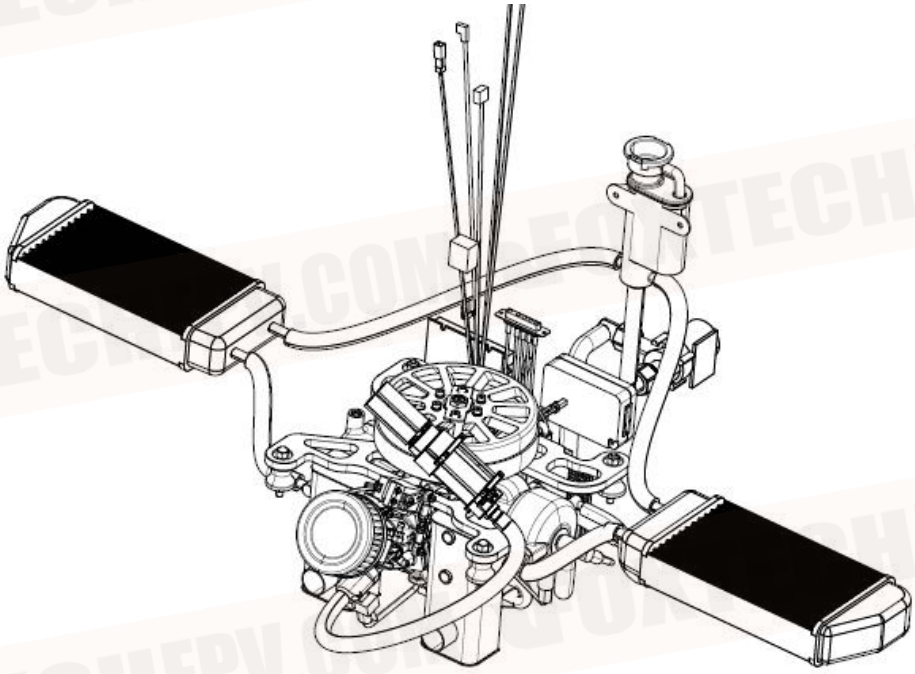
Halo-6000

EFI Generator for Hybrid Drone

User Manual

V3.0 2023.05



FOXTECH

Changes-202305:

1. The fuel filter should be checked/replaced every 25 h.
2. Hot plug of the spark plug and spark plug cap is forbidden

Changes-202210:

1. Assembly instruction.
2. Don't need to use 1:25 (engine gasoline ratio) before normal use.
3. The battery for Halo-6000 should be 3C or higher.
4. 200 h big maintenance.

Changes-202207:

1. Motor oil for Halo-6000 should be MOTUL 710 2T, or motor oil appointed by Foxtech.
2. ~~The battery for Halo-6000 should be 5C or higher.~~

Contents

Safety Code

Before using this product, please read this manual carefully and be familiar with the meaning. Only by correctly operating and maintaining the product can we ensure its safe and effective operation. In case of any irresistible accidents such as disability, death, fire and so on due to improper use, it has nothing to do with the product and the manufacturer. If the user refits, all irresistible accidents after refitting have nothing to do with the manufacturer.

General Safety Precautions

● When disassembling the motor and control system, cut off the power supply first.

● The motor shall be kept clean and free from obstacles. All dirt on the motor shall be cleaned regularly to keep the motor clean and dry.

● Exhaust gas discharged by the engine has certain toxicity, and do not inhale or contact engine exhaust gas.

This manual is an important part of the system. Without written approval, it is strictly forbidden to copy any content of this manual.

Description of Halo-6000

Preface

First of all, thank you for your trust in our brand! Welcome to use the aviation hybrid system (UAV) provided for you. Please read this manual before you use it.

This manual provides guidance on the use, troubleshooting and maintenance of Halo-6000.

This manual does not provide maintenance guide for electrical components. When it is determined that the electrical components have failed, please do not repair them. The whole assembly must be replaced. Other damage may be caused by trying to repair the faulty electrical components.

Please read the safety rules in this manual carefully and follow all the requirements and precautions in this manual.

Functions and Technical Features

According to the requirements of multi-rotor UAV, Halo-6000 is 58V (14S Li battery).

The engine uses two cylinder and two stroke gasoline as fuel. It adopts 32-bit MCU of vehicle gauge level, precise injection ignition, adaptive plateau correction, intelligent self-learning, and has passed the environment and EMC tests. Besides, it has the characteristics of high output power and low fuel consumption. The motor adopts the heuristic integrated external rotor motor, which is integrated with the engine, makes the hybrid system having the advantages of small volume, light weight, low noise and high power-mass ratio. The controller has the protection functions of over voltage, undervoltage, over temperature and overspeed.

Halo-6000 has over-voltage protection and over-temperature protection with 120Ω CAN bus terminal resistance.

Main Technical Parameters

No.	Items	Unit	Parameter Index	Remarks
1	Rated Voltage	VDC	57.4	
2	Rated Power	kW	6.0@ Sea Level	
3	Weight	kg	9.5	Include: radiators, water pipe, water pump, fuel pump etc; Not include: coolant, gasoline, fuel tank
4	Dimension（L x W x H)	mm	312×288×206	
5	Average Fuel Consumption	L/h	5.7	
6	Applicable Models		Multi-rotor / VTOL	
7	Altitude	m	≤2000	The output power will decrease with higher altitude.
8	Operating Ambient Temperature	°C	-20 ~ 50	
9	Start Mode	-	Remote Start	
10	Ratio of Lubricating and Gasoline	-	1:40	Please use engine oil appointed by the manufacturer.

Tab. 1　Main Technical Parameters of Halo-6000

Caution:

1.Please confirm that the technical parameters of UAV match the parameters of this hybrid system before use, so as to meet the operational performance of UAV, Prevent damage caused by improper configuration.

2.Failure to use the oil and engine-fuel ratio suggested by the manufacturer will cause engine damage. The manufacturer will not be liable for any consequences caused by using oil not suggested by the manufacturer.

3.The battery for Halo-6000 should be 3C or higher.

4.The engine oil used for Halo-6000 should be MOTUL 710 2T, or appointed by Foxtech. If the damage is caused by the wrong use of engine oil, Foxtech will not be responsible for it.

Engine Model	247AI
Type	Double cylinder, two-stroke, EFI engine, water-cooling system
Displacement（mL）	124
Rated Power（kW）@7000 r/min	7.3
Rated Speed（r/min）	7000
Rated Max. Speed（r/min）	7500
Idle Speed r/min	5000
Oil	Designated by the manufacture
Gasoline Label Number	95# gasoline

Tab. 2 Main technical parameters of engine configuration

Before Operation

Wiring Diagram

Please wire in strict accordance with Fig. 1 and Fig. 2. If the connection is wrong, the system components may be damaged.

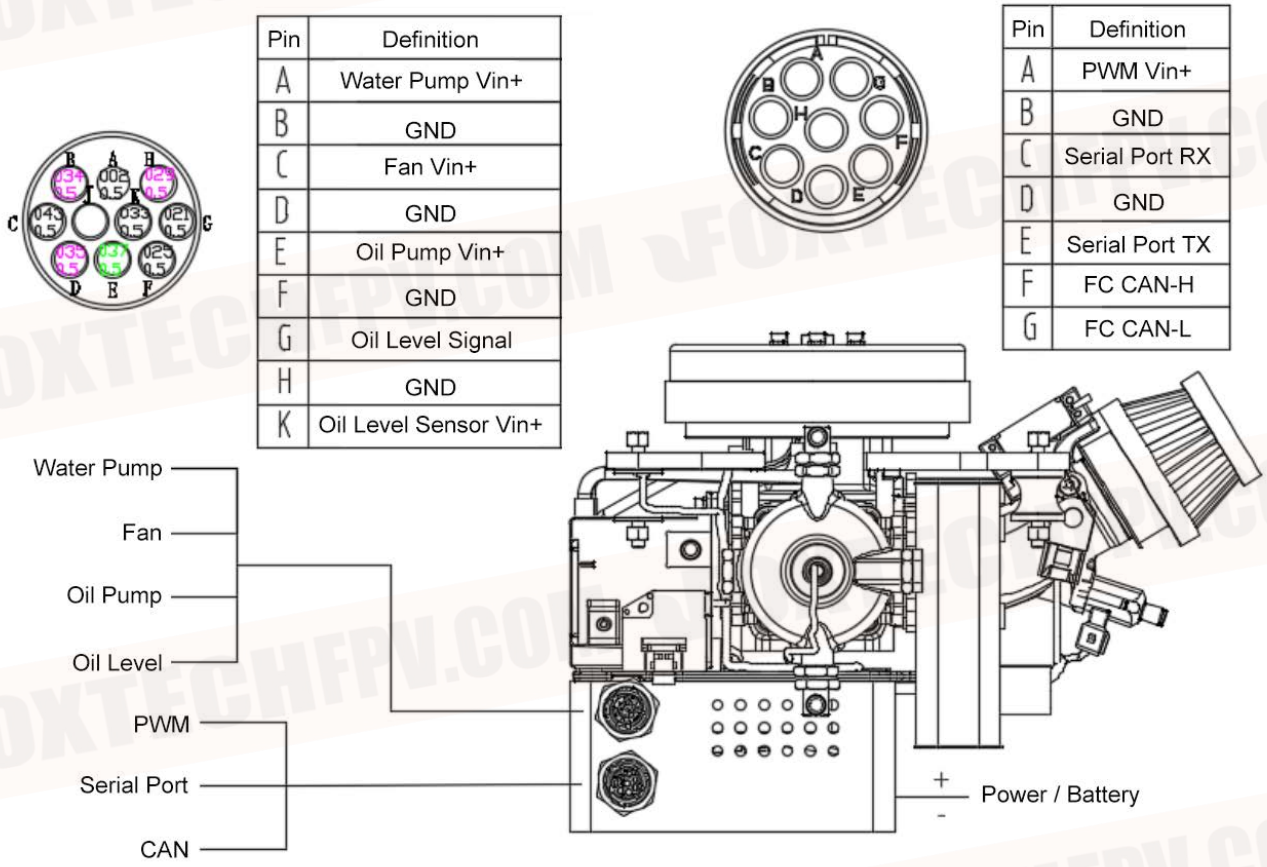


Fig. 1

Note: After mounting all of the modules, GND should be activated first, then positive. When powering off, positive input should be off first, and then GND. Follow the instruction or the generator may get damaged.

Operation

Usage and Operation

1. Halo-6000 is configured as shown in Fig. 2:

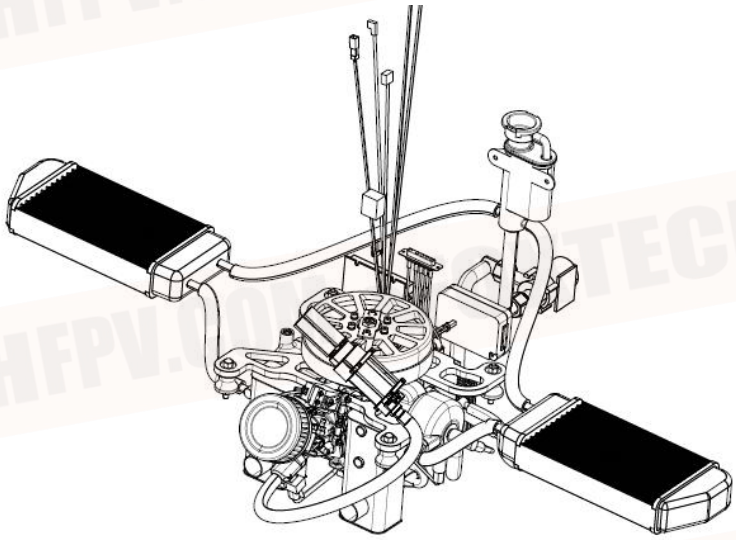


Fig. 2

2. The installation dimension of Halo-6000 is given in Fig. 3:

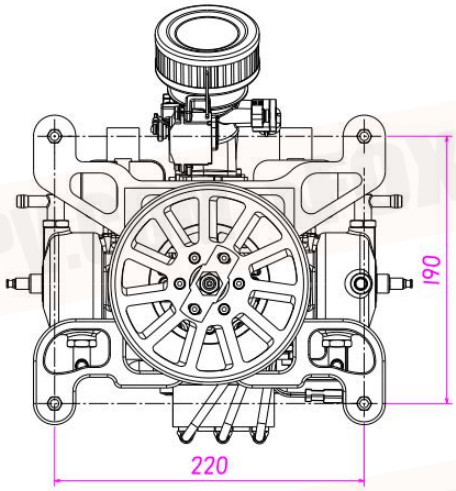


Fig. 3

3. Installation Method

3.1 Install the hybrid system to the appropriate position of UAV. The damping pad is connected with the aircraft mounting mount, as shown in Figure 4 below:

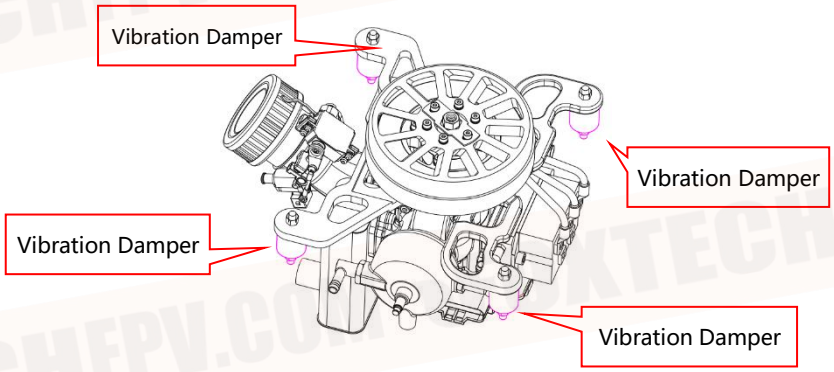


Fig. 4

Caution: The factory default is hoisting, other installation methods will cause shock vibration damper damage

3.2 Cooling system installation and water pipe connection is shown in Figure 5 below:

3.2.1 Install the fixed water-cooling radiator.

3.2.2 Installation of fixed water jacket: the water jacket must be placed at the highest point of the cooling system.

3.2.3 Installation of fixed water pump. 3.2.4

Connect the water pipe.

Water pipe of ①: Ø10 inner diameter;
Water pipe of ②: Ø7 inner diameter;
Water pipe of ③: Ø12 inner diameter

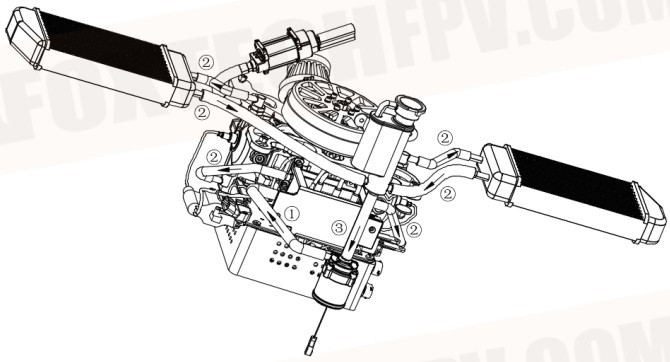


Fig. 5

The arrow marks the direction of the coolant circulation flow, and the

distribution clamp is used at the end of each inlet and outlet.

3.2.5 Precautions for filling water

Water injection is required before starting the water pump,

After the water pump is started, fill the water between the high and low scales of the Water jacket.

3.2.6 Precautions for use of coolant

a) Unscrew radiator cap,

b) Slowly fill the coolant into the water jacket. Be careful not to let the water bubble.

c) After supplying coolant, tighten the water jacket cap.

d) Check the connector of the cooling water rubber hose for looseness, damage or other faults. If the sealing performance of the water pipe is poor, the cooling water may be consumed excessively.

⚠ The radiator shall be installed under the propeller. If it is installed in other positions, the forced air cooling fan shall be added, and the fan power supplied by ECU shall be less than 60W. If the radiator is not purchased along with the generator, the temperature of the water outlet should below 85℃.

3.3 The oil pump installation and oil pipe connection are shown in Figure 7 below:

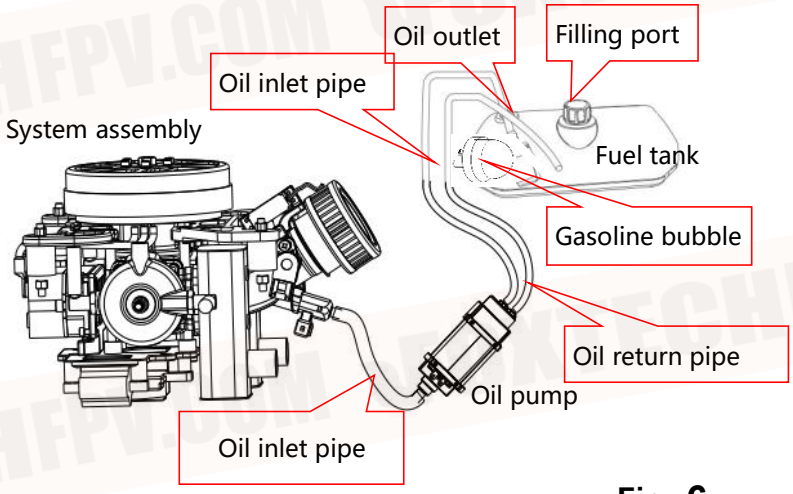


Fig. 6

3.4 Operation method of engine fuel pipe exhaust

When the engine is started for the first time or the oil return pipe is not filled with oil, exhaust treatment shall be carried out before starting the engine. The specific operation methods are as follows: connect the gasoline bubble in series at the end of the oil return pipe, press it several times to exhaust the air in the pipe, so that the fuel fills the whole oil supply pipeline. At this time, remove the oil bubble and start the engine normally.

4. Preparation method of gasoline and oil

Use 95# or higher grade gasoline, 2T engine oil designated by the manufacture, and use a proportioning pot to prepare according to the engine fuel ratio of 1:40 (engine oil: gasoline). It is strictly prohibited to use engine oil that is not suggested by the manufacture.

The specific preparation steps are shown in Figure 7 below.

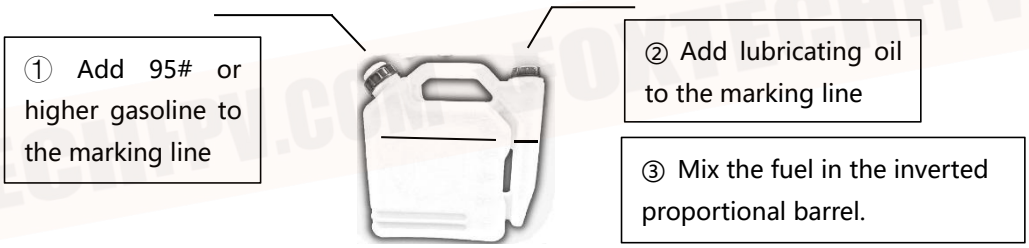


Fig. 7

5. Inspection items before use

5.1 Check whether the connectors of the range extender and controller are connected and installed in place.

5.2 Make sure there is enough fuel in the fuel tank and the fuel pipe is installed correctly.

5.3 Spark plugs shall be checked before use. Spark plugs with excessive carbon and oil stains shall be replaced or cleaned.

5.4 Check the steering gear mechanism, check whether the steering gear rod ball head is flexible, and repair it if it is stuck.

5.5 Check the position of steering gear and throttle, and check whether the steering gear operates normally and whether the throttle position is correct.

5.6 Check the motor to see if it rotates normally.

5.7 Check the oil pipe. The oil pipe shall not directly contact with heat sources such as engine or motor. Meanwhile, excessive bending of oil pipe shall be avoided.

5.8 The ignition coil head should be pressed firmly to check whether the connector is loose.

5.9 There is no obvious bubble in the tubing.

5.10 Check the anti loosening mark of the connecting bolt, and there shall be no dislocation.

⚠ Check whether the exhaust funnel is loose. In case of shaking, be sure to tighten the fixing bolts of the exhaust funnel.

6. Precautions for starting engine

6.1 Before starting the engine for the first time, the air in the oil inlet pipe needs to be

discharged to make the oil inlet pipe full of oil and free of bubbles;

6.2 For the first using, the generator should be power on before adding coolant. After power on, the electrical water pump will continue to run for about 100s. If the water jacket is not full within 100s, the generator shall be re-powered on. Repeat until the air in the pipe line is drained. The pipe lines can be squeezed properly until there is no obvious bubble up welling in the water jacket; Generally, this operation is not needed during subsequent startup, just observe the liquid level of water jacket, and add coolant when it is too low.

6.3 After each power on, the steering gear will execute the self-learning program for about 8s. Operate the remote control to make the system indicator light normally on (the remote control needs to be unlocked).

6.4 Multiple start failures may cause the spark plug to be flooded. In this case, replace or dry the spark plug and try to start again.

7. Running

7.1 Plug in the battery to power the system, at this time, the servo detects the throttle position, the system initializes;

The green operation indicator fast flashes (fast flashing 100ms);

Wait for the green operation indicator to enter the slow flashing state (slow flashing 500ms), initialization is complete.

7.2 Press the start button of the remote control, the green operation indicator turns into the constant light state.

7.3 Turn on the generator and observe the bus voltage, ⚠ ensure that the drone voltage is stable at 57V ± 2V;

7.4 Observe the drone voltage and operate stably for about one minute to warm up the engine;

7.5 In case of maneuver or gust during flight, the bus voltage will drop, which is a normal phenomenon.

⚠ If the drone voltage drops rapidly and continuously and is lower than 53V, special attention shall be paid, and it shall be immediately lowered for maintenance if necessary;

8. Stop Running

8.1 After continuous flight, Halo-6000 needs to be cooled. Therefore, after landing, maintain idle speed for 30s. After the engine is shut down, do not turn off the power supply and keep the water pump running for 3min.

8.2 ⚠ After the booster runs, some parts are at high temperature. After the booster stops running, please do not touch the booster to avoid scalding.

Gasoline is a volatile flammable and explosive liquid. At the end of the day or during long-distance transportation.The remaining fuel in the oil tank shall be drained and properly stored in the oil drum to avoid danger!

Maintenance

Maintenance

1. For routine maintenance items (after each operation), the warranty will not be given if the maintenance manual is not followed

1.1 Check whether the plug of the controller circuit is in good contact, and check whether the oil pipe and water pipe are loose or leaking.

1.2 Check if the controller is damp and keep it dry.

1.3 Check the motor for dirt and moisture, remove dirt and keep it clean and dry.

1.4 Check the air filter, remove the dirt, and keep clean（to prevent foreign matters or dust from entering the engine inlet）.

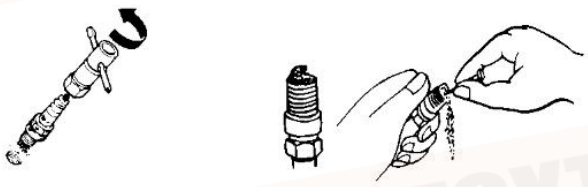
1.5 Check whether the fixing bolts are loose, and no loose bolts are allowed.

1.6 Check whether the steering gear rod ball is stuck. If it is stuck, oil can be applied temporarily and replaced later.

2. Regular Maintenance(Carry out regular maintenance and parts replacement according to Appendix 2)

2.1 After the Halo-6000 running for 50h, check the carbon deposit on the spark plug. If the carbon deposit is serious, remove the carbon deposit or replace the spark plug.

⚠ Please power off the generator and cool down the generator to the indoor temperature before disassembling the spark plug and its cap. Hot plug is forbidden.



（1） Remove the spark plug （2） Remove carbon deposit

Fig. 9

2.2 Check whether the fuel pipe has aging, hardening and cracks. If so, be sure to replace it to avoid potential safety hazards.

2.3 Check the motor for dirt, remove sundries and keep it clean and dry.

3. Maintenance Before Long-Term Shutdown

it is necessary to carry out comprehensive maintenance for the Halo-6000 before storage, if the system is out of service and will not be used for a long time. This can avoid some parts failure caused by long-term shutdown and maintain the system performance.

⚠ Caution: The manufacturer shall not be responsible for the system damage caused by untimely maintenance.

Faults and Maintenance Methods

1 Common faults and maintenance methods are shown in Table 3 below:

No.	Description	Check Item	Cause of Failure	Maintenance Method
1	System cannot be started.	Air filter	Under heavy working condition	Clean the filter with fuel
2		Oil Supply System	Wrong lubricating oil model	Use the suggested lubricating oil
3			Tubing bubble or no oil	Press the oil bubble several times to absorb oil
4		Wire Harness	Poor contact of connector	Check the circuit and connect it again
5		Spark Plug	yellow or weak light	Change the spark plug
6		Spark Plug	Loose of spark plug	Fasten the spark plug
7	Speed fluctuation, voltage fluctuation, heavy smoke	Fuel	Water in fuel or fuel quality Poor quality, fuel storage more than 2 months	Change the fuel
8		Lubricating Oil	Poor quality of lubricating oil	Change to the suggested lubricating oil
9		Oil Way	The oil supply is not smooth, there are bubbles in the yellow oil pipe, or the oil filter in the oil tank has not been replaced for more than 25 hours.	Drain the air from the oil inlet pipe. Open the filler cap to make the top of the fuel filter close to the top of the oil level. Power on and drain the air. In some cases, tilt the fuel tank properly.
10		Control Circuit	The control circuit or sensor is damaged.	Contact the manufacturer.

11	Insufficient Power Output	Carbon Deposition	It's time for maintenance.	Contact the manufacture.
12		Air Filter	The air filter element is too dirty.	Replace the air filter
13		Fuel Supply	Jam of the fuel filter or fuel injector	Replace the fuel filter or fuel injector
14	The voltage drops rapidly after take-off	Battery	Low battery voltage	Before takeoff, turn the three-position-switch to "run" and wait for about 1 minute.
15	miscellaneous		Mechanical parts are damaged.	Contact the manufacturer.

Tab. 3

Caution: This system does not support low power consumption. When the system is not in use, please remove the battery or set a switch to cut off the electrical connection between the battery and the system. The system does not support hot plug. The controller will be damaged by hot plug in case of use and maintenance.

2. Controller Indicator Definition

2.1 Red indicator light: The light is not on in normal state, and is always on in case of system failure

The fault list of the red fault indicator is shown in Table 4 below:

Failure		Fault light mode					
1. Sensor Failure	1. throttle position	——	-				
	2. current sensor	——	-	-			
	3. water temperature sensor	——	-	-	-		
	4. motor temperature	——	-	-	-	-	
	5. liquid level sensor	——	-	-	-	-	-

2. RPM failure	——					
3. voltage failure	-					

Tab. 4

Note：”——“ represents that the red fault light flashes slowly by 1s every time，”-“ represents that the red fault light flashes rapidly by 0.5s every time.

2.2 Green indicator light: It is a running indicator light, and its working state is divided into fast flash (100ms) → slow flash (500ms) → constant light.

Flash: system initialization process;

Slow flash: after initialization, wait for receiving the start command;

Light on: after receiving the start command, you can start the engine through the starter.

Others

Transportation and Storage

Handle it lightly during loading and unloading. During transportation, it is strictly forbidden to bump and scratch to prevent rain. The booster shall be stored in a clean, ventilated, moisture-proof and moisture-proof place.

In idle or for a long-time storage：

1. Please put the booster in a clean, ventilated, moisture-proof and moisture-proof place.
2. Disconnect the power cord of the controller from the battery.
3. The motor rotor needs to be covered to prevent dust and foreign objects from entering.

Unpacking Instructions

Note: operate with care.

When unpacking, the extender shall be placed in the upright direction according to the label of the outer package.

After unpacking, check the packing list and the items (including certificate, operation and maintenance manual, products, etc.) according to the packing list.

Carefully check whether it is consistent with the real object.

Big Maintenance

Maintenance Time: 200h

Content: Clean the carbon deposition; add grease; generator body check and clean; replace spacer.

Appendix 1：List of Accessories

No.	Article	Quantity	Remark
1	Operation and maintenance manual of Halo-6000	1	Standard Configuration
2	Product maintenance of Halo-6000 EFI	1	Standard Configuration
3	Halo-6000 EFI Generator	1	Standard Configuration
4	Oil pump	1	Standard Configuration
5	Water pump	1	Standard Configuration
6	Water jacket	1	Standard Configuration
7	Water jacket cover	1	Standard Configuration
8	T-junction	1	Standard Configuration
9	Clamp(internal diameter φ10~φ16)	4	Standard Configuration
10	M13 clamp (for pipe with internal diameter of φ8)	8	Standard Configuration
11	Motor controller	1	Standard Configuration
12	System controller	1	Standard Configuration
13	PMU(for water&fuel pump)	1	Standard Configuration
14	12V output wire of PMU(female connector)	1	Standard Configuration
15	Input wire of PMU(female connector)	1	Standard Configuration
16	Water pipe Ø 12* outer diameter Ø16	1m	Standard Configuration
17	Water pipe Ø 8* outer diameter Ø 12	3m	Standard Configuration
18	Water pipe Ø 10* outer diameter Ø 14	1.5m	Standard Configuration
19	Liquid level sensor	1	Standard Configuration
20	2*7S 12000 batteries	1	Standard Configuration
21	Radiator	2	Standard Configuration
22	Fuel tank	1	Standard Configuration
23	Fuel Mixer	1	Standard Configuration

Appendix 2：Maintenance List

Part Name	Unit Consumption	Before Start-Up	25h	50h	100h	150h	200h	300h
Air Filter Assembly	1	Check	Check/ Replace	Replace	Replace	Replace	Replace	Replace
Oil Filter	1			Replace	Replace		Replace	Replace
Servo Assembly	1	Check		Check	Check/ Replace		Check/ Replace	Check/ Replace
Spark Plug	2	Check		Check	Replace		Replace	Replace
Reed Valve Assembly	1				Replace		Replace	Replace
Oil Pump	1			Check	Check/ Replace	Check	Check/ Replace	Check/ Replace
Bolts and Connectors				Check	Check	Check	Check	Check
Oil Inlet Pipe	1				Replace	Check/ Replace	Replace	Replace
Damping Sleeve	2						Check/ Replace	
Oil Pipe					Check/ Replace		Check/ Replace	Check/ Replace
Cylinder Block	2				Check		Check/ Replace	
Cylinder Block Shim	2				Check		Check/ Replace	
Hexagon Socket Head Cap Screws M6*16	4				Check		Replace	
Standard Spring Washer M6	4				Check		Replace	
Piston Assembly	2				Check		Check/ Replace	

Retaining Ring For Piston Pin	4				Check		Check/ Replace	
Piston Ring	2				Check		Check/ Replace	
Piston Pin	2				Check		Check/ Replace	
Water Pipe					Check/ Replace		Check/ Replace	Check/ Replace

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