Commercial Vehicle Electronic Air Suspension System

Xian-yan WANG, Zai-wei ZHANG and Chuan-wu LI
SORL Auto Parts, Inc., Wenzhou 325200, China

Keywords: Compressor, Electronically controlled air suspension system, Vehicle.

Abstract. As the requirements of vehicle comfort and stability are getting higher and higher, ECAS has great superiority compared with leaf spring suspension. This paper expounds the traditional structure design principle, functions and advantages of ECAS, and analysis and discussion from the ECU, a high degree of sensor, solenoid valve and other key components.

Introduction

As the requirements of vehicle comfort and stability are getting higher and higher, ECAS has great superiority compared with leaf spring suspension. Air suspension system can be integrated with bus side of the kneeling control, truck pontoon control, load monitoring, traction help and other functions. Increase the failure alarm mechanism to monitor the reliability of the air suspension system. At present, the air suspension system of the domestic vehicle is directly imported from abroad, the air-suspension system is also produced with foreign technology, no independent intellectual property rights. Therefore, the independent development of ECAS system in the commercial vehicles has great development prospects and economic benefits.

Electronic Air Suspension System(ECAS)

Working principle: Figure 1 ECAS structure diagram of working principle ECAS consist of the ECU 3, telecontroller 2, ECAS solenoid valve 6, remote control RCU (truck) 1, height sensor 4, airbags 5 and so on. The height sensor measures the height between the chassis and the axle, then transmits the information to the ECU, which simultaneously received other signals such as vehicle speed, braking state, air pressure, etc. Integrated all the input signals, according to the ECU to set the control parameters and height control indicators, control ECAS solenoid valve exhaust, to compose a closed-loop control system. To achieve the charge and discharge of each air bag, adjust the chassis height to reach the target height.

Electronic air suspension compared with traditional air suspension:
1) Reducing adjustment times, reducing air consumption, extending the life of the control valve
2) Automatically adjust the vehicle height, special height memory
3) Solenoid valve response quickly, there are a variety of combinations can be adapted to a variety of models. Modular system design makes installation and maintenance more convenient.
4) Control parameters can be configured
5) By operating the remote control, it is convenient and safe, such as separate the tractor head and tractor body.
6) Increase a variety of auxiliary functions, such as bus side kneeling, truck overload protection and pontoon control etc.
7) With fault memory, diagnostic function and pressure monitoring

ECAS Main Components
ECU
The layout and function achieved method of the hardware circuit design learn advantages from foreign mainstream sample controller. Adopting automotive-level master control, communication, driving and power-processing electronic components for circuit design, which can resist temperature changes and has superior anti-jamming. Also by adding the PTC fuse, TVS tube etc, the protection circuit composed by a variety of monitoring circuit can ensure that the vehicle can work normally in the rugged environment. The height sensor with specific circuit and temperature compensation design can accurately measure the suspension height and no need to take into account the effects of temperature change on the measurement.

The electronic controller has the software control function. The height control function can accomplish the automatic control of the three height modes (normal height, special height I, special height II) according to the vehicle condition, also can achieve the manual height control and side kneeling control in the preset adjustment range. Using adjustable pulse width for target height control, the software will automatically according to the intake exhaust speed and the gap of current height and target height, adjust the pulse width length of the intake exhaust to be smooth and accurate, to prevent excessive adjustment due to excessive intake exhaust.

The electronic controller has the fault diagnosis function. It can diagnose: Height sensor short circuit, broken circuit, damage; Pressure sensor short circuit, broken circuit, damage; Solenoid valve short circuit, broken circuit, damage; Inductor light broken circuit, model mismatch, power reverse.

In addition, the calibration mechanism of the system parameters is designed, and computer software is designed to communicate with the ECU through the self-designed communication adapter. In the computer interface, you can load the system initial height, height adjustment of the upper and lower limits, calibrate a variety of control functions for the detailed parameter configuration values. According to different customer’s requirements, make the corresponding control parameters.

Height Sensor
The height sensor adopts the inductive displacement sensor structure. The inductance value is changed by changing the length of the iron core installed inside the coil. Then the height signal is changed, and the linearity of the height signal variation curve is ensured in the effective rotation angle range. Self-temperature compensation can be performed when the outside air temperature changes.

Height measurement principle is the phase shift detection method of the waveform, which requires the ECU and the height sensor to cooperate with each other. ECU regular send pulse square wave signal to the inductance coil of the height sensor, through the filter absorption of inductor in height sensor, the waveform changed. Based on this change, detection circuit in ECU will produce phase deviation signal. ECU master chip, which records the deviation value from the different inductance values, will determine the height sensor value.
**Solenoid Valve**

Based on wealth of experience on the development and production of air valve products, our company analyses the structure of foreign mainstream electronic air suspension solenoid valve and test their work characteristics. Re-design the valve body, solenoid valve coil, rubber seal diaphragm, electromagnetic core, spring and so on. Solenoid valve coil is using the coil winding similar as foreign sample, according to foreign sample and mechanical principle to design spring, to ensure adequate switching speed.

Rubber diaphragm is using the superior performance material to be cold resistance, durability, oil resistance and anti-aging properties so on. It can ensure the product reliability.

Strictly control the processing accuracy of valve body, to ensure tightness. Design reasonable gas channel to ensure that the valve body had enough flow during function.

According to different suspension control requirements for solenoid valve, a variety of common and special valve body modules are designed. Through the different valve body combination, the corresponding control channel and function are formed to meet different suspension configuration requirements.

**Conclusion**

Electronically controlled air suspension system is a new product developed by Ruili Group Ruian Auto Parts Co., Ltd, which is market-oriented, user-oriented and developed in a relatively short time. The development of the company's products to the diversified development, will be created a good economic benefits.

**References**