

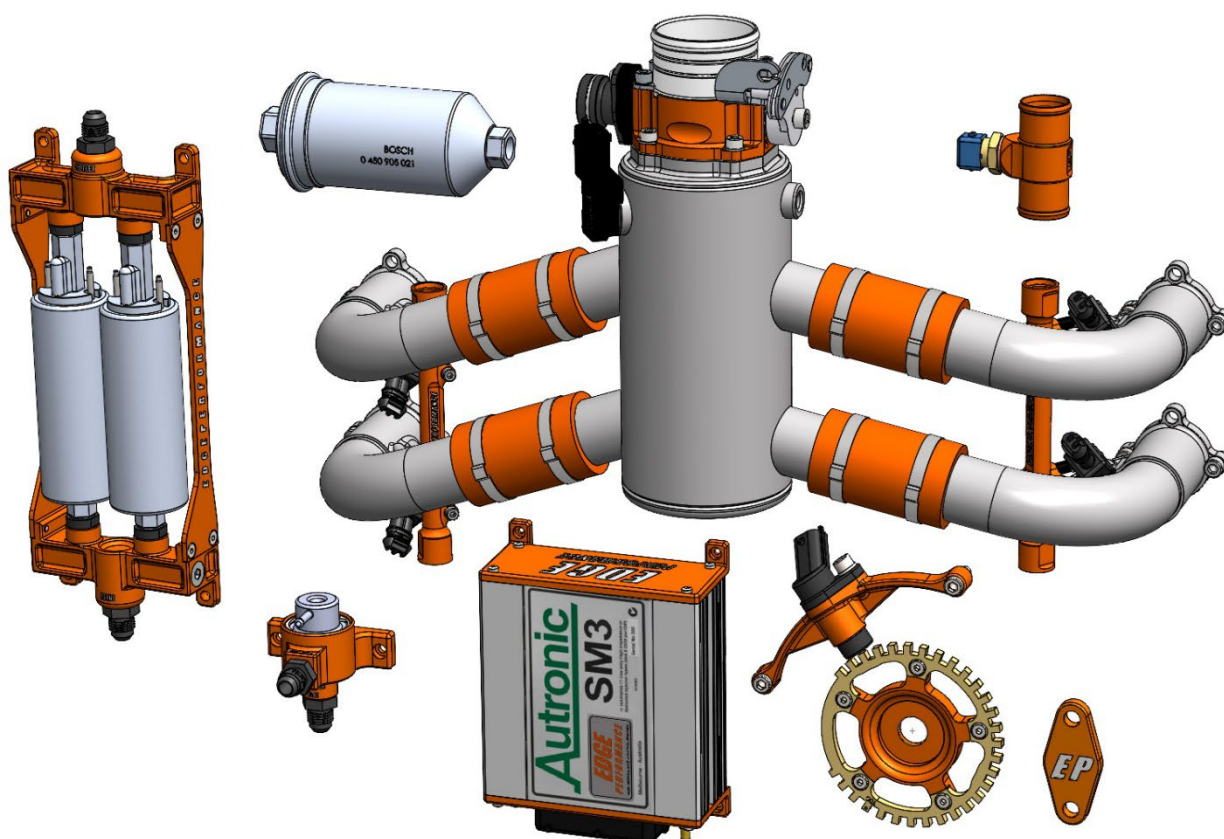


# EDGE PERFORMANCE AS

*DIRECTPORT FUEL INJECTION - with 4-1 intake plenum*

*(ROTAX 912UL/ULS / 914UL)*

## *Installation manual*



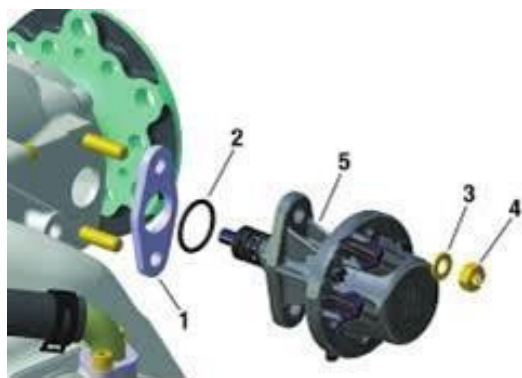


## Introduction

- Firstly, we would like to express our gratitude to you for choosing to buy an EFI kit from EdgePerformance AS. We are always striving to improve on reliability, efficiency, fit, form and finish.
- **The warranty from Rotax will be voided once the engine is modified. Any 12-month-old engine is outside of warranty.**
- This installation manual covers the basic details on how to install the components to complete a conversion from carburetors to modern fuel injection. Pictures are for illustration purposes only. Do not proceed if you are in any doubt. If in doubt, consult with your local dealer or with us immediately.
- Common sense and good workmanship practice must be used. All fuel connections MUST be tightened and properly sealed. This system works under high pressure 45psi/3Bar.
- Make sure to route all fuel lines/hoses away from any heat source. Do not tie down lines and hoses to tight. Keep in mind that all hose connections must have proper slack and that they do not make contact with any sharp corners or edges. We prefer to use fire sleeve whenever fuel hoses are routed any closer than 2" from exhaust pipes or the muffler.
- Use thread-sealant (Loctite) where required. Use correct torque values. Refer to your Rotax "Line and Heavy maintenance manual for proper torque values".
- All electrical connections are HIGHLY critical. Use ONLY high-quality crimpers, tefzel aviation grade wires and terminals. Keep in mind that every unnecessary connection, terminal, relay etc. is a possible source of error. KIS – Keep It Simple!
- On aircrafts with only one fuel tank, a 5/16" (8mm) ID hose/line is required for fuel feed and return.
- On installations with two or more fuel tanks, a 6-way fuel selector with return feed to the fuel tank you are drawing fuel from must be installed to make sure the return fuel ends up in the tank you are drawing fuel from. Alternatively, you can use a header/collector tank with a volume of min. 2.0L. All feed and return lines must have a min. ID of 5/16" (8mm).
- On the suction side of the fuel system, from the fuel tank and all the way up to the fuel pump inlet, ensure that there is no filter besides the finger strainer filter in the fuel tank. If such a filter is not present, use a high flow, high-capacity filter which can support min. 200ltr/hr unpressurized. Failing to comply will result in fuel pump cavitation, air and foaming of the fuel, and ultimately failed fuel pumps.



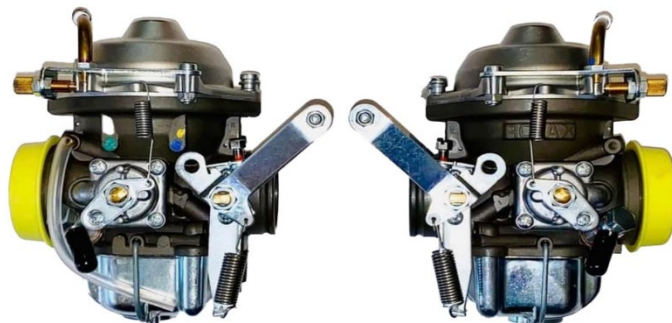
- IF IN DOUBT AT ANY STAGE DURING THE INSTALLATION, ASK FOR ASSISTANCE!



- 1 Start off by removing the existing mechanical fuel pump. Start by removing the 6mm and 8mm fuel hoses. Remember to close the fuel valve before you start on this task. Next, remove the 2x M8 nuts and washers. Pull out the fuel pump and remove the isolator plate, gaskets and O-ring. Remove the M8 stud bolts by using a stud bolt extractor or simply by installing two counter-nuts and unscrewing them.

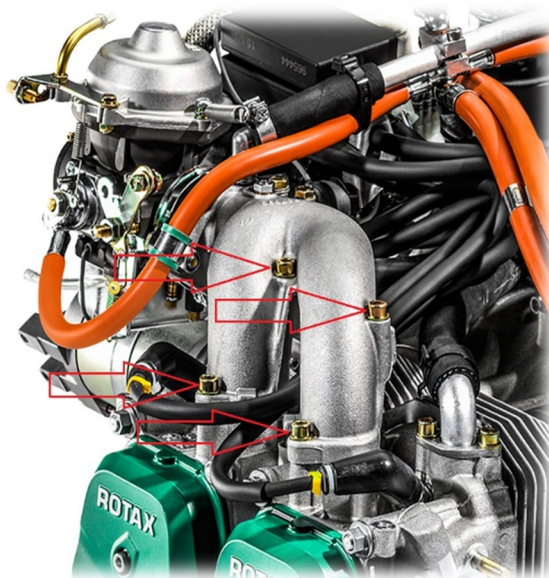


- 2 Clean the mating surface on the gearbox where the pump was attached with brake-cleaner, acetone or mineral spirit. Apply Loctite 243 to the M8 socket head bolts. Ensure the supplied copper sealing washers are under the bolt heads and torque to **14Nm**.



- 3 Remove the LH/RH carburetors. Before you remove them, detach the air filters or airbox.

Disconnect the choke and throttle cables. Disconnect the fuel hoses and hoses for coolant if you have carb heaters installed. Next, loosen the Philips screw on the rubber socket flanges and firmly pull off the carburetors.



- 4 Loosen the hose clamp on each side that secures the balancing cross tube. Remove it from each intake manifold. Next, undo the 4x M6 socket head screws and remove the intake manifolds. Make sure to seal off the intake ports in the cylinder head with a clean cloth, paper or a plastic plug as supplied with new engines in the exhaust ports. Replace the old intake O-rings (4pcs) with the new ones supplied.

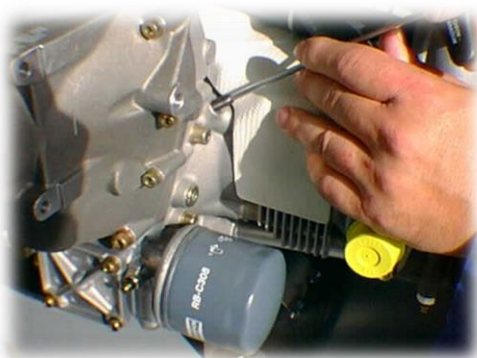


- 5 Remove the flywheel plastic cover by undoing the 3x 10mm M6 hex bolts.



- 6 Remove the M8x20 socket head screw in the engine case right behind the gearbox. Use a flashlight to see where the V-groove for the locking pin bolt is. With the flywheel cover off, use a ratchet wrench with a 24mm socket and turn the crankshaft in the orientation of normal rotation until you see the V-groove in the crankshaft. Caution – Do not turn the crankshaft backwards, as this may cause damage to the brushes inside the starter motor.





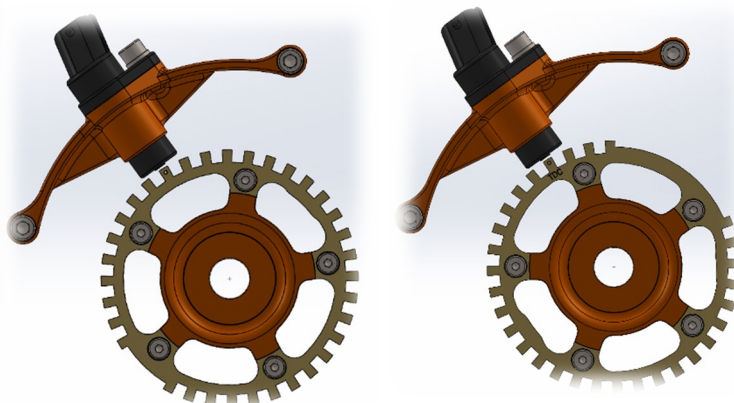
- 7 Install the locking pin bolt (**Rotax part nr 240880**) and tighten firmly.



- 8 Now that the crankshaft is fixed, carefully apply some heat to the hex flywheel bolt with a heating gun. Perform extreme caution when using a heat source around flammable liquids. Take great precautions, and have a fire extinguisher nearby, just in case. Now apply a generous amount of force to undo the flywheel bolt. Normally a 50-60cm long wrench is required to loosen the bolt.



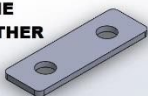
There are two types of trigger wheels. A 36-2 and a 36-6. The 36-6 is for turbo engines with ECU controlled ignition timing.



- 9 Install the crankshaft trigger wheel on the flywheel hub with the M5 bolts facing outwards. Apply **engine oil** on the flywheel bolt after cleaning it properly. The tooth with a machined DOT, shall be centered on the hall sensor with Cyl-1 at TDC, or with the crankshaft fixation bolt installed (**PN 876-640**) Tighten the flywheel bolt to **45NM+180°** or **32.2ft.lb + 180°**. Install the hall sensor mount as shown above with the supplied 2x M6x20 socket bolts. Apply (**Loctite 243**) and tighten to **12NM**.

#### MODULE RELOCATION KIT

USE THE EXISTING HOLE AND BOLT, AND MOVE THE MODULE FURTHER OUTWARDS



ATTACHES TO STANDARD LOCATION AND REPLACES EXISTING BRACKET

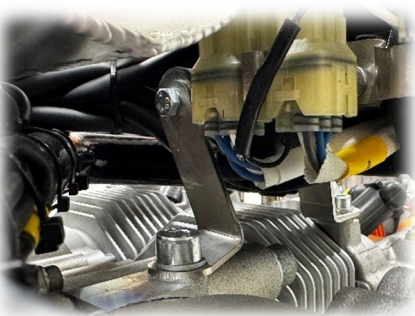
ATTACHES TO COOLANT ELBOW FLANGE ON CYL #3



- 10 Install the provided relocation brackets for the ignition module. There is the standard set as shown above, and a set for engines using ring mount as shown on the next two tables.



This is the relocation kit for engines without ring mount installed which consists of three metal brackets.



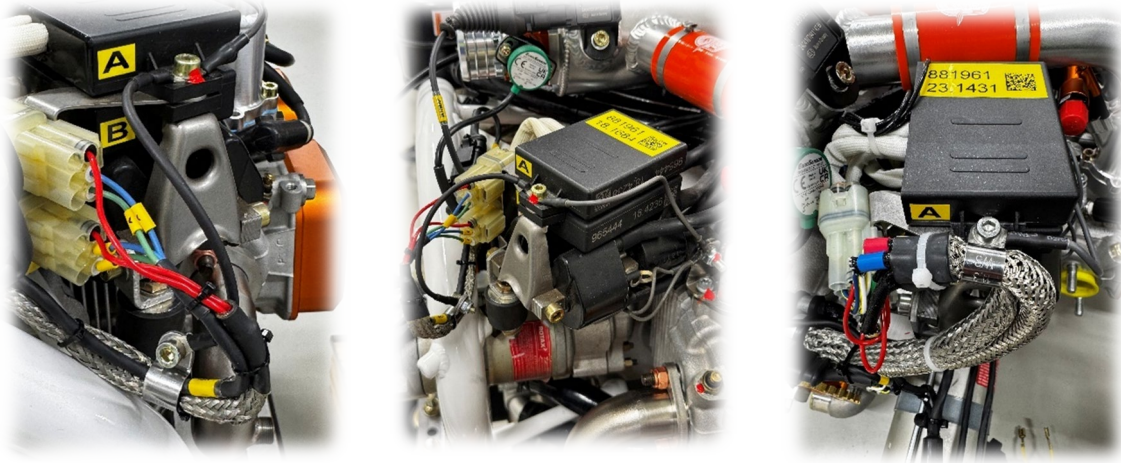
This is the relocation kit for engines with the ring mount, which consists of two metal brackets and a adel clamp.



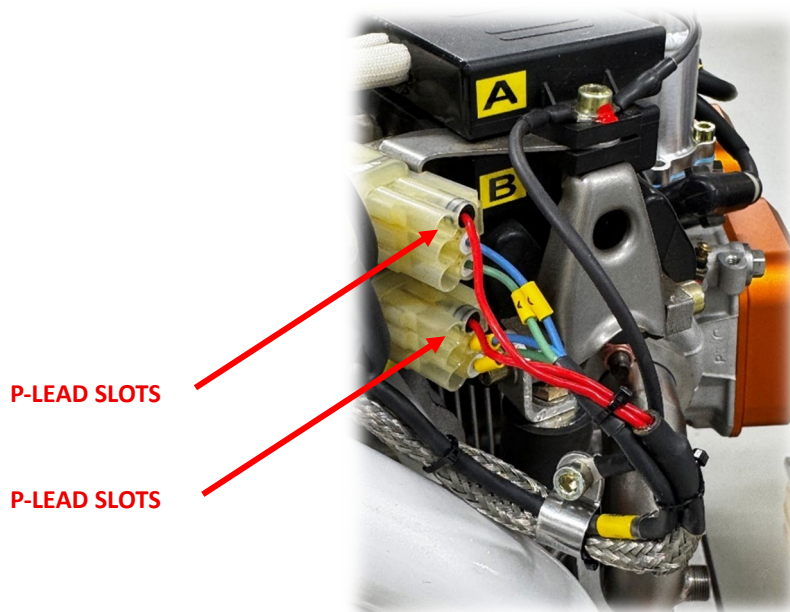




The two grounding wires from the coils are grounded on the bracket bolt which is attached to the cylinder 3 coolant elbow flange. When using a ring mount, you must make up a 16 AWG wire strap that grounds the shielding on the AC charge wires coming up the the SMD modules from the rear SMD module M5 socket bolt as shown on the left and middle picture. The right picture shows how the stock clamp is repurposed to ground the shielding.

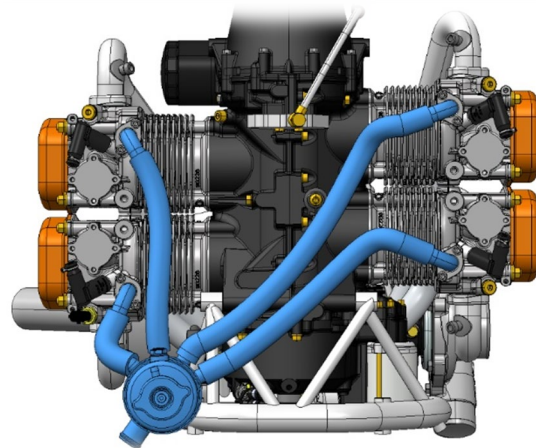
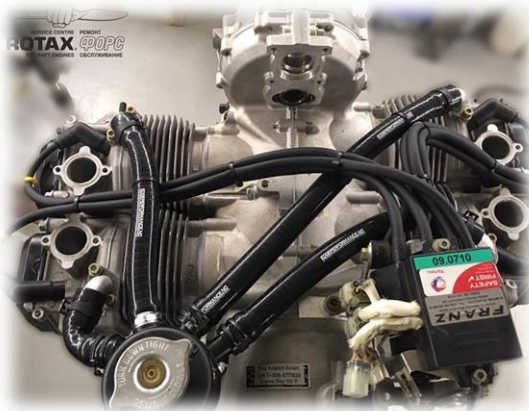


When ECU controlled ignition is used (Mainly only on EP912STi engines) are used, the four pickup sensors for the crankshaft timing and wires are removed. The blue and green wires coming from the ECU loom are fitted as shown in the 6-pin SMD module connectors. As seen on the picture, the p-leads connect in the upper LH slots on each connector. The two lower left slots are not used in this configuration.





- 11 Again, terminate the two ignition grounding wires to the bracket bolt. You can also run the ground strap from the back of the SMD modules M5 bolt to where the nut is attached, depending on the configuration.



- 12 Replace the coolant hoses with the supplied silicone hoses. The short legged 90° elbow is cut down to length in both ends, and the short leg on the L-shaped hose is kept as it. The straight hoses and long leg of the L-hose are trimmed to length. Usually, one can put the elbow from cylinder 1 on cylinder 4, the elbow from cylinder 4 on cylinder 2, and the elbow from cylinder 2 on cylinder 1. This is also a good opportunity to reseal the threads if they show signs of leaking. Use a M18x1 thread die and tap to clean the threads on the elbow and flange. Clean with **Loctite Super Cleaner 7063** or Acetone and re-assemble with **Loctite 577**. Torque the flange back onto the cylinder head with **10Nm**.

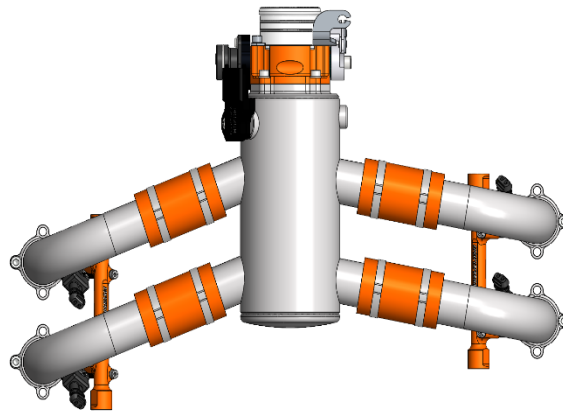


13 Picture showing a typical installation of the EFI system onto a Rotax 912ULS engine.

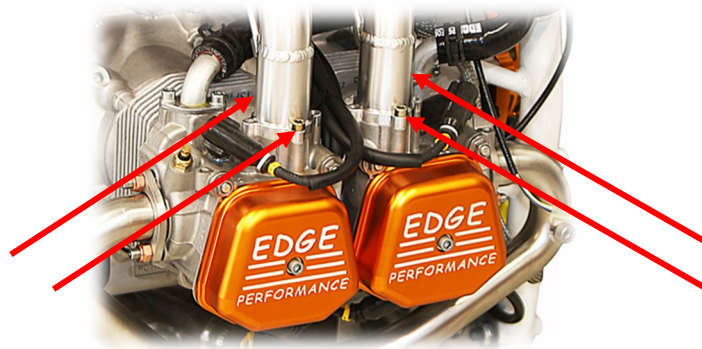


14 Alternative hydraulic governor intake design when installed on engines with hydraulic propeller governor, DUC, Eprops hydraulic actuator etc.





- 15 Install the 4-1 intake system on the engine. Ensure that the sealed off intake ports are free from any cloth, paper or plugs and insert the supplied new O-rings for the intake flanges. Orientate each intake flange with the mating flange on the cylinder heads.



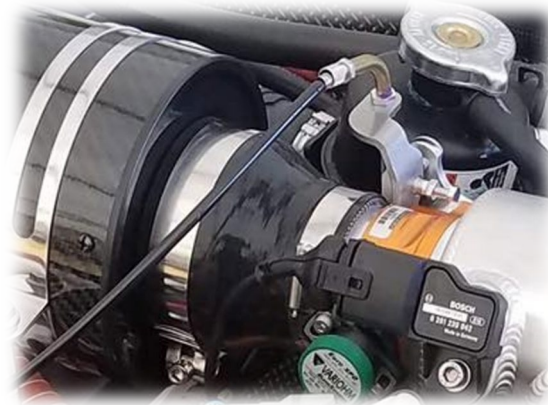
- 16 Install the intake flanges with the supplied M6x20 outboard bolts, and M6x16 inboard bolts. Tighten the bolts to **12NM**. Bolt lengths may vary from intake to intake. Using a Bondhus 6mm "BALL" T-handle wrench is the best way to secure the bolts.



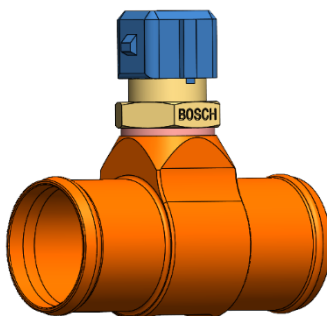




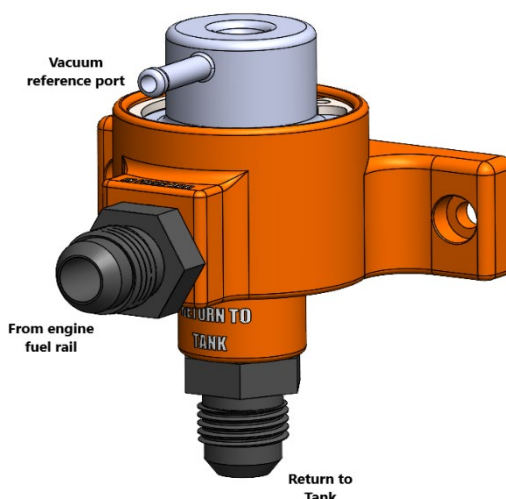
- 17 The wiring harness is ideally installed to the engine after the ignition wires and coolant hoses have been installed and re-routed. Pay special attention so that no cable is chafing against any metal or sharp edge or objects. The Zeitronic Zt-3 lambda sensor controller plugs into the small 4+6 pin Molex connectors, and the O2 sensor into the main wiring loom. There is additionally a 6-pin connector for cal switch and caution/warning lights. The wiring layout is explained in greater detail further out in the manual.



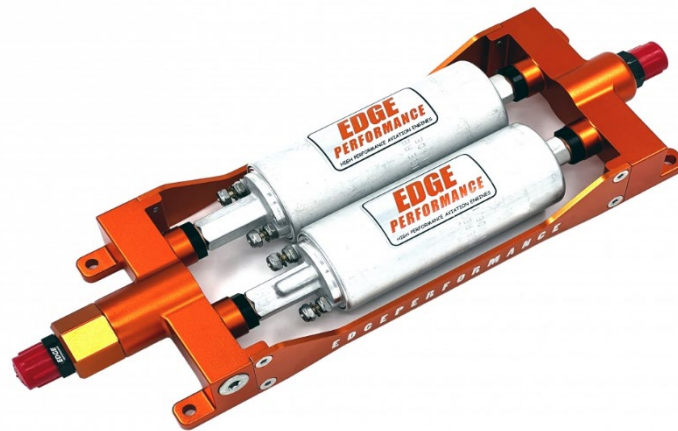
- 18 Use the 90° cable adjuster bend for the choke cable from your BING carburetor. Use the nut from the second bend so that you have two nuts, and are able to clamp it onto the throttle bracket.  
*NOTE – The throttle cable travel from idle to WOT is 51mm (2").*



- 19 Cut the 25mm hose coming from the black water spider tank and install the coolant sensor adapter. It is usually convenient to use a 90° hose elbow. The “CLT” sensor is used for ECU engine temp feedback, mainly for cold or hot start, as well as enrichment when the engine runs hot.



- 20 Now that most of the components are installed on the engine, it is time to start installing the parts to the airframe. The FPR (Fuel Pressure Regulator) is pre-set to 3Bar/45psi, which it will only indicate with one pump running and the engine off. It rises or lowers the fuel pressure 1:3 with the manifold pressure. Meaning 15inHg will result in  $45\text{psi} - 7.5 = 37.5\text{psi}$ . Bolt it onto the firewall or somewhere convenient with some M4 socket head bolts. Ensure that there is nothing blocking the top of it as the filter screen in the Bosch regulator should be inspected and if needed cleaned every 100hrs. Remember to connect the vacuum line from the regulator to the vacuum barb fitting on the intake manifold.



- 21 The dual fuel pumps have internal check-valves in case one pump were to fail, there will be no back flow. They shall be wired with separate ground wires and separate switched +12v wires. One pump is master, and the second pump is back-up. Use 14-16 gauge shielded tefzel wire. Ensure that there are no leaks after installation and prior to starting the engine. Pumps are to be replaced every 1000hr/5years whatever encounters first. Ideally the pumps should be installed such that they sit as low as possible to ensure proper gravity feed from the main fuel source(s). Also, it is recommended to use M5 rubber dampers for installation of the pump assembly.



- 22 The high-pressure post fuel filter should be installed after the pumps. Note the arrow or in/out orientation indicating the direction of flow. Apply Loctite 243 on the threads while using the supplied copper sealing washers.

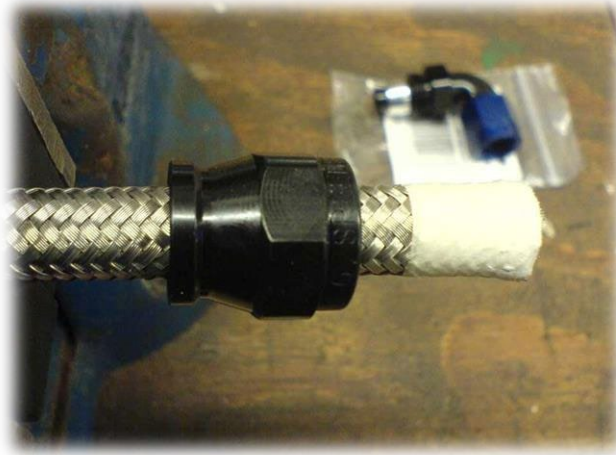


- 23 The PTFE (Teflon) AN hoses and hose fittings shall be cut to desired lengths and installed accordingly. A good tip is to have a roll of black PVC electrical tape handy. Apply 2-3 rounds of tape where the hose is to be cut. Use preferably a hose cutter plier or an angle grinder with a 1mm disc. SAFETY FIRST, USE PROPER PPE. If you use the angle grinder, ensure to clean the hose internally properly with compressed air and flush with some solvent before installation. Apply some engine oil on the fitting threads when mating the two halves. See detailed assembly pictures below in 6 steps.



- 24 Cutting the hose on the tape marked position.





25 Slide on the sleeve nut.



26 Spread the steel braiding to expose the PTFE tube.



27 Install the olive insert ring onto the PTFE hose.



28 Install the hose-fitting end.



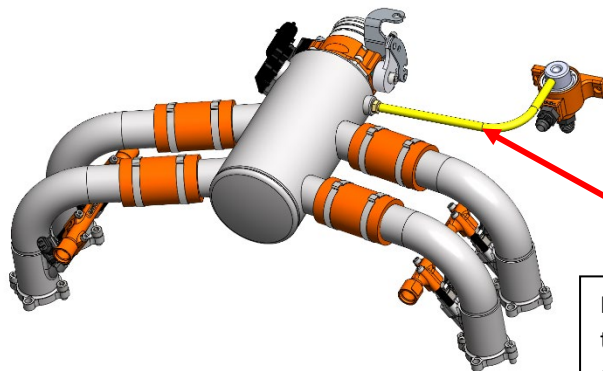
- 29 Clamp the assembly in the vise jaws and start to torque. Remember to lubricate the threads with some engine oil.



- 30 Keep torquing until the hose end and the sleeve nearly mates.



31 This is roughly how the AN hose and fitting assembly should look like when assembled.



If desired, installed the supplied t-piece fitting here to use with external EFIS MAP sensor etc.

32 Cut the supplied 3mm (ID) vacuum hose to length and attach between the barb fitting on the intake manifold, and the pressure reference fitting on the fuel pressure regulator. If using an external MAP sensor for any EIS/EFIS system, the supplied t-piece fitting can be inserted as shown above. Use a thin 2.5-3mm zip tie and secure the hose ends. We do not recommend the use of safety wire on the hose ends, as it may cut into the hose over time.





- 33 You will ideally need 3x switches and 3x breakers in your panel. Skip the “optional” breakers. The breakers act as “short circuit protection” NOT as over current protection. That is why they are set higher than actual consumption. You don’t want the ECU to switch off in case an injector would fail and draw lots of amperage, or the fuel pump due to a clogged or frozen fuel filter.

**USE HIGH QUALITY HARDWARE, YOUR ENGINE RELIES ON ELECTRICITY!**

- 15-20A breaker + 20A rated switch ON/OFF for “Main Pump”
- 15-20A breaker + 20A rated switch ON/OFF for “Aux Pump”
- 10A breaker for “ECU” + 10-15A rated toggle switch for “ECU ON/OFF”



- 34 If you are doing your own harness, modifying it or doing the electrical wiring for the ECU, Pumps etc., ensure to use high quality TEFZEL mil-spec aviation grade tin plated copper wire. Do not use cheap automotive PVC cables. Remember, the wiring job is the most critical task of the entire installation.



35 Use only genuine AMP terminals with double metal crimp jacket. Don't try to save 10 bucks here! You may regret it...

36 The ECU **MUST** be installed inside the cockpit. Typically, behind the firewall to keep it dry and free from the heat exposure and heat soaking in the engine cowling compartment. Also install it with the ECU connector facing down, to avoid moisture or water flowing along the wiring and entering the ECU.

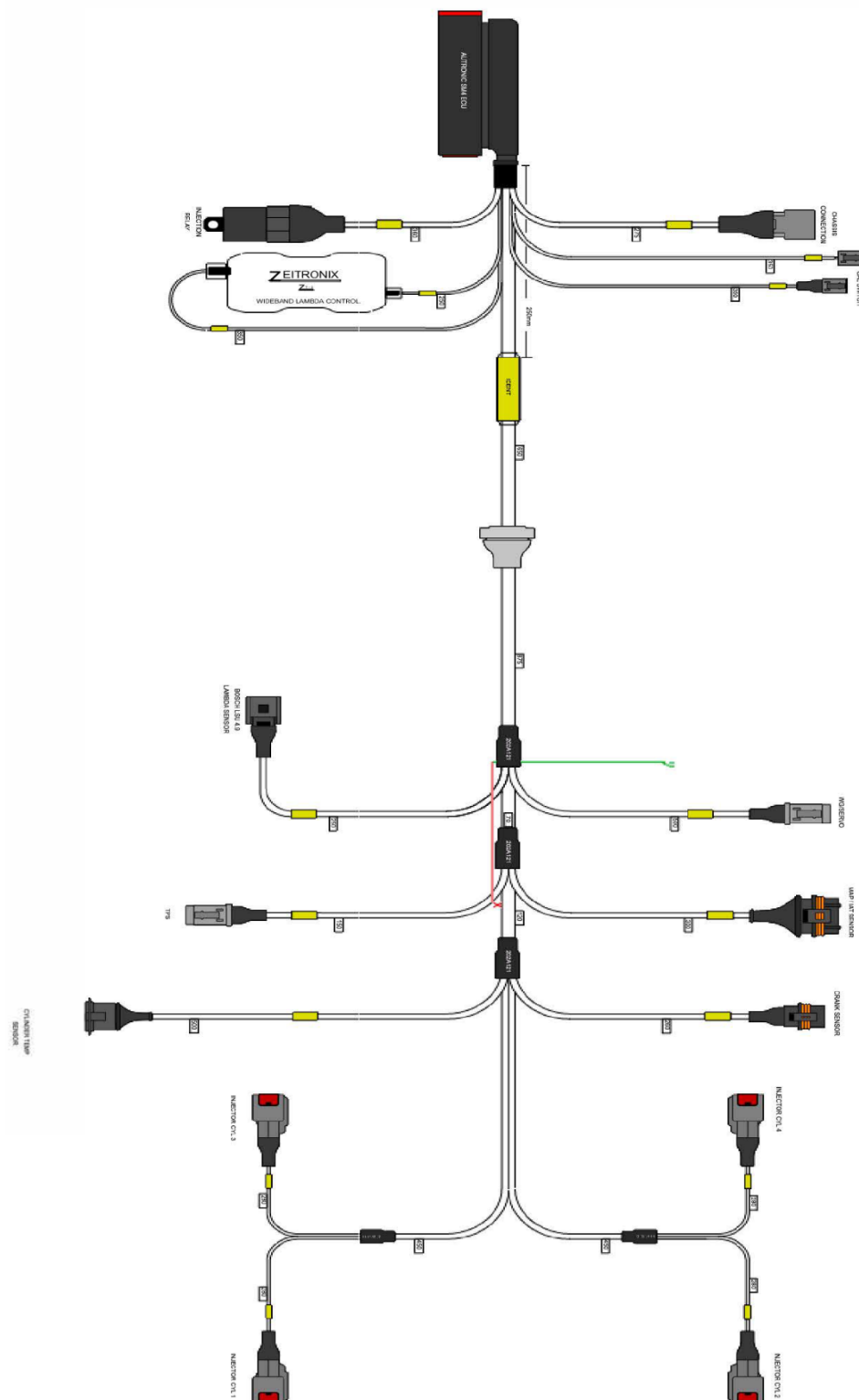
A CNC machined waterproof chassis is also available upon request for seaplane or amphib installations.

**DO NOT INSTALL ANY HOSE TO THE BRASS BARB FITTING ON THE ECU. This port is for barometric sensing !!**



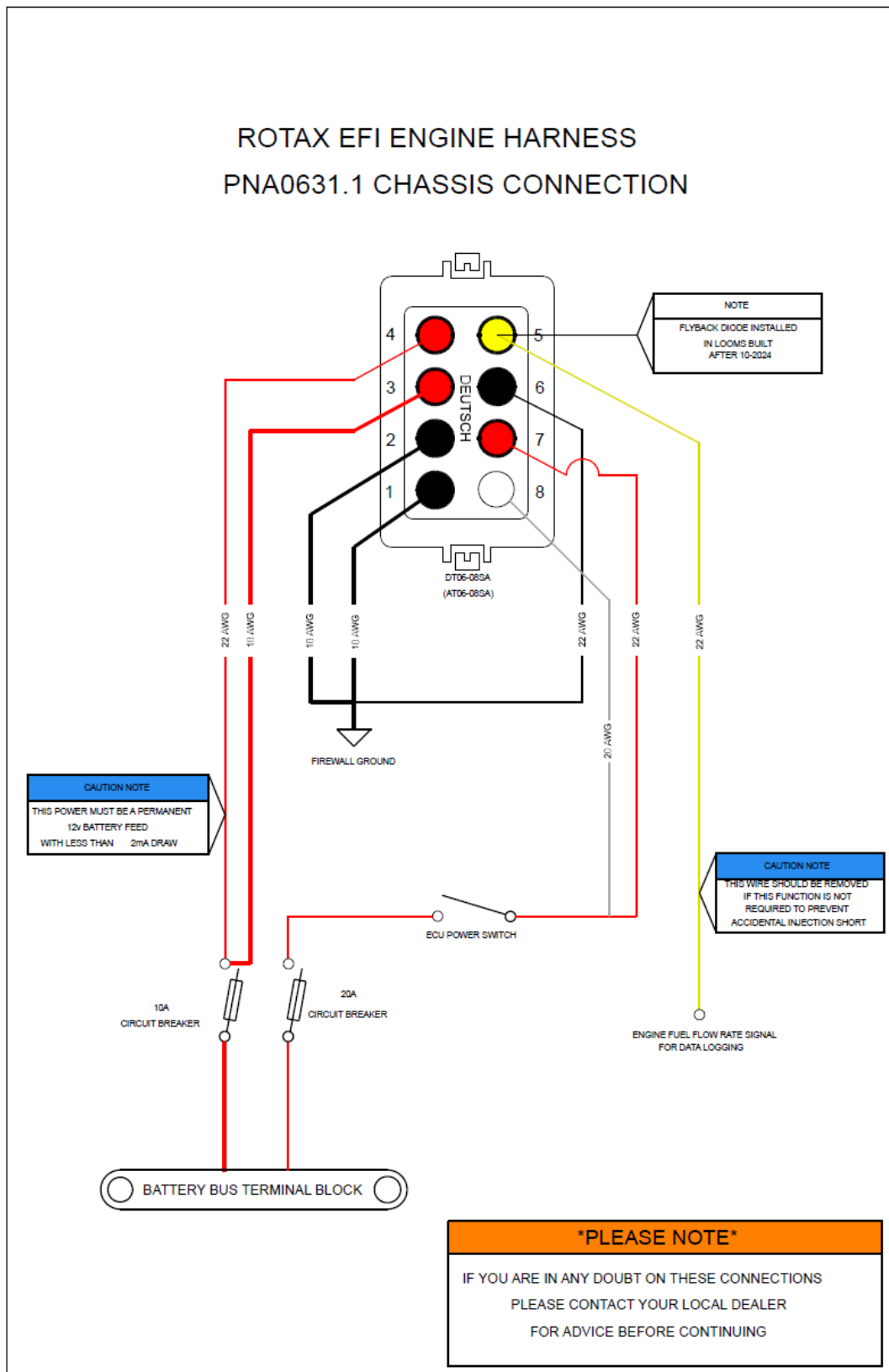


- WG-SERVO** 6-pin connector. Pin-1 WHITE, Pin-2 YELLOW, Pin-3 BLACK, Pin-4 RED, Pin-5 GREY





## 38 8-Pin Deutsch ECU connector (C14 ECU Chassis connector harness)

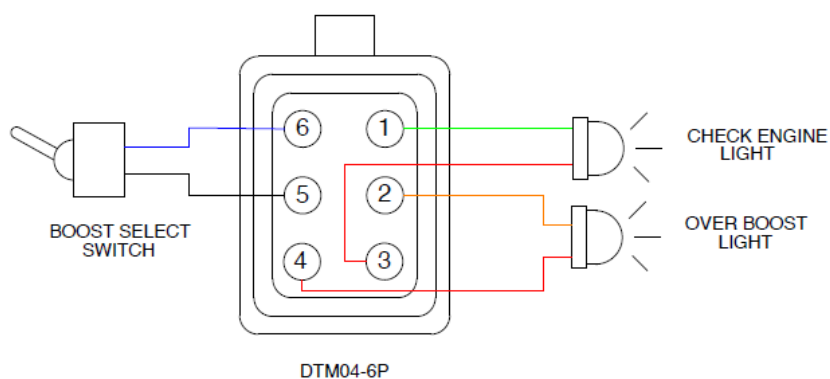






- 39 6-pin AUX connector for caution lights, warning lights and boost selection switch (only applicable for turbo engines)

## EP 912 / 914 AUX WARNING LIGHT CONNECTION

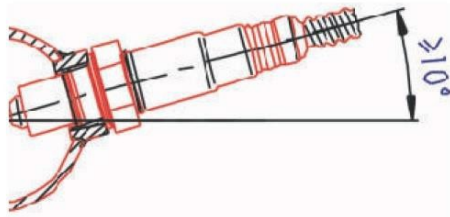


### AUX CONNECTION

- 1 - CHECK ENGINE GROUND SIGNAL
- 2 - OVER BOOST WARNING GROUND SIGNAL
- 3 - 12v
- 4 - 12v
- 5 - BOOST HI / LO SELECT SWITCH INPUT
- 6 - GROUND



Mounting recommendation

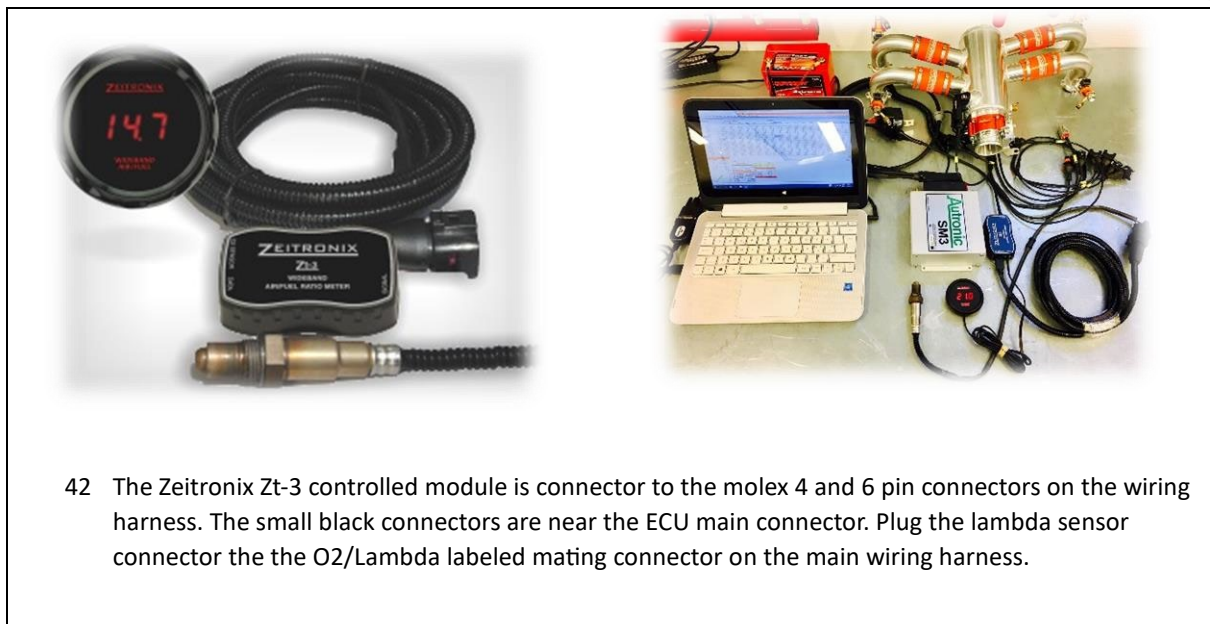


#### O2 LAMBDA INTERGRATION

- 40 Drill an 18-20mm hole as close as possible to the muffler outlet pipe. Ensure that the sensor will not interfere with engine mount etc. TIG welding is recommended. Remove the muffler or ensure that all electrical cables to the battery are disconnected before you perform any welding. **IMPORTANT** – The sensor must be orientated anywhere from vertical top mounted or at a maximum angle of +/- 80°. This is to prevent moisture contacting the ceramic sensor heating element.

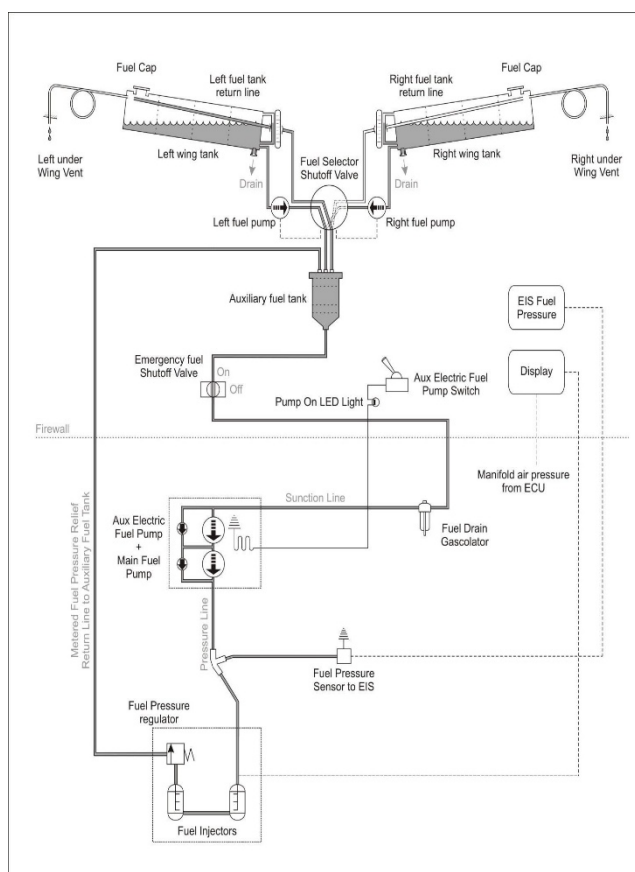


- 41 This picture shows the typical location of the O2 lambda sensor. The sensor is not intended to run on AVGAS. The sensor will correct the air/fuel mixture during normal operation. This ensures smooth running and optimal A/F ratio as well as a clean burning engine.



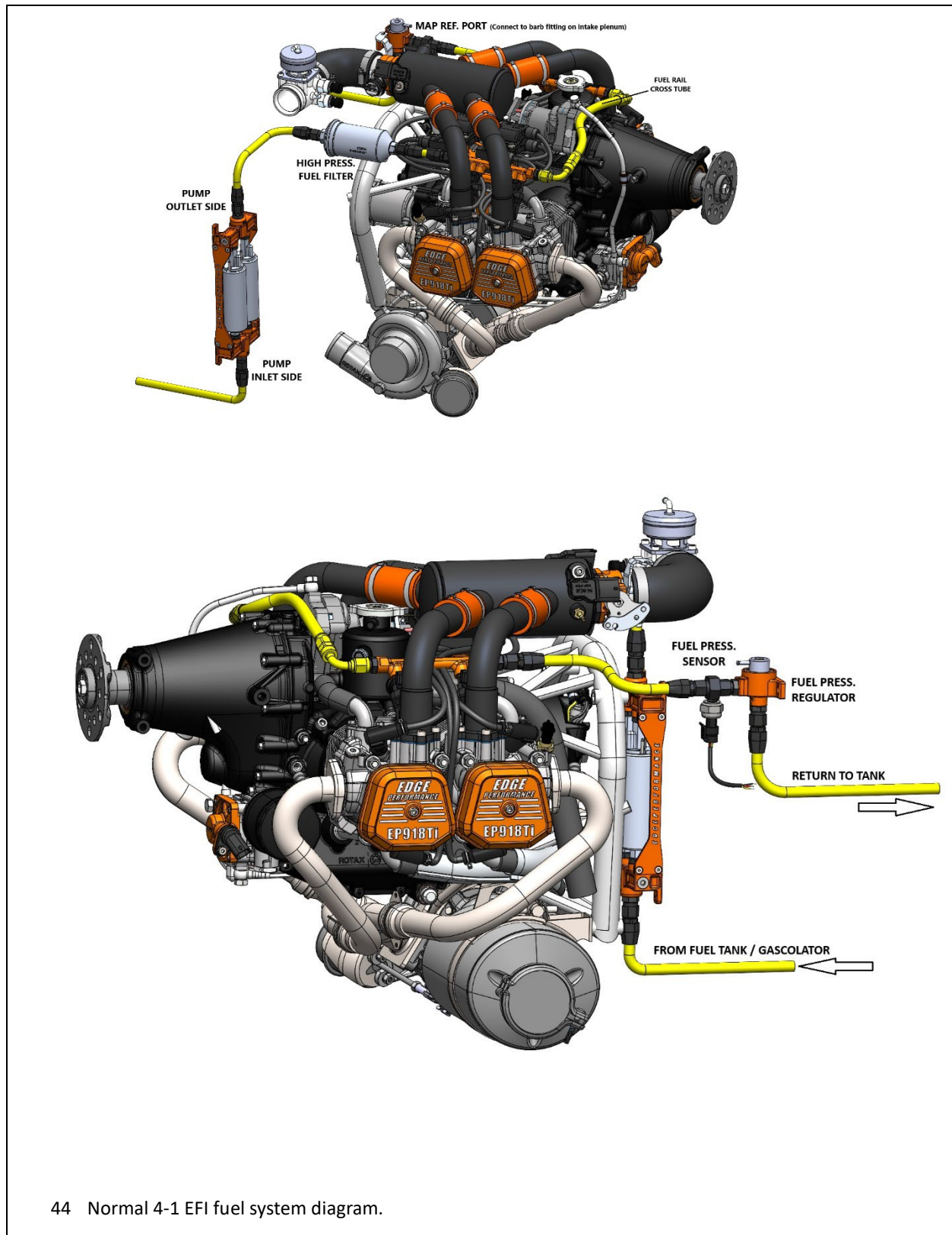
- 42 The Zeitronix Zt-3 controlled module is connector to the molex 4 and 6 pin connectors on the wiring harness. The small black connectors are near the ECU main connector. Plug the lambda sensor connector the the O2/Lambda labeled mating connector on the main wiring harness.

- 43 This is a typical high wing dual wing tank diagram. Left and right fuel tank through a left/right or both fuel selector. From the fuel selector to a header tank (1-4L). From the header tank to the fuel pumps. From the pumps to the HP fuel filter, and then to the fuel rails. From the fuel rail crossover tube, and to the second fuel rail, and finally to the FPR (Fuel Pressure Regulator).

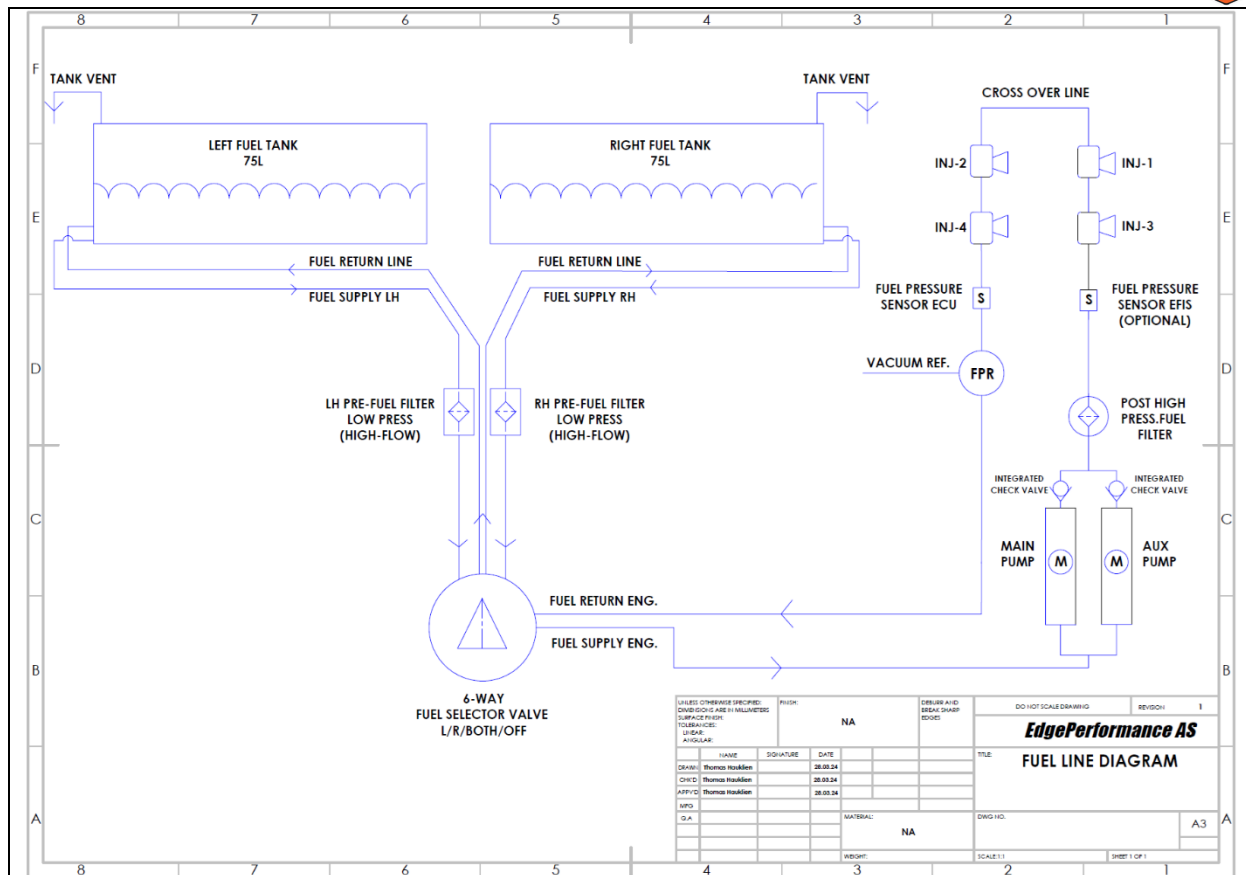




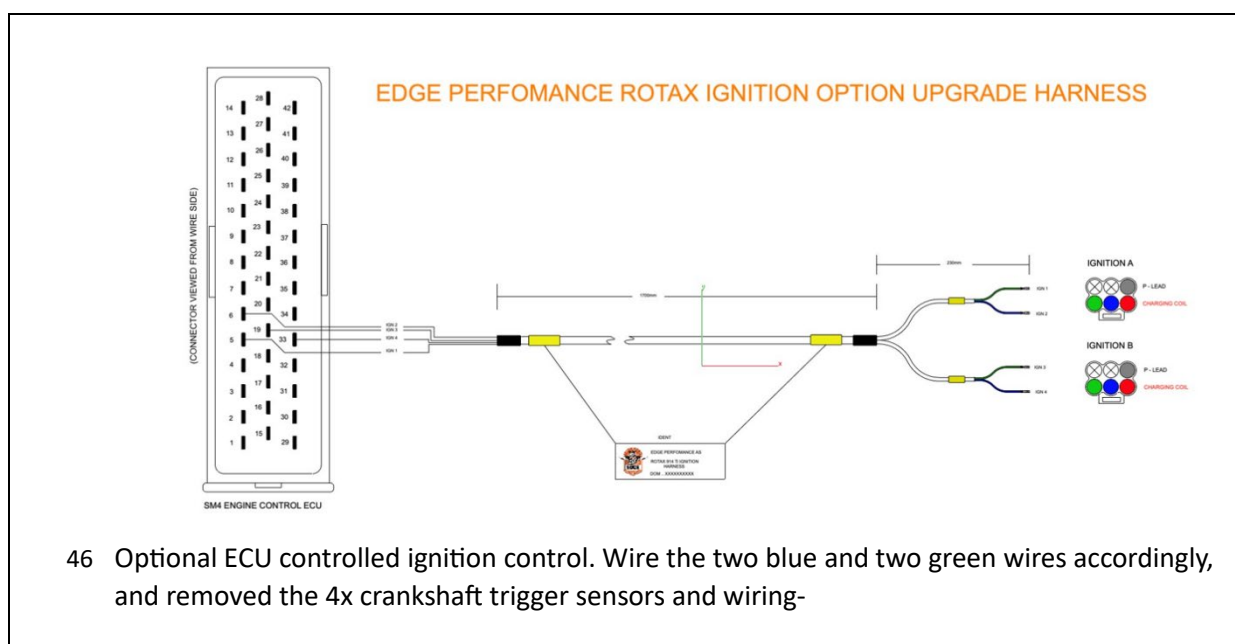
Return from the bottom port of the FRP back to the header tank. Ensure that the header tank is vented.







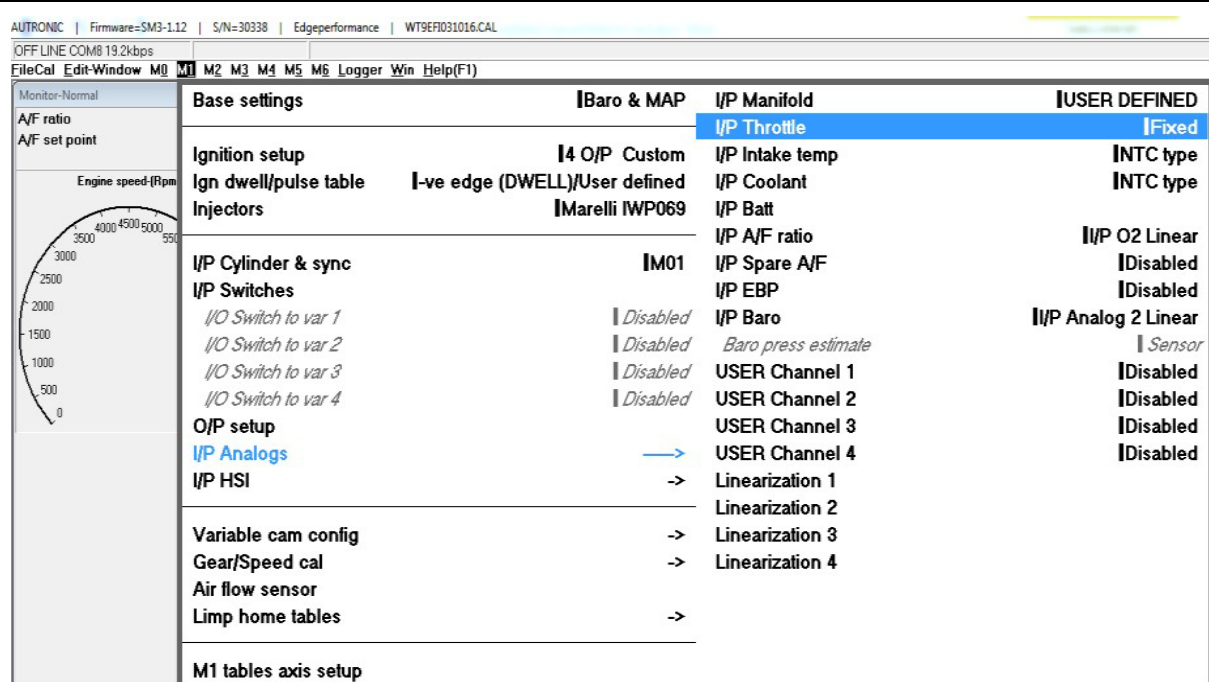
45 Fuel plumbing diagram for low wing dual tank installation.



46 Optional ECU controlled ignition control. Wire the two blue and two green wires accordingly, and removed the 4x crankshaft trigger sensors and wiring-



- 47 After the installation has been completed, turn on the fuel pump and test that both are working, verify fuel pressure 45psi/3bar +/- 5% and look after any signs of fuel leak.



- 48 After starting the engine and setting the idle, go to M1, I/P Analogs and I/P Throttle. Now you can set the TPS idle and WOT limit. The TPS voltage is displayed in the picture as shown in point 49.



I/P Throttle			Throttle position-(%)		Charge temp	Deg C
Parameters			Value		Battery voltage	Volts
			0.0	100.0	TPS volts	Volts
1	I/P Throttle	Fixed	LOAD	%	TPS learn zero	Volts
2	Error limit lo	0.000	Manifold pressure	Kpa	TPS learn full	Volts
3	Error limit hi	5.000	Ign. Angle-MEAN-	Degrees	Error Reg	Hex
4	0% limit	0.630	Inj. Time -MEAN-	mSec	Er.Throttle	On/Off
5	100% limit	4.721	Inj. Duty -MEAN-	%		
			Inj. End	Degrees		
			Inj. Start	Degrees		
			Intake temp	Deg C		
			Coolant temp	Deg C		

- 49 The TPS comes pre-set, but the idle set point may change as the user sets the idle stop.
- 50 The TPS volts is displayed at the bottom of your screen. Read of the TPS volts at idle and insert the value in row 4.

**0% limit.** Next set full throttle and insert the TPS volt into row 5. **100% limit.**

- 51 After start up, let the engine warm up and reach normal operating temperatures before verifying the Air/Fuel ratio.
- 52 Once warmed up (min 50°C on the oil) set the idle to 1600rpm with the idle set screw on the throttle body. Calibrate the TPS
- 53 The engine should start and run relatively smoothly right from the start. Small correction for cold/warm starting may be necessary in certain cases. Consult with EP or your local dealer for this.
- 54 Monitor EGT and/or AFR (Lambda O2) values. Here are some guidelines in terms of what you can expect or want to aim for **NOTE – ON A NORMALLY ASPIRATED ENGINE:**

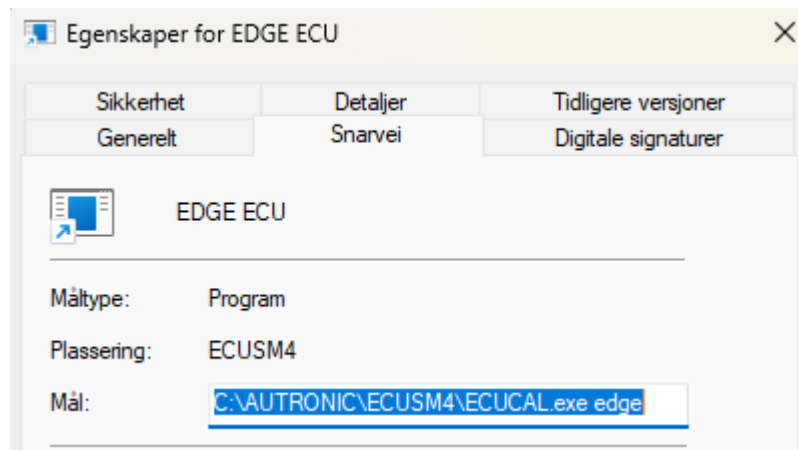
- EGT cruise – 780-820°C
- EGT full throttle – 760-780°C
- AFR 1500-3000rpm – 12.8-13.5
- AFR 3000-4600rpm – 13.8-14.5
- AFR 4600-5200rpm – 13.0-13.3

AFR 5200-5500rpm – 12.8-13.2

AFR 5500-5800rpm – 11.8-12.5 (MAY BE SET RICHER ON HIGH BOOST TURBO APPLICATIONS)



- 55 If minor changes must be made to the ECU map, there is included a DB9 to mini jack ECU communication cable, and a DB9 serial to USB serial converter. Download the ECU software SM4 Software from: <http://autronic.com.au/downloads.html>
- 56 Once installed, right click on the desktop icon, go to properties and add (space and edge) after .exe



- 57 Connect the cable to the ECU and laptop, power on the ECU and launch the software.
- 58 In device manager, verify which COM port is in use, and select the correct COM port when launching the SM4 Autronic software.
- 59 No changes should be made without training, proper instructions or without support from your local EP dealer. Always make sure to save the existing map to your laptop before making any changes. Saving the map is done by pressing F2. Storing changes into the ECU is done by pressing F4. When saving any changes to a new map, go to the top left corner menu (FileCal) and then save cal as. Right click with your right mouse button and choose to save as a new cal file. Enter a new name or revision number to the map to keep track of them.
- 60 Before disconnecting the ECU from the data cable press F3 and (go offline).





61 Refer to the tuning and setup manual for further ECU software instructions.

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