DI-IDC tracking water injection system

HFS4-v2 pwm

User manual -v2.1

Introducing the Aquamist HFS4-v2

Since the introduction of Water Injection Systems with fuel flow tracking by Aquamist in 2003, this method has truly earned its position in the performance industry as the most effective method to meter water/methanol flow for delivering predictable and consistent power.

In order to keep up to date with the fast pace of direct injection (Di) systems, we have refined the engine load detection circuitry to extract and process more engine load information. The newly revised algorithm of the HFS4-v2 reads fuel-IDC, high pressure fuel-line pressure and manifold pressure (boost).

A "Fast Acting Valve" (FAV) controls the delivery rate based on a PWM signal from the controller. The FAV enables superior linearity and atomization across the entire injection range compared to other systems. A constant line pressure (160 psi) to the FAV is provided by an Aquatec pump working in the "by-pass" mode. This method most closely follows the typical automotive fuel injection system for unmatched precision and driveability characteristics.

The combination of a superior method of delivery and a precision direct -injection signal decoding algorithm, the HFS-4 is the most advanced and capable injection system in the world today. In addition, it is also backward compatible with all conventional fuel injection systems.

The latest v2 has an addition user setting failsafe trigger.

Contents:

Checking the contents of the box carefully

This is a "must do" immediately after unpacking ....

Water pump

Unpack the corrugated sheet carefully. The pump should be labelled with the original custom Aquatec/Aquamist logo.

The white box

- 6M of 6mm OD nylon hose (806-261)
- 2M of 4mm OD nylon hose (806-266)
- HFS-4 Electronic controller
- 0.8 mm water jet (806-323) in plastic bag
- 0.9 mm water jet (806-324) in plastic bag
- 1.0 mm water jet (806-325) in plastic bag
- 1x 4mm Tee compression fitting (806-395) in plastic bag.
- 2x M8 x 1/8 NPT jet adapter with plug (806-357N)
- A set of three restrictors with insertion tool
- 1x water tank adapter 1/8 BSP (806-270), 6mm compression fitting and in-tank filter (806-258)
- 4x M5x40mm bolt, washers and fasteners for pump
- 1x M6 grounding stud with washer and nuts and 6mm eyelet for pump ground.
- 2x 6mm to 1/8 BSP compression fitting for pump..
- 2x 3/8BSP-M to 1/8BSP-F reducer for pump.
- 1x 4mm to 1/8 BSP compression fitting for FAV.
- 1x 6mm to 1/8 BSP compression fitting for FAV.
- Water pump harness. 6M of #12 AWG cable and 5M of multi-core cable with blue harness.
- 1x Fast Acting Valve with red harness
- 1x turbine flow sensor with yellow harness
- 1x water level switch with connector (806-281c)
- 1x DDS3v12 Gauge with 1.5M x 8-way cable
- 2.0 M of multi-core with grey capped RJ48 for ECU interface, fail-safe and map switching.
- Molex type 4-way power in harness
- Green harness for Direct Injection engines (v2.12).
- User manual

Note: Please contact your supplier immediately should you discover any missing parts.

Getting started on installation

Before installation guidelines

- The pump and water tank are designed to be fitted in the trunk. Install the water pump below the water tank if possible.
- Ensure all fittings are tightened and leak proof before filling up with methanol. **Test it with water first.** If a high concentration of methanol mix is used, please vent the tank's breather hole externally. Methanol is poisonous when inhaled.

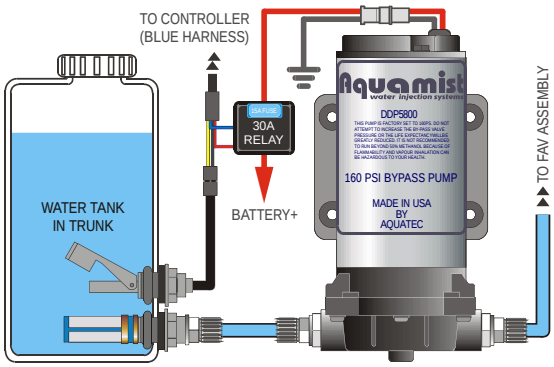
Assembling the pump in steps

- Gently assemble the two 3/8 BSP adapters into the pump without crossing the threads. Ensure the o-ring is properly embedded between the fitting and the I/O port. Do not over-tighten.

Water tank components

- Ensure the outlet is facing the rear or the side of the tank. Drill/bore a burr-free 23mm hole. Clear up all the burred edges and wash the tank thoroughly. No debris or plastic shavings should remain in the delivery system. Locating the outlet 1-2 inches from the bottom of the tank is ideal.
- Screw fit the in-tank filter on the inlet side of the tank adaptor. Insert the assembly into the tank and tighten the M16 plastic nut. Stop the assembly from rotating with a 6mm allen key into the centre of the assembly. Do not over tighten, to avoid splitting the rubber gasket seal.
- Drill the same hole size as the tank adapter for the water level sensor (23mm). IF using a washer tank for supply, do not locate the Aquamist float sensor near the stock washer pump. The float arm should swing upwards.

A tall and slim water tank is ideal for this type of application. This minimizes delivery surge problems at low water level.



Installation for long-term reliability

This is the most important section of the HFS-4 chapter. Please do not skip reading this part.

52mm Dash Gauge:

Location is not too critical as long as it is in view of the driver. There are not too many pitfalls on this.

HFS-4 controller box:

Please locate the box in a dry location in the passenger compartment. The glove box is a good place. Please allow plenty of slack to ease accessibility during tuning and diagnostic work.

Fast acting valve and flow sensor assembly (FAV):

The location of this module is most critical to overall system reliability. It is designed to be installed in the engine compartment,

This module must be installed in a cool, dry and well ventilated area and away from any heat source. The bulkhead/fire wall is not always a good location as most heat is flowing towards it during driving. Avoid locations near any electromagnetic components such as the ignition coil, solenoid valves and electronic motors. If possible, locate it not too far away from the water jet/jets.

It is very important that the hose is cut cleanly. It is also vital that the hose is cut perpendicular /square relative to its length. This is because the compression fitting has a short hosetail. An accurate cut will allow maximum grip on the walls of the hose.

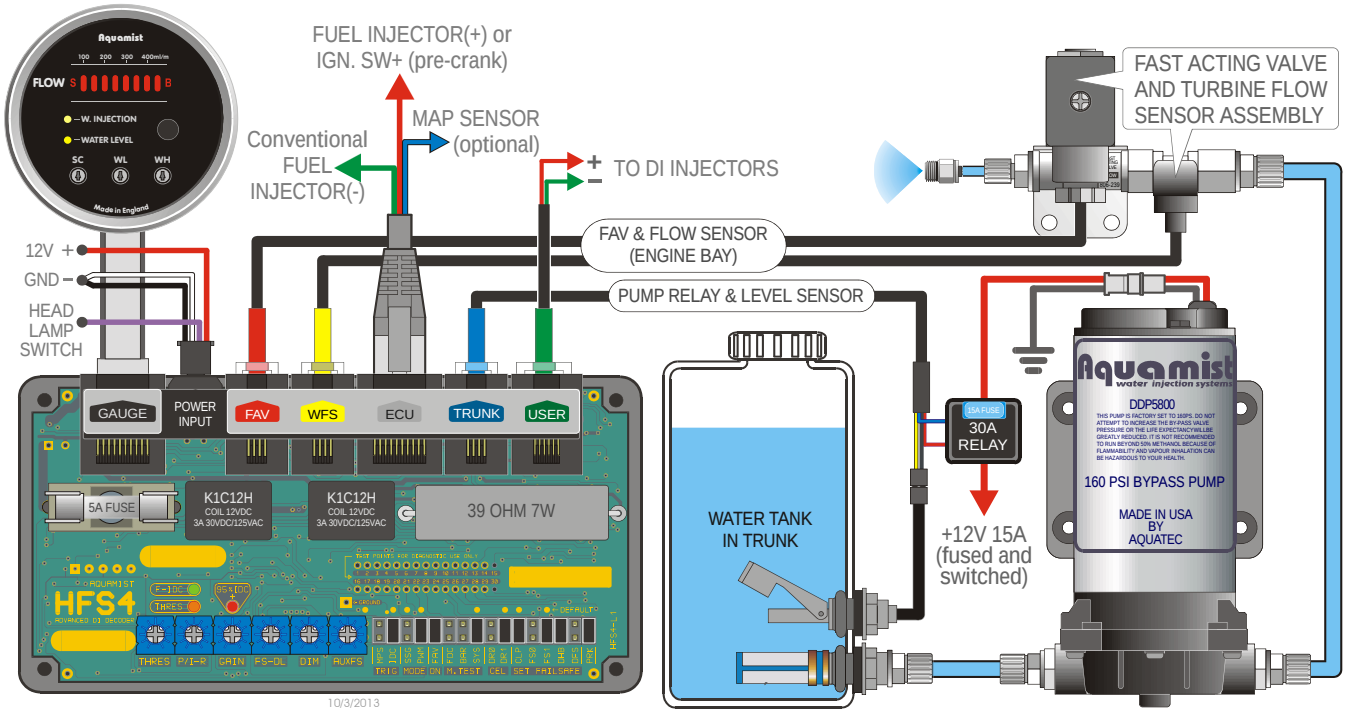
The thin rubber gasket must be placed between the FAV coil and electrical plug (red harness) before tightening. Press the clip of the yellow harness into the centre section of the flow sensor body. Orientation is not important. Ensure the electrical plug's cable outlet is facing downwards. All cables leading away from the assembly must be looped downwards to avoid condensed water trickling into the clip and plug. Never pull the cable to unclip the sensor.

The tank level sensor:

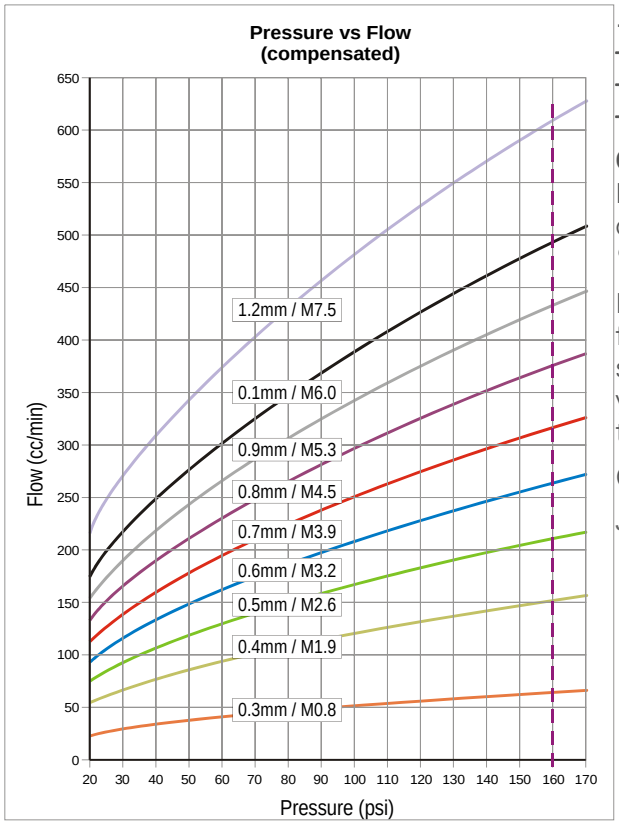
Drill/bore the same hole size as for the tank adaptor for the water level sensor. A 23mm burr-free hole must be used to ensure a good seal. The float arm should swing upwards. Check that there is ample room for the sensor arm to swing before drilling. A tall and slim water tank is ideal for this type of application. This minimizes delivery surge problems at low water levels.
If the stock washer tank is going to be used, do not mount the float near the stock washer pump. The motor magnet will affect the sensor reading properly. The sensor can be installed 3/4 way down the tank, preferably at the rear facing wall of the tank. Never over tighten or the seal will split; just tighten enough to prevent leakage, no more.

The pump/relay is **not** designed for engine bay installtion unless they are well insulated from water ingression.

Generic wiring diagram for HFS-4



Choosing jet sizes



.**This is a general guide only:**

- 100% water: run 10-15% water/fuel ratio.
- 50:50 methanol/water: run 15-20% to fuel.
- 100% methanol: run 20-25% to fuel

Choosing the jet by calculation:

First work out the total fuel flow by adding up the capacity of the fuel injectors. Multiply the result by the preferred % recommended above.

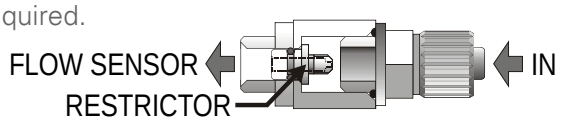
Pick the nearest jet/jets size to match the flow. Don't forget to subtract the boost pressure from the line pressure of 160psi. For example, if you are boosting 25psi, you should select the jet flow at 135psi. Allow 10-15% on top in case flow needs to be increased in future.

Once the jet/jets and flow are determined, insert the nearest larger restrictor to regulate the fluid flow so the delivery will be linear to the duty cycle.

JET	20	40	60	80	100	120	140	160	180	PSI
0.3	23	32	36	41	46	50	53	57	60	FLOW RATE CC / min
0.4	54	71	85	97	108	117	126	135	143	
0.5	75	99	118	134	149	163	175	186	197	
0.6	93	123	147	168	186	203	219	233	247	
0.7	112	148	177	202	224	244	262	280	296	
0.8	133	188	220	250	278	303	326	347	367	
0.9	153	217	252	288	319	348	374	399	422	
1.0	174	246	285	325	361	393	423	451	477	
1.2	215	305	373	431	482	528	570	610	646	

The HFS-4 is supplied with a set of high-flow water jets, sized at 0.8, 0.9 and 1.0mm (see chart for flow rate). A Tee is supplied with the kit for twin jet applications. There are two nickel plated brass jet adapters (1/8 NPT). The tapping hole should be 11/32" or 8.8mm. Do not over tap. Clean the mating part with alcohol first, and trial fit before loctiting into position.

Three restrictors are supplied for duty cycle/ flow matching should good linearity be required.



For flow greater than 1100cc/min you can omit it. It should be fitted in the hose side of 6mm fitting of the FAV assembly.

Undo the compression fitting from the FAV inlet port. Use the threaded insertion tool to push the restrictor into position, Apply a smear of grease to avoid damaging the o-ring.

0.5mm restrictor ..... 0 - 380cc/min
0.7mm restrictor ..... 0 - 680cc/min
0.9mm restrictor ..... 0 - 1080cc/min

Applications involving a methanol mix beyond 50%:

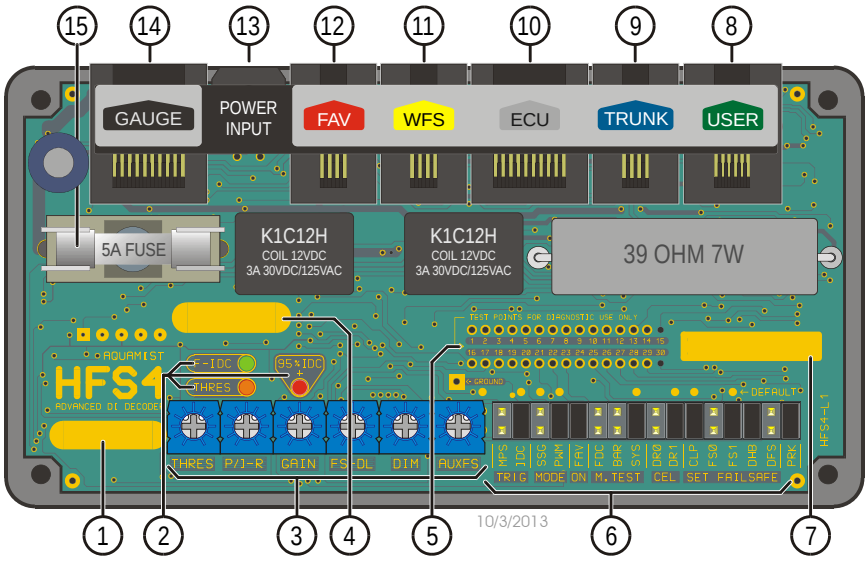
Great care and attention must be taken to ensure the fluid tank is capable of handling methanol and is designed for this type of application. These tanks are normally termed as a Fuel Cell and are available from most reputable racing parts suppliers. Anti-surge foam should be used for circuit racing. Follow the maker's guidelines carefully.

The breather hole must be vented externally with a suitable hose. All fluid delivery hoses and fittings must be leak-free Ensure the area is well ventilated and isolated from the driver's compartment. Take whatever measures necessary to avoid any methanol fumes building up in trunk area.

Methanol is highly flammable. The main delivery hose to the engine bay should be routed underneath the car. Ensure it is securely clipped and fastened. Avoid kinks and close proximity of moving parts and heat producing components. Please treat this recommendation seriously. If in doubt, ask advice from a professional person familiar with this kind of application. DO NOT take any undue risks. It is recommended that a suitable fire extinguisher is placed within easy reach of the driver. All electrical connections must be properly tightened to avoid spark production.

Warning: Prolonged use of 100% methanol may cause premature pump failure and may not be covered under warranty.

HFS-4 function directory



1. CONTROLLER SERIAL NUMBER
2. SYSTEM STATUS LED INDICATORS (P.13)
3. SYSTEM CONTROL TRIMMERS (P.13)
4. FLOW SENSOR MAP IDENTIFICATION
5. 30 TEST POINTS FOR SYSTEM DIAGNOSTIC WORK
6. SYSTEM CONFIGURATION JUMPER LINKS (P.12)
7. CUSTOM CONFIGURATIONS IDENTIFICATION
8. DI INPUT and FLOW SENSOR SIGNAL OUTPUT (P. 20-22)
9. LEVEL SENSOR and PUMP CONTROL: BLUE HARNESS:
10. ECU INTERFACE I/O PORTS: GREY HARNESS (P.7, 18, 20)
11. FLOW SENSOR I/O PORTS : YELLOW HARNESS (P.7)
12. FAST ACTING VALVE (FAV) OUTPUT: RED HARNESS (P.7)
13. POWER INPUT: 4-WAY MOLEX TYPE CONNECTOR. (P.7,11)
14. DASH GAUGE INPUT: RJ45 FLAT CABLE (P.7, .15)
15. 5A SYSTEM FUSE (QUICK BLOW). DO NOT REPLACE IT WITH A HIGHER RATED FUSE. (P. 7)

Quick Start

Mechanical work (checklist):
Only after testing with distilled water should methanol be used. BEFORE hooking up line to the jet the system should be manually activated to flush any possibly dirt/debris from the lines.

Wiring work for first three harness only:
The HFS-4 is pre-configured from the factory. Only plug in the following harness for testing the power supply into the controller.

1. 4-way Power-in connector:
- Red ..... Switched 12V (IGN SW/pre-crank)
- Black ..... Chassis ground
- White ..... Chassis ground
- Purple ..... Head lamp (+)switch (optional)

2. Signal to the grey RJ48 connector:
- Red ..... Ignition switched 12V(pre-crank)
- Green ..... Fuel injector (-) pin (conventional)
- Blue ..... MAP sensor (optional)

3. Black flat cable to the Dash Gauge

Power-up procedure:
Please follow this procedure "strictly" or permanent damage to the system may result. Do NOT SKIP any steps please....

1. Ignition key in the "OFF" or "0" position:
- Dash Gauge button is depressed (system on).
- No LEDs should be lit anywhere.

2. Ignition key in the "ACC" or "#1" position:
Absolutely no change, same as the above conditions.

3. Ignition key in the "pre-cranking" or "#2" position: -
- Do not crank. Observe the gauge LEDs. Yellow LED on the gauge will stay lit for 5-10s before the rest of the gauge lights up. Safe to continue testing.

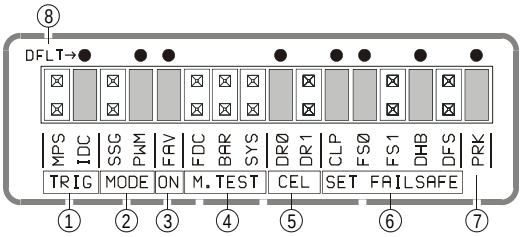
4. Start the engine and let it idle for a minute or so:
- The green LED on the controller should flicker. The flicker should speed up with engine speed. If the system behaves as stated above, you have successfully wired up the HFS-4!

Now plug in the rest of the harnesses:
- The "S" LED should confirm the presence of the flow sensor.
- The yellow LED will activate if the tank level is low.

This completes the basic system test. The next stage will be testing the system manually by using the jumper links on the controller board.

System setting and manual testing.

Knowing the default controller functions:
(function explained from left to right)



1.TRIG:
The system is set to be triggered by IDC (fuel injector duty cycle) % from factory. The alternative trigger mode is MPS (Manifold Pressure Sensor). Flow will be progressive depends on "MODE" setting.

2. MODE:
- PWM mode (factory default): Flow can be progressive with IDC, Boost or Both (P/I R trimmer P.13.2).
- SSG (single stage) mode: "all on" or "all off"

3. ON: Enabled FAV (default) or disable FAV.

4. M. TEST:
- FDC: Link to display F-IDC on gauge (testing only)
- BAR: Link to test bargraph with the "SC" trimmer.
- SYS: This link can be used to activate the system for testing. For pump activation only, unlink the #3 (FAV) to disable FAV to avoid hydro-locking.

5. CEL:
Boost cut without CEL (check engine light) activation. This is only used in conjunction with internal relay fail-safe output. DR1 = No CEL.

6. SET FAIL SAFE:
- CLP (factory default): Output voltage is clipped from 8V to 5V.
- FS0 (factory default): Fail-safe output to ground upon activation.
- FS1: Fail-safe output switches from 0 to 5V or 8V upon activation.
(this fail-safe output option is on the orange wire of the grey harness.

- DHB (defaut=linked):"Disable High Boost". When the gauge is switched off, all fail-safe outputs become activated. This safe guards any engine damage. If the DHB is "unlinked", the yellow LED (water level) will be lit when the gauge is switched off, giving the user a reminder that the engine is not protected againist "High Boost".

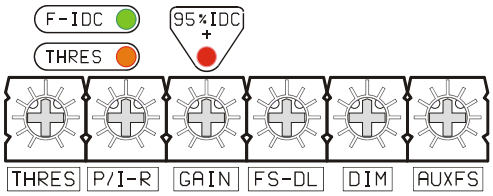
- DFS (defaut=unlinked):"Disable Fail-Safe". Link to stop all fail-safe activation during test or preliminary test run prior to finalizing fail-safe window. .

7. PRK: Parking for unused jumper link.

8. DEFAULT: Factory default setting (gold dots)

Flow management and other trimmers

Setting the onboard trimmers: (default=12 o'clock)



The system requires no trimming from factory. If the user wants to alter the flow and other parameters, just use a small screwdriver to complete the task.

Below are the working details of each trimmer. (left to right).

1. LED panel:

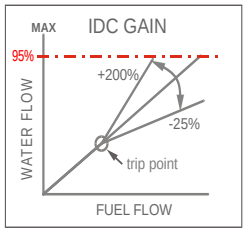
- Green (F-IDC): Blinks upon successful detection of fuel injector duty cycle signal. The blink rate and brightness increase with engine speed and duty cycle respectively.

- Amber (THRES): At 42% F-IDC (default), this LED will activate, confirming the system is triggered and delivery commences.

- Red (95% DC): When the water/methanol duty cycle is approaching 95%, the red LED begins to turn on, indicating that you have almost reached the maximum flow of your system. More flow requires additional jets.

2. Trimmers for fine tuning:

- THRES: Factory set to 42% (12 o'clock), User adjustment range is between 12 to 72% (fully clockwise).



- GAIN: Increases/decreases the rate of ramp relative to the incoming signal after trigger point. No flow increase is expected when the 95% IDC+ red LED is activated.

- P/I-R: Alter the flow relative to boost or fuel. For 100% boost controlled, set the trimmer fully counter-clockwise. Vice versa for fuel. Trimmer at mid point is 50% pressure and 50% IDC.

- FS-DL: Fail-safe delay to undue fail-safe activation due to spikes and noise signal from the flow sensor. The factory default setting (12-o'clock) is 400mS (milli-second). User adjustable between 200mS to 600mS.

- DIM: Activated when the purple wire of the power connected is connected to a 12V source. Headlamp (+) is an ideal location.

- AUXFS: Setting the "over-range" of Auxillary Failsafe input (Page: 21.3). Additional failsafe for third-party signal to active the HFS4's onboard failsafe relay to reduce boost. Useful for engine equipped with a WBO2 sensor or EGT probe. Input range is 0-5V.

Preparation for a test run of the system (spray test)

1. First step - system check list:

a. Tank and pump are fully secured and leak free.
b. The FAV assembly is securely located in a cool and dry spot of the engine bay.
c. The controller is accessible and can be secured down with minimum movement during motoring.
d. The jets are securely installed on the windscreen.
e. Dash gauge installed and in sight.

2. Priming and purging of the system:

a. Fill up the tank with water half way.

b. Disconnect the 6mm hose from the FAV assembly and put the hose into a container securely.

c. Ignition switch in pre-crank position and gauge is switched on. Uncover the controller and pull out the "FAV" jumper (disabling the FAV) and put it to the link marked "SYS". The pump should power up and water should come out of the 6mm hose within a few seconds, Let it run for 10-20 seconds so that trapped air and debris are purged.

d. Listen to the pump during the priming period; it should go very quiet after completion of the purging procedure. If not, repeat step "c".

e. Upon successful completion of the above, reinstate the 6mm hose into the FAV assembly.

3. Test spray pattern and SC setting:

a. Secure the intended jet/jets onto the windscreen and connect it to the outlet port of the FAV assembly.

b. Activate the system by linking up "FAV" and "SYS" on the controller. You should see an instant full-cone spray at the jet. Do it for a few seconds only. Good time to set the SC (on the gauge) to display 5-6 bars. Remove the "SYS" test link after test. Leave the FAV jumper link in the slot.

4. Activate the system by F-IDC:

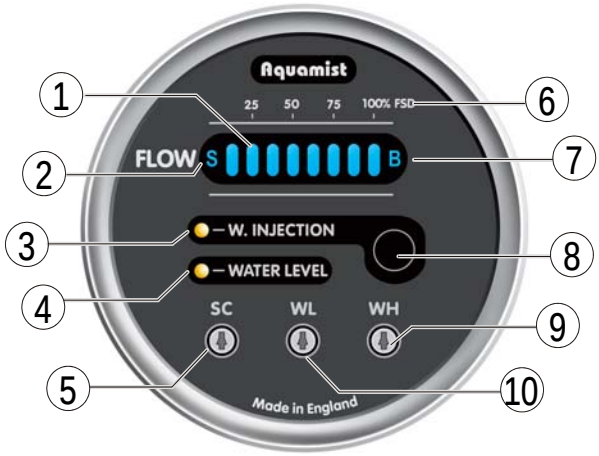
a. Set the "THRES" trimmer to fully counter-clockwise. Crank the engine and leave it to idle. You should see the blinking green LED on the controller board.

b. Blip the accelerator paddle sharply to induce an artificial load. The amber LED should respond. A faint but noticeable spray should develop at the jet. This may not work with very large capacity injectors. A test drive under load is necessary in this case.

5. Road test the system:

Still with jet on the windscreen, make a short drive and confirm the spray is progressive with load. After a successful road test, The system is now ready for dialling in the failsafe windows WL and WH.

Dash Gauge Functions



1. 8-element Bargraph (0-100% Fullscale)
Each segment is equivalent to a percentage of the total flow of the sensor scaled by the SC potentiometer.

2. "S" indicates the presence of a flow sensor.
The letter "S" (sensor) must be lit after power up and stay on to show the flow sensor cable is connected and on-standby.

3. Fail-safe activation LED (normally off)
When the fail-safe is triggered. This yellow LED will illuminate "with" the water tank level LED below it.

4. Water Level LED + Failsafe (yellow)
(This LED has three functions)

a. During "power on delay" period:
This LED will activate for approximately for 5 seconds during the system-on delay before the main system turns on. Check tank level if the system does not start.

b. During normal operation period:
This LED is on during the fail-safe activation (in conjunction with the yellow LED above). Water level low (intermittent flashes). Solid after 20s of low level detection.

c. LED stays lit after the gauge is switched off:
This LED warns the user that the DHB (Disable High Boost) jumper is unlinked (p.12.7). The engine is no longer protected by low boost or safe-map.

5. SC (Sensor Calibration) - default table
20-stepped potentiometer allows user to scale the flow sensor to give an ideal visual indication of a given flow rate. Ideally, set the LED to display 5-6 bars at full flow. (page 22 for alternative flow tables)

6. Backlit flow legend
Legend displays % of full scale of 8-bars

7. "B" High Boost Enabled LED
When the flow falls inside the fail-safe window after the system triggers, the "B" LED will activate. This is a useful indicator that the WL and WH are set up correctly. It also stays lit if the DFS jumper is selected.

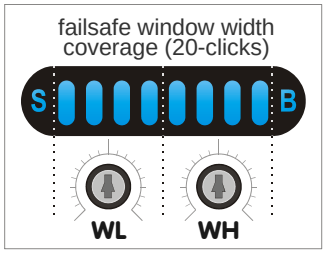
Dash Gauge Functions cont.

8. Water injection enable button
Due to extra power level achieved under WI, user may want to reduce the power to the wheels in less than ideal driving conditions. Disabling the WI will reduce boost to the wastegate bleed valve setting (if fitted) as well as switching to a less aggressive MAP on custom engine management.

9. Over-range setting potentiometer (WH)
It is just as important to monitor over-range conditions as well as under-range flow conditions. If a leak develops close to the water jet and starves the engine of the water, the user must know this condition.. A 20-stepped potentiometer allows accurate and repeatable adjustment range.

10. Under-range setting potentiometer (WL)
This setting can indicate partial blockage and trapped air inside a delivery hose. Again a 20-stepped potentiometer is employed. Each click represents a fixed portion of the window width of 8-bars.

WL covers the lower 4 bars of the display and the WH covers the upper 4 bars. The figure on the right illustrates the span of the coverage. Setting is very simple once SC is calibrated.



NOTE:
In order to make the fail-safe adjustment easier, it is recommended to set the bargraph to display 5-6 bars at maximum flow. This way, the fail-safe window can span from the centre outwards.

If the WL and WH is set at 12 o'clock, the fail-safe window is approximately spanned between 2-7 bars. This is a good starting point.

Minor trimming for the WL is necessary if the water injection trigger point is set to commence earlier.

The gauge will display the activation of the "fail-safe" with two yellow LEDs:

1. "B" LED (right of the bargraph) will only stay activated if the flow is inside the fail-safe window during the injection period.

2. The two "yellow" LEDs Both LEDs will activate when the fail-safe is triggered. Only the lower LED illuminates during low tank level.

As soon as the "fail-safe" is tripped, there will be a 3 second reset period before it resets while the fail-safe drops boost.

When the gauge is switched off, expect low boost and safe MAP unless the board is re- configured to DHB (page 12.7).

Setting up the fail-safe

This final stage should be quick, simple and effective. Please read it before proceeding. It will save you time in the long run.

If fluid flow falls inside the fail-safe detection window after triggering, no action will be taken. Setting up the width of the window to accommodate the full fluid flow is vital.

Setting up the fail-safe should only be done after the car has been tuned or the jet/jets sizes are finalized.

Recommended steps to set up the fail-safe

1. Adjust the "SC" to display 5-6 bars at full power.

2. Make a mental note of the number of displayed bars during spool up. This is made easier in a higher gear.

3. Set the WL to match the number of spool-up bars. It is recommended to allow 2-3 clicks below that point to avoid false triggering. Full span of WL is 20 clicks, covering from 0 bar to 4 bars.

4. Same procedure is used to set up the WH, allowing 2-3 clicks above 6 bars. Full span of WH is 20 clicks covering 4-8 bars.

This completes the fail-safe set-up ...

What steps to take after the fail-safe triggers

The most common way to minimize engine damage in the absence of injection is to reduce the boost pressure.

1. For engines with an electronic boost control valve: The grey harness contains a set of relay contacts that goes open circuit when the fail-safe is triggered. See page 18.2 and 19 for more details.

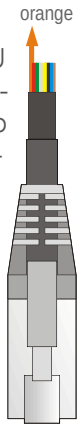
2. For engines with MBC (manual boost controller): The onboard fail-safe relay can be used to control a 3-port solenoid valve to by-pass the MBC or a stepper motor type of boost controller. Essentially, this directs full boost to the wastegate.

3. For an engine with MAP switching capabilities: The orange wire on the grey connector has a dedicated output to perform such a task. This pin can be user configured to match the signal requirement of the "third party" ECU to switch MAP. See page 18-1 for more details. This pin is factory configured to give a 5V for "OK" and "0v" is "flow fault"

Maximum current of this output is 5mA.

Setting up the alternative Fail-safe Channels

1. The MAP Switching Channel:
The orange wire from the grey RJ48 connector is a voltage based MAP Switching for an ECU equipped with this input. This wire is factory configured to send out a voltage of 4.7V DC under a "no fault " condition, from idle to full boost. This voltage will switch to 0v upon a fail-safe activation or the gauge is switched off.



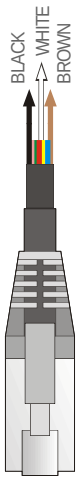
Other voltages such as 0, 5V or 8V can be user configured (page 12.7) This is by far the most effective method to save your engine from lack of water injection. A jumper link can invert the MAP switch output if necessary.

Although it is simple and convenient to use a single wire to communicate a fail-safe activation, this can only be achieved "as long as" the system is powered up properly. The alternative way is to use the on-board relay to convey a fail-safe activation since the relay will guarantee a "make or break" circuit when system's power is lost or a blown system fuse.

2. Change-over relay: (HFS-4)
The HFS-4 has an onboard relay to supply a set of voltage-free, change-over contacts for the sole use of fail-safe activation. It can be used to perform various tasks to save your engine. Contact rated up to 1 amp.

Please refer to page 19 for full switching sequence under various conditions.

Example1: OE boost control valve (BCV):
Disabling the OE boost control valve. "Cut and splice" the boost control circuit. White to "ECU side". Brown to "BCV side". You will need to link the "Anti-CEL" option on page 12.6 to avoid the onset of CEL during fail-safe activation. Dummy resistor replaces the BCV.



Example 2: (third party boost controllers)
Disabling the third party electronic boost control system. "Cut and splice" the pulsed wire to the BCV. White to the "Controller" and Brown to the "BCV" side.

This option will not work with EBC (Electronic Boost controller) utilizing a stepper motor to control boost. HKS-EVC is such an example. Use the MAC valve option on page 17.

Note: During the initial testing period soon after the installation, you can disable the fail-safe from activation by connecting the "DFS" (Disable Fail Safe) jumper link.

Relay Fail-safe output switching tables

● NORMAL SYSTEM OPERATION
● FAIL SAFE ACTIVATED

		DHB LINKED (DEFAULT)	DHB UNLINKED	DFS LINKED	DFS UN-LINKED (DEFAULT)
1	IGNITION SW. KEY - OUT	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK
2	IGN.SW - ACCESSORY	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK
3	GAUGE OFF IGN.SW @ PRE-CRANK/RUN	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK
4	GAUGE ON IGNITION @ PRE-CRANK/RUN	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK
5	GAUGE ON (NOT TRIGGERED) IGNITION @ PRE-CRANK/RUN	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK
6	GAUGE ON (TRIGGERED) FLOW INSIDE FAILSAFE WINDOW	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK
7	GAUGE ON (TRIGGERED) FLOW OUTSIDE FAILSAFE WINDOW	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK
8	GAUGE ON (FAILSAFE TRIGGERED) RESET AFTER ~3 SECONDS	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK	● WHITE — BROWN / BLACK

Fail-safe relay output truth table:
The above table is created to simplify the fail-safe relay switching status under all circumstances.

White, Brown and Black wires are located in the grey harness. The relay contacts are capable of switching 1A@30V continuous and 3A pulsed due to the 24awg wires used.

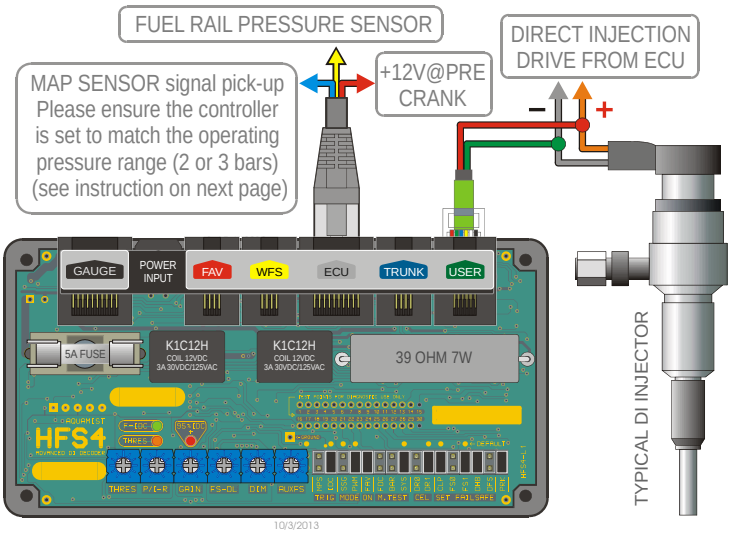
Based on the table above, you can use these contacts to either connect or disconnect electro-mechanical components such as a wastegate control valve or third party fail-safe devices. The contacts are gold flashed so it can be used for low current signal switching.

Direct injection fuel system integration

DI engine overview:
Due to the vast variation of switching methods employed on the direct-injection fueling systems, we have created a special input channel for the sole purpose of decoding those complex signals. In addition to the IDC input we added two more engine load related signals: boost pressure and fuel rail pressure. Only when combining those signals are we able to determine the actual fuel flow in real time.

DI signal pre-amplification:
The vast range of DI waveforms and pulse durations require different levels of gains to achieve full flow range. The HFS-4 has three pre-set amplifications. x1 (default), x1.5 and x2.5. x2.5 will cover 95% of pulse duration systems of 0 to 5mS (common DI systems). .(see page 21 for re-configuration details)

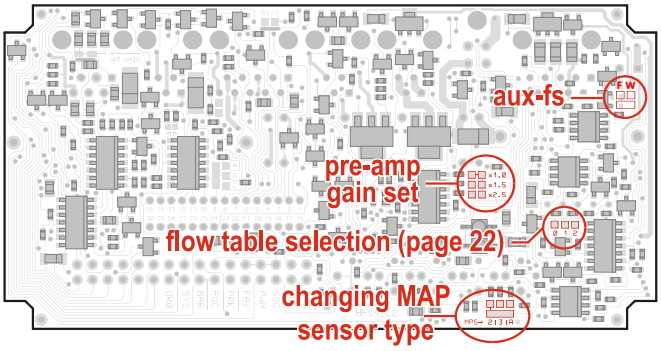
MAP sensor input:
This sensor monitors the manifold pressure. Depending on the application, the sensor's operating range can vary from car to car. The HFS-4 is equipped with three pre-configured ranges: Absolute, (default) 2-bar and 3-bar.



The user needs to pre-set this (see page 21.2 for more details).

Fuel rail pressure input:
As the fuel flow is governed by pulse width as well as fuel pressure, the HFS-4 has an input to monitor this pressure and alter the water/methanol flow proportionally. The correction factor is set internally and cannot be changed. This input is on the yellow wire of the grey connector.

Direction injection wiring and advanced configurations

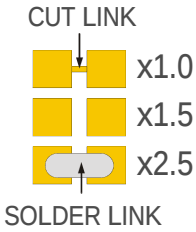


1. Configuring the pre-amp gain:
(Three gain settings are available)

(a) x1.0 (default): This one is for conventional fuel injection systems and some DI systems.

(b) x1.5: For systems with over-sized fuel injectors designed for E85 fuel that run on 100% gasoline.

(c) x2.5: For 95% of the current DI fueling systems.



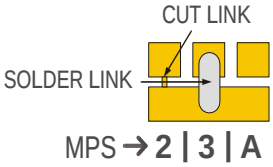
Note: If you are unsure which one of the above settings are correct for your engine, use the FDC jumper link (P12.5) to change the gauge display to show fuel duty cycle instead of water flow.

2. Configuring the MAP sensor type:
(Three types of MAP sensors can be selected)

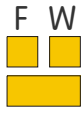
(a) Absolute (default): This can be used for any sensors with 0-5V output, such as throttle position, mass air flow sensors etc.

(b) 2-bar MAP sensor: Select this link to convert a 2.5 bar MAP sensor to read from atmospheric to 22psi full scale 0-5V output.

(c) 3- bar MAP sensor: Select this link to convert a 3.5 bar MAP sensor to read from atmospheric to 36psi full scale 0-5V output.



3. Activating the AUXFS:
Addition failsafe option for the HFS4-v2. The blue wire of the green harness can be used to trigger the failsafe relay (F) or the water level led (W) if the voltage of signal goes above the AUXFS trimmer on the controller. Voltage range is between 0-5V. You need to solder link either one of both of the copper pads to activate.

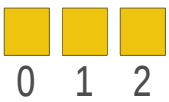


HFS-4 flow sensor range configuration

The HFS-4 flow sensor:
Extensive progress has been made over the last few years to stretch the operating range of the new flow sensor assembly, now up to 2,500cc/min coverage.

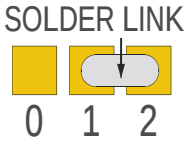
In order to maximize the output resolution from one to multiple jets, we have created three flow tables for single, twin and four jet applications.

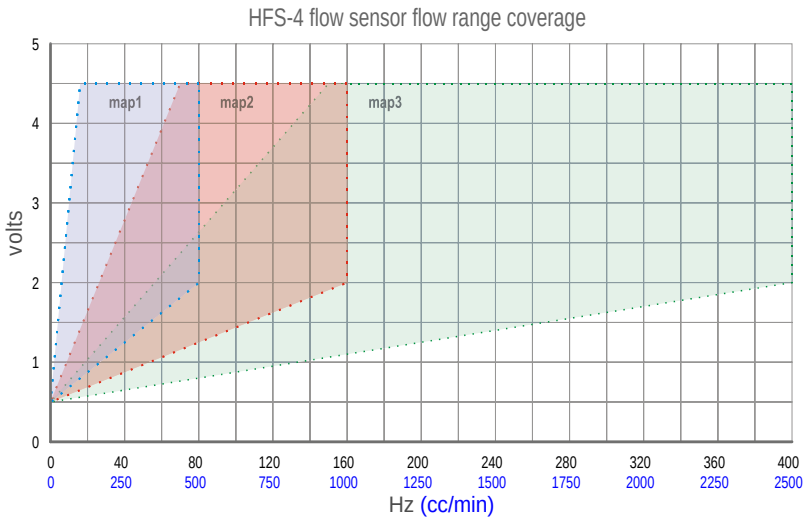
Changing the table requires a simple under-board "Cut and solder link" operation. See page 21.



The image on the right shows a factory default (map2) table.

There is no need to modify the board if you intend to run two jets, flowing within the region of map2 (see chart: up to 1000cc/min). However, if you are running three or more jets, you need to modify the circuit board by depositing a solder blob covering pads 1 and 2. See diagram on the right. 0+1 for one jet.





Note: For the benefit of third party controllers, fail-safe and data logging purposes, raw pulses and signal conditioned voltage from the flow sensor are available on yellow (voltage) and white wire (5V pulses) of the green harness.

Appendix

Pin	Colour	Size	Description	Electrical parameter
Molex Microfit power harness (1.5 M): Main Power supply and Dimmer control				
1	red	20awg	+12V Power supply (switched)	250mA max@12v
2	purple	20awg	Gauge dimming input to head lamp switch+	0-5 VDC @10mA
3	white	20awg	0V Ground (signal ground)	250mA max@12v
4	black	20awg	0V Ground (Power ground)	1A @12V max.
Red Harness to Engine bay (2.5M): To Flow Control assembly				
1	red	24awg	+12V PSU to Fast acting valve	1A max @12v
2	yellow	24awg	+12V PSU to Fast acting valve	1A max @12v
3	blue	24awg	PWM ground switch to Fast acting valve	1A max @0v
4	black	24awg	PWM ground switch to Fast acting valve	1A max @0v
Yellow Harness to Engine bay (2.5M): To Flow Control assembly				
1	red	24awg	+5V Power supply to Turbine flow sensor	5mA max @5v
2	yellow	24awg	Turbine fow sensor signal output	1mA max @5v
3	blue	24awg	Feedback signal (return ground)	1mA max @0v
4	black	24awg	0V/ground power supply	1mA max @0v
Grey Harness to EMS (2.5M): IDC/Boost detection and Fail-Safe / Map-Switching interface				
1	===	24awg	Reserved for external plug-in use only	----------
2	red	24awg	Ignition Switching detection	30mA max@12v
3	green	24awg	Fuel injection IDC detection	10mA max@12v
4	orange	24awg	Map switching interfacing	0.5V, 7.5V @1mA
5	white	24awg	Failsafe Relay contact (COM, Wiper)	1A @24V max.
6	yellow	24awg	High pressure fuel pump signal inpput	0-5VDC @100uA
7	blue	24awg	Map Sensor Signal input	0-5 VDC@100uA
8	black	24awg	Failsafe Relay contact (N/C contact) or DR	1A @24V max.
9	brown	24awg	Failsafe Relay contact (N/O contact)	1A @24V max.
10	===	24awg	Reserved for external pluig in use	----------
Blue Harness to Trunk Area (6M):				
1	red	24awg	+12V Power supply to 40A relay	0.5A max @12v
2	yellow	24awg	Water level sensor signal	signal ground 0.5A
3	blue	24awg	Pump relay activation (ground switch)	----------
4	black	24awg	Water level sensor ground	----------
Green Harness: For direct injection engines (2M+):				
1	red	24awg	DI injector (+) signal pick-up	input
2	green	24awg	DI injector (+) signal pick-up	input
3	blue	24awg	Auxillary input	----------
4	yellow	24awg	Flow sensor S-conditioned. voltage output	0.5v TO 4.5v
5	white	24awg	Flow sensor raw pullse output	TTL logic
6	black	24awg	system signal in/out ground	---------
Power supply cable to pump (6M):				
1	Red	12awg	12V Power cable to water pump relay	38A @12V max.

GUARANTEE

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Any claim against us must be made to us in writing within the period of 12 months after the sale by us , or our agents, or our distributors of goods in question (or such other period as may be indicated by us) and any goods to which the claim relates must be returned to us within that period suitably packaged and cleaned and, with any particular instructions which we may have notified to you at the time of supply. Original invoice, the nature of any claimed defect must accompany the goods in question prior to despatch to us.

If these requirements are not complied with our Guarantee shall not apply and we shall be discharged from all liability arising from the supply of defective goods.

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We shall not be under any liability whether in contract, or tort or otherwise and whether or not resulting from our negligence or that of our employees, in respect of defects in goods supplied or for any damage or loss resulting from such defects.

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THE END