 Engine Bay Harness Routing

- Route the engine harness away from exhaust heat and moving components.
- Use heat shielding and loom where necessary.
- Maintain service loops at sensors and actuators to reduce strain.

11.2 Firewall and Bulkhead Connections

- Use a bulkhead connector or grommet for engine harness pass-through.
- Seal firewall penetration to prevent fumes and water ingress.

11.3 Switch Panel Connectors

- Use labeled multi-pin connectors for switch panel removal.
- Consider motorsport-style connectors where budget allows.

12 Diagnostics and OBD

12.1 OBD Connector

- Retain or add a diagnostic connector compatible with Hondata K-Pro harness.
- Ensure constant 12 V, ground, and K-line/CAN are correctly wired.

12.2 Check Engine Indicator

- Wire ECU MIL output to a dash LED.
- LED should be visible from the driver's seat for quick feedback.

13 Validation and Testing

13.1 Pre-Power Checks

- Verify all grounds are tight and on bare metal.
- Inspect all connectors for correct seating and pin alignment.
- Check for shorts between power and ground with a multimeter before connecting battery.

13.2 Initial Power-Up

- Connect battery with FUEL, START, and AUX switches OFF.
- Turn IGN switch ON and verify:
  - ECU powers up (K-Pro LEDs / laptop connection),
  - No fuses blow or wires heat.

13.3 Fuel and Start Tests

- Turn FUEL switch ON and listen for pump prime.
- Verify fuel pressure with gauge.
- With IGN and FUEL ON, press START button and confirm starter operation.

13.4 Post-Start Electrical Checks

- Confirm alternator charging voltage at battery (typically 13.5–14.5 V).
- Monitor ECU logs for stable sensor readings.

14 Bill of Materials (BOM)

Subsystem	Component	Brand/Type	Qty
Power	Main battery cable (1/0–2 AWG)	TBD	____
Power	Main fuse/breaker 100–150 A	TBD	1
Relays	4/5-pin automotive relays (30/40 A)	TBD	4–6
Relays	Relay sockets with pigtails	TBD	4–6
Fuses	Blade fuses (10–40 A assortment)	TBD	set
Switches	IGN toggle switch	TBD	1
Switches	FUEL toggle switch	TBD	1
Switches	AUX toggle switch (optional)	TBD	1
Switches	START momentary push button	TBD	1
ECU	Hondata K-Pro and harness	Hondata	1
Sensors	MAP, IAT, ECT, Knock, O2, etc.	K-series/OEM	set
Wiring	Automotive primary wire (various gauges)	TBD	spool(s)
Connectors	Weather-pack/Deutsch connectors	TBD	set
Grounding	Ground straps (engine/chassis)	TBD	2–3

Table 3: High-level electrical BOM for wiring and ECU integration.

15 Future Revisions

- Add exact Hondata K-Pro pinout table (per chosen ECU variant).
- Add detailed harness drawings (2D/CAD) with connector callouts.
- Include actual fuse sizes and wire gauges used after final component selection.
- Add photos or diagrams of the installed switch panel and relay/fuse block layout.