CATALOGUE

Foreword

This manual mainly introduced the working principle of the electronic speed control system,system composition,Regulation,operation, maintenance and simple troubleshooting method, suitable for a certain understanding, to the engine and the electronic governor routine installation, use and repair personnel. Recommend the product specification in the workplace, and strictly follow the method given here to operate.

Caution

- **Speed sensor to the electronic control system shall not be shared with other systems, or they may cause serious consequences.**
- **You can't rely on the electronic speed control system to prevent engine overspeed, and overspeed protection device installed independently, effectively in the engine system.**
- **Before starting the engine should confirm the fuel injection pump rod in oil cut-off position, push and pull the fuel rack should be flexible and no jam.**

1 The Principle Of The Electronic Governor System

Electronic governor, with its simple structure, high reliability, convenient operation, easy function extension and high cost performance, applies to all kinds of diesel generating sets, vehicles and marine diesel engines.

Its normal type is all-electronic single pulse speed and close loop position structure, provided with functions of non-corresponding or corresponding control, speed and rated speed during running maximum fuel supply control, emergency stop and etc.

It is also capable of adding other control functions according to the customer's particular requirements.

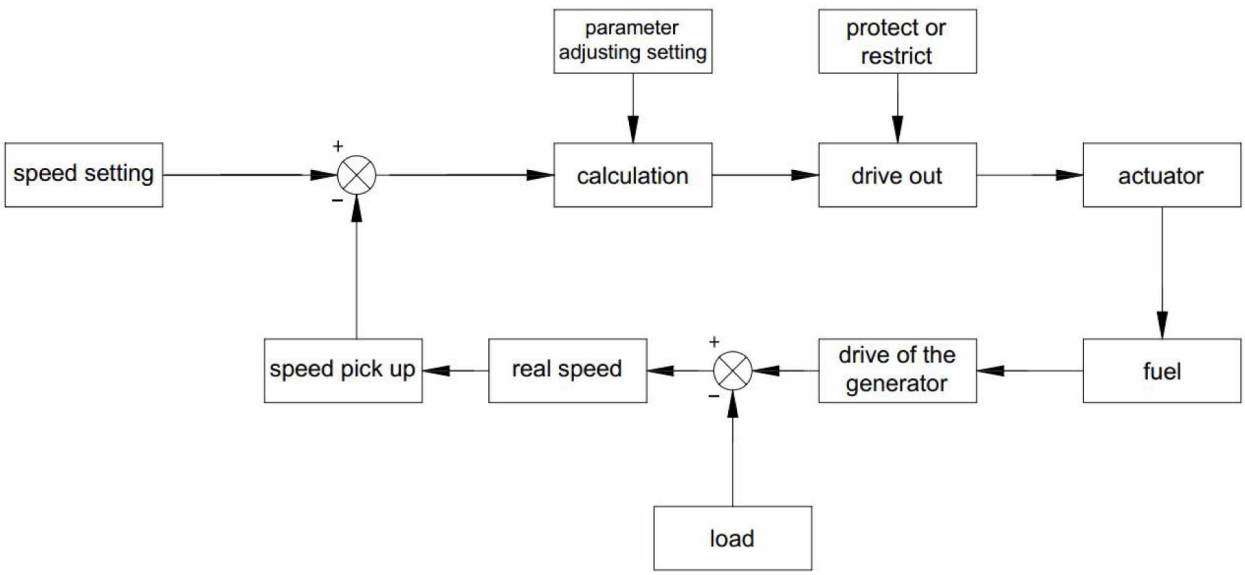


Figure 1.1 Electronic governor system

2 The Structure Of The Electronic Governor System

2.1 Speed Control Unit

2.1.1 The basic electronic characteristics

- SUPPLY VOLTAGE : DC 24V（Scope 18V～32V）or DC12V（Scope9V～16V）
- SUPPLLY CONSUMPTION : < 0.1A (static state)
- SPEED FLUCTUATION RATIO : ≤±0.25%
- HIGH SPEED SCOPE: 1KHz～7.5KHz
- AMBIENT TEMP. : -40°C ~ +85°C
- RELATIVE HUMIDITY : <95%

2.1.2 Basic Performance Of C2003 controller

Speed Control: Control Speed by the single close loop.

● High & Low Speed Switch: Switch between the idle and rated.

● Automatic stopping protection: The engine will stop automatically when there is no signal and no power.

For more information about the basic performance, please see the following chapter about the parameter setting instruction.

2.1.3 The wiring diagram of speed controller C2003

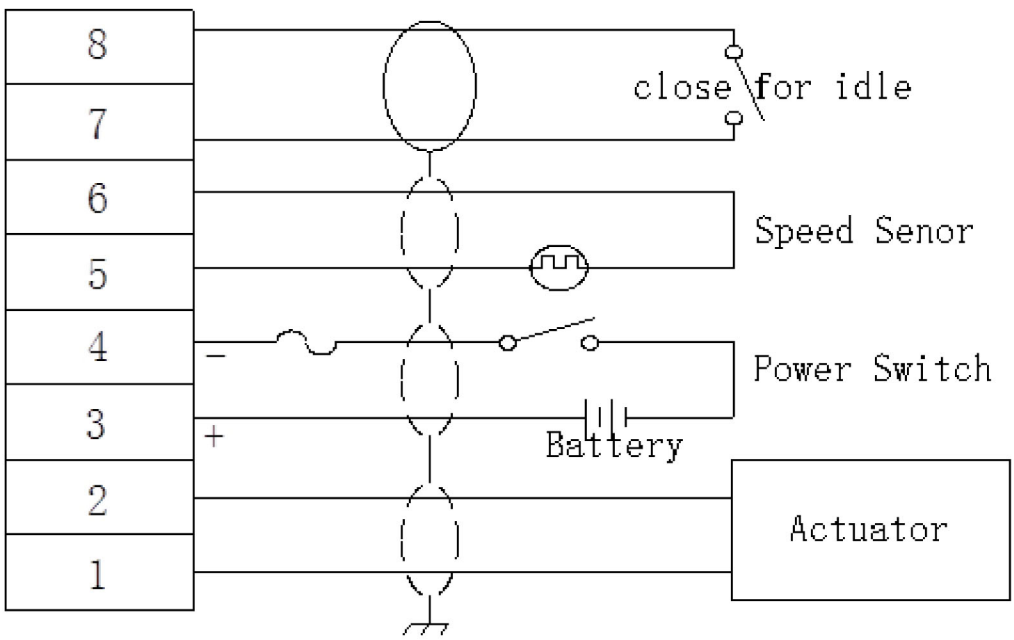


Figure 2.1

2.1.4 C2003 speed controller appearance and installation dimensions

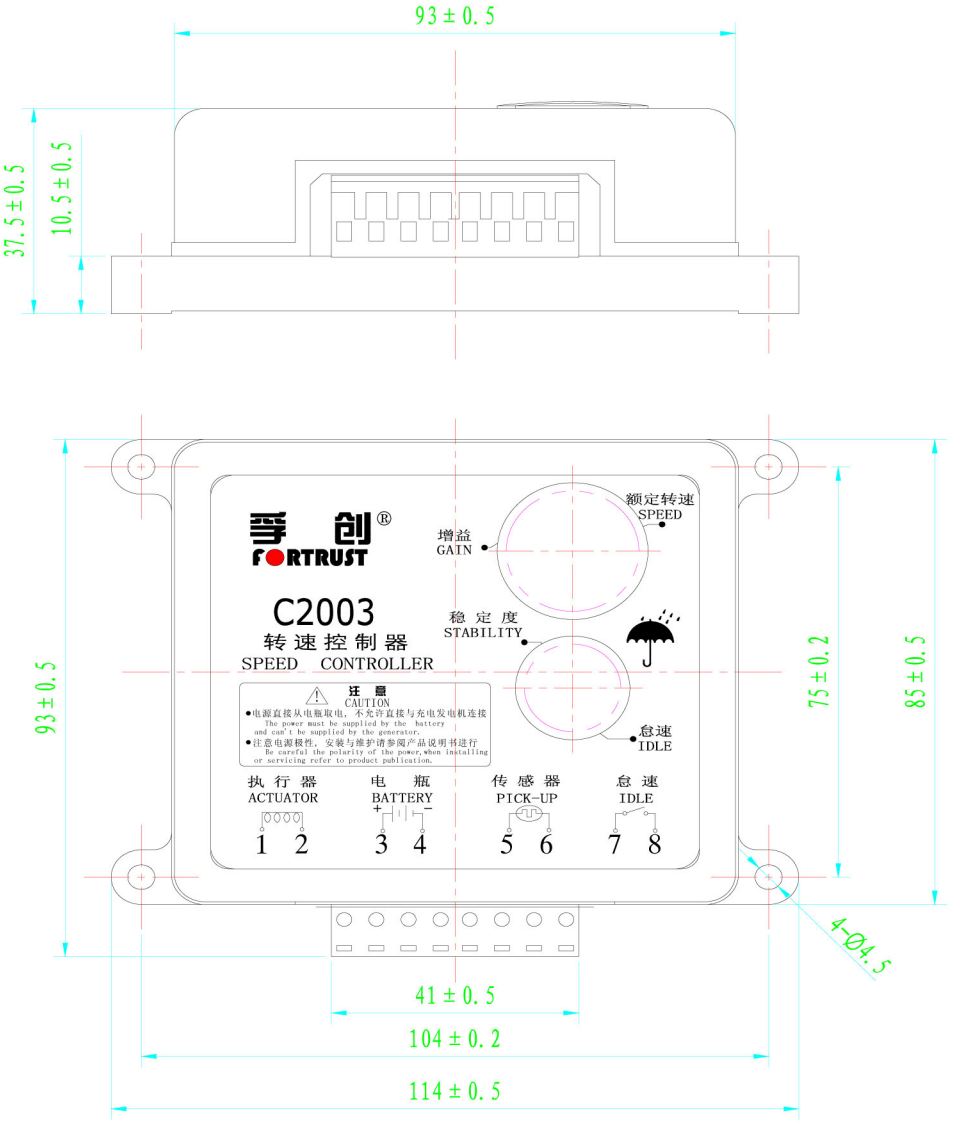
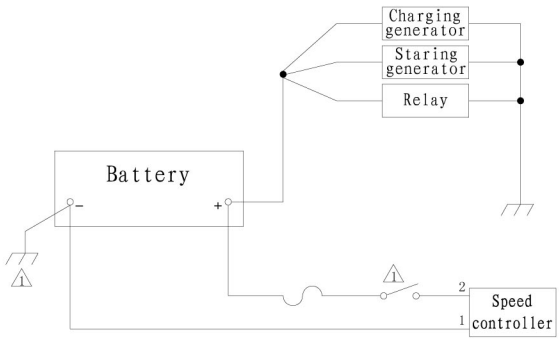


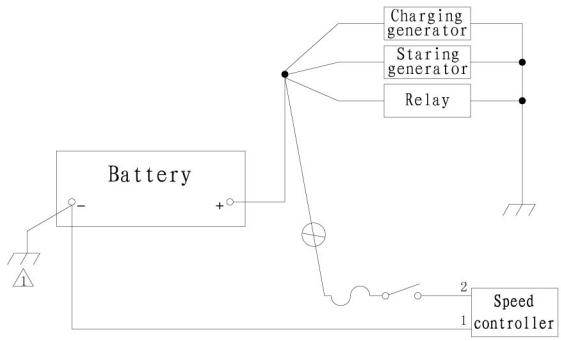
Figure 2.2

2.1.5 The definition and requirement of Connection Terminal

● Terminal 1 and 2 is use for connecting the actuator, terminal 3 and 4 is use for connecting the battery, the cable section should be 1.3 mm^2 or more to decrease the voltage drop, so more long more bigger. For avoiding the accident, a 15 A fuse is necessary on the cable that is from the battery positive to the power positive of the speed controller (terminal 3);The cable of the speed controller should be connected directly and separately from the battery positive and negative, please don't connect to other terminal, for the correct way see below.



☑ The correct wiring diagram



■ The wrong wiring diagram

● Terminal 5 and 6 is use for connecting the speed sensor, the cable should be the braided shielded net cable and connect to the point by 360°as figure 3.1 indicated, but it can't be connected to others of the engine ,otherwise it may have the interference signal input to the speed controller and result in the unpredictable consequence.

● Terminal 7 and 8 is use for connecting high & low speed switch, it is idle condition when closed, the speed ramping of preset will rise to rated speed after shut off.

2.2 The Electromagnetic Actuator

The speed controller as this manual mentioned can used with all of the single close-loop actuator that produced by Fortrust, customer choose the actuator and middle plate flexibly according to the model number of the pump, and you also can ask for Fortrust People provide a best solution to you after testing in the site. The actuators as this manual listed according to the requirement of your products, if you need more information of the actuators please log in Fortrust company website as www.fortrust.cn or send mail to sales@fortrust.cn or call us 021-51961611/12/13;

Different actuator with different stability, if you find the problem about that please contact us, we will provide the professional solution to you.

2.2.1 The Basic Character of Actuator A07A

☑ Supply Voltage: DC24V (16V～32V)

☑ Working Torque: 0.8N M

☑ Working Stroke: 15mm

☑ Ambient Temperature: -40℃～ +95℃

☑ Ambient Humidity: < 95%

☑ Installation: according to the pump section in the engine.

2.2.2 The Outline Overall and Installing dimensions of A07A Electromagnetic actuator (See Figure 2.3)

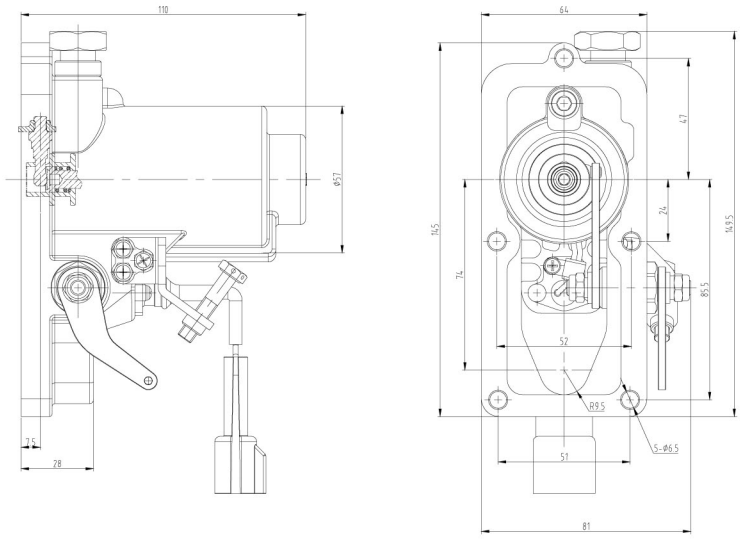


Figure 2.3

2.3 Speed Pick-up

The speed sensor of this electronic governor system we used is the passive magnetoelectric speed sensor, it output the speed signal through the magnet gap change that caused by the rotation of the speed measuring gear, and the change will generate the induced electromotive force in the coil of the speed sensor. The speed sensor should be fixed on the engine gear plate when install it, the engine speed will be got through the reaction of flywheel gear numbers; The best gap of installation of the speed sensor is return 1/2 — 3/4 circle(about 0.45mm) after touching the gear teeth. f=nz/60, f is frequency (Hz), n is speed (speed/minute),z is flywheel gear numbers. Customer could use this formula to calculate and get the initial speed value of speed controller, and adjust the value to the required value after starting the engine.

Speed sensor produced by Fortrust have different model with different installing dimension, people choose according to your demand.

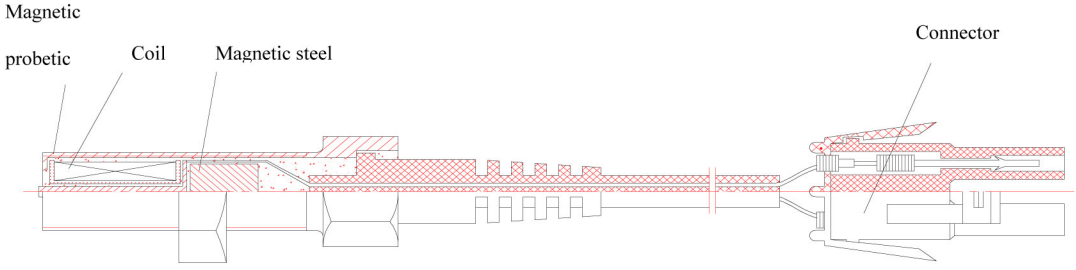


Figure 2.4 The Structure Chart of Speed Senor

Cautions: The speed sensor is only use for this electronic governor, it cannot be used with other speed measuring system, otherwise it may result in very serious consequence.

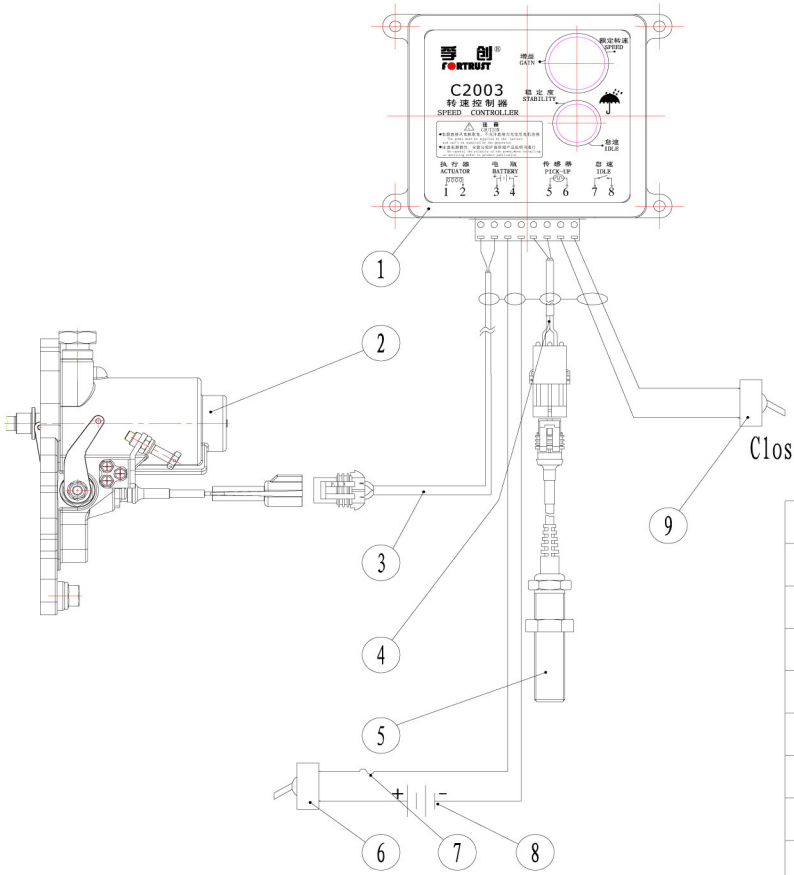
3 Installing and Debugging

3.1 Installing Of The Electronic Governor

The C2003 speed controller is usually installed in a control cabinet or fixed on other external device of the engine, and please choose the place with dry air and appropriate temperature. The the speed controller should be far away from the water, the mist or the freezing object, even if it has the dampproof surface; the speed controller also should be far away from the high temperature and the thermal radiation to avoid it was damaged. If the place is near the water or with the heavy moisture, please install the controller by vertical direction.

Cautions: The engine should have its own over speed protection device, it cannot only rely on the control system of electronic governor to stop over speed

3.2 Connection Diagram Of The ESG2003 Series Electronic Governor System



No.	Commponent Name
1	Speed control unit
2	Electromagnetic actuator
3	Actuator cable
4	Sensor cable
5	Magnetic pick-up
6	Switch of the power
7	Fuse
8	Battery
9	Idle/Speed switch

Figure 3.1 the wiring diagram of electronic governor

3.3 Debugging before starting engine

If start the engine in the first time, please strictly check as below.

▲ Check the flexibility of the oil rod

The whole oil supply of the pump should work without jamming and the oil rod works flexibly. If the oil rod worked inflexibly, it means the control system is not work properly and it may cause the major failure of the engine such as speed unsteady, over speed and run away.

▲ Check the flexibility of the actuator

There should have no gap between the shaft of the actuator and oil rod, the actuator is working flexibly, the minimum section is reach to stop oil and the maximum section is reach to supply oil at largest.

▲ Check the relative electrical connection

According to figure 3.1 wiring diagram or the requirement of mating electronic governor system, please check if the electrical connection is correct and battery voltage is accord with the requirement (No-load is slightly larger than 24V,starting moment is not less than 18V).

▲ Check the factory parameter setting

The electronic governor produced by Fortrust have been finished the parameter setting usually according to customer's supply agreement, so you just need to check it, if you cannot get the information under the special situation, please check and set as below.

(1) heck the potentiometer section of GAIN and STABILITY, please set them to 12' clock position if you cannot be sure.

(2) If there is no special indication, please set the dial switch as following, SW1 turn to 1 down 2 up 3 down. (For the details, please refer to the status switch adjustment)

(3) Turn the high speed / low speed switch to low speed.

(4) The speed of controller have been preset according to user data, you don' t need to adjust the the speed setting potentiometer of the controller before starting the diesel engine, you just need to adjust it accurately after starting the engine. If you cannot sure the speed setting value, please turn the rated speed setting potentiometer by anticlockwise several circles, meanwhile observe the positon of the idle potentiometer, then set it to 12' clock position.

3.4 Parameter adjustment of speed controller after starting engine

Cautions：Before setting the parameter, please pay more attention to the following. Except the rated speed potentiometer (can turn 25 circles, see figure 3.2),other potentiometer of the controller such as Stability, Gain, Idle cannot be turn more than one circle, their largest adjustable angle is 270°，it is about from 7'clock to 4'clock by clock direction. When you are setting the parameter, please don't turn it over this range, otherwise the potentiometer will be damaged and result in the major failure such as the engine stop, instability and over speed. All of the above potentiometers are the precision electron device, please adjust slowly by the special tools to avoid the man-made

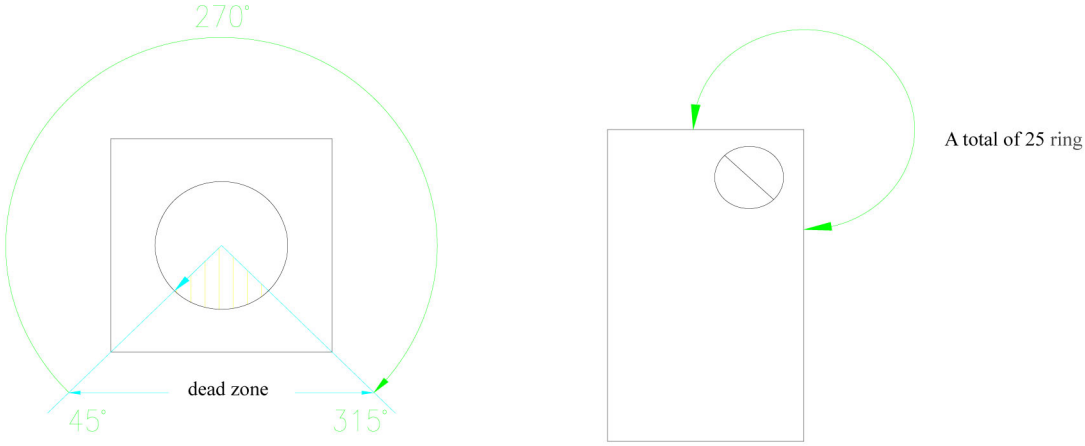


图 3.2 电位器的调节位置

3.4.1 High/Low Speed Adjustment

The controller should control on the idle position after starting the engine, the idle potentiometer is used for setting speed value under the idling condition, turn clockwise is for increasing speed, turn anticlockwise is for decreasing speed; turn the idle potentiometer slowly until to the required value according to the speed value under the condition of starting up.

When turn the switch to OFF terminal, the engine will increase speed from idle value to rated speed gradually according to the raising speed slope. The speed potentiometer is used for adjusting the rated speed of the engine, turn clockwise is for increasing speed and turn anticlockwise is for decreasing speed until to the required value.

Need to pay attention to is, when adjust the rated speed potentiometer or external Trimming Potentiometer to adjust the rated engine speed value。At the same time, will affect the idle speed setting value, so after setting the rated speed value, it should be on the idle value correction.

3.4.2 Stability Adjustment

If the engine is starting with instable speed, you can adjust it as the below information. The stability adjustment has three steps and there are idle, high speed and full loading.

Cautions: The engine works under the stability of the idle, high speed and full loading is syntrophic, so adjust the system refer to three steps to the best stability. After reaching to the stability, adjust Gain potentiometer to the larger value to be sure the engine get the best dynamic indicator.

The engine instability has the periodicity and the aperiodicity.

Periodicity instability has the speediness and the low speed. The speediness is usually means the frequency is 3HZ or more, but the frequency is less than 3HZ is low speed instability. Low speed may cause the strong instability and pay more attention to that; If happened, please adjust the parameter to the speediness firstly, then adjust slowly to avoid to damage the machine or the accident happen.

The stability adjustment of engine finished mainly through the adjustment of GAIN, STABILITY potentiometer and SWI switch. Gain Potentiometer is used for adjusting the sensitivity of the governor system, turn clockwise is for increasing, on the contrary is for decreasing. The stability potentiometer is used for adjusting the respond time of the governor system, turn clockwise is for increasing, on the contrary is for decreasing. The adjustment between Gain and Stability will let the engine works under the best condition. When start the engine with instable status, please adjust as following.

Solution Ⅰ:

1. **Adjust Gain potentiometer:** Turn clockwise Gain potentiometer, if instability is tend to increase, please turn anticlockwise until to stable; If the stable point cannot be found, please turn Gain to relative stable position; then turn anticlockwise to a little back to be sure the stability.

2. **Stability Potentiometer:** Turn clockwise the Stability potentiometer, if the instability is tend to increase, please turn anticlockwise until to stable; If the stable point cannot be found, please turn Stability to relative stable position; then turn anticlockwise to a little back to be sure the stability.

Repeat 2 steps of the solution, usually the engine will reach to the stability, if failed, please see the below solution.

Solution Ⅱ: Adjust SW1:

We know from the above, the dial switch of the controller SW1 is the status switch, it is used for changing

the controller signal way to adapt the different engine, for the meaning of each dial please see the below

Chart 1. SW1 adjustment (Up means ON, Down means OFF)

Item	Status	Apply to
SW1(three numbers)	1 up 2 down	Apply to the machine with major damping force, such as medium and large diesel engine or gas egine/
SW1(three numbers)	1 up 2 down	Apply to small diesel engine, with well dynamic indicator and stability.

To be attention, all of the above solution we got from the plenty of matching test and daily service experience, for the problem caused by the engine design, manufacturing or system integration may not be classified as the above, even the phenomenon of state cross, that is why we see the above classify is not specific correspondence.

No.1 positon of SW1 is designed for the respond time of the controller to governor.

No.3 position of SW1 is designed for increasing a compensation capacitor.

We know from the above, when the engine works unstably with speediness, the faster the engine run, the higher the unstable frequency is, on the contrary is same If happened like this, you can try to turn No.1 switch of SW1 to OFF terminal(underside), it will decrease the sensitivity of controller from the high frequency signal. Please repeat solution Ⅰ after that, if it is still unstable, please find out NO.2 and No.3 switch of SW1 dial switch refer to chart 2 an adjust, after finished, repeat solution Ⅰ until the engine reach to the stability.

When the engine works with low speed is unstable, you can try to turn NO.1 switch to ON terminal (upside), or adjust according to chart 2,and repeat solution Ⅰ for each time until reach to the stability.

If the periodic instability is happened, you also can adjust refer to Chart 1 and Chart2.If the problem still can't be solved, it may caused by the engine own problem, please check the stability of fuel system, the air intake system and the loading. You also need to evaluate the engine performance and check the power stability, the speed signal range, speed signal cable and the shielding effect of external signal cable for speed governing. About the speed signal range, the normal idle should be more than 1.5Vpp and the normal speed is more than 4Vpp.

Chart 2 Compensation Capacitor Adjustment Of SW1

If the engine works unstably with speediness, please find out the right position according to SW1 status and adjust as this chart by the underside.		
If the engine works unstably with low speed, please find out the right position according to SW1 status and adjust as this chart by the upside.		
1	2	3
ON	ON	ON
	ON	OFF
OFF	OFF	ON
	OFF	OFF

4 Failure Predication And Treatment

4. 1 **Check-up the Fault**

The failure of the electronic governor will decrease the performance of the engine ,it will result in the engine works in failure. If the electronic governor is fail to work, you need to change a new one; If the failure is from the engine or its auxiliary system, it may show the problem as the engine speed can't reach to the requirement, the problem is hard to solve even you change a new governor, therefore, the failure reason should be estimated through the comprehensive analysis and test each item.

Failure Phenomenon	Parts Test	Testing Method
The engine is fail to start.	Battery Voltage	Measure Terminal 3 and Terminal 4 should be DC24V or DC12V.
	Speed Sensor	1.The installation is unqualified with big gap.
		2.The cable of speed sensor is broken, please measure its DC resistance and it should be 830～970 Ω.
	Actuator	1.There is the jamming phenomenon in the linkage section between the actuator and pump gear.
		2.The cable of the actuator is broken, please measure the internal resistance of the coil.
The actuator is fail to open fuel valve.	Battery Voltage	Measure the battery voltage when starting, if the voltage is less than 75% of rated voltage, it means undervoltage and the battery need to be charged.
	Actuator	2.There is the jamming phenomenon in the linkage section between the actuator and pump gear.
The engine works with unstable speed.	Speed Controller	Adjust the stability and gain potentiometer, for the details please see chapter 3.4.5.
	Actuator	Please check the linkage section between the actuator and pump gear if there has the gap or moveable phenomenon.
The engine works with over speed.	Speed Controller	1.Incorrect RPM.
		2.Low Gain with bad sensitivity, it result in the transient speed is too high when load discharge suddenly.
		3.You should change a new speed controller.
	Actuator	1.Please check the linkage section between the actuator and pump gear if there has the jamming or moveable phenomenon.
		2.The actuator is not match with fuel supply parts of the pump, even shut off the power but can't shut off the fuel supply.
	Speed Sensor	.Wrong signal because the connection is broken.

4.2 Sensor Signal because of inadequate magnetism

When the sensor works with strong signal, it can resist the external impulse interference. The speed controller can measure more than 3V effective signal from sensor. When the voltage of the sensor signal is under 3V, please decrease the gear gap between sensor and engine, it will improve the amplitude of sensor signal. If the gap has been adjusted to less than 0.45mm, the voltage still is under 3V, please check the magnetism of the sensor and it may too small.

4.3 Electromagnetic interference

The big interference signal will enter into the control loop of the governing system through the cable conduction or direct radiation, it will generate the badly difference to the control loop and effect the governing system. For preventing the medium interference, all of speed controller produced by Fortrust have the filter unit and shield setting, it will protect the sensitive loop from the external interference effect.

The interference value is hard and complex to forecast, so all of these should be considered into the possible interference range such as the wireless communication in the space, wireless walkie-talkie, radio transmitter, magneto, solid state ignition system, voltage regulator or battery charger. When you think the space field or other system have affected the governing system through conduction or direct radiation during using, we suggest you change all of the cables for this governing system to double-shielded cables, and it to be sure one of shielded terminal of the cable and also included the sensor shielded cable should be connected 360° to a supporting point of the controller housing, and you also need to install the metal plate of the controller inside of sealed metal box or connect to ground, it will resist the interference from the electron radiation, the metal covering or metal container will be better, the shielded cables is a common anti-interference measure. If the engine with the brush, its electric spark interference can't be omitted, so the big interference environment should have a special shielded measurement, if you can't solve the problems like these, please contact our engineers, they will give you more suggestion.