EFII System32 Installation Instructions
For Lycoming 4 and 6 cylinder engines
(This manual can be found on the Downloads page at www.flyefii.com)

Introduction
This document is intended to serve as a guide for the installation of the EFII System32 Electronic Engine Management System for Aircraft engines. The System32 kit provides a fully redundant, aviation grade, electronic fuel injection and electronic ignition system for your aircraft.

Installation of this system requires modification to the fuel system, electrical system, and engine components of the aircraft.

The EFII System32 kit is a complete electronic engine management kit for aircraft engines. System32 includes semi-sequential electronic fuel injection and high energy electronic ignition for all spark plugs. The EFII system is similar to the type of engine management that you would find on any modern automobile. When properly installed and operated, the EFII system will improve engine reliability, efficiency and horsepower output as well as reduce pilot workload.

Please refer to the System32 User Manual for details on how to use System32 after installation.

Description
The EFII system consists of dual System32 Electronic Control Units (ECUs), System32 Cockpit Controller, System32 Crank Trigger, System32 wire harness, sensors, coils, electronic fuel injectors, Iridium spark plugs, spark plug adapters, spark plug wires, fuel pumps, fuel filters, fuel pressure regulator, and all mechanical adapters required for the installation on your aircraft engine. The only significant components not included are airframe fuel lines and a duplex fuel valve (if required).

The EFII system displaces a number of parts that would otherwise be used on the engine. Parts no longer used are the magnetos, aircraft spark plugs, mechanical fuel pump, carb or injector servo, and any mechanical injection components including the fuel spider and mechanical injectors.

Flying with the EFII system is very easy. Once the system is tuned, the pilot no longer needs to worry about fuel mixture or any other aspect of the engine operation except where the throttle should be set. We recommend running a wide band oxygen sensor to give you a continuous readout of the air/fuel ratio present in your engine. This combined with one or more EGT readings gives you a very good idea of how your EFI system is operating. PLX Devices makes a nice wide band O2 sensor kit. You will not need a separate air/fuel ratio gauge. Your air/fuel ratio will be displayed on your System32 Controller. PLX can be found at: www.plxdevices.com (Part No. SM-AFR - Wideband Air/Fuel Sensor & Module).

The EFII system has proven to provide approximately 10% more horsepower for your aircraft. This is due to the greater efficiency of always having the right amount of fuel delivered in combination with a high energy ignition and proper spark timing curve. The ignition system built in to the EFII system can easily jump a 1" spark gap in free air. This is in stark contrast to the tiny anemic spark available from magnetos. As a consequence, we can run a much larger spark gap and burn more of the available fuel with the EFII system, again contributing to better power and efficiency. More complete combustion also helps minimize lead fouling, carbon build up, and engine wear.

EFII System32 engine management systems are available for all most four and six cylinder Lycoming engines and related engines from Superior and Titan. The EFII system is extremely reliable and built from the best components available. This is exemplified by our state of the art ECUs and Controller, billet crank triggers, environmentally sealed Tefzel wire harness, Walbro fuel pumps, Bosch sensors, Siemens fuel injectors, and NGK Iridium spark plugs. The quality and reliability of our systems is un-matched by any other aircraft engine electronics manufacturer.

EFII System32 kits for Lycoming engines

Part Number	Description
EFII32-4R	System32 EFII kit for Lycoming 4 cylinder engines
EFII32-6R	System32 EFII kit for Lycoming 6 cylinder engines
EFII32-8R	System32 EFII kit for Lycoming 8 cylinder engines

Notes

System32 EFII kits are available for 233 through 720 cubic inch 4 cyl, 6 cyl, and 8 cyl Lycoming aircraft engines and their derivatives.

Kits listed above are all System32, dual ECU, dual ignition plus electronic fuel injection, fully redundant EFII systems.

Contents

Limited Warranty and Limited Liability Agreement

Though we at EFII will attempt to be as thorough and helpful as possible in educating customers about the safe installation and use of this system, the ultimate responsibility for proper installation, maintenance, and use of this system can only be provided by the person performing the installation of components and maintenance of the aircraft.

It is the responsibility of the aircraft owner and system installer to ensure that the components provided by EFII are applicable and safe for your application. It is also the responsibility of the aircraft owner and system installer to ensure that this system is operated and maintained in a safe fashion. EFII cannot guarantee any aspect of the installation, maintenance or safe use of this system.

EFII limits warranty solely to the replacement of components provided by us which may have been delivered with a factory defect. We can in no way guarantee, warranty, provide protection from or assume any liability for any other systems, components, aircraft or other property, or personal injury that may result after the installation of this system.

Fuel System

Fuel system components included with the EFII kit include:
1 FPM-1 Fuel Pump Module with 2 Walbro electric fuel pumps.
1 FF-1 Post-filter, 10 micron, mounts after fuel pumps.
1 FF-2 Pre-filter, 90 micron, mounts before pumps.
1 FPR-1 fuel pressure regulator, internally drilled for quick re-prime.
2 (or 4 for six cylinder) Precision length fuel lines to connect adjacent injectors.
2 AN -6 Male to Female 90s.
4 (or 6 for six cylinder) EFII injector assemblies with -6 fittings.

The EFII system requires a full return type fuel system. This is a fuel system that is capable of supplying fuel a minimum of 35gph to the engine area and returning excess fuel back to the selected fuel tank or to a header tank. Our Fuel Pump Module including two high quality Walbro fuel pumps is included in your EFII kit. One fuel pump will serve as the primary fuel pump, the other pump will serve as a backup in case of primary pump failure. The included FF-1 post filter is designed to be mounted after the pumps to keep fine particulates from getting into the fuel injectors. The included FF-2 pre-filter is designed to be mounted before the pumps to catch any large particulates that may come out of the fuel tank. A gascolator is not required or desired with this type of fuel system.

There are two common schemes for plumbing the fuel system.
1**. (Refer to DRAWING 3)** If your airframe includes a fuel tank in each wing, you have the option of using a duplex fuel valve that selects both a supply line from each tank as well as a return line back to each tank. This method uses a stacked fuel valve that contains two valves in one housing. The best choice for this is the duplex valve from Andair, part no. FS2020-D2-M (www.andair.co.uk).

Andair duplex fuel valve with AN -6 fittings.

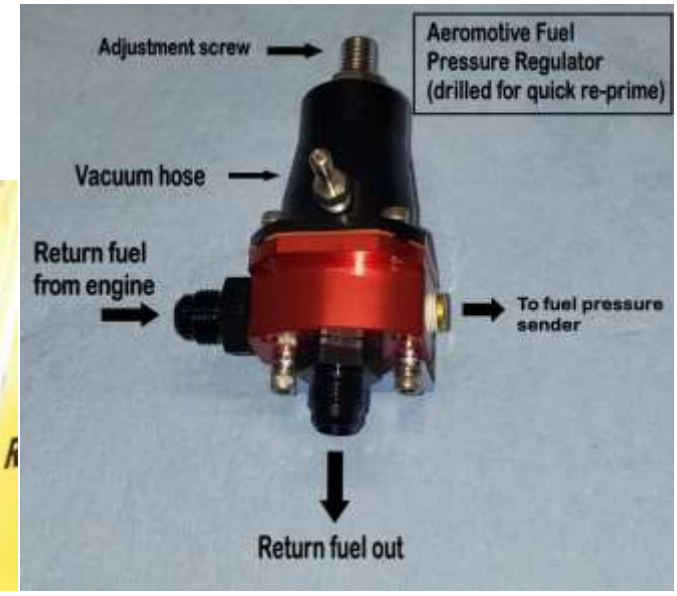
2. **(Refer to DRAWING 2)** If you have a dual fuel tank high wing plane, you have the option of gravity feeding a fuselage mounted header tank from the wing tanks and using a simple ON/OFF fuel valve between the header tank and the engine. This set-up also works for planes that have a central fuselage fuel tank. The header tank should be at least five gallons so that the heat gathered by the fuel as it circulates through the engine area can be sufficiently dissipated into the cold fuel in the header tank after the fuel returns to the header tank from the engine. Smaller header tanks will tend to experience fuel heating which in the worst case can cause vapor lock. A popular header tank location is in the bottom of the baggage area. If a custom tank is fitted to this area, it generally can be as little as 3 to 4 inches thick on the baggage area floor and take up very little room. Header tanks need to have their own independent vent line running to a high point in the plane similar to the wing tank vent tube routing. If a header tank is not properly vented, air cannot easily get out of the header tank and the tank may not completely fill with fuel.

For either fuel system layout, the fuel lines should be AN -6 (3/8”) throughout, AN -4 (1/4”) is adequate for vent lines. Fuel lines residing forward of the firewall should be fire sleeved and routed as far as practical from exhaust components. If fuel pumps are mounted forward of the firewall, they should have a heat shield installed to deflect direct exhaust pipe heat radiation.

Please refer to **DRAWINGS 2 and 3** for sample fuel system layouts

Return line installation in wing tanks – If you are installing fuel return fittings into wing tanks, make sure the return fuel dumps into the tank at least 3 inches from the fuel pickup tube in the tank. This will allow any bubbles that are in the return fuel to percolate out without being sucked into the pickup tube. The EFII Fuel Tank Bung kit provides simple to use hardware to install fuel return fittings into fuel tanks. (See the Accessories page at www.flyefii.com)

Fuel pressure regulator mounting



The Fuel Pressure Regulator is typically mounted to the firewall and fed from the fuel line leaving the fuel injectors. The side port is the INLET to the regulator. The bottom port is the OUTLET from the regulator that will then return to the header tank or fuel selector return plumbing. There is a 1/8NPT port on the side of the regulator that can be used to provide the pressure connection to the fuel pressure sender that is part of your engine monitor system.

Fuel pressure is set by adjusting the set screw on the end of the Fuel Pressure Regulator. Turning the screw clockwise will increase the fuel pressure, counter clockwise will decrease the pressure.
After completing the installation of your fuel system, you set the fuel pressure by running one fuel pump with the engine stopped and adjusting the regulator until the fuel pressure is 35 psi. It is best to use a mechanical pressure gauge temporarily installed in the fuel rail to make this measurement. You can calibrate the fuel pressure readout of your engine monitor at the same time. It is not wise to assume that the fuel pressure readout of your engine monitor is correct without double checking it with a mechanical pressure gauge at least once to verify calibration of the monitor.

The Fuel Pressure Regulator has a vacuum nipple on the side. This should be connected to one of the manifold pressure sources on your Throttle Body Sump Adapter. Only use heavy wall vacuum line tie wrapped at all connections.

Electrical Supply System

When operating an aircraft that relies upon the continued operation of critical engine electronics such as the EFII system, we strongly recommend using a redundant essential bus power system to guarantee that a good source of +12v is available at all times to power the engine electronics.
The simplest way to implement a protected essential bus is to use the EFII Bus Manager product which provides a triple redundant essential bus using two batteries. The Bus Manager also incorporates automatic backup fuel pump monitoring and activation as well as a number of other useful functions. Please read more about the Bus Manager at:
www.flyefii.com

Grounding the vehicle systems
(Refer to DRAWING 1)
Proper operation of modern vehicle systems demands a good electrical grounding system. The airframe should never be considered an electrical path.
The airframe should be grounded at ONLY one point to the vehicle ground system, typically at the firewall. All other vehicle systems should ***not*** rely on a connection to the airframe as a method of completing the ground circuit. All vehicle systems should have ground returns to a ground bus which is in turn connected to the battery ground with an appropriate gauge return wire. The engine needs to have a large gauge ground wire connected to a secure bolt on the engine case or block. Never use a motor mount bolt as a ground cable connection point to the engine. Motor mount bolts experience a great deal of stress and movement and can be the source of a grounding problem if the engine ground is connected to them. The engine ground cable should be the same gauge wire that connects the main +12V power feed to the starter motor.

If a ground bolt is used as a main ground pass through on the firewall, this is also a convenient place to tie in the ground bus which all vehicle systems will be grounded to. The ground bus can be electrically connected to the firewall ground bolt with a number 8GA wire.

System32 EFII kits require 5 circuit breakers as listed below. If you plan on using an EFII Bus Manager, you may also need panel space for a Fuel Pump Mode Switch, and Start Battery Select Switch. The circuit breaker requirements for the different versions of the EFII system are listed below:

System	ECU breakers	Ignition breaker	Fuel Pump breakers
EFII32-4R	5A (x2)	15A	10A (x2)
EFII32-6R	5A (x2)	15A	10A (x2)

Engine Component Installation
Crank Trigger

Your System32 EFII kit includes a billet aluminum, Hall effect crank trigger assembly as shown below:

The System32 crank trigger sensor contains two electrically independent sensors in one housing. One sensor provides rpm and timing information to ECU1, the other sensor provides similar information to ECU2.

The crank trigger mounts onto the front two 3/8" engine case bolts that are above and below the crankshaft. Remove the nuts and washers from the right side of these two bolts. Locate the two one inch long threaded hex standoffs in your crank trigger kit. Apply a drop of red Loctite onto the threads of each case bolt and screw the standoffs onto the ends of the case bolts. Make sure the bolts go no more than ½" into the standoff when assembled. If the bolts are too long, shorten them or add washers as necessary under the bolt head. DO NOT put a washer between the threaded standoffs and the engine case – this will set the crank trigger at the wrong height. Torque the standoffs to 300 in. lbs.

Locate the two stainless 3/8"-24 x 1 1/2" set screws included with the crank trigger. Ensure that there is approx ½" of available thread depth in the hex standoffs installed in the last step. Install the two set screws into the ends of the threaded standoffs using red loctite and torque them to 200 in. lbs.

Position the crank trigger assembly onto the installed set screws and secure with the included all-metal lock nuts and AN washers (never use Nylock nuts on the engine). Torque the lock nuts to 200 in. lbs.

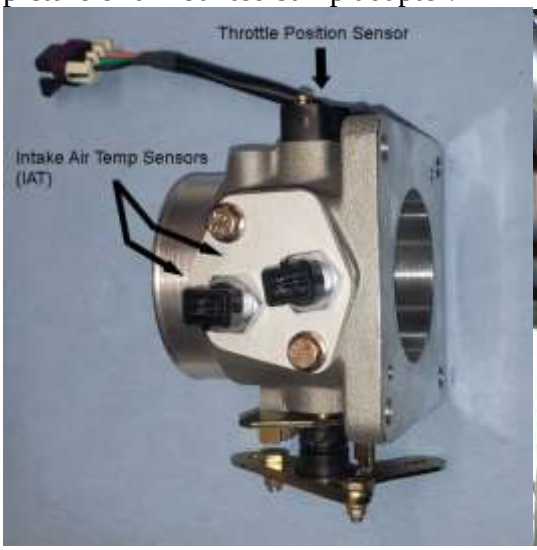
Carefully test fit your flywheel onto the engine. Make note of the indexing (larger) prop dowel position on the prop flange and the flywheel. The flywheel will only go on one way. With the flywheel properly clocked to the crankshaft, carefully slide it onto the end of the crankshaft and watch for any interference with the crank trigger assembly. With the flywheel fully seated, there should be an air gap between the flywheel and the crank trigger

of approx .030” to .050”. A drill bit makes a good gauge to measure the airgap. If the airgap is too small, material must be machined off the threaded hex standoffs to increase the airgap.

Once the crank trigger is installed, route the crank trigger cable over the center of the top of the engine. Support the crank trigger cable using adel clamps attached to the top case bolts. (retorque ¼” case bolts to 75 in. lbs.)

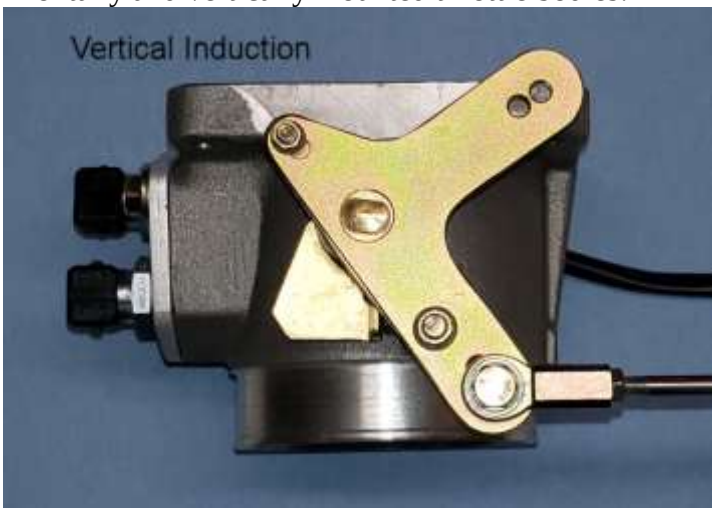
Throttle Body

Locate the throttle body assembly in your kit. There is a 1” thick Lycoming sump adapter plate included with the throttle body. Separate the sump adapter from the throttle body. The sump adapter has two 1/8” NPT pressure ports on one side. These are included as pick off points for manifold pressure lines. Manifold pressure lines will connect to your EFII MAP sensors as well as to the fuel pressure regulator and engine monitor MAP sensor. The sump adapter can be rotated in any direction to facilitate manifold line connections. Below is a picture of a mounted sump adapter:



Attach the sump adapter to your engine sump using the included 5/16”-24 x 1 ¼” socket head screws. Use Ultra Black Silicone Gasket Maker between the engine sump and the sump adapter. Use blue loctite on the 5/16” allen head screws and torque to approx 180 in. lbs.

The throttle linkage will generally be located on the left side of the throttle body. The throttle body has a universal linkage bracket that can be easily connected to your throttle linkage whether the throttle body is mounted in a vertical or horizontal fashion. It is acceptable to cut off the unused arm of the linkage adapter plate if desired. Apply Ultra Black Silicone Gasket Maker between the throttle body and sump adapter. Attach the throttle body to the sump adapter using the supplied hex bolts, lock washers and nuts. Below are pictures showing throttle linkage hookup for horizontally and vertically mounted throttle bodies:

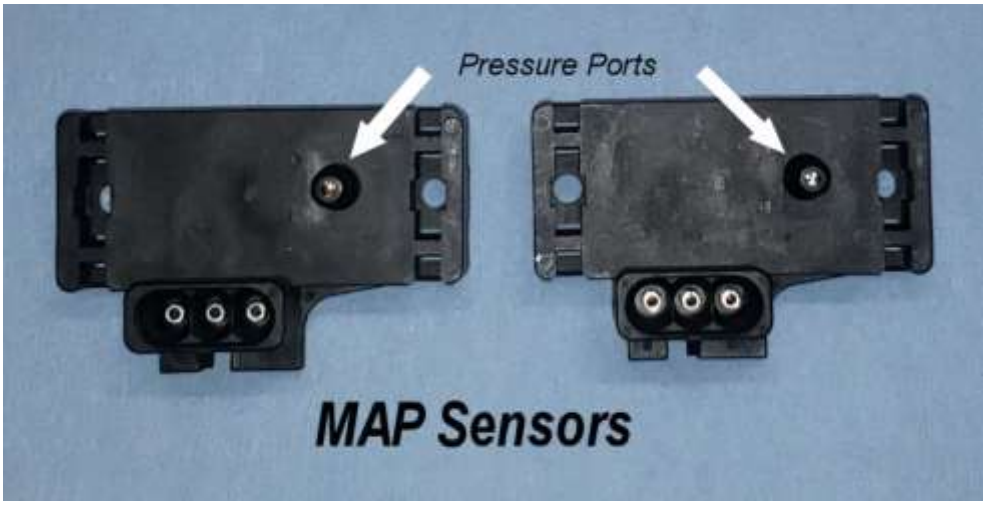


Note – the throttle cable throw is 2.3” or 2.6” depending on which hole you use to mount the cable end.

MAP Sensors

Your System32 EFII kit includes two MAP (manifold absolute pressure) sensors.
These sensors monitor the air pressure inside the intake tract of the engine. The MAP sensors are connected to the engine intake with two pressure lines that originate at the throttle body sump adapter plate. Each MAP sensor should have its own separate pressure line for best system redundancy. Please refer to **Drawing 7** for details of the MAP pressure hose connections.
The MAP sensors are typically mounted on the upper area of the engine side of the firewall.
This provides for easy plumbing of the pressure hoses and easy inspection/maintenance of these devices.

System32 MAP Sensors are available in different pressure ranges. Normally aspirated engines will always use a 1 Bar (= 1 atmosphere = 0" to 30" pressure range) MAP sensor. Turbocharged or supercharged engines will use a higher pressure range sensor if manifold pressures will go above 30". The following MAP sensor ranges are supported by System32 ECUs:
1 Bar MAP sensor – normally aspirated engines, 0" to 30" pressure range.
2 Bar MAP sensor – turbo engines, 0" to 60" pressure range.
3 Bar MAP sensor – turbo engines, 0" to 90" pressure range.
4 Bar MAP sensor – turbo engines, 0" to 120" pressure range.



Ignition Coils and Magneto Block Plates

Typically, the ignition coils are mounted to magneto block off plates which serve to cover up the magneto holes in the accessory case. In some cases, it may be more convenient to mount the ignition coils to the firewall. EFII can provide magneto block off plates that do not include the coil mounting features if this suits your installation. Below is a picture of typical ignition coil mounting on the accessory case:

4 cylinder systems will typically be installed with the 2 coil packs mounted on the included magneto block plates. It is important to make sure there is clearance between the motor mount and the coils. It is highly recommended to hang the motor mount onto the engine when fitting the coils. In some cases, the impulse coupling spacer that typically sits under the left mag (Lyc pn 61666) can be used to space one of the coils out about .8" away from the motor to improve clearances. When mounting the coils with the magneto block off plates, the left coil will mount with its connector pointing down and the right coil will mount with its connector pointing up (as seen in the picture above). After you have test fitted the coils and motor mount, apply Ultra Black Silicone Gasket Maker between the magneto block off plate and the accessory case and permanently mount the coils.

6 cylinder systems utilize three coil packs which are mounted on a CNCed subplate for easy installation. RV-10 installations have room to mount the coil packs on top of the motor mount as in the image below. If you don't have room for the coil packs in this location, they can be firewall mounted.

Spark Plugs and Adapters

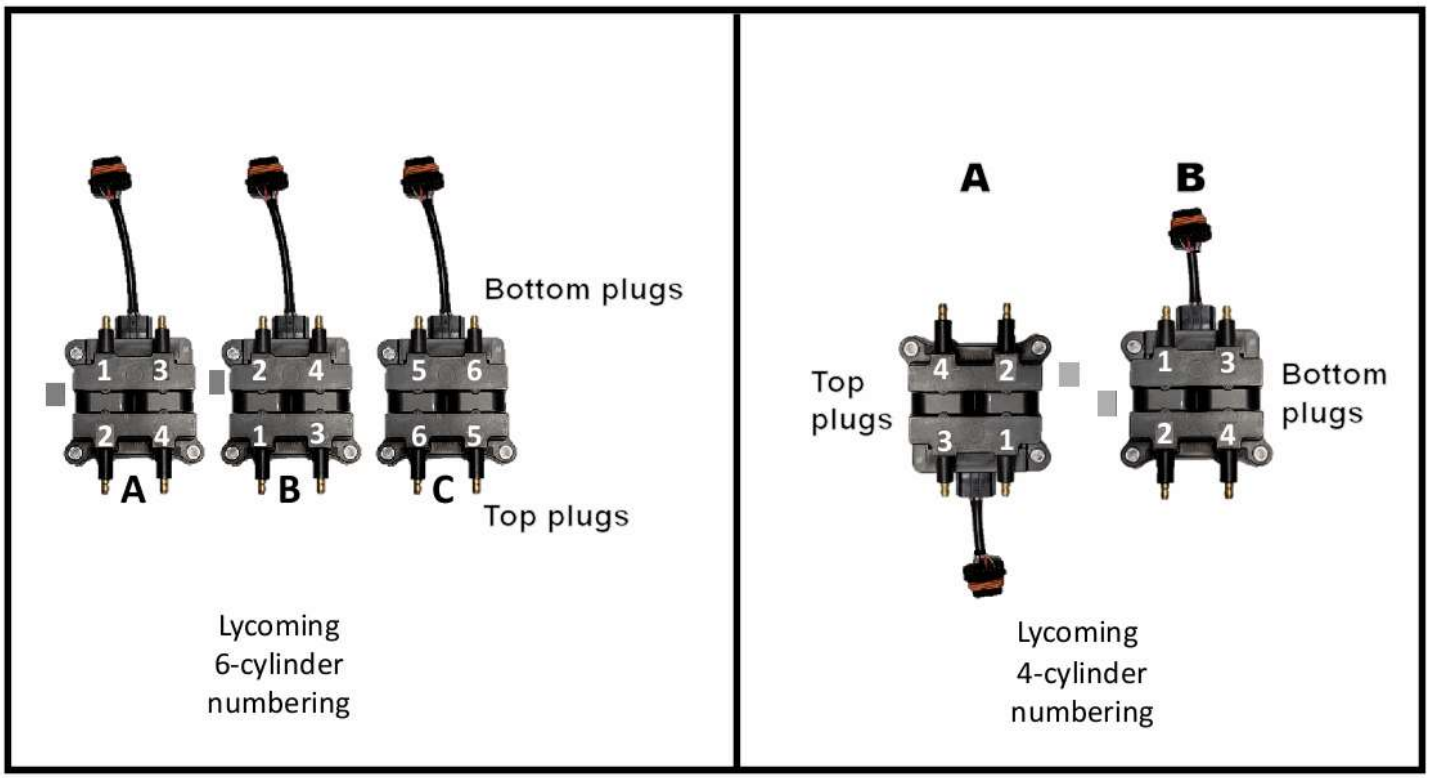
Your kit comes complete with Iridium spark plugs and spark plug adapters for all plug locations.

CAUTION- Always install the brass spark plug adapters onto the spark plug first and then install the assembly into the cylinder. Never torque the spark plug adapters into the cylinder without a spark plug installed – this could damage the spark plug adapter. With spark plugs and adapters installed into the cylinders, torque the spark plug only to 30 ft lbs. This will seat the washers on both the adapter and the spark plug with one step.

Your plugs should be factory gapped at .032" to .035". If you adjust the gaps, be very careful not to damage the thin center electrode (don't pry against it). Install the adapters and plugs in all plug locations.

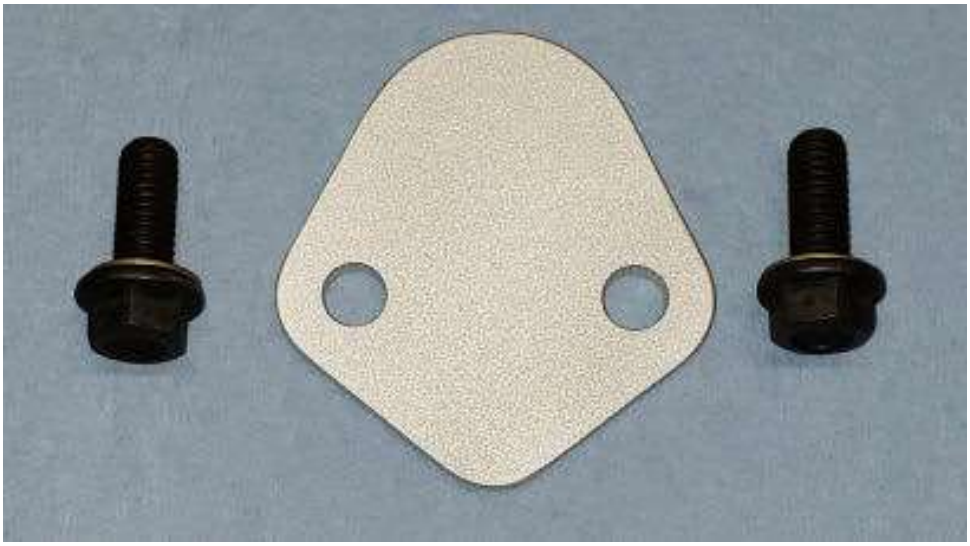
Spark Plug Wires

It is best to wait on spark plug wire assembly until the motor is on the motor mount and all engine accessories and baffling are mounted. This will ensure when you establish wire lengths and routing that everything fits well. When you are ready to prepare the spark plug wires, follow the instructions that come with the included spark plug wire set. A pair of spark plug wire crimpers are handy to have available. If you don't have access to proper crimpers, you can get them from summitracing.com pn TAY-43390. Below is a diagram showing which coil outputs should be connected to which spark plug.



Mechanical Fuel Pump Block Plate

The EFII system does not use the original engine driven mechanical fuel pump. A block off plate is installed over the accessory case opening where the mechanical fuel pump would be mounted. Locate the fuel pump block plate assembly in your kit. Below is a picture of this assembly:

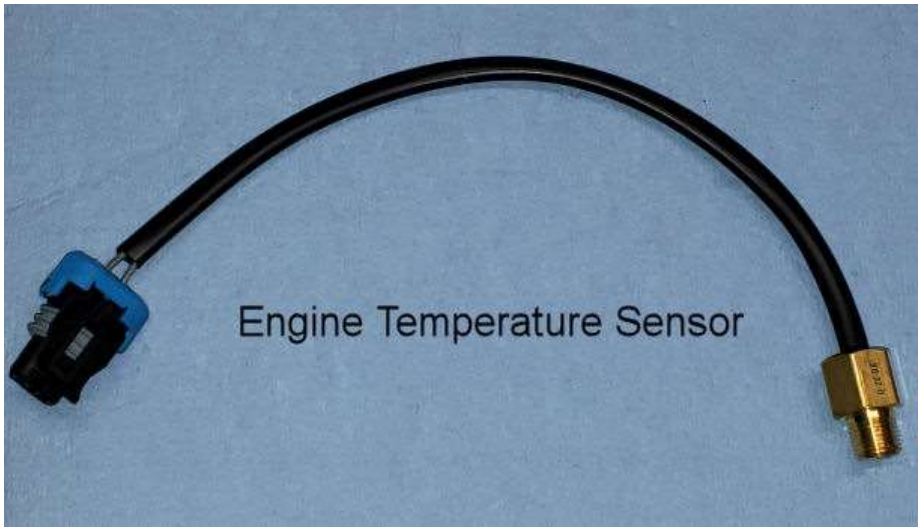


The pushrod inside the accessory case that originally actuated the stock mechanical fuel pump can be left in place, or it can be left out of the engine assembly if your engine is being re-assembled. Leaving the fuel pump push rod installed in the engine will not cause any issues.

Clean the area of the accessory case where the fuel pump block plate will be located. Apply a smear of Loctite Ultra Black gasket maker to the area of the accessory case that will contact the block plate. Affix the block plate to the engine with the included 3/8" bolts and lock washers.

Engine Temperature Sensor

The EFII system uses an engine temperature sensor to detect when the engine is cold or warming up. Extra fuel is added during engine warmup to make the engine run smoothly while it is coming up to operating temperature. The engine temp sensor is a two wire unit with a male 1/8NPT mounting thread at one end. Apply some Teflon pipe dope to the NPT threads of the sensor and install it into the top (mechanical) injector port of the right rear cylinder. The engine temperature at this position is similar to oil temperature and is a convenient location for this sensor.



Electronic Fuel Injector Assemblies

Your EFII kit includes 4 (or 6 for six cylinder engines) of our ultra compact PMI Electronic Fuel Injector assemblies. The PMI (Port Mount Injector) assemblies screw into the primer port holes on the sides of the

cylinders. This provides for a clean, simple installation that keeps the injectors away from cylinder heat soak and allows for a cold fuel rail connecting all injectors. This means that the injectors always have fresh, cold fuel feeding each cylinder. Heat soak or vapor lock cannot occur with EFII systems. EFII PMI injector assemblies include stainless steel base fittings and 7075 aluminum top fittings for maximum mechanical strength.

The high pressure portion of the fuel system consists of the fuel path that starts at the outlet of the fuel pumps, goes to the rear injector on one side of the engine, continues to the adjacent injector on the same side of the engine, crosses to the other side of the engine, under the front of the engine case to the forward injector on the opposite side of the engine, continues to the adjacent injector rearward and then back to the firewall to the fuel pressure regulator. 2 (or 4 for six cyl systems) precision length fuel lines are included in your kit along with 2 AN-6 male to female 90 fittings. The precision length lines should be installed between adjacent injectors on each side of the engine. The 90 fittings should be installed on the forward side of the two front injectors. These fittings provide a good entry point for the custom fuel line that will cross from one side of the engine to the other.

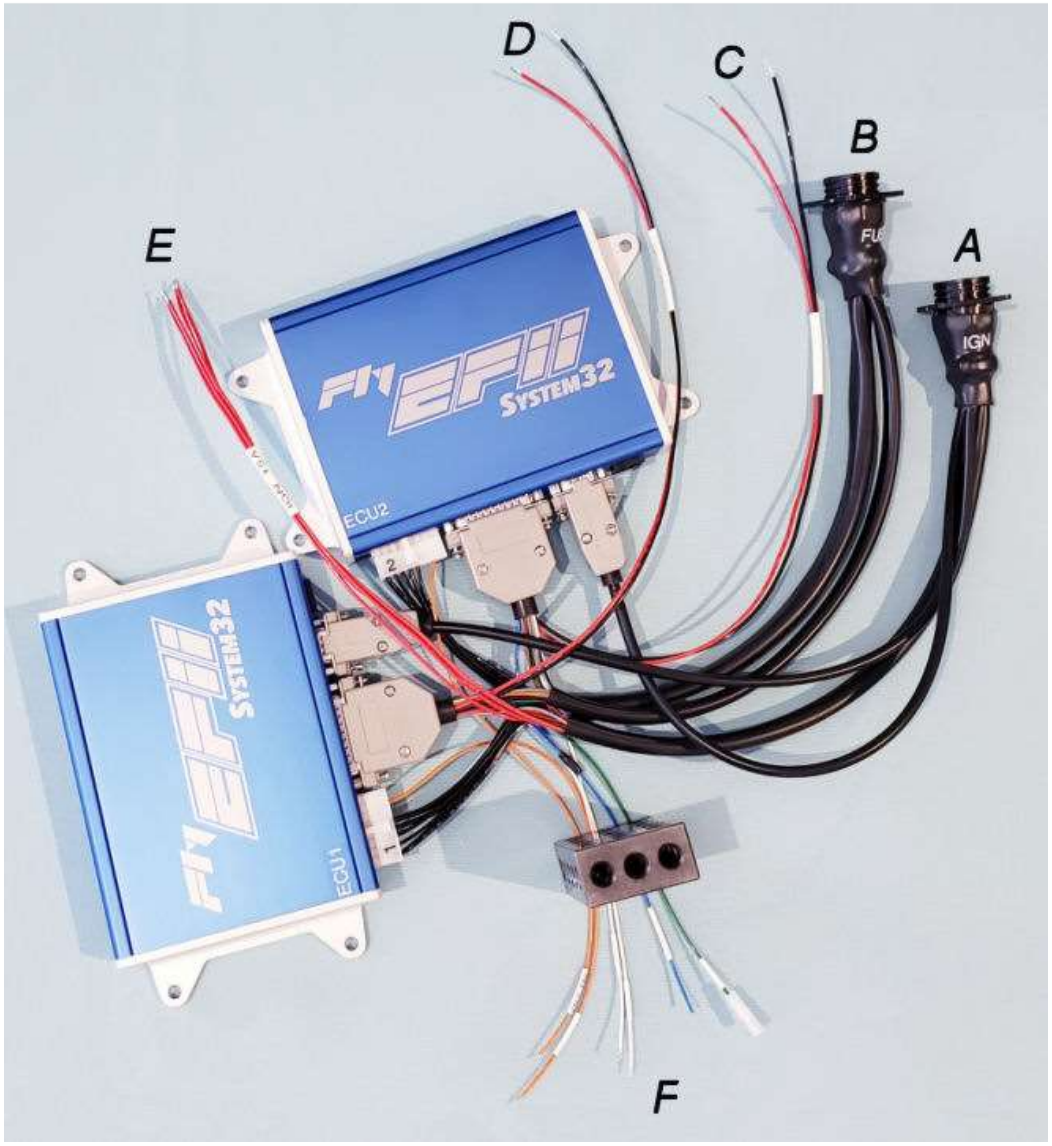
Fuel lines. All engine area fuel lines should be fire sleeved AN -6 teflon lines. No lines should be stretched tight between fittings. There should always be a small curve to each installed line to account for engine growth and movement. All lines should be secured every six inches with Adel clamps or other suitable cushioned hose mount hardware. Follow the additional injector installation instructions that are packaged with your PMI injector assemblies.

Wire Harness

Your EFII kit includes a prewired Tefzel wire harness. The majority of connectors are pre-installed for easy installation. The following two images show all of the harness connectors.

The image below shows the cabin side of the harness. Descriptions of the connectors follow.

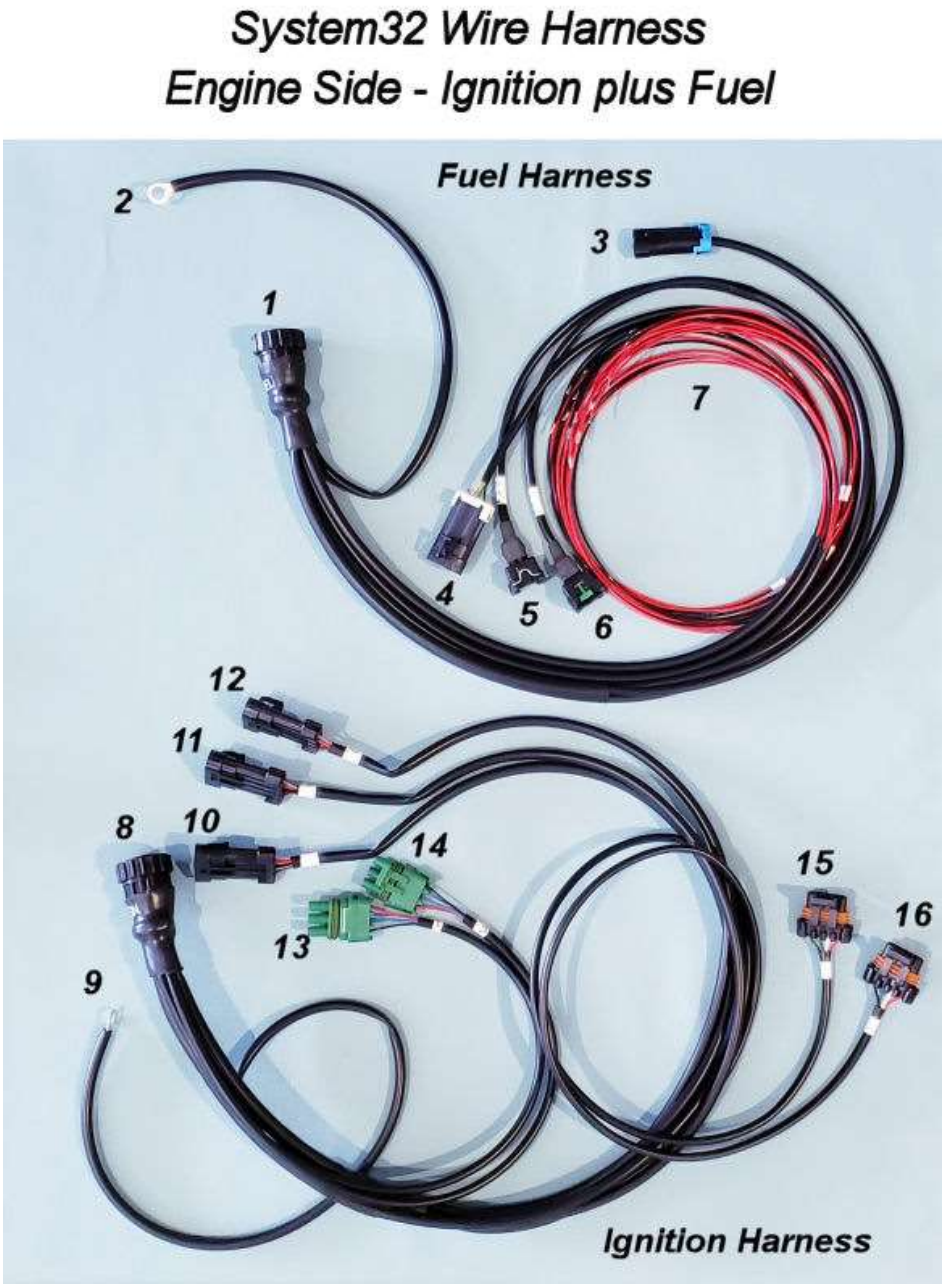
System32 Wire Harness
Cabin Side - Ignition plus Fuel



Harness Connectors – Cabin Side

A. Firewall circular connector (ignition).
B. Firewall circular connector (fuel).
C. ECU2, +12v and ground wires.
D. ECU1, +12v and ground wires.
E. Ignition +12v (one power wire for each coil pack, one power wire for the injector power circuit).
F. Signal wire group:
Injector Enable Wires (2ea), orange.
P-Lead (ignition run-up function) (2ea), white.
Fuel Flow signal out, blue.
Tach signal out, green.

The Image below shows the engine side wire harnesses. Descriptions of each connector follow.



Harness Connectors – Engine Side
Fuel Harness Connectors
1. Firewall circular connector (fuel).
2. Ring terminal ground - injector ground returns.
3. Engine temperature sensor (sensor in top 1/8" NPT port of right rear cylinder).
4. Throttle position sensor (on throttle body).
5 and 6. Intake air temperature sensors (on throttle body).
7. Injector wires (one red, one black for each injector).
Ignition Harness Connectors
8. Firewall circular connector (ignition).
9. Ring terminal ground – coil pack grounds.
10, 11, 12. Coil pack control. (2 connectors for 4 cyl, 3 connectors for 6 cyl).
13 and 14. MAP sensors.
15 and 16. Crank trigger sensors.

+12V and Ground Wiring for the EFII Wire Harness
Please refer to **DRAWING 9**. Three circuit breakers are required to feed power to the EFII wire harness. Each ECU requires a 5A breaker, and the Ignition power circuit requires a 15A breaker.
The EFII wire harness has additional circuit protection built into the harness. Each coil pack power wire and each injector power wire has its own fusible link circuit protection inside the harness. The fusible links for the coil pack power wires are located within the backshell of the engine side circular connector for the ignition portion of the harness. The fusible links for the coil pack power wires are located within the backshell of the engine side circular connector for the fuel portion of the harness. ECU ground wires should be connected to your avionics ground bus. The ring terminal grounds near the engine side of the circular connectors should have a low resistance ground path back to the battery. This is typically the firewall pass through ground bolt that also connects to the engine ground cable.

Signal Wire Group on the Cabin Side of the Wire Harness
Injector enable wires – these are two orange wires, one from each ECU. These wires have a "ground to stop" functionality. Grounding the injector enable wire shuts off the fuel injector drive from that ECU. One of these wires will always be grounded, the other will have an open circuit per **DRAWING 9**.

P-Lead wires – these are two white wires, one from each ECU. These wires have a "ground to stop" functionality. When a P-lead wire is grounded, the ignition outputs for that ECU will be turned off. These wires are used to implement the ignition run-up function per **DRAWING 9**.

Fuel Flow signal out – blue wire. This wire provides a signal that mimics a Floscan 232 or Red Cube type fuel flow sensor. You do not need a mechanical fuel flow sensor with System32. The fuel flow signal is derived electronically. This signal wire should be connected directly to the fuel flow signal input of your engine monitor. Use the K factor parameter in your engine monitor to calibrate the engine monitor fuel flow reading. Higher K factor = lower reading and vice versa. If you decrease the K factor by 20%, you will get a 20% higher fuel flow reading, etc.

Tach signal out – green wire. Connect this signal wire to the tach input (or rpm input) of your engine monitor or tachometer. This is a 12 volt square wave signal with 2 pulses per rev for 4 cylinder systems, 3 pulses per rev for 6 cylinder systems.

Circular Firewall Connectors
Your System32 wire harness includes pre-installed circular connectors to serve as a firewall pass-through and to ease wire harness installation. EFII systems (ignition + fuel) have two circular connectors in the harness. One circular connector contains all of the signals required to run the ignition portion of the system, the second circular connector contains the additional signals required to add the fuel injection portion of the system. There are colored dots on the connectors to show which engine side connector goes to which ECU side connector.

The ignition circular connectors have white dots on them. The fuel circular connectors have red dots on them. You can see the dots when you separate the connectors.

The ECU side of the harness will mount to the cabin side of the firewall using the square flange that is part of each ECU circular connector. Aircraft that have firewalls that are more than 1/8" thick (some composite aircraft) will require that the circular connectors be mounted on a metal subplate that is then mounted to a hole in the firewall.

+12V power distribution through the Ssytem32 wire harness includes fusible links on the power wire feeding each coil pack as well as each fuel injector. The System32 wire harness design ensures that a short circuit at one coil or injector does not affect the 12v power to the other coils or injectors. This provides the highest level of safety and redundancy on the 12v power distribution of your EFII system. The fusible links are located within the engine side backshells of the circular connectors. These are factory installed, factory serviced items. If you

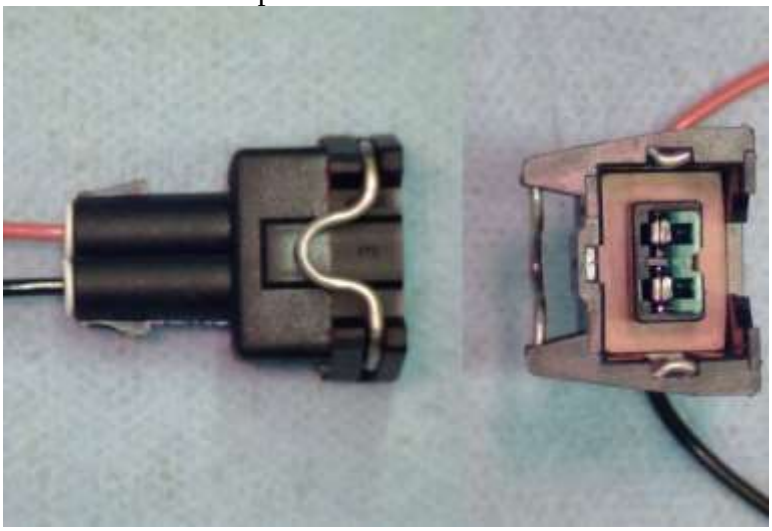
accidentally short out one of these fusible links, please call EFII for assistance. If an injector power fusible link is blown while you are travelling, an acceptable field fix is to jumper power from the adjacent injector after the shorting fault is corrected.

Fuel Injector connectors

EFII System32 fuel injection is a semi-sequential fuel delivery system that fires the fuel injectors in phase with each cylinders intake valve operation. The fuel injector wires are grouped and numbered by cylinder number. There is one black wire and one red wire for each injector. It is recommended to use -4 fire sleeve on the injector wires for added heat protection. After you have routed the injector wires, trim the wires to length and attach the injector connectors. The injectors are non polar, meaning that it doesn't matter which terminal gets the red wire and which gets the black wire, they will work either way.

To install the injector terminals, first push the wire through a rear rubber seal as shown below. Strip the wire back approximately 3/16" and lay the wire and rubber seal into the terminal. Carefully close the small barrel of the connector around the stripped portion of the wire with a pair of needle nose pliers and close the large barrel of the connector around the rubber seal as shown below. Now carefully solder the portion of the terminal that is crimped onto the stripped area of the wire. If soldering is not your best skill, this would be a good place to get help from someone familiar with assembling wire components.

After soldering the terminals onto the wires, push them into the back of the connector housing until the terminals click into position. The finished result should look something like below:



ECUs and Cockpit Controller

Outline drawings of the ECUs and Cockpit Controller can be found in **DRAWINGS 4 and 5**.

System32 EFII kits use dual state of the art 32 bit microprocessor ECUs to manage the fuel and ignition requirements of your engine. System32 ECUs are designed specifically for the high demands of aircraft engine operation. Reliability and redundancy were the chief design goals in the specification of the EFII System32 ECUs. The ECU fuel map and ignition timing can be modified by the end user to tailor the operation of your EFII system to the specific requirements of your vehicle. The ECUs are typically mounted under the instrument panel, not far from the firewall. It is best to mount the ECUs such that the connectors can easily be accessed for the sake of attaching the wire harness. The ECUs should be mounted such that moisture cannot find its way into the ECU enclosures – the enclosures are not waterproof.

Your kit also contains the EFII System32 Cockpit Controller. The System32 Controller utilizes a sunlight readable full color LCD screen to display EFII system information. The Controller fits into a standard 3 1/8" round instrument hole and gives you access to all the parameters of your EFII system. The Controller displays four pages of engine information that give you direct access to the values coming from each of the sensors attached to your EFII system. The EFII system can be flown without the Controller present, though most people prefer to have it mounted in the instrument panel for easy access to EFI data and programming.
The Controller portion of your kit includes two cat5 serial cables (same as an Ethernet cable) for connection between the Controller and the ECUs. Plug one end of each cat5 cable into the Controller first and then plug the remaining end of the cable into the mating connector on each ECU. The Controller receives 12v power and ground through the cat5 serial cables and requires no additional power wiring to operate.

Pressing the "Monitor" button on the Controller will rotate the display through the four engine data screens – two screens for ECU1, two screens for ECU2.

The Controller provides system monitor information, access to fuel and ignition mapping, firmware update capability, and a fuel trim knob all in one attractive package that matches up nicely to any modern glass panel instrumentation. The Controller also has built-in annunciator functions that save panel space and add to the available system information. The annunciator functions include ECU power, ignition run-up (p-lead) switch position and ECU Select switch position, fuel pump power, voltage level indicators for two batteries, and an air fuel ratio display.

Controller Annunciator Functions

Refer to **DRAWING 8** for wiring connections required to use the Controller annunciator functions.
The System32 Cockpit Controller can support a number of annunciator functions that require connection of the Controller wire harness included in your kit. This wire harness has a DB-15 female connector at one end with five wires extending from the connector. The annunciator functions include:
Battery 1 voltage, blue wire, connect to Batt 1+12v or to pin 2 of Bus Manager control plug.
Battery 2 voltage, orange wire, connect to Batt 2 +12v or to pin 8 of Bus Manager control plug.
Fuel Pump 1 On/Off, red wire, connect to Fuel Pump 1 +12v power wire.
Fuel Pump 2 On/Off. white wire, connect to Fuel Pump 2 +12v power wire.
Air Fuel Ratio display, green wire, connect to 0-5v output from O2 sensor amplifier.

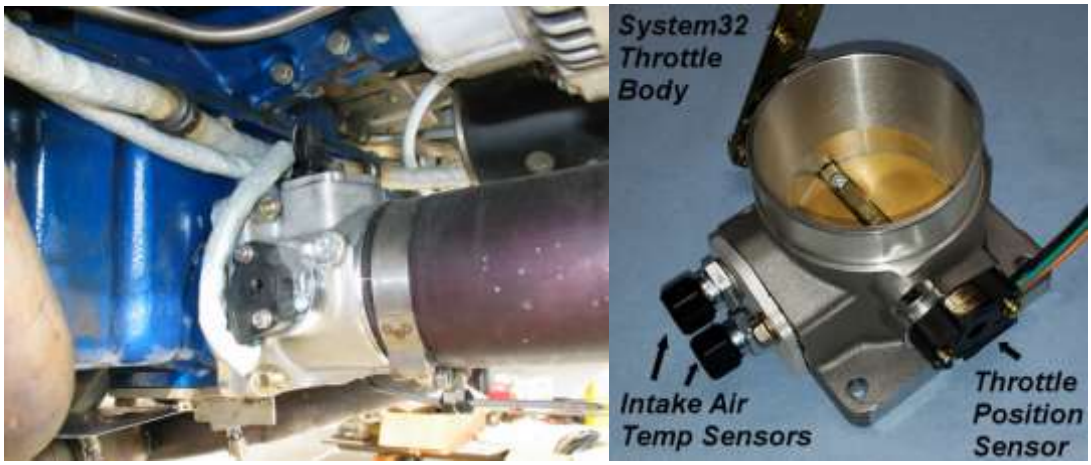
Please refer to the System32 User Manual for detailed information on using System32 after installation.

Explanation of the System32 Sensors

There are five types of sensors associated with your EFII system as follows:
1. Crank Trigger – importance ESSENTIAL – The System32 Crank Trigger assembly contains two electrically separate crank trigger sensors – one sensor for ECU1 and one sensor for ECU2. The Crank Trigger sensor mounts to the font two bolts of your engine case that reside above and below the crankshaft centerline. This sensor gives rpm and ignition timing information to the ECUs. We have installed three magnets (four magnets for six cylinder engines) into the ID area of your flywheel, under the alternator belt pulley flanges. Four cylinder engines have two timing magnets 180 degrees apart and one sync magnet. Six cylinder engines have three timing magnets 120 degrees apart and one sync magnet. Each Crank Trigger is actually a dual element sensor. One element senses the timing magnets and one element senses the sync magnet.

2. Manifold Absolute Pressure Sensor (MAP) – importance ESSENTIAL – System32 kits include two MAP sensors – one for each ECU. The MAP sensors are three wire sensors that are typically mounted in an upper location of the firewall to keep them away from exhaust heat.. The MAP sensor tells the ECU how much air pressure is in the engine intake manifold. The combination of the MAP sensor and the rpm information from the Crank Trigger are the most critical inputs to your ECU. So please mount and hook up both of these sensors with care. A manifold pressure source must be routed to the MAP sensor. A pressure source directly from the sump adapter plate is preferred since this will be a more steady pressure signal than from one of the cylinder heads. Your system includes a vacuum hose kit which has heavy wall line and barb fittings to make the pressure line connections to your MAP sensor and fuel pressure regulator. Tie wrap the vacuum line on at all fittings.

3. Intake Air Temp Sensor (IAT) – importance IMPORTANT – There are two IAT sensors mounted on the throttle body, one for each ECU, The information from the IAT sensor allows the ECU to make an air density correction to compensate for the temperature of the intake air. Though the IAT signal is important, the engine will still run if this sensor has a problem. The IAT is a two wire sensor that is mounted on the side of the throttle body. In the picture below, you can see the IAT sensor sitting at the top of the throttle body and the TPS sensor on the side of the throttle body.



4. Throttle Position Sensor (TPS) – importance LOW – The TPS sensor is a three wire sensor mounted on the butterfly shaft of the throttle body. The throttle position sensor serves only to provide a simulated accelerator pump function when the throttle is moved rapidly. Whenever the ECU senses a rapidly opening throttle movement, it adds some additional fuel to keep the engine from stumbling during the ensuing engine acceleration. The level of TPS fuel enrichment can be adjusted through the Controller to fine tune this function. The TPS sensor also works when the engine is not running. In this case, it provides a primer squirt of fuel before engine cranking to make cold starting easier. Both ECUs have visibility of the TPS sensor.

5. Engine Temp Sensor (ET) – importance LOW - The ET is a two wire sensor that is typically installed in the upper 1/8NPT port of the right rear cylinder. The ET sensor lets the ECU know if the engine is cold or if it has warmed to operating temp. When the engine temp is below 120 degrees F, the ET sensor input causes the ECU to enrich the fuel delivery to help the engine run smoothly while it warms to operating temperature. Once the engine is warm, this sensor no longer affects the fuel delivery. The ET sensor is only connected to ECU1. ECU2 does not provide the warm up enrichment function. (always start and warm the engine using ECU1 to take advantage of warm up enrichment).

EFII Pre Start System Checks

All elements of your EFII system should be checked for proper operation before starting your engine. Below is a checklist to aid in this process.

Fuel system

Double check fuel selector valve function and positions
Fuel pump function, primary and backup pump control
Check and set fuel pressure (35psi with one pump running, engine stopped)
Fix any leaks, check tightness of all fuel lines

ECU

- Verify power and ground
- Check and set ECU parameters
- Verify function of sensors

  Crank trigger
  (check for T1, S1, T2, S2 indication on Controller as prop is turned by hand)
  MAP (check MAP reading for each ECU on Controller – should read atmospheric pressure for both ECUs when engine is not running)
  IAT (should read close to ambient temperature for both ECUs)
  TPS (should increase with application of throttle)
  Engine temp (should be close to ambient temperature for ECU1, should read "---" for ECU2)

Controller

- Power up full system – Verify that Run-up switch 1 in STOP position causes ECU1 label to turn red. Verify that Run-up switch 2 in STOP position causes ECU2 label to turn red. Move both P-lead switches to Run position for the next steps.
- Power up full system – then pull breaker for ECU2 - verify that ECU2 label on Controller is gray (ECU not seen) and that ECU1 label on Controller is blue, green or red (not gray). Swap cat5 connectors at Controller if necessary.
- Power up full system and set ECU Select switch to ECU1 – verify ECU1 label turns blue, indicating ECU1 has fuel control. Move ECU Select switch to ECU2 – verify ECU2 label turns blue, indicating ECU2 has fuel control.
- Select Fuel Pump 2 and verify that Pump 2 label is yellow (pump 2 ON).
- Select Fuel Pump 1 and verify that Pump 1 label is green (pump 1 ON).

Ignition

Verify injector power (red wire at each injector should have +12V when ignition power is on)
Check injector plugs (make sure they are all fully plugged in)
Verify coil power (red wires at coil pacl control plug should have +12V when ignition power is on)
Check spark plug wires are installed to correct cylinder numbers (***mis-wired spark plug wires is the most common installation error***)
Verify spark plugs are tight

Throttle

Verify full travel of throttle body butterfly from fully closed to fully open with movement of throttle.

(Pre Start System Checks continued on next page)

EFII Pre Start System Checks (cont.)

Batteries

Check battery voltages, charge or replace if necessary.

Starter

Check starter and starter solenoid wiring for proper operation

Running The Engine

Before you start your engine, please review the System32 User Manual.

The System32 User Manual covers topics including:

- System32 Configuration Parameters
- Engine Starting Procedures
- Use of the System32 Cockpit Controller
- Air/Fuel Ratio, EGTs and CHTs
- Engine tuning

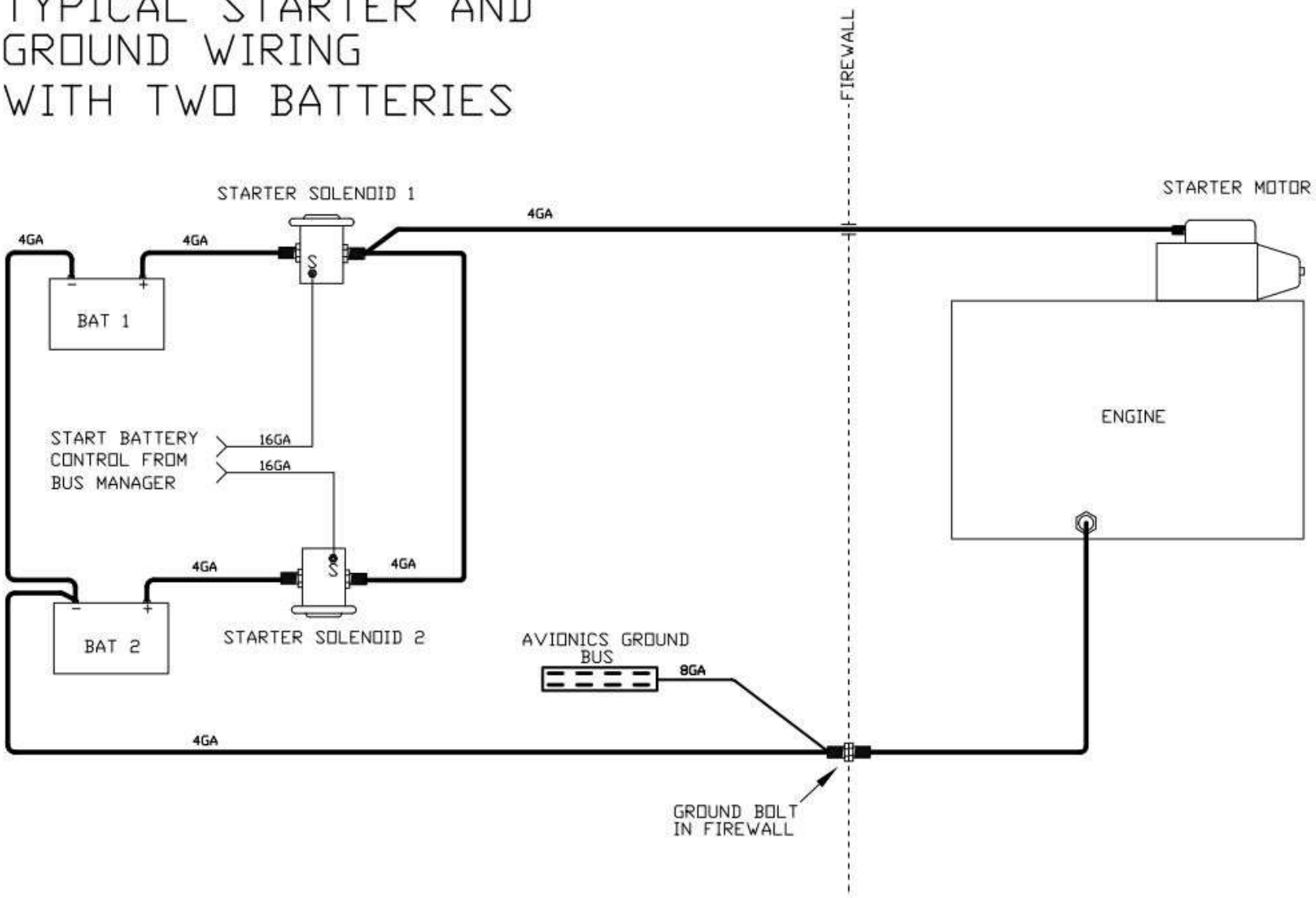
The System32 User Manual can be found on the Downloads page at www.flyefii.com

List of Drawings

DRAWING 1

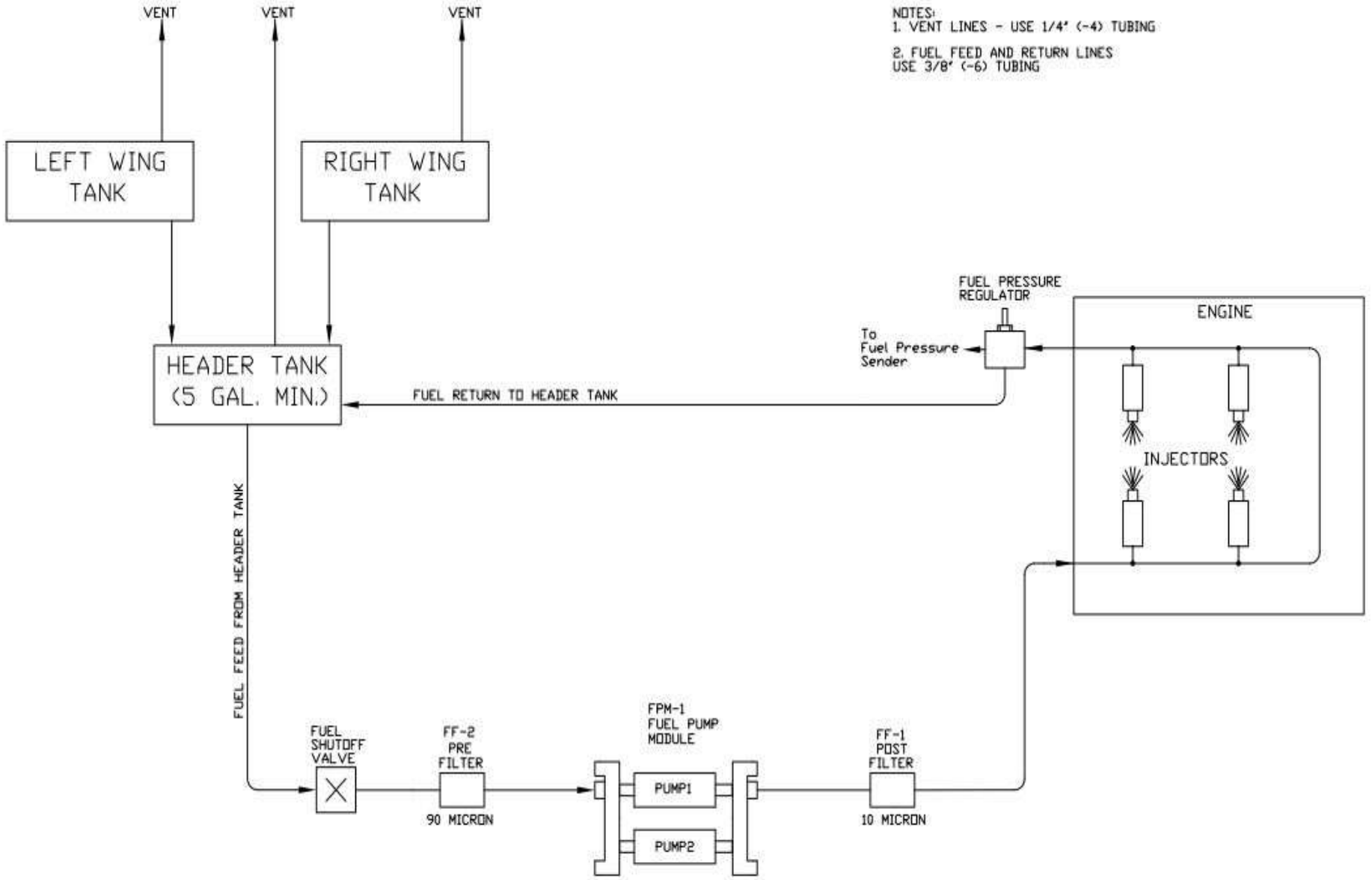
REV 5/19

TYPICAL STARTER AND GROUND WIRING WITH TWO BATTERIES



SAMPLE FUEL SYSTEM USING HEADER TANK

DRAWING 2
REV 5/19

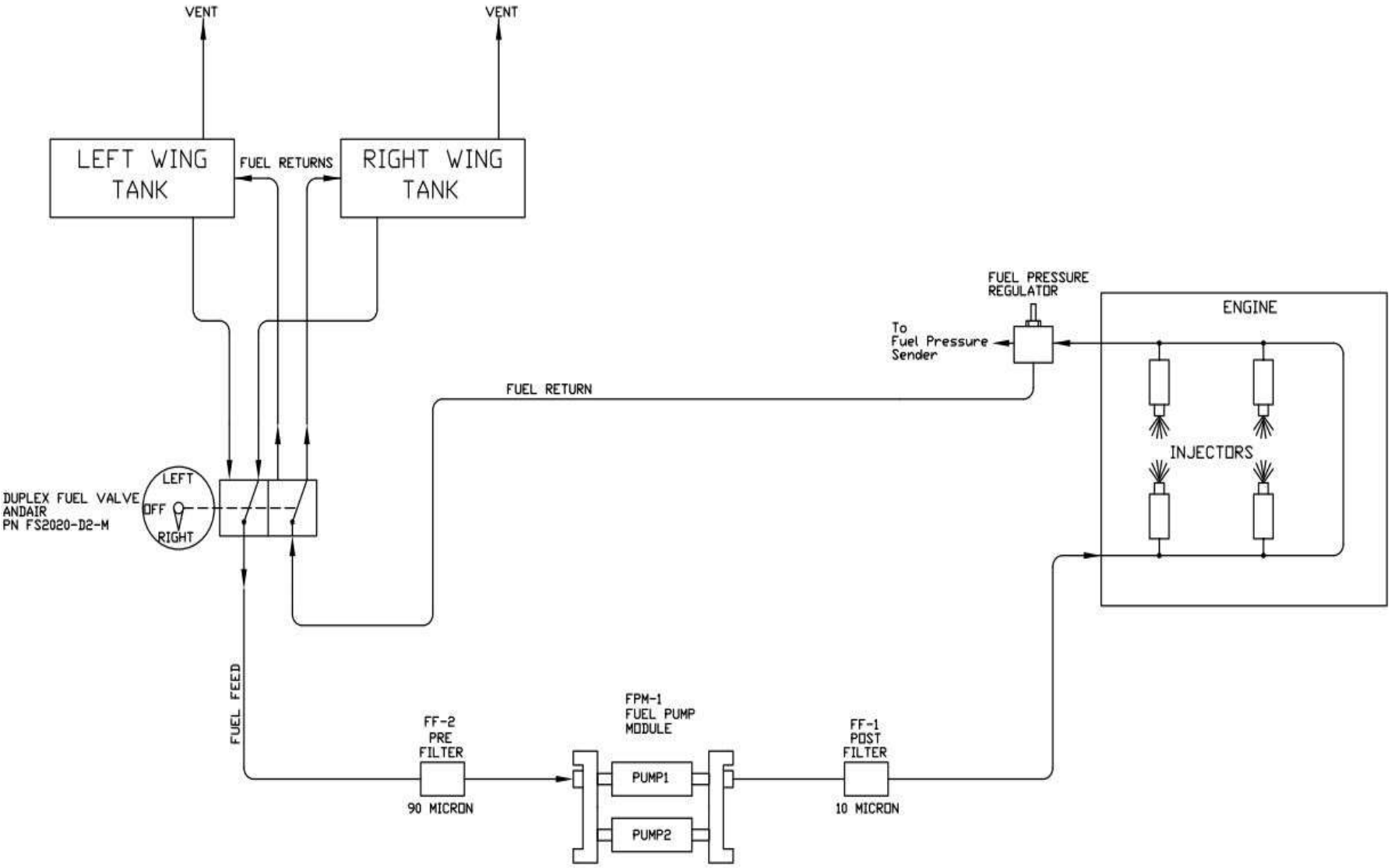


SAMPLE FUEL SYSTEM
WITH RETURN TO EACH TANK

DRAWING 3
REV 5/19

NOTES:
1. VENT LINES - USE 1/4" (-4) TUBING

2. FUEL FEED AND RETURN LINES
USE 3/8" (-6) TUBING



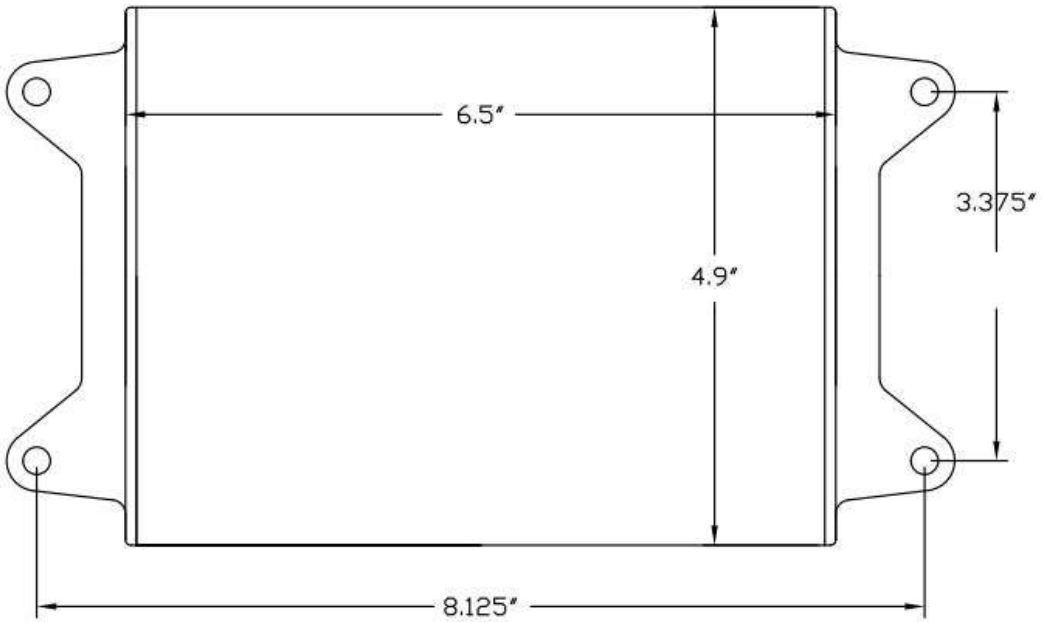
System32 ECU dimensions

DRAWING 4

rev 6/19

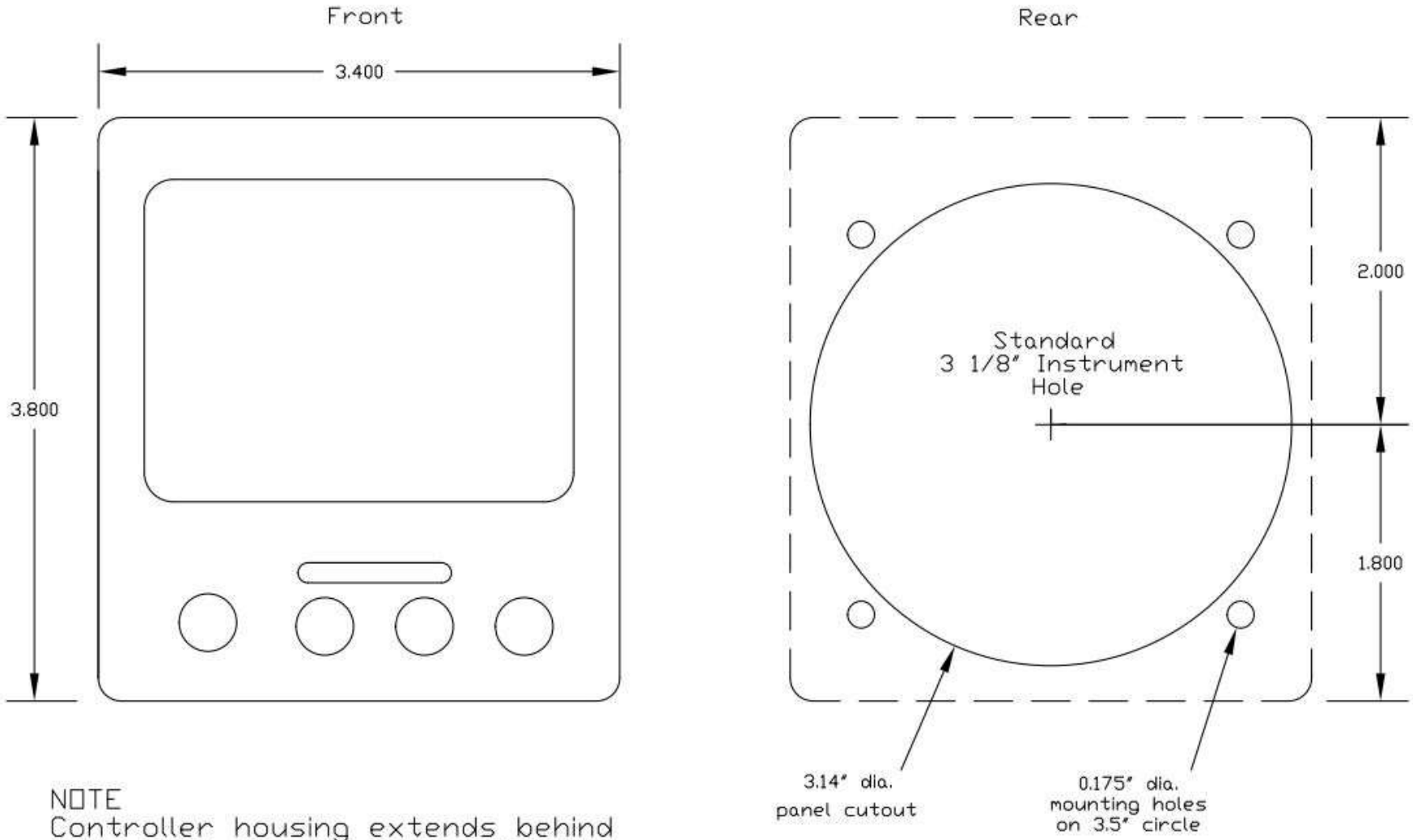
NOTES:
1. System32 ECU enclosure (less mounting flanges) measures 6.5" x 4.9" x 1.2"
2. One installation includes 2 ECUs. ECUs do not generate heat and can be bolted directly together.

System32 ECU dimensions



DRAWING 5
Rev 9-17

EFII System32 Cockpit Controller Dimensions

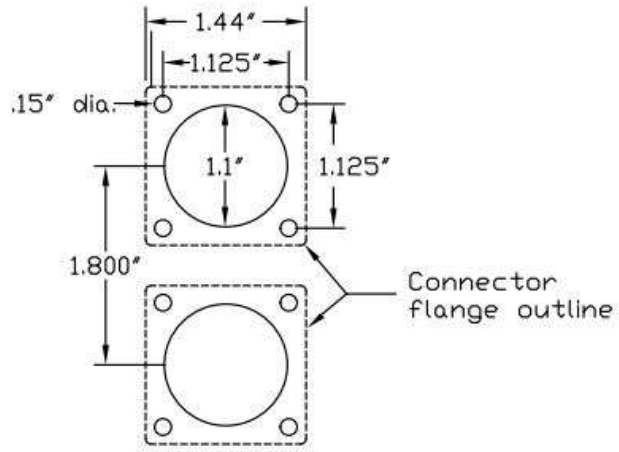


NOTE
Controller housing extends behind instrument panel approx 1.25".
3.5" total depth required for electrical connectors and Controller housing.

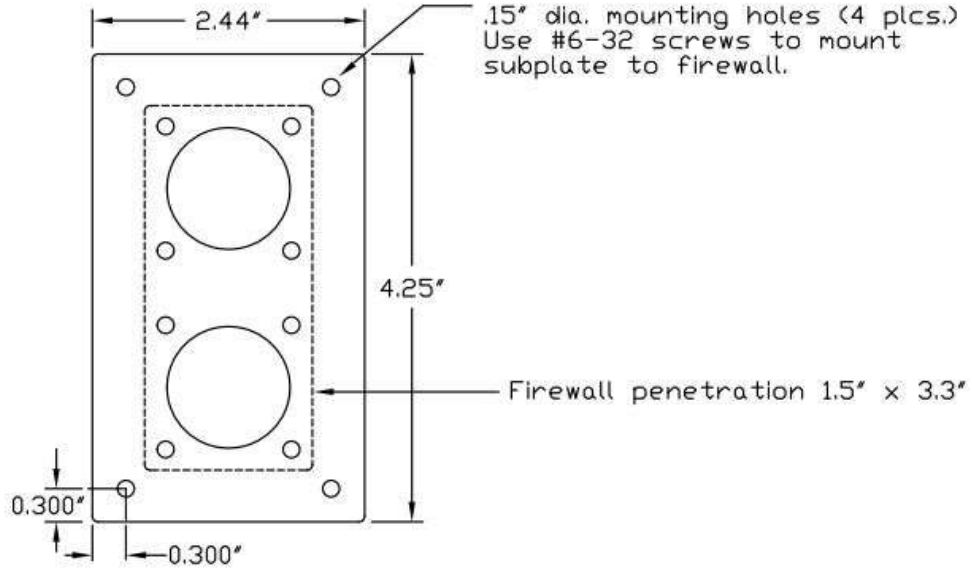
Firewall Circular Connector
Firewall Penetrations

DRAWING 6
rev 5/19

NOTES
1. Firewall penetration for one circular connector consists of 1.1" dia. canter hole and four .15" diameter screw holes.
2. Centers of mounting screw holes are on a 1.591" dia. circle.
3. Use #6-32 mounting screws and locknuts to secure connector flange to firewall.
4. Make sure that mounting screws and locknuts do not interfere with circular connector mating.
5. Two circular connector firewall penetrations are required for full EFII (ignition + injection) system.
6. If firewall thickness exceeds 0.1", mount circular connectors to a subplate that is less than 0.1" thick and mount the subplate to the firewall.



Firewall penetration for firewalls less than 0.1" thick



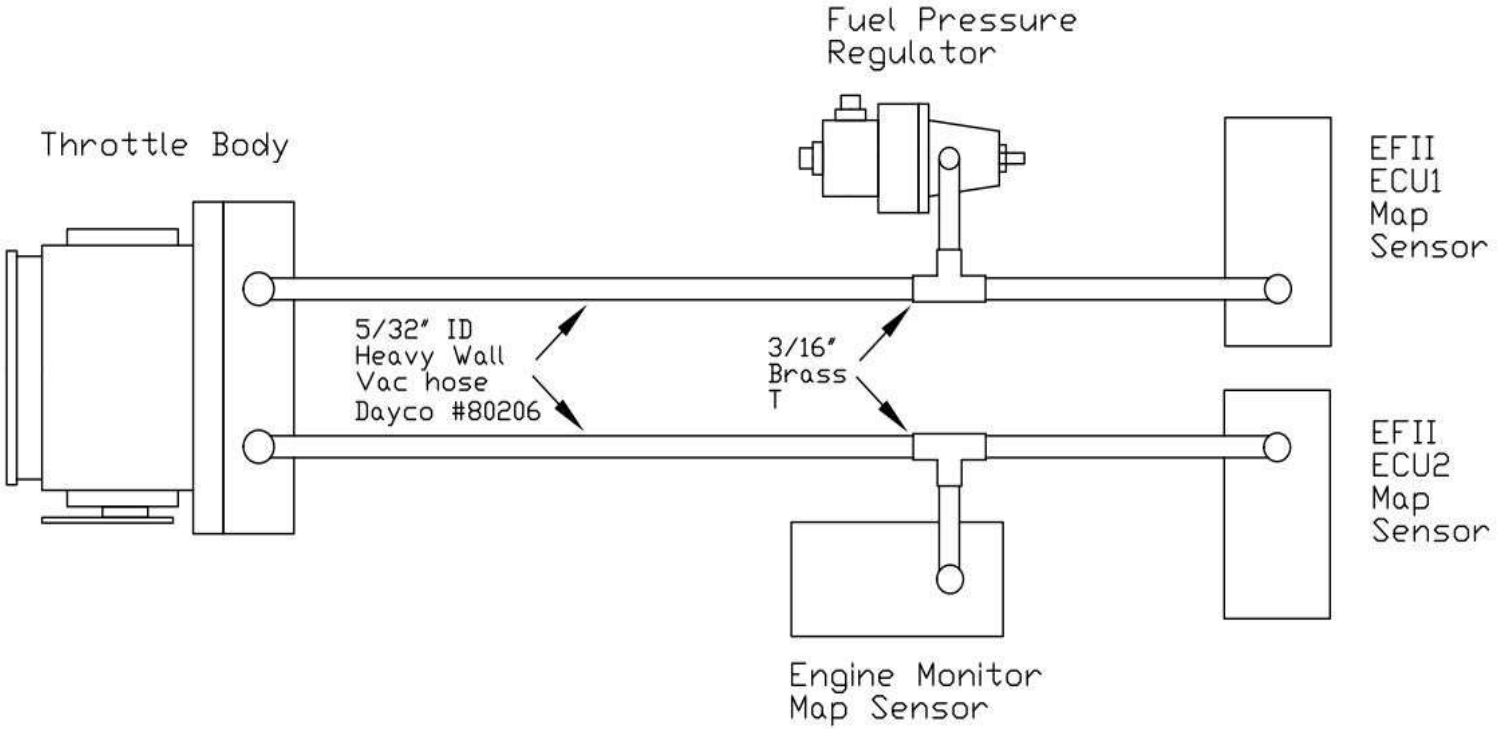
Firewall connector subplate for firewalls more than 0.1" thick (customer fabricated)

Manifold Pressure Hose Plumbing

DRAWING 7

rev 5/19

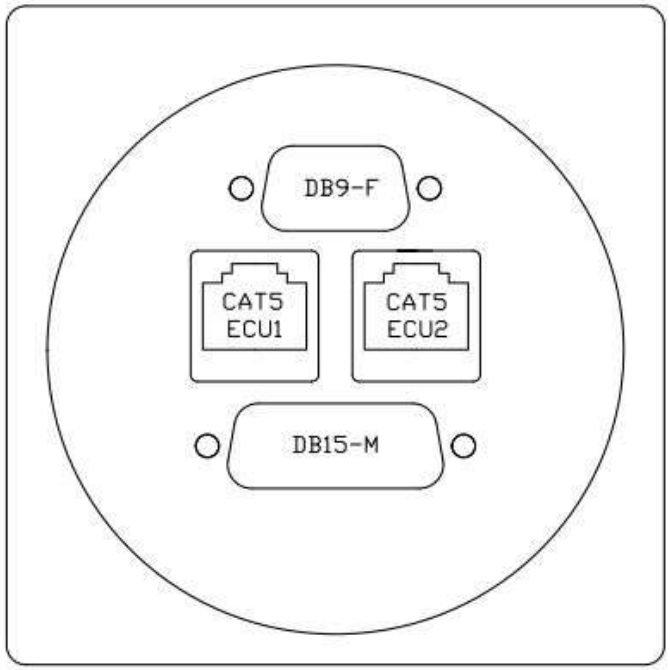
NOTES
1. EFII MAP sensors should be connected to separate manifold pressure hoses for best redundancy.
2. Use included brass Ts to connect engine monitor MAP sensor and fuel pressure regulator pressure port to manifold pressure lines as shown below.
3. Secure all pressure hose to barb fittings with three wraps of safety wire (lightly tightened).
4. Warning - Use only brass Ts or connectors on MAP hoses. Plastic hardware will eventually fail.



System32 Cockpit Controller Wiring

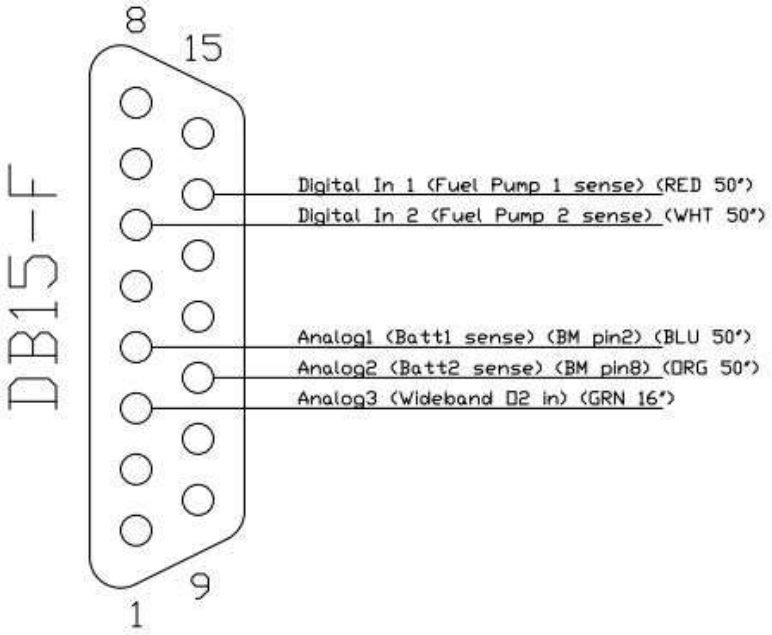
DRAWING 8
rev 5/19

System32 Cockpit Controller
Rear panel connectors



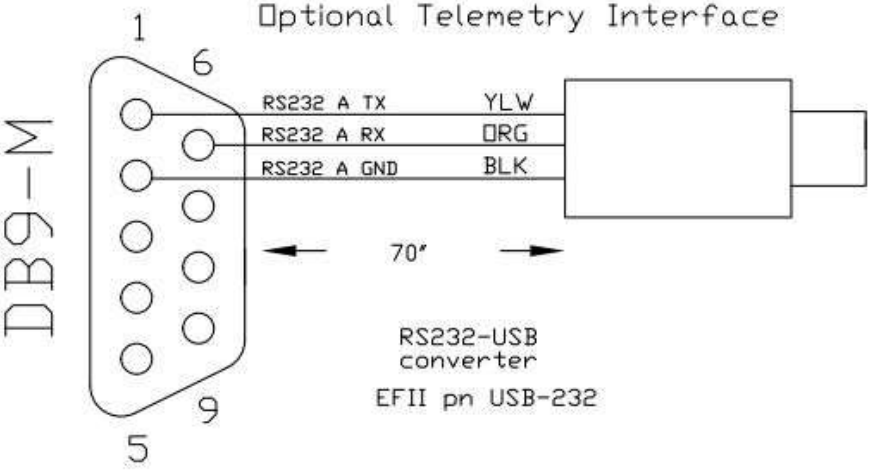
NOTE
1. CAT5 cables from ECUs to Controller are the same as a standard straight through Ethernet cable.

Controller Input Signals



Wire side shown

Optional Telemetry Interface

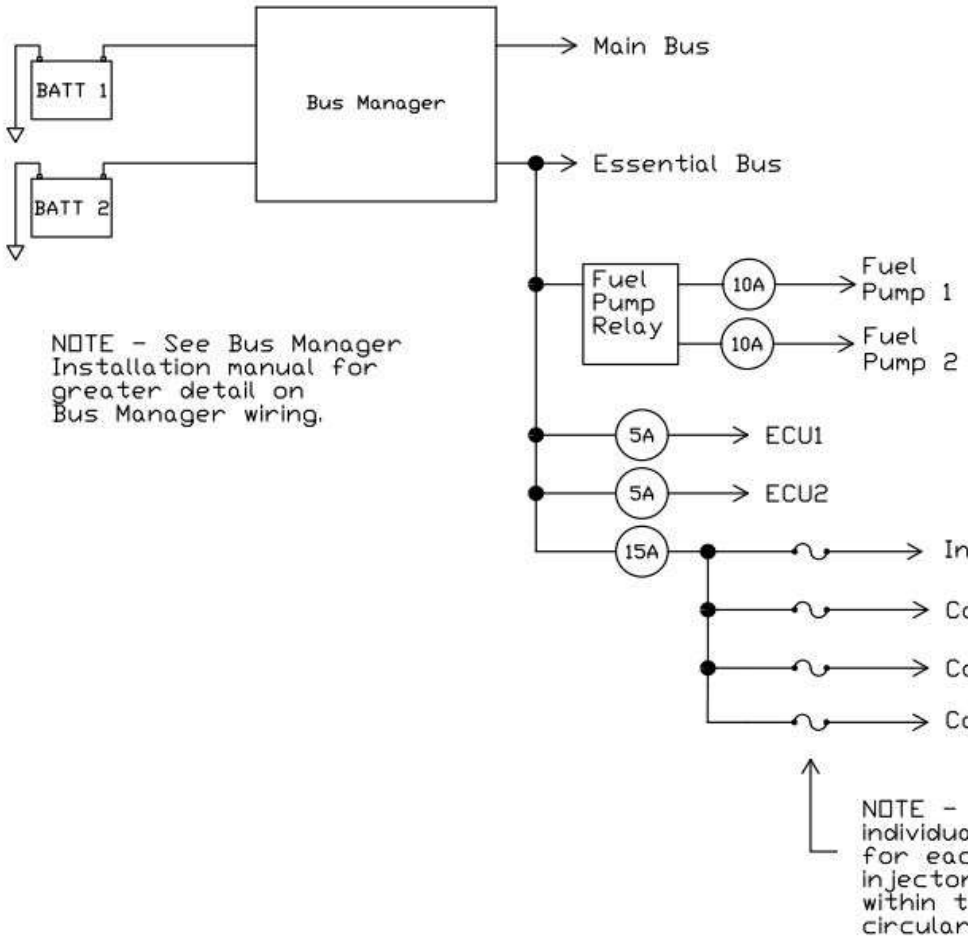


DRAWING 9

rev 5/19

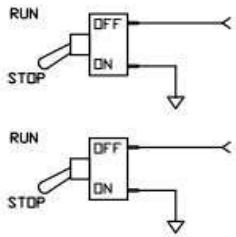
EFII System32 Power Wiring

(4 and 6 cylinder installations)



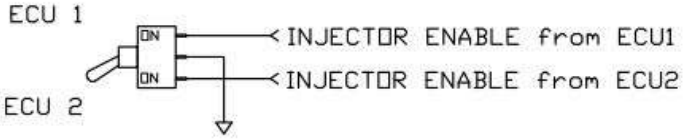
NOTE - See Bus Manager Installation manual for greater detail on Bus Manager wiring.

Ignition Run-up switches



When P-lead input is grounded, ignition operation will STOP
When P-lead input is open, ignition operation will RUN

ECU Select switch



NOTE - The ECU Select switch, determines which ECU has control of the fuel injectors. Grounding the INJECTOR ENABLE wire, disables the injector drive outputs of the given ECU.

NOTE - System32 wire harnesses include individual fusible links within the harness for each coil pack power lead and each injector power lead. Fusible links are located within the backshells of the engine side circular connectors of the harness.