



HFE International

Electronic Fuel Injected Desert Aircraft Engines

OWNER'S MANUAL



Document Revision Table					
Rev.	Description of Change	Revised by	Revision Date	Approved By	Approved Date
A	Initial Release	K.GRATIEN	2021/09/17	DRB	2021/09/27
B	Updated EFI Warranty wording	K. DICKEY	2023/02/08	J. JERRICK	2023/02/08
C	Added Duo Tubing and 10 micron Filter	T.West	2023/09/15	DRB	2023/10/23



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General Safety:

Read and understand this Owner's Manual before operating your engine. You can help prevent accidents by being familiar with the controls and observing safe operating procedures.

Operator's Responsibility:

1. The operator should know how to stop the engine quickly in case of an emergency.
2. A safety zone around the propeller should be established in which no person or object is allowed to enter. Install a guard around the propeller when appropriate.



WARNING

1. Observe all safety precautions when working around the propeller.
2. Exhaust contains poisonous carbon monoxide, a colorless and odorless gas. Breathing carbon monoxide can cause loss of consciousness and may lead to death.
3. Never run your engine in an enclosed space. Always allow for appropriate ventilation.
4. Observe precaution around the muffler. The exhaust system gets hot enough to ignite some materials.
5. Keep flammable materials away from the engine.
6. Gasoline is extremely flammable and is explosive under certain conditions. Do not smoke or allow flames or sparks where the engine is operating.

Un-Packing Your Engine:

Caution

Your engine comes with wire harnesses attached to the intake assembly. Handle the engine with care when removing the assembly from the box.

Package Contents:

1. Engine with Intake Assembly
2. Engine Control Unit (ECM)
3. Main Wire Harness
4. Fuel Pump
5. Ignition
6. Fuel Lines & Pressure Lines
7. Air & Fuel Filters
8. Owner's Manual
9. (Optional) Mufflers and Installation hardware



ATTENTION

Observe Precautions for Handling Electrostatic Sensitive Devices (ESD).

The ECM and Throttle servo on this engine contain sensitive electronic hardware. As a result, this engine is packaged in electrostatic dissipative foam and contained in electrostatic dissipative bags. Any handling of these devices should be contained in an ESD safe area.

EFI Components and Descriptions

18 Pin
Connector
from Receiver



27 Pin
Connector to
Engine

Engine Vacuum
Line

Figure 1: Engine Control Module (ECM)

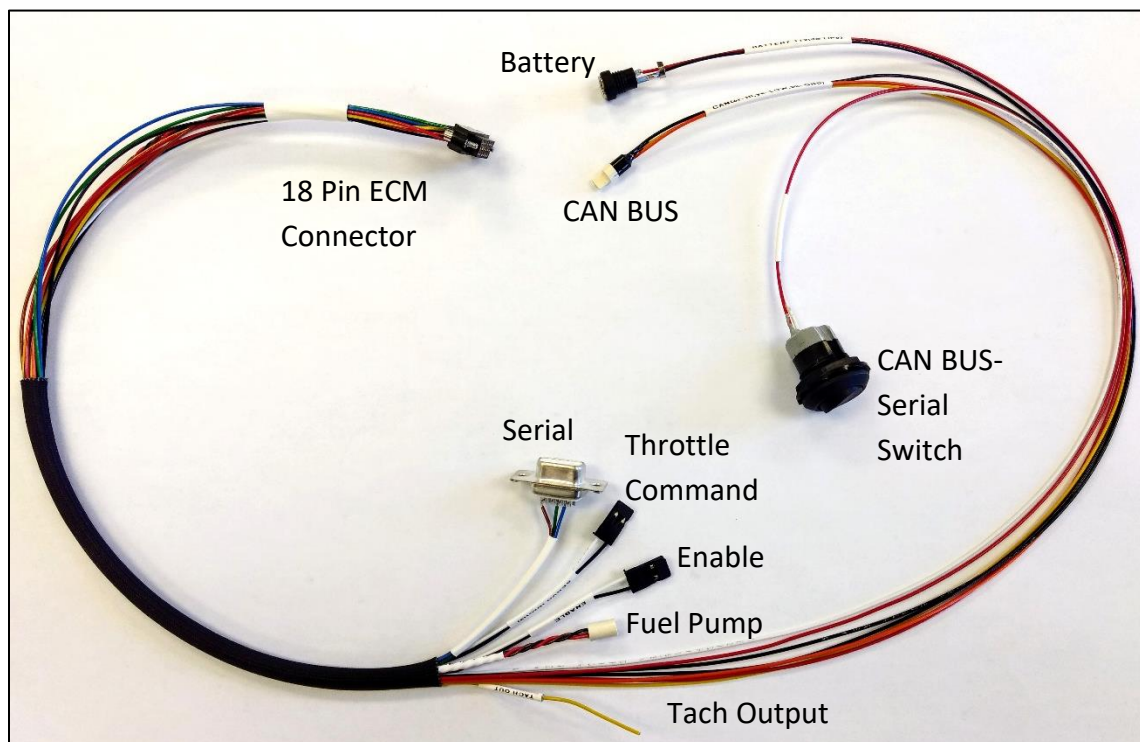


Figure 2: 18 Pin Harness

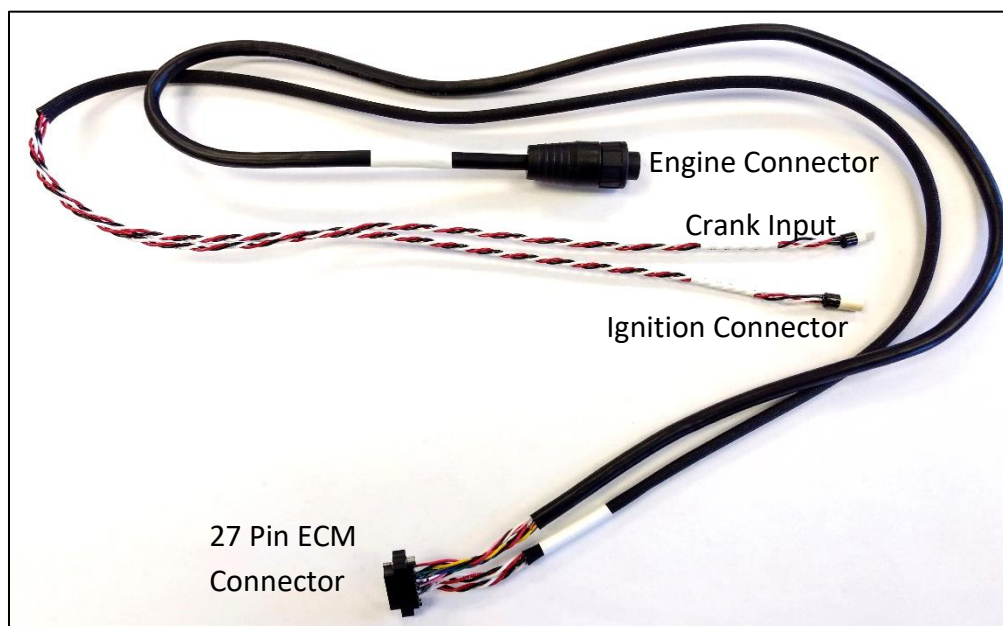


Figure 3: 27 Pin Harness

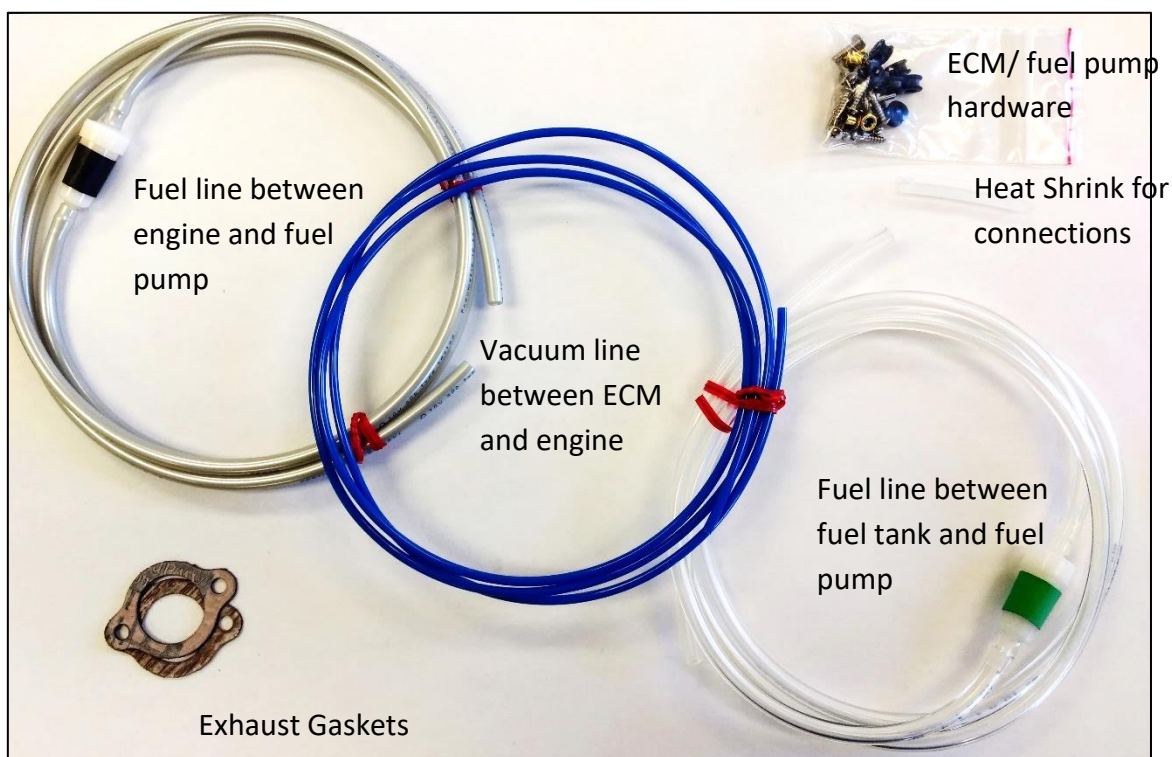


Figure 4: Assembly Hardware

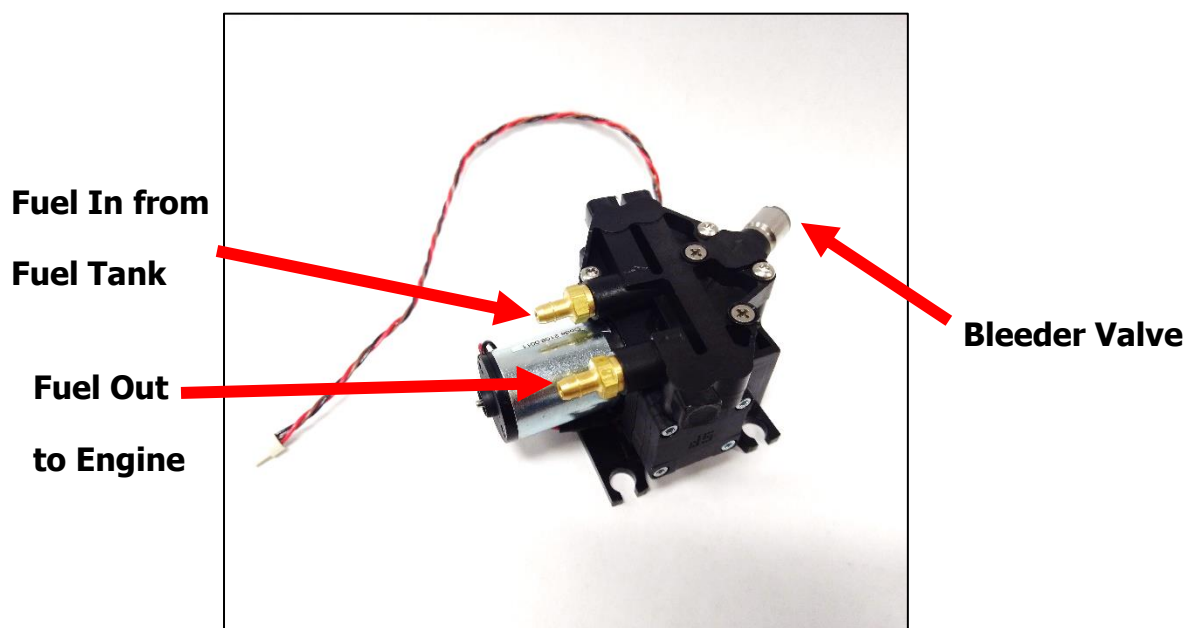


Figure 5: Fuel Pump

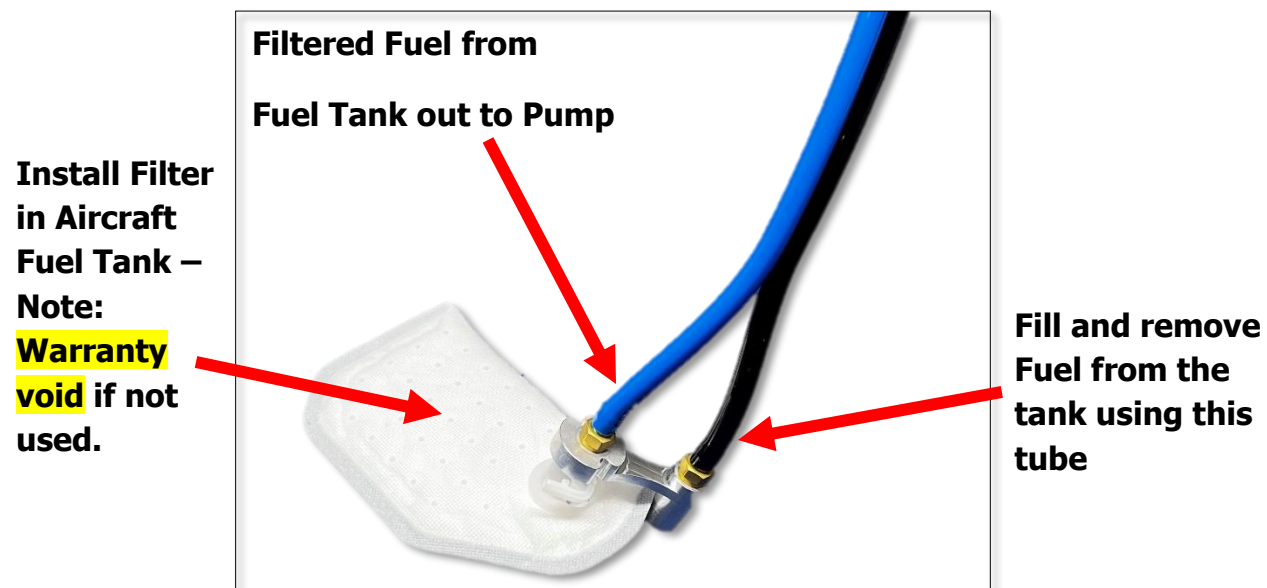


Figure 6. In-tank 10 micron Fuel Filter

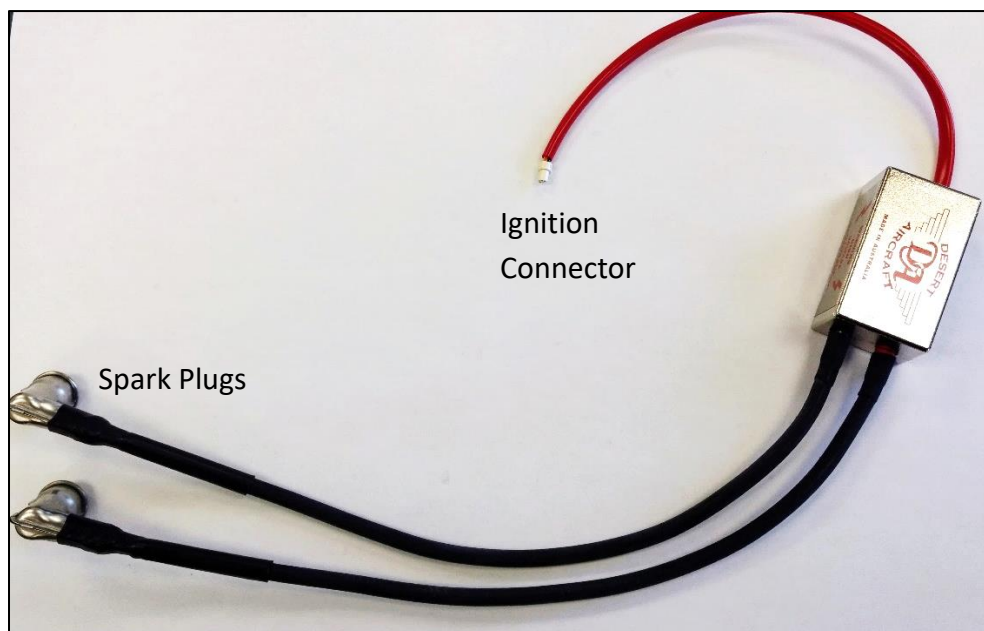



Figure 7: Ignition

Getting Started:

Engine Oil

This engine was calibrated using Red Line 2 Stroke Racing Oil at a mix ratio of 40:1. This oil type and mix ratio should be maintained to ensure that the fuel injection system and engine operates as designed.

<p>Oil Brand: Red Line</p> <p>Oil Type: 2 Stroke Racing Oil</p>	
<p>Mix Ratio: 40:1</p> <p>40 parts gasoline to one part oil.</p>	

Fuel Recommendations

The engine was calibrated with standard 87 octane gasoline mixture.

Hardware Installation

1. Do not install the ECM to the engine or motor mount. The vibration will damage the hardware. Route the ECM to a location inside the vehicle and mount it where vibration is minimal. The ECM does not produce excessive heat and can be encapsulated in foam to isolate it from vibration if needed.
2. Refer to the diagrams in section 2 for wire harness designations and connections.

Use Heat Shrink to connect any Omnetics connectors. This is both for strain relief and for positive locking of mates.



3. Install blue tube between the ECM and the manifold air pressure port on the throttle body.
4. Install the gray tube from the fuel pump barb to the fuel port on the throttle body.
5. Install the In-tank fuel filter inside the aircraft fuel tank as shown in figure 6.

WARNING: Do not fuel the aircraft using the tube going to the filter. Use the fuel-de fuel tube to fill the tank and remove fuel. Only the Fuel/De-Fuel tube can be used for fueling the aircraft.

6. If not attached, install the green fuel filter between the fuel pump inlet and the fuel tank, and the black fuel filter between the fuel pump outlet and throttle body.

Battery Recommendations

Any 3 cell Lipo battery or equivalent battery pack with an amp hour capacity of 2000mA/hr or greater will run the engine for 2 hours continuously.

Using a 4 cell Lifepo4 is also permitted as its output voltage range is with in the 10 to 14 volt range.

Communication

The ECM has two available modes of communication. The default communication protocol is Controlled Area Network (CAN BUS). The secondary communication is RS232 Serial. These protocols do not work simultaneously. To utilize RS232 Serial, refer to the communication harness and toggle the switch to 'Serial'. Refer to HFEDCN0191 ECM Telemetry protocol, for instructions on how to receive data via CAN BUS or Serial.

CAN BUS COMMUNICATION: The CAN BUS communication protocol has a baud rate of 1Mbps. It is essential to have a 120 Ohm at the furthest node between CANH and CANL. Refer to figure X. Throttle is commanded through CAN messages with a command between 0900 μ s and 2100 μ s.

- a. There is a fail-safe throttle via PWM signal applied to Channel 3 line in the event CAN BUS communication is lost.
- b. Ensure to **always** have the vehicle cruise throttle set on the PWM line when utilizing CAN BUS communication.

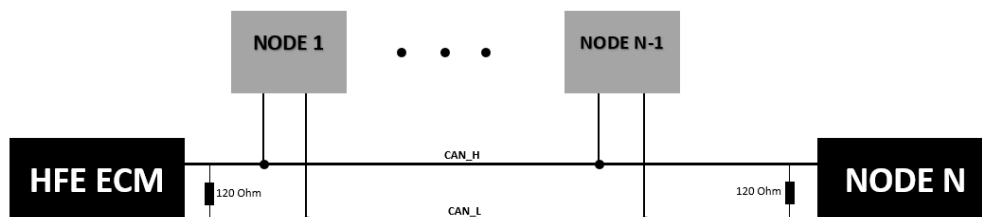


Figure 8: CAN BUS Setup



SERIAL COMMUNICATION: The Serial communication is RS232 \pm 12V at a baud rate of 112500. Throttle commands are not handled via RS232. Throttle is commanded via PWM to Channel 3 of the receiver. Expected pulse width range from 900 μ s for closed throttle and 2100 μ s for wide open throttle. You may need to extend the end limits for Channel 3 in your transmitter to produce the appropriate range. Adjust the exponential rate to get the desired throttle response.

Engine Enable

Using the HFE EFI system does not require an opto kill for proper operation. Engine enable is utilized to power the engine. When disabled, the ignition and injector will not operate, regardless of throttle commands or attempted starts. The type of engine enable can be quickly identified on the ECM depicted by a marking on either TPS or 5VE.

(Throttle Kill) Using the DA EFI system does not require an opto kill for proper operation. When the pulse width from the receiver falls below 960 μ s (5% throttle), the ECM will remove power to both the injector and ignition system thus stopping the operation of the engine.

(UAV Option) Provide constant 5V DC power to the enable line, when power is removed ECM will remove power to both the injector and ignition system thus stopping the operation of the engine.

FUEL SYSTEM WARNINGS:

Do not connect the fuel port to the Manifold Air Pressure tube.

Do not exceed 30 PSI (2 bar) of fuel pressure.

Starting Your Engine for the First Time

1. Verify that the ECM is powered up (Blue Light on ECM).
2. Verify that the throttle setting is at about 30%.



3. Prime your system for the first time by holding a cloth over the bleeder valve and pressing on the button. Cycle the battery power to the ECM in 5 second intervals until fuel is flowing from the bleeder valve. You should not have to complete the priming process again unless the engine fuel system is allowed to run dry or has been disconnected for any reason.
4. The engine should be started using an external spinner, or using a built-in starting alternator. ***Flip starting is an additional option but is not recommended due to possible injuries.***
Note: The engine may struggle to run for the first few minutes as it is purging all the air from the fuel system. This may not be evident until you go to 100% throttle.
5. Allow the engine to run for a few minutes.
6. Hold at 100% throttle for 15 seconds to verify that the air in the fuel system has been purged. Reduce the engine speed to idle.

Starting Again After First Start

The engine should start with one or two start attempts with the alternator or external spinner. If the engine does not start, increase throttle above 50% to clear possible flooded condition.

Maintenance

Item	Before Each Flight	Every 50 Hours	Every 100 Hours	Every 200 Hours
Engine Oil Pre-Mix	X			
Spark Plug Check/Adjust		X		
Spark Plug Replace			X	
Air Filter Check/Clean		X		
Air Filter Replace			X	

Fuel Filter		X		
HFE OEM Maintenance				X

Table 1: Maintenance Table

Signal Inputs/Outputs for ECM

Pin	Signal	Description
1	NC	Not Connected (Signal Cowling)
2	NC	Not Connected (+5V Cowling)
3	MAT (+)	Manifold Air Temperature sensor. Variable resistance thermistor.
4	CHT (+)	Cylinder head temperature sensor. Variable resistance thermistor.
5	SERVO SIGNAL	Throttle position with logic-level output. A Pulse Width Modulated (PWM) signal at nominally 100Hz with ON time ranging from 900 μ s to 2100 μ s corresponding to throttle position. This pin has an 8mA draw.
6	NC	Not Connected (O2 SIGNAL)
7	CRANK SIGNAL	+5V logic-level digital input. Bi-polar type.
8	IGN SIGNAL	Modified integrator filtered output.
9	NC	Not Connected (IGN 2 SIGNAL)
10	NC	Not Connected
11	NC	Not Connected (GND Cowling)
12	MAT (-)	Manifold Air Temperature sensor reference.
13	CHT (-)	Cylinder head temperature sensor reference.
14	SERVO GND	Throttle servo ground.
15	NC	Not Connected (O2 GND)
16	CRANK GND	Crank sensor ground.
17	IGN GND	Ignition Ground
18	NC	Not Connected (IGN 2 GND)
19	NC	Not Connected (INJ 2 GND)
20	INJECTOR GND	Injector Switching to Ground. Frequency matches engine RPM.
21	NC	Not Connected (INJ 2 POWER)
22	INJECTOR POWER	Battery voltage.
23	SERVO POWER	+5V power supply output from the Engine Control Unit for the throttle servo power.
24	NC	Not Connected (O2 POWER)
25	CRANK PWR	+5V power supply output from the Engine Control Unit for the crank sensor.
26	IGN PWR	+5V power supply output from the Engine Control Unit for the ignition power.
27	NC	Not Connected (IGN 2 PWR)

Table 2: 27 Pinout

Pin	Signal	Description
1	TACH OUT	+5V logic-level digital output. This pin has a maximum continuous load of $\pm 20\text{mA}$. Output signal has a 50% duty cycle.
2	SERIAL RX	RS-232 level Rx
3	CAN (HIGH)	High Signal for the CAN BUS communication.
4	ENABLE (On request)	Engine enable signal from AP. A 5 volt signal present to enable. This pin has an 8mA draw. 10k pull down resistor.
5	THROTTLE SIGNAL	Throttle position with logic-level input. A Pulse Width Modulated (PWM) signal at nominally 100Hz with ON time ranging from 900 μs to 2100 μs corresponding to throttle position (0% to 100%). This pin has an 8mA draw.
6	MAIN GND	Main Ground
7	POWER 12V	Main power input. 10 to 14 volts. Maximum power draw is 12 W at wide open throttle. (11.1v 3 cell LiPo 2000ma or bigger)
8	SERIAL TX	RS-232 level Tx
9	CAN (LOW)	Low Signal for the CAN BUS communication.
10	PUMP SIGNAL	Variable voltage output from fuel pump assembly.
11	GND	Enable ground reference
12	PUMP (+)	Fuel System power (routed internally from system power pin 14 and enabled by a high side driver (relay) from ECM state commands).
13	SWITCH SIGNAL	Applying 12V to Signal puts ECU into Serial communication.
14	SERIAL GND	Ground reference for RS-232
15	CAN GND	Ground reference for CAN BUS
16	SWITCH POWER	+12V for applying to Switch Signal
17	Throttle GND	Throttle input ground reference.
18	PUMP (-)	Fuel system ground reference.

Table 3: 18 Pinout

ECM Blink Patterns

If the engine is not starting, checking the STATUS light on the top of the ECM can signal what problem is seen by the ECM. The pattern repeats after 3 second pause, and blinks at 1 to 2 Hz.

# of Blinks	Issue
1	High battery disconnected
2	MAT disconnected/no signal
3	CHT disconnected/no signal
5	Pulse train (throttle) not active

Table 4: Blink Patterns

Technical Specifications

Only use NGK CM-6 spark plugs.

Plug gap is .018" to .020" (.38 to .50 mm)

	Size	Torque	Engines
Spark Plug	CM-6, 10mm	90 in. lbs	All
Steel Crankcase Bolts	M5x25mm M5x20mm M5x16mm	90 in. lbs	All
Steel Motor Mount Bolts	M6x16mm	120 in. lbs	DA100-215
Air Filter Cap Nuts	M5	10 in. lbs*	DA100-215
Throttle Body Mounting Bolts	M5	20 in. lbs*	DA35-70
	M5	30 in. lbs*	DA100-120
	M5	50 in. lbs*	DA150-215
Steel Cylinder Base Bolts	M5x13mm M5x16mm	90 in. lbs	DA35-150
	M6x20mm	110 in. lbs	DA170-215
Steel Prop Bolts	M4x40mm (wood)	65 in. lbs	DA35-70
	M4x40mm (carbon)	65 in. lbs	DA35-70
	M5x50mm (wood)	75 in. lbs	DA100-150
	M5x50mm (carbon)	90 in. lbs	DA100-150
	M6x55mm (wood)	90 in. lbs	DA170-215
	M6x55mm (carbon)	110 in. lbs	DA170-215
Prop Shaft Nut	MEXT	48 ft. lbs	DA50-170
	MEXT215	48 ft. lbs	DA215
	MEXT35	25 ft. lbs	DA35

***Caution: Care must be taken to not over tighten the TBI mounting bolts or air filter nuts. Over tightening can distort and damage the air filter, injected molded reed valve parts, rubber gaskets, or throttle body.**



Warranty

Thank you for choosing a Desert Aircraft & HFE International Product.

Your Total satisfaction is our #1 priority.

If you have any questions on the installation and operation of this engine, please contact us directly. Please have your engine serial number on hand when calling for service.

Desert Aircraft Engine Customer Service:

Phone: 520.722.0607

Email: UAV@Desertaircraft.com

1815 South Research Loop
Tucson, Arizona 85710
U.S.A

Engine Core Warranty

Your DA motor and ignition system are covered with a 3 year warranty by Desert Aircraft, starting from the date of purchase.

- This warranty covers defects in workmanship and materials only.
- Do not disassemble the motor or ignition system. Disassembly of the motor or ignition system can void the warranty on that item.
- Any modifications to the motor, or the ignition system, other than those authorized by Desert Aircraft, will void this warranty.

This warranty does not cover the following:

- Shipping expenses to and from Desert Aircraft for warranty service.
- Damage caused by improper handling, operation, or maintenance.
- Damage caused by a crash.
- Damage caused by using improper fuel or additives.
- Damage incurred during transit to Desert Aircraft. **WRAP AND PACK ENGINE CAREFULLY!!**

NOTE: DESERT AIRCRAFT WILL NOT SHIP ANY WARRANTY REPLACEMENT ITEMS UNTIL POSSIBLY DEFECTIVE ITEMS IN QUESTION ARE RECEIVED BY DESERT AIRCRAFT.



HFE International Fuel Injected Engine Customer Service:

Phone: (520)578-0818

Email: Sales@HFEInternational.com

8060 E. Research Ct.

Tucson, AZ 85710

U.S.A

EFI System Warranty

Your HFE International EFI system is covered with a 1 year warranty by HFE International starting from the date of shipment from HFE International.

This warranty covers defects in workmanship and materials only to include Fuel Pump, wiring, ECM and throttle body.

Do not disassemble the ECM or Throttle Body assembly. Disassembly of the ECM or Throttle Body assembly will void the warranty on that item.

Any modifications to the ECM, or Throttle Body assembly, other than those authorized by HFE International, will void this warranty.

This warranty does not cover the following:

- Damage caused by improper handling, operation, or maintenance.
- Damage caused by a crash.
- Damage caused by using improper fuel or additives.
- Damage incurred during transit.

NOTE: HFE INTERNATIONAL WILL NOT SHIP ANY WARRANTY REPLACEMENT ITEMS UNTIL POSSIBLY DEFECTIVE ITEMS IN QUESTION ARE RECEIVED BY HFE INTERNATIONAL.

NOTE: COMPONENTS NOT MANUFACTURED BY HFE INTERNATIONAL/DESERT AIRCRAFT ARE SUBJECT TO THE MANUFACTURER'S RETURN POLICIES AND NOT COVERED BY THIS WARRANTY.