



Royal Flush

Installation & Setup Guide

V1.2

About Us

At Aces, we believe performance should be within reach for every car enthusiast. Born from a passion for hot rod technology, we push the boundaries of EFI innovation, empowering DIY builders and professionals alike. We do it “*For the People*” because we believe that achieving your dreams should never be exclusive.

Our commitment is simple: deliver exceptional products that inspire, at fair prices that make high-performance accessible. Whether it’s your first EFI setup or your latest build, we’re here to fuel your journey with precision, reliability, and cutting-edge technology.

We don’t just build EFI systems, we craft experiences that ignite passion, break barriers, and bring the joy of customization to everyone. Performance should never be out of reach, and with Aces, it never is. Our goal is to give our customers the absolute best value for their money both in the short and long run, so that they can look back and be proud that they bet on Aces.

Backed by over 10 years of experience, a history of winning results, and an unwavering dedication to research and development, Aces is built for performance, designed for dreamers, and made for those who refuse to settle.

Built for performance. Designed for dreamers. Made for you.

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1.0 Introduction

The purpose of this manual is to guide you through the installation and basic setup of your EFI System. It covers installation through initial start-up and includes essential troubleshooting steps to help you achieve a smooth, stable idle before moving on to driving.

This manual does not cover advanced setup, advanced drivability adjustments, or performance tuning. For further guides, diagrams, videos, and expanded troubleshooting resources, please visit our resource center at acesefi.com, where you can also connect with our support team during business hours.

This EFI system is designed to be easy to use for first-time users. This manual does not cover EFI theory in detail, but instead provides the steps needed to get the engine up and running quickly. The EFI system also allows the user to make more advanced tuning changes if desired.

Important Note

Depending on the type of kit you purchase, it may or may not include fuel systems or other components such as the fuel pump, fuel filters, fuel pressure regulator, fuel lines, manifolds and/or ignition components. Aces Fuel Injection offers complete kits, which can be purchased separately.

1.1 Parts List

This list applies to standalone systems only and does not include items or exchanges done during promotional periods or offers.

Item#	Name	QTY	SKU
1	Royal Flush ECU	1	AH2014
2	Handheld	1	AS2009
3	Throttle Body Assembly	1	AM1001
4	Main harness	1	AH2014
5	Wide band O ₂ sensor	1	AE1060
6	Coolant Temperature Sensor	1	AE1052
7	Clamp-on Oxygen Sensor Bung	1	AE1061
8	Air Cleaner Gasket	1	
9	4150 Flange Gasket	1	
10	Breather Stud	1	
11	2" Grommet	1	

2.0 Warnings, Notes, & Notices

 **WARNING:** Before disconnecting the battery, identify a clean, switched 12-volt ignition source. This source must provide 12 volts during cranking and when the key is in the run position. Always disconnect the battery before performing any work on the vehicle.

NOTE: Some installation and adjustment procedures may require an assistant. Ensure an additional person is present for safety reasons.

2.1 Critical Warnings

 **WARNING:** Failure to follow these instructions may result in an improper installation, which could cause serious injury, death, or property damage. Improper installation or misuse of this Aces product will void all warranties.

 **WARNING:** Installation, adjustment, and repair should only be performed by a trained mechanic with adequate experience in fuel and automotive electrical systems.

 **WARNING:** Aces EFI systems consist of multiple sophisticated components. Failure of a single component does not justify a warranty claim for the entire system. Individual components are available for warranty replacement.

 **WARNING:** To preserve the warranty, these installation instructions must be read and followed thoroughly. Failure to follow instructions can void the warranty and may result in serious injury or property damage.

 **WARNING:** The oxygen sensors in this kit are designed for use with unleaded fuel ONLY. Using leaded fuel will degrade the oxygen sensor, leading to incorrect oxygen readings and improper fuel delivery.

 **WARNING:** RTV silicone sealers can damage oxygen sensors. Ensure that any RTV silicone sealant used is compatible with oxygen sensor-equipped vehicles. This information should be clearly indicated on the RTV package.

 **WARNING:** Fuel vapors are heavier than air and can accumulate in low areas, where they may be ignited by sparks or flames, resulting in property damage, injury, or death. Always prevent fuel spills to eliminate this risk.

 **WARNING:** Work must be performed in a well-ventilated area. Do not smoke or have open flames nearby, as gasoline vapors are highly flammable and can cause explosions.

 **WARNING:** Aces EFI systems offer extensive adjustability, and proper setup and calibration are essential for safe operation. If you are not comfortable with engine fundamentals and EFI tuning, we recommend having the system installed and calibrated by an Aces authorized installer or

qualified tuning shop. Our technical support team is also available at acesefi.com or +1 (423) 590-2237 to help answer basic installation, setup, and troubleshooting questions.

2.2 Calibration Responsibility Notice

Note: All supplied Aces Fuel Injection calibrations, wizards, and tuning information are provided as starting points only. It is the responsibility of the end user to confirm that the calibration is safe for the intended use.

Aces Fuel Injection, Inc. holds no responsibility for engine damage resulting from the misuse or improper tuning of this product.

3.0 System Requirements

3.1 Engine Requirements

Before the installation, please verify your vehicle meets the engine and fuel system requirements below:

- Engine is in sound mechanical condition
- Engine horsepower is between 200-650
- Engine is a 4-, 6-, or 8-cylinder
- Engine has a 4-barrel, 4150-style flange intake manifold
- Unleaded fuel only
- Any RTV silicone sealants used on the engine are sensor safe

Note: the Royal Flush is compatible with any 4150-style flange manifold. Always use proper gaskets to seal the throttle body to the intake manifold and ensure that there are no vacuum leaks.

3.2 EFI System Compatibility & Limitations

This EFI system is intended only for the applications listed in this manual. While it may be possible to make it work with other applications, and Aces may occasionally highlight such builds on social media or elsewhere in the spirit of ingenuity, doing so can void your warranty. Aces may be unable to provide customer support for systems used outside their intended applications, and performance cannot be guaranteed. The user assumes all risks when operating the system in unsupported applications. For complete warranty details, please review our warranty policy at acesefi.com.

3.3 Electrical System Requirements

- A clean 12V source direct to the battery.
- A clean 12V switched ignition source.
- A direct connection to the negative terminal of the battery for all ground circuits.

NOTE: Do not connect to the starter, alternator, or any other “dirty” voltage sources, as they can damage electrical components.

3.4 Fuel Delivery System Requirements

Fuel pressure directly affects how much fuel is delivered to the engine when the injectors are opened. Higher fuel pressure delivers more fuel during an injector opening event. Lower fuel pressure delivers less. It is critical that the fuel pressure matches the injector pulse widths required by the calibration for your specific application.

A complete high-pressure EFI fuel system must be installed for the Royal Flush System. The pump should be capable of supplying 255 liters per hour or 400 pounds per hour of fuel. The system requires a minimum of 43.5 PSI fuel pressure. Fuel pressure must be regulated between 43.5 PSI and 58 PSI. The system will not self-regulate fuel pressure and must be regulated by your fuel delivery system.

Required fuel system components:

- A 100 micron pre-filter (installed before the pump)
- A 10 micron post filter (installed after the pump)
- An EFI fuel pressure regulator (installed after the fuel rail)

3.5 Return Line Requirements

Your fuel delivery system may require a fuel return line to the tank. This depends on the location of the regulator and whether it is in-tank or external.

- If the regulator is external, a return line is required.
- Surge tank-style fuel pump modules also require return flow.

 **WARNING:** Some late-model vehicles originally equipped with a throttle body injection system may have a usable return line. However, the return line must not create a pressure restriction. Return line pressure should remain below 3 to 5 PSI and must be at least 3/8" in diameter. A restricted or undersized line can cause tuning issues.

 **DANGER:** Do not use vapor canister lines as fuel return lines. This can lead to fuel leaks, fire, or explosion, and may result in serious injury or death.

 **DANGER:** Proper installation of a return line may require complete removal of the fuel tank. This should be performed only by a qualified technician. Improper handling can cause an explosion or serious injury.

3.6 Minimum Tools Required For Installation

The following list is not comprehensive.

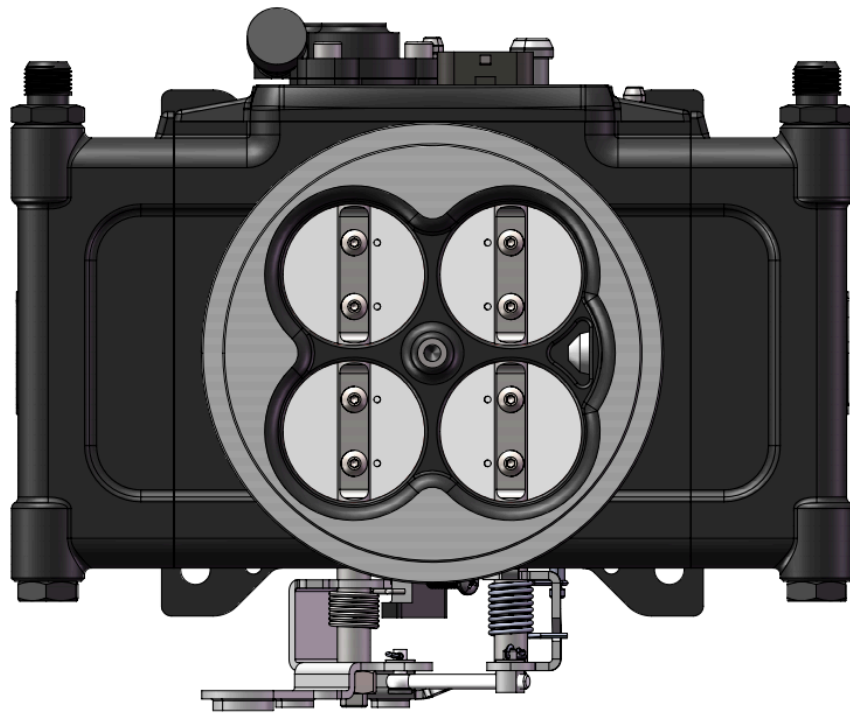
- Standard socket and wrench set
- Standard screwdriver set
- Standard allen wrench set
- Wire strippers
- Rags or shop towels
- Drill and assorted bit sizes
- Welder and PPE if welding the O2 sensor bung (not required when using a clamp-on method)
- Electrical connectors
- Up to a 2" hole saw (depending on ECU mounting location)
- Factory Service Manual for your vehicle and or engine
- Digital voltmeter
- Terminal crimping tool

An assistant is required for certain installation and adjustment procedures. For safety reasons, do not attempt to complete the installation alone.

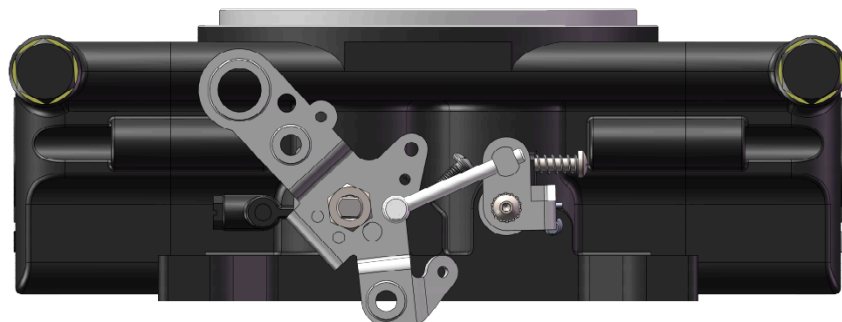
4.0 Installation

The throttle body features two connectors: one for controlling the Throttle Position Sensor (TPS) and another that manages the fuel injectors, Idle Air Control (IAC), and the TMAP sensor.

NOTE: If you are installing a new distributor, such as the Aces Fuel Injection Black Jack Pro Distributor, you may find it easier to complete its installation before securing the throttle body. This can provide additional space to work.

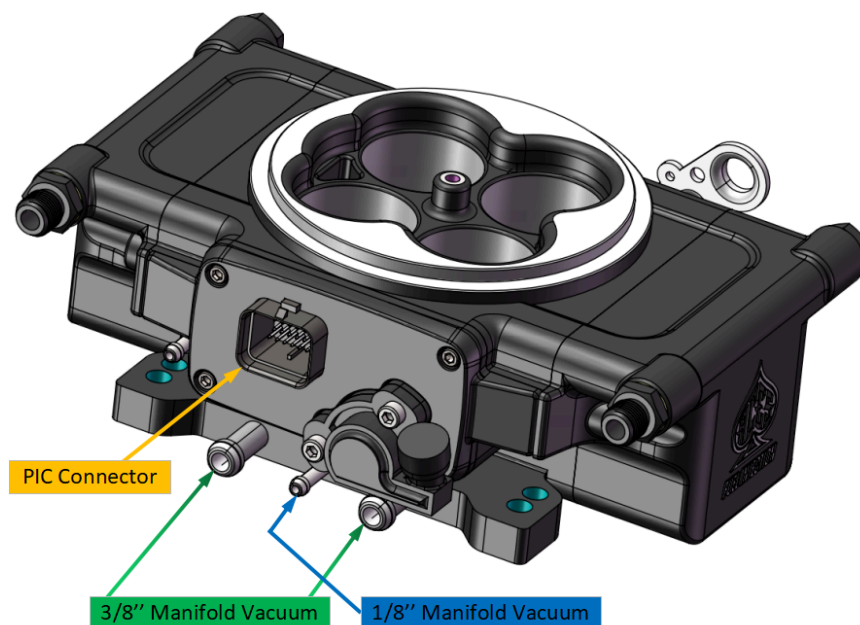


Throttle Body Aerial View



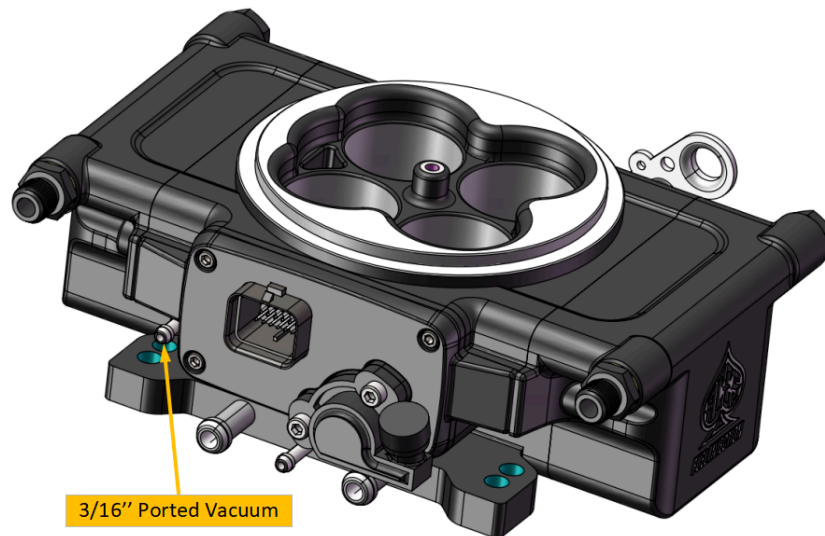
Throttle Body Side View

- 1) Begin by removing the carburetor or other aftermarket EFI system. As you do so, take note of the vacuum lines and whether they are connected to ported or manifold vacuum. The method for identifying ported versus manifold vacuum varies by carburetor model, so refer to the manufacturer's specifications for your specific carburetor.



NOTE: If the carburetor will remain removed for an extended period, cover or plug the intake manifold with an appropriate material to prevent any foreign debris from entering the engine.

- 2) Install the new Royal Flush throttle body using the provided gasket. Secure it in place with the screws or studs that were previously used for the carburetor or EFI system.



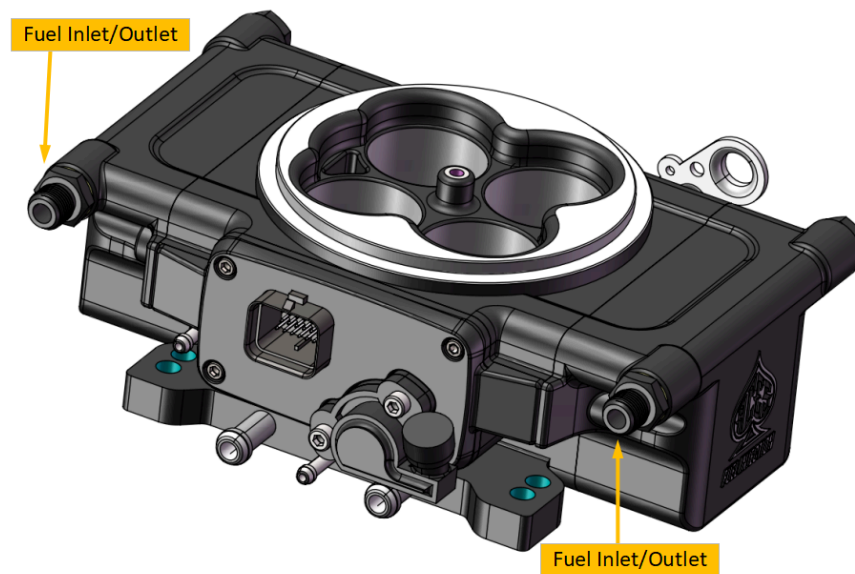
- 3) Reconnect all vacuum hoses, ensuring that any ported vacuum systems are connected to the correct 3/16" port as shown in the instructions. Cap any unused ports with the provided rubber caps.
- 4) Once the installation is complete, install an air filter onto the throttle body. Air filters are available for purchase separately at acesefi.com.

4.1 Fuel System Installation

A complete high-pressure EFI fuel system is required for the Royal Flush EFI system. This system operates at a minimum of 43 PSI and functions best with a return-style fuel system. When selecting a fuel pump, regulator, and fuel lines, ensure that all components are designed to handle high pressure (43 PSI or greater).

The following guidelines will help with setting up the fuel system for your Royal Flush EFI system. If using an in-line fuel pump, a coarse pre-filter must be installed before the pump.

All fuel systems should include a 10-micron post-fuel filter after the fuel pump. Additionally, an EFI-rated high-pressure, vacuum-referenced, bypass fuel pressure regulator is required. The fuel pump must be mounted lower than the lowest part of the fuel tank and as close to the tank as possible. The fuel tank must also be properly vented to function correctly.



4.2 Fuel System Installation Steps

If you purchase a standalone EFI system, Fuel System components, such as fuel lines, fuel filters, and fuel pumps, will not be included.

1. Refer to the provided diagram for the correct orientation and location of fuel system components.
2. If using an electric in-line fuel pump, mount it as close to the fuel tank outlet as possible using the provided bracket that comes with the fuel system. This placement ensures that the pump primes efficiently, allowing for quicker starts.
3. Install the pre-filter between the fuel tank and the fuel pump inlet. This filter prevents dirt and debris from reaching the fuel pump. Be sure to install it with the arrow on the filter pointing in the direction of fuel flow.
4. Install the post-fuel filter between the electric fuel pump outlet and the throttle body injection (TBI) unit. This should be a 10-micron EFI filter positioned to allow fuel hoses to be routed without kinks or sharp bends. The filter must also be installed with the arrow pointing in the direction of fuel flow.

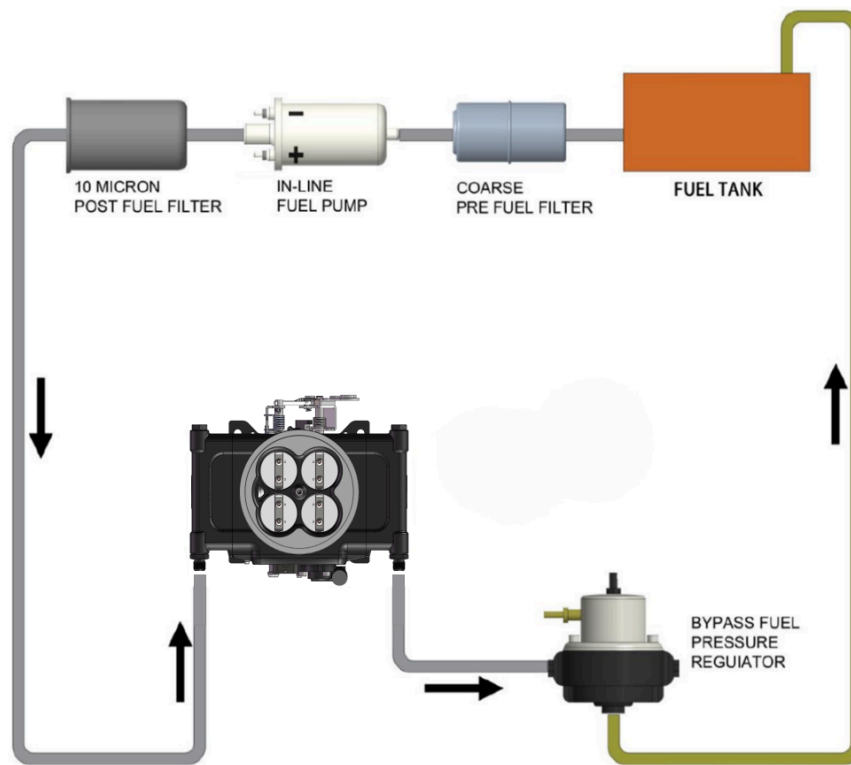
 **WARNING:** Make sure you flush out all fuel lines before connecting them or assembling the fuel system. Failure to do so commonly results in debris traveling to the throttle body and clogging the injector(s).

 **WARNING:** Ensure that both fuel filters are installed in the correct direction. Each filter has a flow direction arrow printed on its side. Installing filters incorrectly will result in a system malfunction.

 **WARNING:** Some late-model vehicles originally equipped with a throttle body injection system may already have a fuel return line to the tank that can be utilized. However, the return line must not create a pressure restriction. The fuel pressure in the return line should not exceed 3-5 PSI. Using a line that is too small or has restrictions may cause tuning issues.

 **WARNING:** Do not use vapor canister lines as a fuel return line. This can lead to fuel leaks, fire, or explosion, potentially resulting in serious injury or death.

 **WARNING:** Proper installation of a fuel return line, if required, may necessitate the complete removal of the fuel tank. This task should only be performed by a fuel tank specialist familiar with the safety regulations and precautions necessary for this type of work. If an unqualified person attempts this procedure, an explosion could occur, causing serious injury or death.



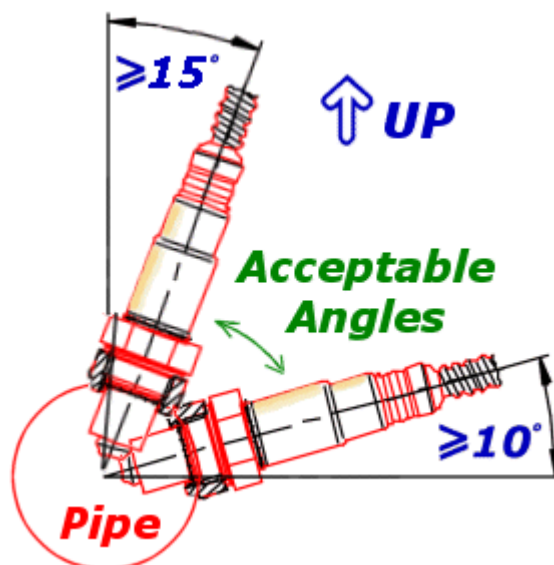
5.0 Sensor Installation

IMPORTANT! Before beginning installation, ensure your vehicle is positioned on a stable and level surface. Use only properly rated jacks and jack stands to lift and support the vehicle. Never work under a vehicle supported solely by a floor jack or bumper jack. If available, a two-post underarm lift or a four-post drive-on lift will significantly reduce installation time and effort. Ensure lift locks are engaged before working under the vehicle.

⚠ WARNING: Failure to disconnect the air smog pump or improperly positioning the oxygen sensor downstream from air injection will result in an extremely rich fuel mixture. This can cause drivability issues and severe engine damage. If you choose to disconnect the air smog pump, check local regulations to ensure compliance with emissions laws in your area.

5.1 Oxygen Sensor Installation Steps

1. Identify an appropriate mounting position for the oxygen sensor as close to the engine as possible. The sensor should be placed where it can read an average of all cylinders in one bank, typically just after the cylinders merge. For long tube headers, mount the sensor 6"-10" after the collector. Ensure at least 18" of exhaust pipe extends beyond the sensor. If your vehicle has catalytic converters, the oxygen sensor must be placed between the engine and the catalytic converters.
2. Position the sensor at the recommended angle as shown to help prevent condensation from entering the sensor through the exhaust tubing. The sensor can be mounted on either side of the exhaust pipe.



3. Drill a 7/8" hole at the selected location. Then, either:
 - a. Weld the included sensor bung into the hole, ensuring a full weld around the bung for a leak-proof connection.
 - b. Alternatively, a clamp-on bung may be utilized. Clamp-on bungs are available for purchase at acesefi.com.

Allow the weld to cool completely before proceeding. Once cool, install the oxygen sensor into the bung and tighten securely. Apply anti-seize to the sensor threads to aid in future removal, but avoid contact with the sensor tip.

Additional Considerations:

- The sensor should be installed in or after the collector, as this allows the ECU to take an average reading across all cylinders in a bank rather than from a single cylinder.
- The sensor should not be installed near the open end of the exhaust system. At low engine speeds, free air can enter the exhaust and cause inaccurate readings.
- Ensure there are no exhaust leaks, as any unmetered air reaching the sensor will cause false lean readings. The ECU will compensate by adding unnecessary fuel, leading to poor performance.

NOTE: Never run the engine with the oxygen sensor installed if it is not plugged in and powered by the ECU, as this can damage the sensor. If you need to temporarily plug the hole, use an O2 sensor plug or a spark plug with an 18mm thread.

5.2 Coolant Temperature Sensor Installation

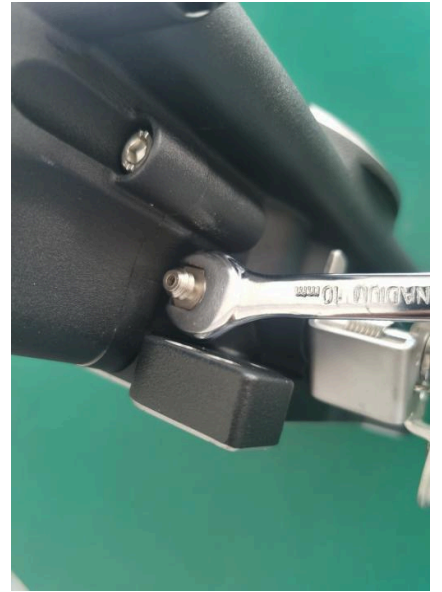
Install the coolant temperature sensor into a 3/8" NPT coolant passage located in either the intake manifold or cylinder head. Be careful not to overtighten, as this could damage the cylinder head or intake.

Before installation, it is recommended to drain some coolant to prevent spillage. Apply thread sealer or a small amount of thread tape to the sensor threads to ensure a proper seal.

IMPORTANT: Do not install the sensor in the thermostat housing or any location that does not experience a constant flow of coolant, as this will lead to inaccurate temperature readings.



Coolant Temperature Sensor



7.0 Boost Reference Port

If you are not using a Roots-style supercharger, you may skip this step.

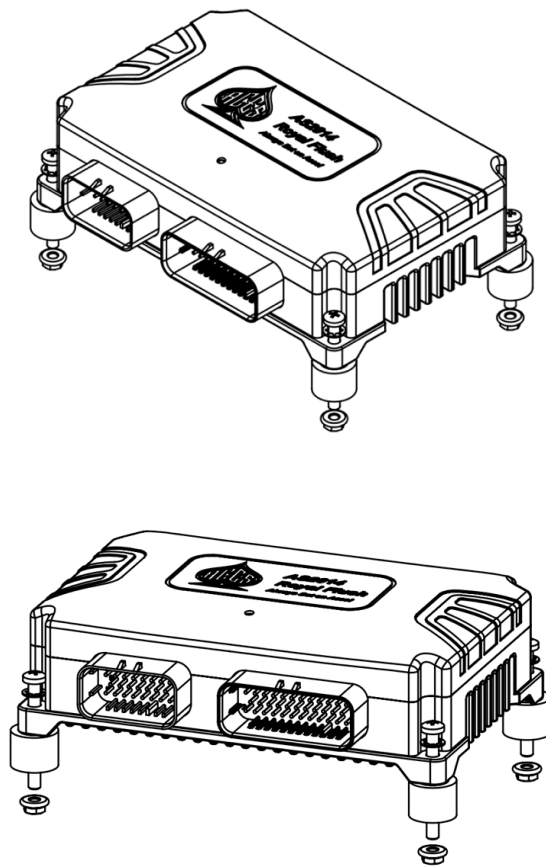
1. Turn the throttle body upside down. Apply a small drop of Loctite to the plug and install it into the threaded orifice located next to the throttle blades.
2. Identify the boost reference port on the throttle body. This port is positioned at the lower right corner, on the same side as the throttle cable linkage. Remove the existing plug.
3. Install a 1/16" pipe-to-hose fitting into the boost reference port.

The boost reference port on the throttle body should be connected below the supercharger, directly off the manifold. Alternatively, it can be split off from the boost gauge reference line if necessary.

6.0 ECU Mounting and Wiring Overview

The Royal Flush ECU can be mounted either inside the passenger compartment (preferred location) or in the engine compartment. If installing in the engine compartment, follow these guidelines:

- Choose a mounting location as far away as possible from exhaust manifolds or headers to prevent heat damage.
- Keep the ECU away from spark plug wires, CD ignition boxes, or other electrically noisy devices to prevent interference.



An EFI system relies on a clean and stable voltage source for proper operation. Equally important are the grounding connections, which must be correctly installed to ensure consistent performance.

6.1 ECU Wiring Guidelines

- The Royal Flush ECU contains multiple processing units that require a clean power and ground source. The wiring harness must be routed to avoid exposure to dirty power or ground sources.

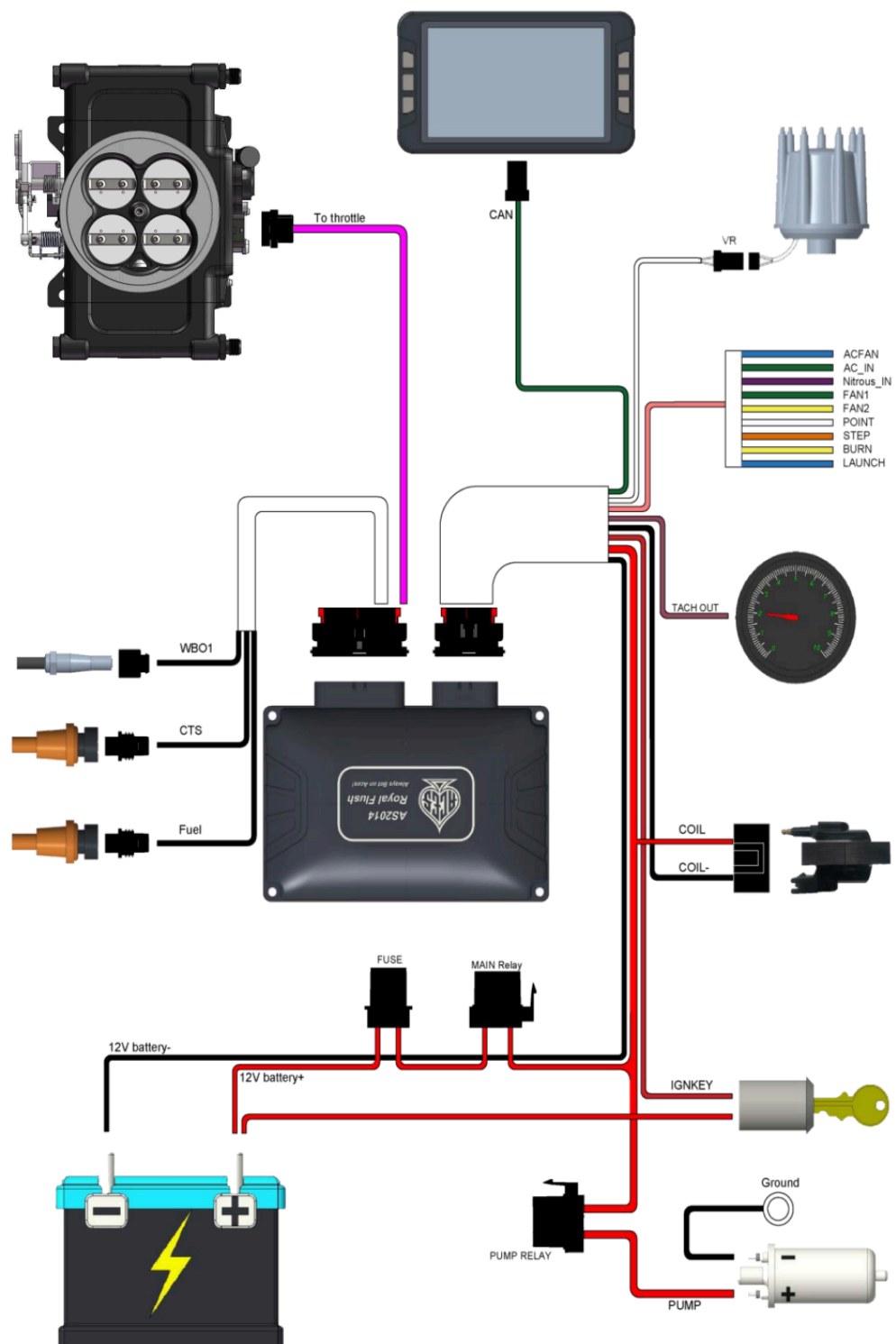
- Keep sensor wiring separate from high-voltage or “noisy/dirty” components, especially:
 - Secondary ignition wiring (e.g., spark plug wires).
 - Ignition boxes and their associated wiring.
- Ensure that spark plug wires do not come into direct contact with EFI wiring.
- Never bundle or loom EFI sensor wiring together with high-voltage or “noisy/dirty” wiring in parallel. If crossing is necessary, wires should intersect at an angle rather than running alongside each other.

6.2 Power and Grounding

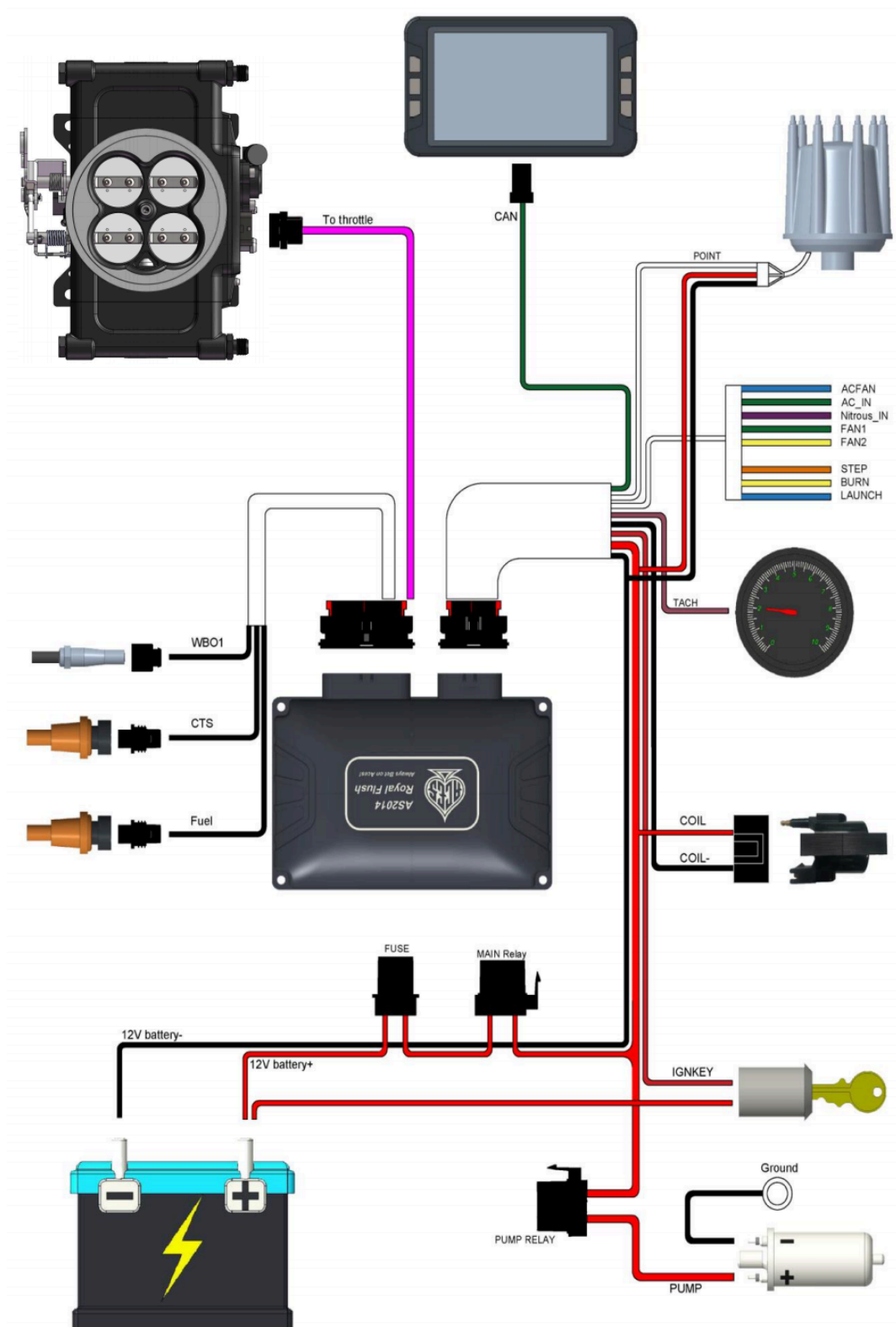
- The main power and ground connections must be made directly to the positive and negative battery terminals—not to any other connection points.
- Ensure the engine has a proper ground to both the battery and chassis.
- All wire connections should be properly crimped and soldered, with quality heat shrink applied over the joints for protection.
- Avoid using T-taps or similar connectors—use proper crimp connectors, solder, and heat shrink for all connections.

6.3 Additional Wiring Precautions

- Do not use the electric fan outputs to power the fans directly. These outputs should only serve as a trigger source for a properly sized relay that matches the fan(s) being used.
- Never splice or share signal wires (such as the Throttle Position Sensor (TPS) signal) between different electronic control units (e.g., "piggyback" systems). This can cause erratic behavior and unreliable sensor readings.



Magnetic Pickup Distributor



Distributor with Hall Effect Crank Signal Sensor

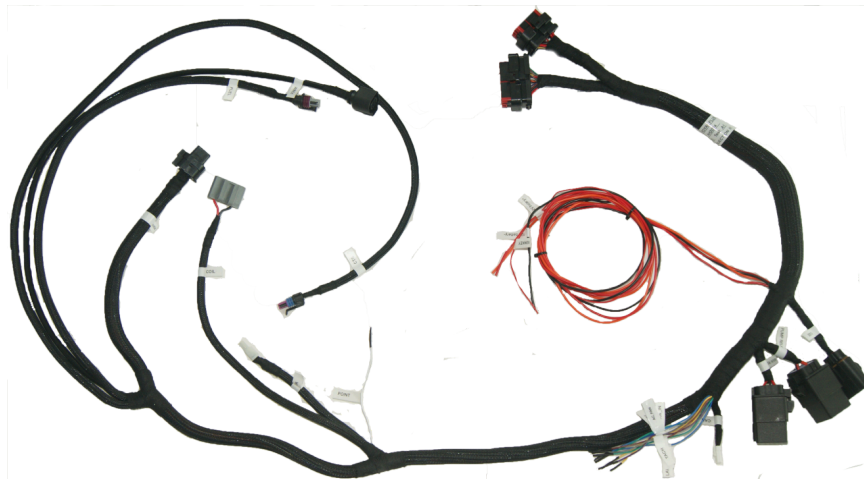
7.0 Wiring Installation

7.1 Harness Routing

If the ECU is mounted inside the interior, the wiring harness must be routed through the firewall into the engine compartment. If no existing access point is available, use a 2" hole saw to create an opening in a suitable location. Install the included 2" grommet to seal the opening and protect the harness.

If the ECU is mounted in the engine compartment, the handheld tuning module cable must be routed to the "CAN" connector on the main harness, located near the ECU's main connector. To access the handheld module after startup, route the small CAN connector through the firewall to a convenient location.

- Connect the PIA and PIB connectors of the main harness to the ECU.
- Approximately 22" from the ECU main connectors, a 40A relay is present. This relay powers the fuel injectors and the wideband O₂ sensor heater. Additionally, a fuel pump relay is included to control the fuel pump.



7.2 Sensor Connection

Connect the following components to their dedicated sensors and connectors as shown in the wiring diagram:

- Bulkhead connector
- Coolant Temperature Sensor (CTS)
- Wideband O₂ Sensor (WBO2)
- CAN connector
- Throttle body connector (PIC)

The PIC throttle body connector integrates wiring for the injectors, TMAP, TPS, and IAC. Plug this PIC connector into the corresponding throttle body port.

If using Royal Flush ignition control, connect the distributor coil connectors accordingly.



Throttle Body Connector (PIC)

7.3 Ignition Coil (With Timing Control)

The Killshot 2 Pro ECU features a built-in ignition coil driver utilizing a high-performance IGBT chip. Aces recommends using the Blackjack Pro Series Ignition Coil (PN AC2008), which delivers 90mJ of spark energy with a 3ms dwell time—all without requiring a CDI box. This setup enhances cold starts, idle stability, and fuel economy.

If the harness and ECU are configured for timing control, connect the coil connector to the AC2008 ignition coil. If not, proceed as outlined later, in section 7.8.

NOTE: Canister-style coils are not recommended as some will not work with timing control.



Ignition Coil Connector

- Primary Resistance: 0.273Ω
- Primary Inductance: 2.63 MHz
- Secondary Resistance: $3.42\text{ k}\Omega$
- Secondary Inductance: 15.77 Hz
- Output (50pF load): 47 kV
- Output Energy: 150 mJ
- Peak Secondary Current: 100 mA +/- 7%
- Arc Duration: 200 μS
- Turns Ratio 78:1



AC2008 Black Jack Pro Ignition Coil

7.4 Loose Wires

The following loose wires in the main wiring harness must be connected as specified for all systems:

IGNKEY (Red): Connect to a clean key-on/cranking +12V power source that is active when the ignition is on. Verify with a voltmeter that this source also provides power when the engine is cranking, as some sources do not.

- Located approximately 20" from the ECU connectors.
- DO NOT connect to a "dirty" source like an ignition coil.

12V Battery + (Red): Must be connected directly to the positive battery terminal. This wire supplies power to the fuel pump and injectors and is protected by a 20A fuse in a sealed fuse holder.

- The fuse holder is located about 8" from the ECU connector, with the fuse pre-installed.

12V Battery- (Black): Connect to a chassis ground point that has excellent connectivity with both the engine and battery. There must be good continuity between the connection point and the battery when checked with a digital volt ohm meter (DVOM). This ground should not be connected at the same location as other grounds.

- This wire is located approximately 18" from the ECU connectors.

Pump+(Orange): Provides +12V output to activate a fuel pump.

- Do not use this wire to power pumps that require more than 15A. Instead, use it to trigger a separate relay for high-current pumps and use a 10-gauge wire for the fuel pump's power feed.
- Ensure the fuel pump has a proper ground connection by running a wire from the negative fuel pump terminal to a solid chassis/frame ground.

7.5 Additional Wires

The following additional **optional** wire outputs should be connected as required. These wires are found approximately 23" from the ECU connectors unless otherwise specified.

- **Tach Out (Color = Grey)** This wire provides a 12v square wave output and can be used to trigger a conventional tachometer.
- **Point (Color = White)** A Tach output from billet distributor with Hall effect crank signal sensor like Holley Sniper distributor.
- **Fan1 (Color = Green)** This output will provide a ground output to trigger a relay used for a cooling fan. This output should never be directly connected to a fan, but the relay that powers the fan. It should be connected to the ground trigger of the relay.
- **Fan2 (Color = Yellow)** This output will provide a ground output to trigger a relay used for a cooling fan. This output should never be directly connected to a fan, but the relay that powers the fan. It should be connected to the ground trigger of the relay.
- **Nitrous_IN (Color = Purple)** Nitrous activation wire. Feeding 12 V power to this wire tells the ECU that a nitrous oxide system has been activated.
- **Burn (Color = Yellow)** Burn out Rev Limiter, feeding 12 V power to this wire tells the ECU that a burn out control has been activated.
- **Launch (Color = Blue)** Launch Rev Limiter, feeding 12 V power to this wire tells the ECU that a Launch control has been activated.
- **Step (Color = Brown)** Step Retard, feeding 12 V power to this wire tells the ECU that a step retard has been activated.
- **AC_IN (Color = Green)** This 12V input will provide a 12V input defined AC is on.
- **REV (Color = Blue) Optional** - Programmable ground output
- **Fuel Level (red)** This is a fuel level sensor input resistance that can go from 0-250 or from 250-0, it can be represent the percentage of fuel in the tank.

7.6 Pressure sensor kit

ACES EFI pressure sensor kits are top-quality parts for use with ACES EFI systems. These kits include plastic/steel sensors that have 1/8 in.-27 NPT threads and include a -6 AN fuel pressure take-off adapter fitting and 2 sets of 45 push lock hose ends.

Pressure sensors are great for logging oil pressure, fuel pressure, boost pressure. displaying pressure on the Handheld or Dash screen and on your data log files.



7.7 Handheld or Bluetooth Module Connection

Connector Label: CAN

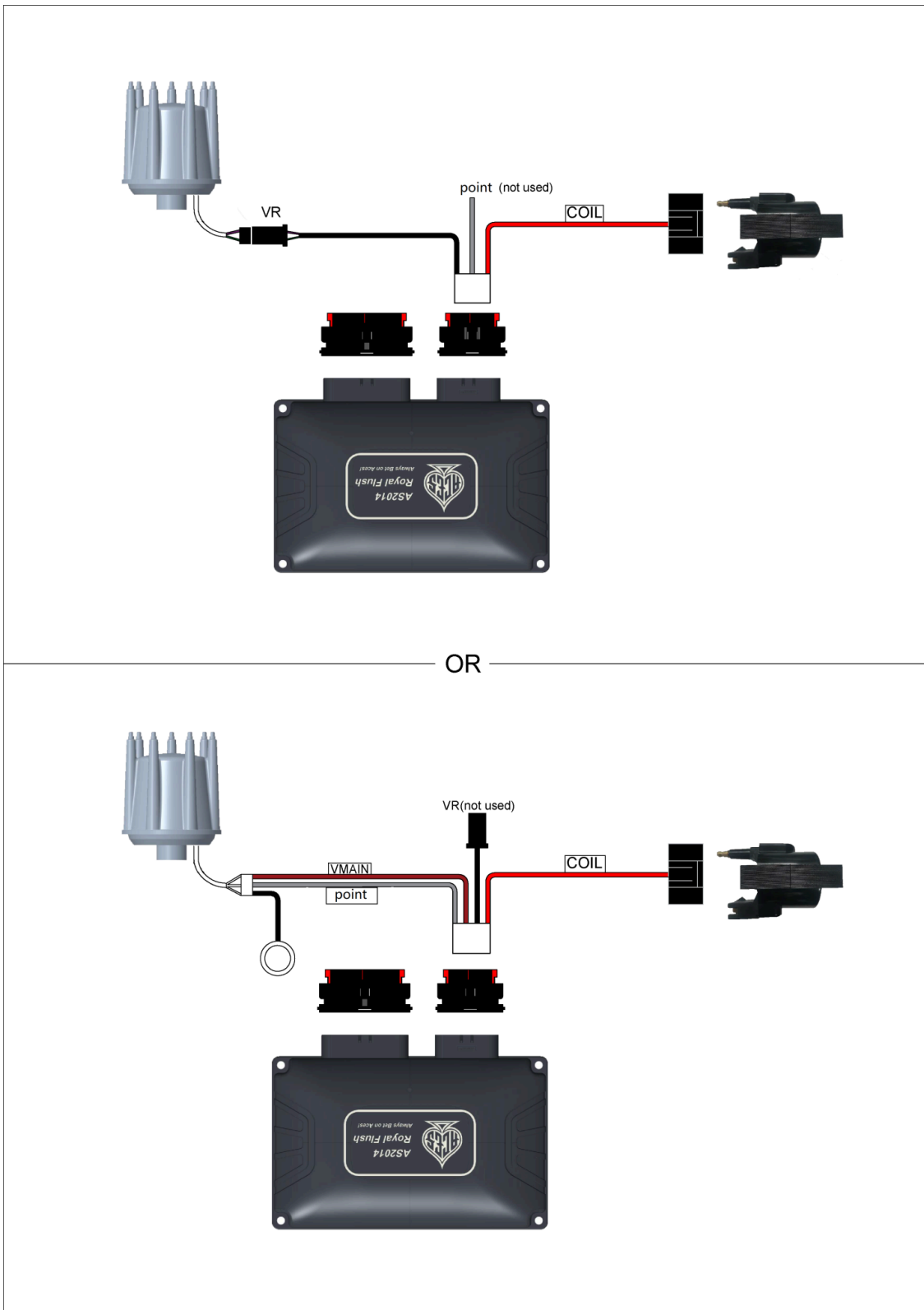
The CAN connection is used for communication devices such as the handheld controller or Bluetooth module. These devices allow initial system setup, access to live EFI data, and certain user adjustments or monitoring functions.

- Mount or route the connection so the device can be reached from the passenger compartment during installation, startup, and configuration.
- Plug the handheld or Bluetooth module into the designated CAN connector on the main harness. Verify the connector label before making the connection.
- Once the system has been configured and the engine is operating correctly, the handheld does not need to remain connected unless continued monitoring or tuning access is desired.

7.8 Ignition Wiring - No Timing Control

In a “no timing control” setup, the vehicle may be using an older mechanical points distributor or a more modern ignition system for carbureted engines. In this configuration, another component—such as the distributor or an ignition module—determines when the coil fires. The ECU needs to receive an RPM signal each time the coil fires to accurately determine engine speed.

- If a CD ignition box is used, the Royal Flush ECU will receive its RPM signal from the ignition box’s “Tach Out” connection.
- If a traditional dwell-controlled inductive coil ignition system is used (without a CD ignition box), the Royal Flush ECU will get its RPM signal through the RPM Module, connecting to the negative side of the coil.



8.0 Ignition Setup for Timing Control

The Royal Flush EFI system can control ignition timing when used with most common magnetic pickup distributors, such as the Aces Black Jack series or MSD distributors. However, some modifications to the distributor are necessary to ensure proper function.

If you wish to use your Royal Flush system to control timing, your distributor must be locked out. Failure to do so can result in poor engine performance or even severe engine damage.

8.1 Required Components for Timing Control

- A locked-out distributor
- A timing light
- (Recommended) An Aces Black Jack Pro Series Billet Distributor with a 2-pin magnetic pickup connector
- A degreed harmonic balancer with a 15-degree BTDC (Before Top Dead Center) mark

8.2 Distributor Lockout and Installation Procedure

1. Lock out the distributor's centrifugal advance. The distributor must be physically locked to prevent any changes in the relationship between the pickup and paddle wheel due to engine speed or load. Follow the distributor manufacturer's instructions for the proper lockout procedure. **Locking out the distributor is a necessary step and must not be skipped.**
2. Rotate the engine to 15 degrees Before Top Dead Center (BTDC).
3. Insert the distributor into the engine, but do not tighten it down yet.
4. Rotate the distributor body so that the pickup aligns with the nearest paddle on the paddle wheel. Ensure the paddle is as centered as possible.
 - Later in the installation, the Handheld Controller can be used to fine-tune this alignment if needed.
5. Secure the distributor by clamping it down.
6. Install the distributor cap and mark the center of the #1 terminal on the distributor body for reference.

9.0 Sensor Verification

IMPORTANT: If any of these sensors do not read properly, DO NOT attempt to start the engine.

Before starting the vehicle, verify that all sensors are reading correctly.

- Turn the key off, then cycle it back on.
- Listen for the fuel pump, which should activate and run for approximately 5 seconds.
- Inspect for any fuel leaks before proceeding.

9.1 Sensor Readings on the Home Screen (Key ON, Engine OFF)

- **Engine RPM:** Should display “0” (RPM will be detected once the engine is cranking or running).
- **MAP (Manifold Air Pressure Sensor):** Should read between 95-102 kPa or 13-14 PSI. At higher elevations, it may read as low as 75 kPa or 10-11.
- **TPS (Throttle Position Sensor)**
 - Slowly press the throttle to wide open; it should read 85-90 at wide-open throttle (WOT).
 - Cable-operated throttle bodies should read 0 when closed.
- **CTS (Coolant Temperature Sensor):** Displays engine temperature. If the engine is cold, it should be close to ambient temperature.
- **Battery Voltage:** Should read 12.0V minimum.

10.0 Startup Engine

At this stage, you are ready to start the engine. Before attempting to start your vehicle with the newly installed Royal Flush EFI system, Aces recommends following this checklist to ensure a safe and successful startup.

10.1 Pre-Startup Checklist

- ☐ Double-check all wiring connections, especially:
 - ☐ Power and ground are directly connected to the battery.
 - ☐ The small Red “IGNSW” wire from the Royal Flush ECU has power during both Key-On and Cranking.
- ☐ Ensure that the Royal Flush ECU, fuel pump, fuel lines, and wiring are securely mounted away from heat sources and pinch points.
- ☐ Wideband Oxygen Sensor is installed in the proper location.
- ☐ Check for exhaust leaks.
- ☐ Throttle linkage is fully connected and operational from the pedal.
- ☐ Handheld controller powers on when the key is turned to the ON position.
- ☐ The Startup Wizard has been completed on the handheld controller.
- ☐ Fuel pump primes when the key is in the ON position.
- ☐ No fuel leaks are present when the system is under pressure.

10.2 Starting the Engine

When ready, turn the key to the ON position and observe the Handheld Dash to confirm that the Royal Flush ECU is receiving an RPM signal.

- Crank the engine and check the RPM parameter on the handheld display.
- If the ECU is functioning correctly, the RPM value should register, and the engine should fire, run, and settle into an idle.
- A cold engine may initially idle at a higher RPM (approximately 1200-1500 RPM), depending on engine temperature.

10.3 Troubleshooting

If the RPM signal is missing, there is likely an error in wiring or system setup.

For assistance, contact Aces Fuel Injection support at (423) 590-ACES (2237) or acesefi.com.

11.0 After Startup

Once the vehicle has started, inspect for any fuel or coolant leaks. Allow the vehicle to warm up while checking the following parameters to ensure proper operation:

Key System Parameters to Monitor:

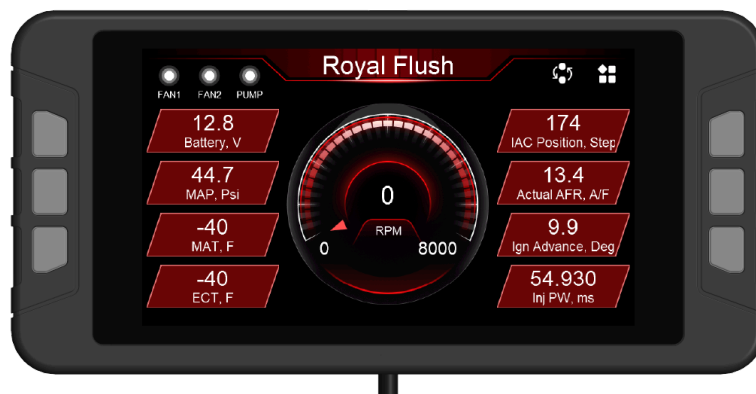
- **Fuel Loop State:**
 - Indicates whether the engine is running in Closed Loop or Open Loop mode.
 - Closed Loop means the ECU is adjusting fuel delivery to maintain the target air/fuel ratio (AFR).
 - The Royal Flush EFI system is designed to operate in Closed Loop most of the time.
- **Inj Percent (Injector Compensation Percentage):**
 - Shows the percentage of fuel adjustment the ECU is making.
 - Below 100% → ECU is removing fuel.
 - Above 100% → ECU is adding fuel.
 - In Open Loop mode, this value will always remain at 100%.
- **Inj PW (Injector Pulse Width):**
 - Displays the injector pulse width (how long the injectors remain open).
 - Varies depending on engine speed and load.
- **Target Air/Fuel Ratio (AFR):**
 - The desired AFR that the ECU is programmed to maintain.
 - This will change based on engine speed and load.
- **Actual AFR (Air/Fuel Ratio):**
 - The real-time AFR reading from the wideband oxygen sensor.
 - The Closed Loop Compensation should be constantly adjusting fuel delivery to keep the Actual AFR close to the Target AFR.
- **Fuel Learn State (Self-Learning Status):**
 - Indicates the status of the Royal Flush "Self-Learning" function.
 - The system will automatically adjust fuel delivery as you drive.
 - Conditions for Self-Learning to Activate:
 - Engine temperature must exceed 160°F.
 - The system must be running in Closed Loop mode.
 - Self-learning must be enabled (this is enabled by default in the base Royal Flush setup).
 - Once the engine reaches 160°F, self-learning should become active.

—

12.0 Handheld Controller Navigation and Use

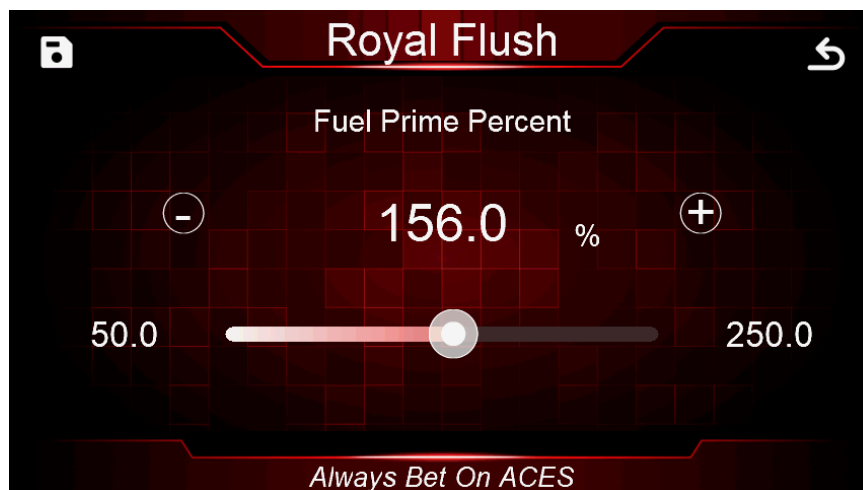
The Aces EFI ROYAL FLUSH™ Handheld Programmer utilizes a 5" capacitive touchscreen and six manual buttons. The LCD screen has a large, vividly colored display. The Handheld uses CAN bus communication to the ECU and has a type-C USB interface for programming and other operations. All operations are done by touching the screen or the manual buttons.

The handheld can be used for monitoring and calibrating the system (for example: idle speeds, AFR targets, fuel pump, etc.) after connecting it with the ECU. It is portable and convenient for tuning at any time.



12.1 Making Adjustments

1) Slider Bar: Slide the bar or click "⊖" and "⊕" to adjust the parameters, click "💾" to save, and click "↶" to cancel.

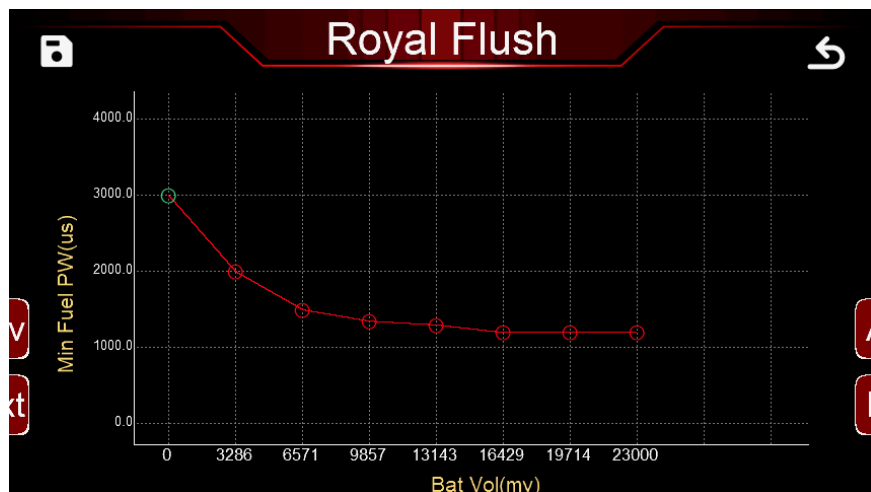
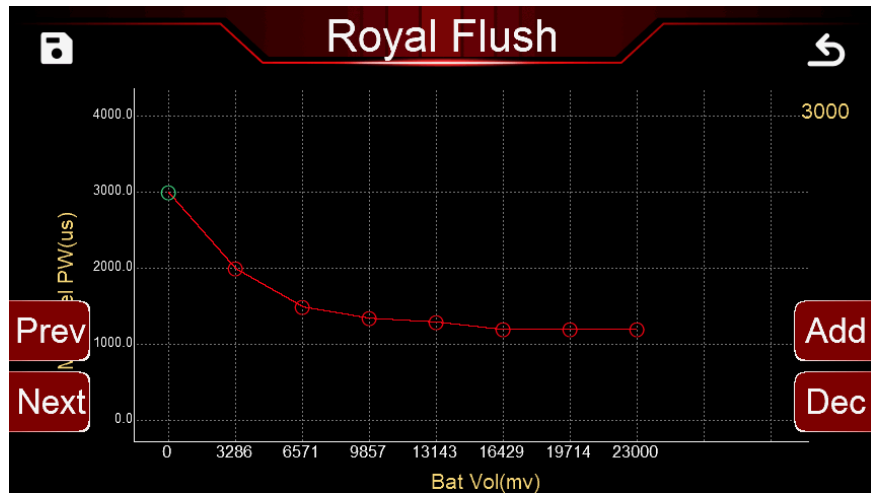


2) Numeric keyboard: Click the edit box "156.0%" above the sliding bar to pop up the numeric keyboard.



4) 2D Graph: Drag the red dot on the graph or click the mechanical buttons on both sides to adjust the parameters. When adjusting the parameter, the y-axis coordinate value of the currently adjusted parameter will be displayed in the upper right corner. The four buttons on both sides of the interface will disappear after a short display. Clicking the two mechanical buttons at the lower left corner can switch the position of the green dot, clicking the button at the right center can raise the position of the green dot, and clicking the mechanical button at the lower right corner can lower the position of the yellow dot. The y-axis coordinate value of the green dot is displayed in the upper right corner of the interface.

After the configuration is complete, click " " to download the calibration data to the ECU; click " " to cancel the modification.



12.2 Connection

The handheld is connected to the ECU through the CAN bus. Program upgrading can be done through the type-C USB interface.

12.3 Navigation buttons

The ACES Handheld is designed for reliable operation and use. There are buttons on both sides of the display. The handheld is operated by touching the screen or the buttons on the sides. (See figure on the next page.)



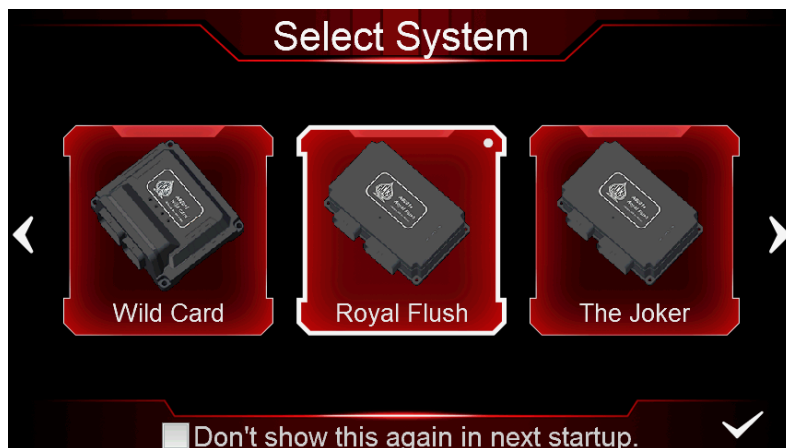
12.4 Main Menu



The Main Menu has six selections: Monitor, Tuning, Logging, Files, Settings, and Wizards.

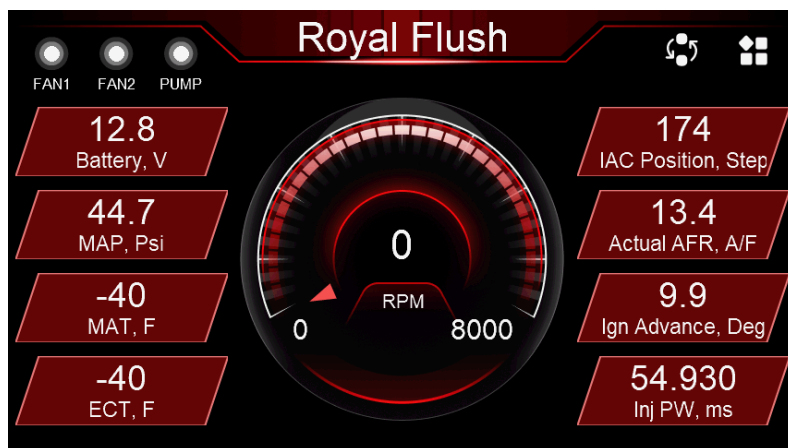
- **Monitor** - A variety of gauge and dash displays.
- **Tuning** - Allows for various parameters to be easily adjusted.
- **Logging** - Users can freely choose the monitored object to write to the log file to better observe the ECU data.
- **Files** - Saves and loads tuning calibrations. Also shows information about the ECU and handheld controller.
- **Settings** - Adjust the backlight brightness and volume for sound of buttons or touchscreen and see information about the handheld.
- **Wizards** - Creates a base calibration and performs the TPS Zero Learn function.
- The Royal Flush EFI system will build a custom calibration for your engine based on a few easy to answer questions. To begin, Choose the Wizards icon from the main menu.

13.0 Calibration Wizard



Select System

Connect the Handheld to the wire harness and Power up the ECU. Select ROYAL FLUSH™.



Home Screen

Click the "☰" icon in the upper right corner to enter the Main Menu.



Main Menu

Click Wizards from the main menu.



Wizards

Click Start Wizard to configure your ROYAL FLUSH™ EFI system.



Camshaft Type

Select your camshaft type:

- Stock/Mild = This selection will work well on most applications equipped with stock or “street performance” camshafts. Choose Stock/Mild If you are unsure of your camshaft specs.
- Street/Strip = Select this if your engine has between 8” and 13” of manifold vacuum.

Press “”.



Dual WBOS

Select Only WBOS1 for your ROYAL FLUSH™.

Press “”.



RPM To Royal Flush/Ignition Type

Select your distributor type:

- Magnetic = magnetic pickup distributors like ACES blackjack series
- Point = billet distributor with Hall effect crank signal sensor like Holley Sniper distributor

Press “”.



Spark Energy

Select spark energy, Ignition coil AC2008 is 150mj

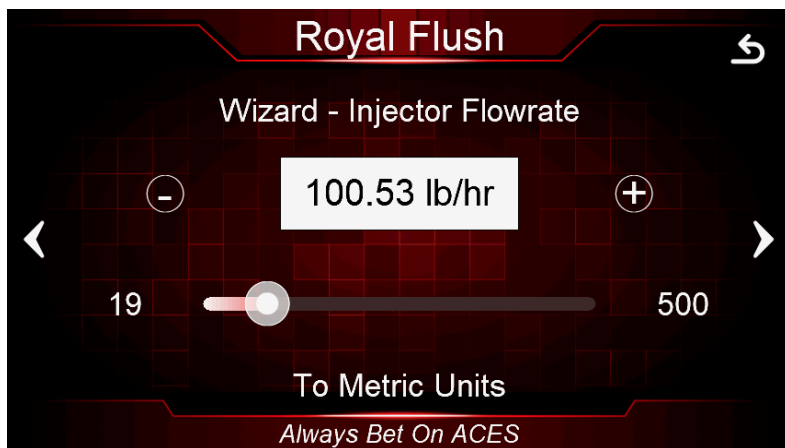
Press “”.



Number of Injectors

Select 4 injectors for your ROYAL FLUSH™.

Press “”.



Injector Flowrate

The injectors of the ROYAL FLUSH™ throttle body are 100 lb./hr.

Press “”.



Engine Displacement

Use the slider bar to set your engine displacement.

Press “”.



Hot Idle Speed

Use the slider bar to set your hot idle speed. This is the target RPM that will be enabled at coolant temperatures above 160 °F.

Press “”.

Royal Flush

Wizard - details

1. CAM Type---Stock

2. Dual WBOS---Only WBOS1

3. RPM To RoyalFlush/Ign Type---Magnetic

4. Spark Energy---150mJ

5. Number Of Injector---4

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Click "  " to save the configuration to the ECU. Click "  " to return to the wizard to modify configuration. Or click "  " to return to the main menu.

13.1 TPS Autaset

Click "TPS Autaset" to enter the TPS self-learning page. If you select "YES", make sure the throttle is completely closed and engine is not running.



14.0 Timing Verification

Proper timing verification is essential for ensuring smooth engine operation and avoiding drivability issues. Follow the steps below based on whether timing control is enabled or disabled in your Royal Flush EFI system.

14.1 No Timing Control

If timing control is disabled, the ECU does not adjust ignition timing.

- Use a timing light to verify that the timing is set correctly for your engine.
- Adjust as necessary based on your engine specifications.
- **Proper timing setup is crucial before driving with the Royal Flush EFI system, as incorrect timing can lead to drivability and idle issues.**

14.2 Timing Control

If timing control is enabled, follow these steps to properly position the distributor and configure the ECU:

1. Position the Distributor

- Turn the ignition key to ON to power up the Royal Flush system.
- On the Handheld Controller, navigate to:
Tuning >> Spark >> Basic >> Static Timing.
- This screen allows you to set the distributor position for proper ECU-controlled timing operation.

2. Set Initial Static Timing

- Start the engine.
- Set the static timing to 15 degrees BTDC (Before Top Dead Center).
- Navigate to Tuning >> Spark >> Advanced >> Lock Ignition Timing.
- Select Lock, then Save.
- Now, ignition timing is locked at 15 degrees BTDC.
- Using a timing light, rotate the distributor until you see 15 degrees BTDC on the balancer.
- Tighten the distributor hold-down clamp once correctly positioned.

3. Enable ECU Timing Control

- Set Lock Ignition Timing to "Unlock".
- Confirm static timing is set to 15 degrees BTDC.
- Return to the Home Screen—the Royal Flush ECU will now control ignition timing.

14.3 Idle Speed and Timing Adjustment

The Royal Flush ECU uses ignition timing adjustments in addition to the Idle Air Control (IAC) to maintain idle speed.

- The ECU can use advanced or retarded timing to help stabilize idle speed.
- Fast Adjust Mode: Uses timing adjustments to quickly respond to idle fluctuations.
- Slow Adjust Mode: Uses the IAC valve to control idle speed more gradually.

Note: When using a timing light, idle timing may not appear accurate due to ECU calculations. However, once the engine is revved above idle, the timing should appear correctly.

14.4 Adjust Timing Settings

- Navigate to Tuning >> Spark >> Basic.
- Here, you can adjust:
 - Idle timing
 - Cruise timing
 - WOT (Wide Open Throttle) timing
 - Cranking timing

14.5 Building a Timing Map

- For building a custom timing map, it is highly recommended to do so using the free Advanced Tuning Software available for download on Aces' website.
- The Handheld Controller's timing map is basic, but a custom map tailored to your engine will significantly improve performance.

14.6 Timing Offset Adjustment

- Use Timing Offset to sync timing at higher RPMs.
- By default, these values are set to 0 in the base calibration.
- Some ignition modules may require adjustments if the actual timing does not match the commanded timing as RPM increases.
- If timing starts to retard at higher RPM, increase the Timing Offset value to correct it.

15.0 Idle Setting

Once the engine has warmed up, you can adjust the idle speed to the desired level.

15.1 Adjusting Target Idle Speed

1. Select the Tuning tab.
2. Locate the Target Hot Idle Speed setting.
3. Adjust the setting by moving the slider left or right.
4. Click the Save button to confirm the new value or select Cancel to exit without saving.

15.2 Setting the Throttle Plates for Optimal Idle Control

Regardless of whether you change the target idle speed, you must set the throttle plates on the throttle body correctly.

15.3 Checking IAC Position & TPS Calibration

1. With the engine running, select the Monitor tab.
2. Locate the Idle Screen and check the following values:
 - IAC Position should be between 6 and 20 with the engine in neutral and at operating temperature.
 - TPS (Throttle Position Sensor) should read 0.
3. If TPS does not read 0, you must perform a TPS Zero Learn by selecting: Wizards > TPS Autoset.

15.4 Adjusting Throttle Shaft for Proper IAC Position



If the IAC Position is 0:

- The throttle plates are too far open, causing a higher idle speed than the target.
- Solution: Slowly turn the throttle shaft adjustment screw counterclockwise to close the throttle plates until the IAC Position reads between 6-20.

If the IAC Position is Greater Than 20:

- The throttle plates are too far closed, making the IAC work harder than needed.
- Solution: Slowly turn the throttle shaft adjustment screw clockwise to open the throttle plates until the IAC Position reads between 6-20.

If the TPS Position Goes Above 0 During Adjustment:

- The ECU exits idle mode, and the IAC Position locks to a fixed value.
- Solution: Shut the vehicle off, perform a TPS Zero Learn, then restart and continue adjusting.

Once all adjustments are complete, ensure that the TPS reads 0 with the engine idling.

16.0 Self-Learning

16.1 How to Perform the Self-Learning Process

- Drive the vehicle under varied operating conditions (different engine speeds and loads).
- Start in neutral by slowly revving the engine and holding it at different speeds up to 2500 RPM.
- Then, drive the vehicle, shifting through different gears to help the system learn across a wide range of conditions.
- If the vehicle has an automatic transmission, you can:
 - Put it in gear
 - Hold the brake pedal
 - Apply a small amount of throttle to help the system learn in that range.

16.2 Conditions Where Self-Learning Will NOT Occur

Self-learning will not take place under the following conditions:

- If the engine temperature is below 160°F
- During rapid accelerator pedal movement
- When the accelerator is released and the vehicle is coasting
- If learning is manually disabled in the system settings

16.3 Checking Self-Learning Status

To verify if self-learning is active, follow these steps on the Handheld Controller:

1. Select “Monitor” from the Main Menu.
2. Choose “Monitors.”
3. Select the Fuel Inj PW icon.
4. The Fuel Learn Status will indicate whether self-learning is active.

Once the learning process is complete, your Royal Flush EFI system is ready to be driven and enjoyed.

17.0 Diagnostic LEDs

LED #	Title	Color	Purpose/Behavior
1	Power Indicator	Red	System power indicator
2	Engine Running Indicator	Blue	Engine running indicator. The blinking will become faster as RPM increases.
3	Main Relay Indicator	Red	This is the main relay indicator. When illuminated, the main relay is active and receiving power from the 12-volt key source.
4	Fuel Pump Indicator	Blue	This is the fuel pump relay indicator. When illuminated, the ECU is supplying 12 volts to the fuel pump wire.