Chapter 29
Diagnostic Testing and Analysis of CAN Data Bus Based on the Sagitar Power Transmission System

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Abstract Based on the Sagitar power system of CAN data bus, analysis of a power transmission system network structure, elaborated the power system of CAN data bus termination resistor working principle and test method. Diagnostic testing by the BOSCH FSA740 standard engine analyzer, a power system CAN data bus circuit breaker, CAN_H and CAN_L data between the wire short circuit, CAN data bus to the positive or negative electrode short-circuit diagnostic testing and analysis.

Keywords CAN · Data bus · Diagnosis · Testing · Power transmission system

29.1 Introduction

Through the network can satisfy the people to the modern vehicle driving safety, comfort, emission performance and fuel consumption growing demand, reducing wire and connector number reduces the required space and the weight of a vehicle. But the automobile network application for repair and technical personnel raised taller requirement, is the current automotive electrical network repair of a problem.

Automobile network structure for various manufacturers varies, generally divided into a power transmission system, comfortable and infotainment systems, combination of instruments and diagnostic interface system, each system data exchange through CAN data bus. Wiper motor, light and rain sensor and anti-theft alarm device assembly using the LIN data bus. Due to the adoption of the central diagnosis interface or gateway, so the CAN data and the LIN data can be cross-border data exchange. In this chapter, based on the FAW-Volkswagen power of

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E. Qi et al. (eds.), *The 19th International Conference on Industrial Engineering and Engineering Management*, DOI: 10.1007/978-3-642-38391-5_29,

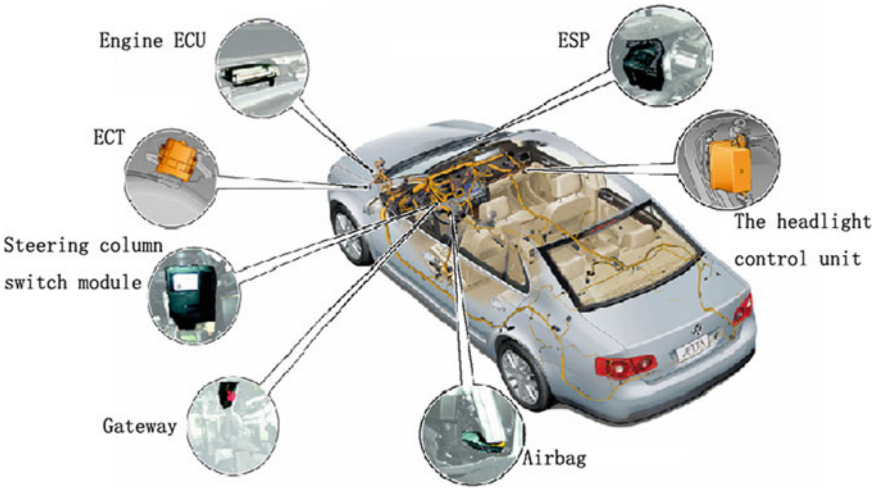

Fig. 29.1 Sagitar power system network structure

CAN data bus, through a vehicle network diagnostic test for repair, technical staff to provide a good reference.

29.2 Network Structure of Power Transmission System

Power CAN data bus sub-system includes engine management system control unit, automatic transmission, with EDS ABS, steering column electronic device, illumination distance adjusting device and airbag. The data transmission rate of 500 kbit/s, each control unit receives information by CAN data bus continuously from the other control unit, and immediately on power system working condition changes, for real-time bus. The data bus of short circuit or open circuit causes the bus off (Fig. 29.1).

29.3 The Principle and Detection of Power System CAN Data Bus Terminal Resistance

29.3.1 The Principle of Power System CAN Data Bus Terminal Resistance

For the CAN data bus signal, bus wire end is equivalent to the role of independent transmitter, so at the end of wire will produce reverse operation of the signal, the signal is superimposed on the effective signal will cause the distortion, must be in the high frequency bus network end termination abort signal, which might otherwise occur reflection. The process of reflection and crashed into a dock embankment, then reflection and with follow-up wave superposition is similar, terminal resistance effect is like sand, if the wave washed onto the beach, the beach will absorb the energy of waves and causing no wave superposition. So the data bus to be connected to a terminal resistor termination data transmission, absorption signal operation to the data wire end when the energy.

High speed bus connects the CAN physical interface typically uses the standard ISO11898. This standard stipulated the transmission medium for a two bus lines, two terminal resistances are provided for 120 ohm. But not all manufacturers are using the standard ISO11898, in the Sagitar power transmission system on the CAN data bus, the data wire end without installing the standard two 120 ohm resistor. But the engine management system control unit of resistance of 66 ohm resistor to assume a central, power transmission system bus remaining on the control unit has a high resistance, each of the resistance for 2.6 k ohms. Because the control system of the resistance is connected in parallel, so according to the following way of calculating the load resistance of the total resistance value:

$$\mathrm{R}_{ges} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3} + \frac{1}{R4} = \frac{1}{2600} + \frac{1}{2600} + \frac{1}{2600} + \frac{1}{66} = 61.35\,\Omega$$

29.3.2 The Detection of Power System CAN Data Bus Terminal Resistance

In the system can use the resistance measuring device for short and open fault diagnosis. As the power transmission system of CAN data bus through a bus terminal 15 is switched on and in short-term continue operation after shut down completely, so it will be in the interval after the time, allowed pull off the control unit plug, check the CAN_H and CAN_L data between the wire resistance. If the resistance value is greater than 250 ohms, show that the engine control unit of a data conductor circuit; if the resistance value is less than 30 ohm, show that the data wires may exist between short circuit; if the CAN_L or CAN_H data wire and a grounding between measured resistance value is less than 300 ohm, then the negative short circuit (Fig. 29.2).

29.4 Power Transmission System CAN Data Bus Diagnosis Test and Analysis

When the automobile multiplex system for information transmission link (or communication lines) have a fault occurs, the communications line short circuit,

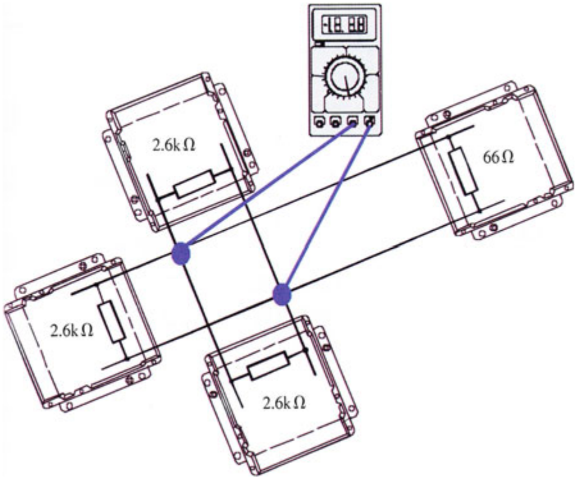

Fig. 29.2 The Sagitar power system CAN data bus termination resistor connection

broken circuit and circuit physical nature of the communication signal attenuation or distortion, will cause multiple electronic control unit not working or electronic control system error action. Power transmission system CAN data bus failures that may occur with the power transmission system of CAN data bus circuit, CAN_H and CAN_L data between the wire short circuit, CAN data bus to the positive or negative electrode short circuit. Through the BOSCH FSA740 standard engine analyzer diagnostic test, observation different of data communication signal and standard communication data signal.

29.4.1 Power Transmission System CAN Data Bus Normal Waveform Test

From the oscillogram, CAN_H signal, the CAN_L signal, signals are under the symmetrical arrangement. Level from dominant to recessive state switching state without interference. CAN_H and CAN_L signal recessive level is 2.5 V, dominant state CAN_H signal voltage value is about 3.5 V, CAN_L signal voltage value is about 1.5 V. According to the bus load, these values may be vary in the hundreds of millivolt range. Voltage signal curve depends largely on the use of oscilloscope. The general rule is: the higher resolution, signal display more clearly (Fig. 29.3).

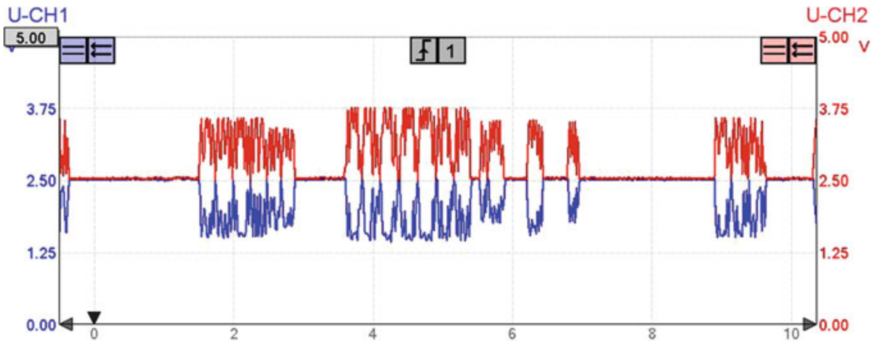

Fig. 29.3 Normal system oscillogram

29.4.2 Power Transmission System CAN Data Bus Circuit Breaker Waveform Test

29.4.2.1 CAN_L Wire Breaker

Oscilloscope preferably using two channel and measurement data wire signal voltage to ground for diagnosis, can be more easily analyzed voltage level and fault diagnosis. Relative measurement data wire on the voltage signal display the voltage difference. From the oscilloscope, CAN_H and CAN_L signal level are 2.5 V recessive dominant state CAN_H signal voltage value of about 3.5 V, is normal waveform; the voltage of the CAN_L signal values of approximately 3 V, is abnormal waveform. Thus can judge CAN_L wire circuit breaker (Fig. 29.4).

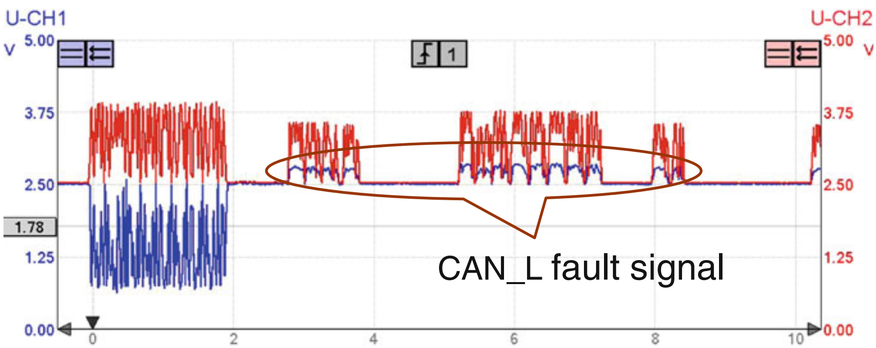

Fig. 29.4 CAN-L wire breaker oscillogram

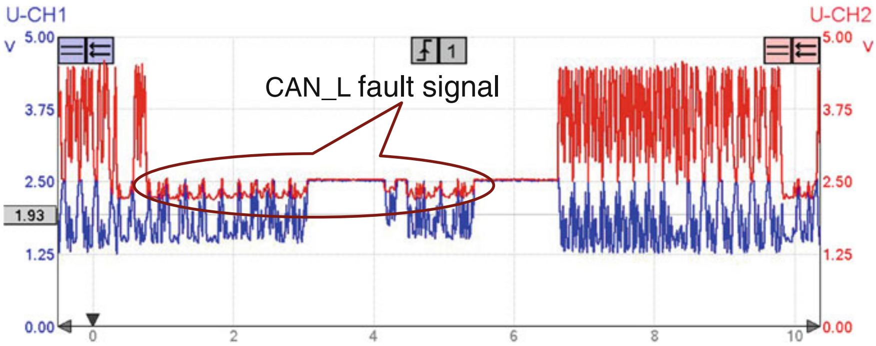

Fig. 29.5 CAN-H wire breaker oscillogram

29.4.2.2 CAN_H Wire Breaker

From the oscilloscope, CAN_H and CAN_L signal level are 2.5 V recessive. Dominant state CAN_H signals voltage value of about 2.3 V is abnormal waveform; the voltages of the CAN_L signal values of approximately 1.5 V, is normal waveform. Thus CAN_H wire circuit breaker can be judged (Fig. 29.5).

29.4.3 Power Transmission System CAN Data Bus: On the Positive or Negative Electrode Short Circuit

29.4.3.1 CAN_L Short Circuit to Negative or Positive Electrode

CAN_L line voltage is 0 V if the CAN_L data wire short circuit to ground. CAN_H wire recessive level becomes 0.2 V from about 2.5 V, at the same time the voltage level becomes the dominant state from the recessive state; if the CAN_L data wire short circuit to positive electrode, and the engine is shut off and the connection without contact resistance, CAN_L signal voltage level is increased to the voltage value 12 V (Fig. 29.6 is about 11.75 V), while in the data wires cannot be observed changes from the recessive state level to the dominant state (Fig. 29.7).

29.4.3.2 CAN_H Short Circuit to Negative or Positive Electrode

The oscilloscope must be observed two data wires without voltage signal if CAN_H data wire on the negative short. CAN_H data wire voltage level becomes 0 V, CAN_L becomes 0.2 V wire level; if the CAN_H data wire short circuit to positive, CAN_H signal voltage level is increased to the voltage value 12 V when the engine is shut off and the connection without contact resistance, at the same

Fig. 29.6 CAN_L short circuit to negative electrode

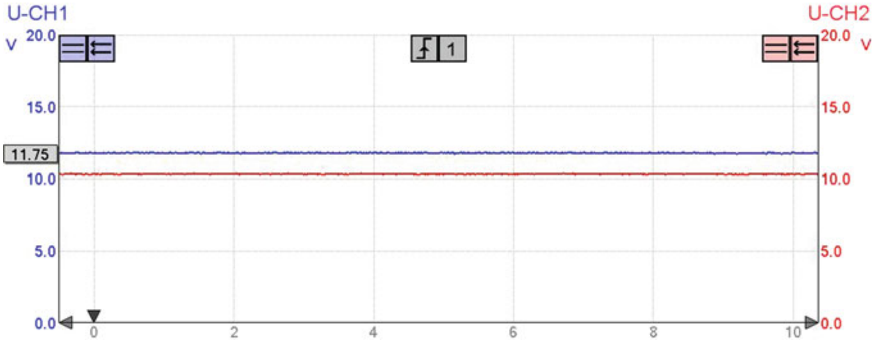

Fig. 29.7 CAN_L short circuit to positive electrode

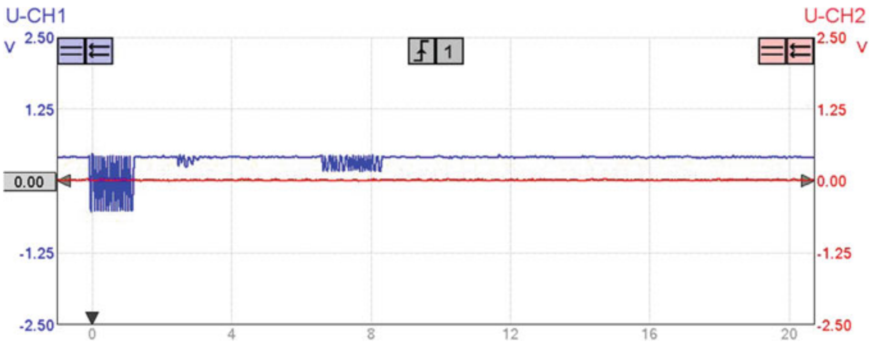

Fig. 29.8 CAN_H short circuit to negative electrode

time in the two data wires cannot be observed changes from the recessive state level to the dominant state (Figs. 29.8 and 29.9).

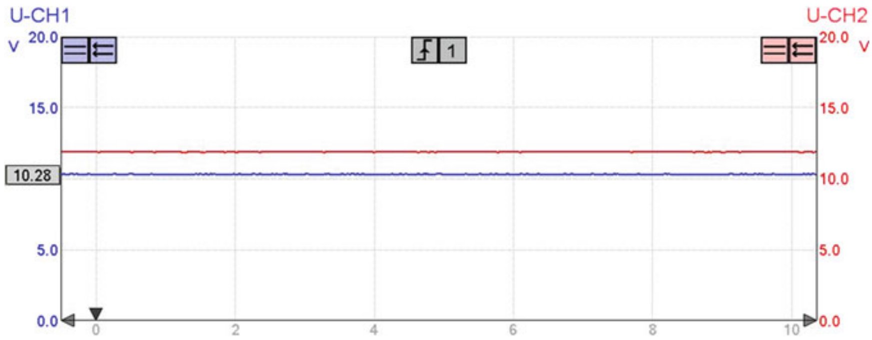

Fig. 29.9 CAN_H short circuit to positive electrode

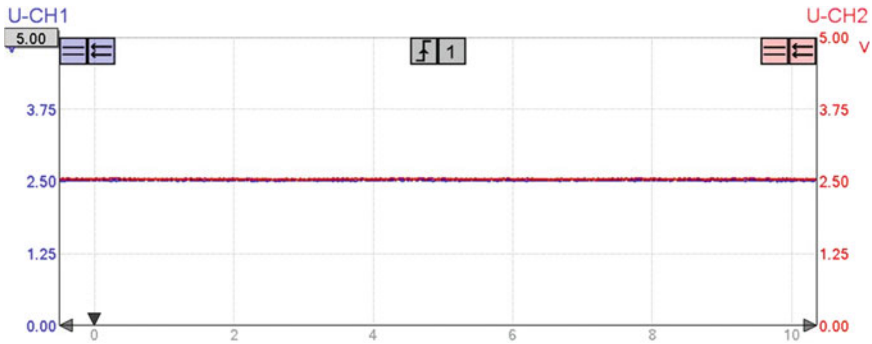

Fig. 29.10 Between CAN_H and CAN_L data wires short circuit oscillogram

29.4.4 Between CAN_H And CAN_L Data Wires Short Circuit

Oscillogram shows two voltage signals overlap each other and curves of the same if data wires are connected to short circuit each other. The two signal voltages are 2.5 V approximately (Fig. 29.10).

29.5 Conclusion

CAN bus (multiplex transmission system) is one of the most promising buses; its application field is constantly expanding. Multiplex transmission system has incomparable advantages to the traditional automobile wiring. Because high technology content, there are still some fault can not accurately find and eliminate via the test equipment. Automobile repair and technical personnel must be find fault by the systematic analysis of multiplex network basic structure and signal transmission principle, the flexible application of multiplex transmission network specific diagnostic methods, multi-path transmission network diagnostic test, find out the multiplex network structure inherent laws.