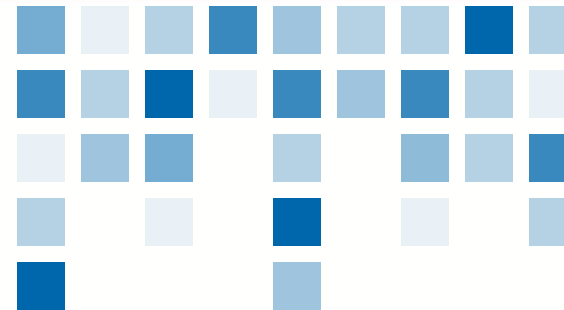
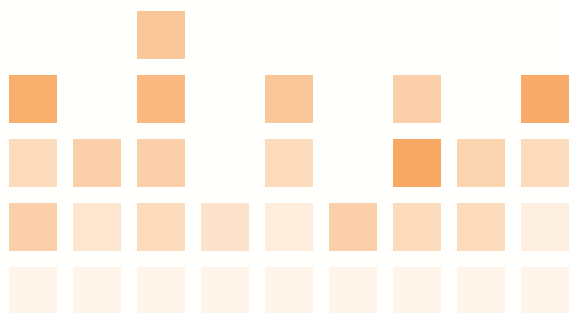




SHACMAN 汽车电器知识培训

F2000-F3000

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第三十三课 分动器电磁阀控制

1.分动器简述:

4×4、6×6、8×8 驱动形式车型为全轮驱动车型，军车、特种车辆、全驱车型除了装配变速箱以外，还经常装配分动器这种动力分配装置，使动力经分动箱分别传递给前驱动桥和后驱动桥，可以给整车提供更强的动力和更好越野性能。

分动器是军车、全轮驱动车型的常用配置，下面对分动器与电磁阀之间的连接进行讲解。

Transfer case overview:

4×4, 6×6, and 8×8 drive configuration vehicles are all-wheel-drive models. Military vehicles, special-purpose vehicles, and all-wheel-drive models often have a transfer case, in addition to the gearbox, as a power distribution device. It allows power to be transmitted separately to the front and rear drive axles, providing the vehicle with stronger power and better off-road performance.

The transfer case is a common configuration for military vehicles and all-wheel-drive models. Below is an explanation of the connection between the transfer case and the electromagnetic valves."



图（3-56）分动器操纵气缸



分动器按操纵形式分主要分为：机械挂挡和气动挂挡两种。

机械挂挡的分动器常用的是拉线式操纵，不需要电磁阀控制气路。

气动挂挡的分动器需要3个电磁阀组合来控制分动器的挂挡，由电路控制气路，操纵挂档气缸。

对于全驱车型来说，电磁阀需要电器连接，分动器需要气管路连接，必须要保证电路和气管路正确连接，否则整车发动后，由于分动器不能挂上挡位，导致车辆不能正常行走。

分动器的挂挡气缸又分为前置式和后置式两种如图（3-56）所示：

前置式指操纵气缸朝向驾驶室一端。

后置式指操纵气缸朝向车辆尾部一端。

The transfer case can be primarily classified by its operating method into two main types: mechanical shift and pneumatic shift.

Mechanical Shift: In transfer cases with mechanical shift, a commonly used method is cable-operated control. These systems do not require electromagnetic valves to control the air circuit.

Pneumatic Shift: Transfer cases with pneumatic shift require a combination of three electromagnetic valves to control the shifting of the transfer case. The air circuit is controlled by the circuit, operating the shift cylinder.

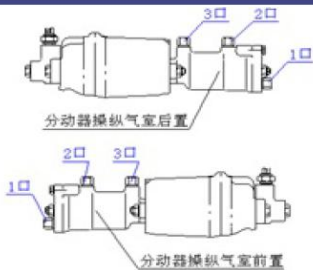
For all-wheel-drive models, electromagnetic valves need electrical connections, and the transfer case requires pneumatic connections. It is essential to ensure correct connections of both the circuit and pneumatic lines. Otherwise, after the vehicle is started, if the transfer case cannot shift into gear, the vehicle will not be able to move properly.

The shifting cylinder of the transfer case can be further classified into two types, as shown in Figure (3-56):

Front-mounted: The operating cylinder faces towards the end of the driver's cabin.

Rear-mounted: The operating cylinder faces towards the rear end of the vehicle.





图（3-57）气管路接口

前置式和后置式操纵气缸管路接口定义如图（3-57）所示：对于分动器操纵气缸，不论是前置还是后置，它的3个气管路接口的定义，都是把气缸尾部的接口定义为1口，气缸中间部位的接口定义为2口，气缸安装固定螺栓旁边的接口定义为3口。

常用的分动器种类主要有ZQC1200、ZQC1600、ZQC2000 三种。

ZQC1200 高低档控制气缸有前置式和后置式2 种，一般装配前置式分动器用于SX2110 系列车型；

ZQC1600、ZQC2000 一般为后置式分动器用于其它全轮驱动车型。



分动器上装配的信号开关有2种，

第①种如图（3-10）所示左边所示为3针开关分别连接棕蓝黄色、棕黄色、棕色；

第②种如图右边所示为2针开关，当分动器高低档控制气缸为后置式时，操纵气缸上的信号开关为低档信号（越野档）；
当分动器高低档控制气缸为前置式时，操纵气缸上的信号开关为高档信号（公路档）。

The definitions of the interfaces for the front-mounted and rear-mounted operating cylinders are shown in Figure (3-57): For the operating cylinder of the transfer case, whether it is front-mounted or rear-mounted, the definitions of its three pneumatic interface ports are standardized. The port at the tail end of the cylinder is defined as Port 1, the port in the middle section of the cylinder is defined as Port 2, and the port next to the cylinder mounting bolt is defined as Port 3.

The commonly used types of transfer cases mainly include three types: ZQC1200, ZQC1600, and ZQC2000.

ZQC1200: This type of transfer case has two variants of front-mounted and rear-mounted high-low gear control cylinders. The front-mounted transfer case is generally used for SX2110 series models.

ZQC1600, ZQC2000: These transfer cases are typically rear-mounted and are used for other all-wheel-drive vehicle models.



图（3-10）分动器信号开关



分动器上主要的电器开关是公路、越野信号灯开关，锁前桥信号灯开关，分动器取力器信号开关，根据分动器型号不同，各开关位置也不一样，图（3-9）汇总了各类分动器上信号开关的位置以及接线颜色。

The main electrical switches on the transfer case are the highway/off-road signal switch, the front axle lock signal switch, and the power take-off signal switch. Depending on the model of the transfer case, the positions of these switches vary. Figure (3-9) summarizes the positions of various signal switches on different types of transfer cases, along with the wire colors for connection.



(a) ZQC1200 分动器



(c) ZQC2000 分动器



(b) ZQC1600 分动器



2、分动器操纵气路控制简介：

第一种：分动器前置式操纵控制时气管路连接。

图（3-58）a是老式电磁阀，图（3-58）b是新式电磁阀。

如图（3-58）所示，图中电磁阀出口标注“接1口”表示此电磁阀气管路与前置式操纵气缸的“1口”连接。以此类推。

分动器操纵气缸管路接口的定义如图（3-57）中所示。

图（3-58）a、b中右下角所示为分动器各档位时，各接口的通气状态图。以此作为装配、维修、调试的气路判断参考。

图中为装配1个常通气电磁阀和2个常断气电磁阀时的示意图。

Introduction to the control of the transfer case operating pneumatic circuit:

The first type: Connection of pneumatic circuit for front-mounted control of the transfer case.

Figure (3-58) a depicts the old-style electromagnetic valve, while figure (3-58) b depicts the new-style electromagnetic valve.

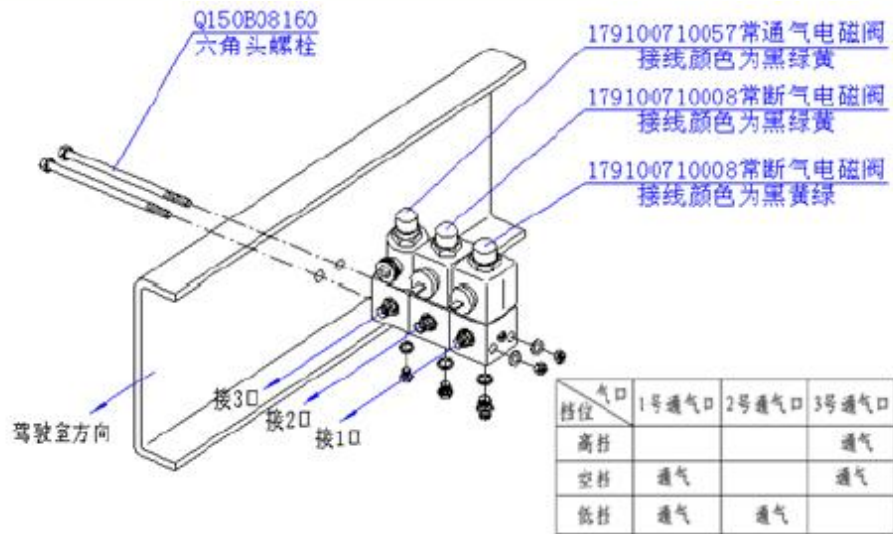
As shown in Figure (3-58), the outlet of the electromagnetic valve is marked "connect to port 1", indicating that the pneumatic circuit of this electromagnetic valve is connected to port 1 of the front-mounted operating cylinder. Similarly for other ports.

The definitions of the interfaces for the transfer case operating cylinder are as shown in Figure (3-57).

In the lower right corner of Figures (3-58) a and b, the ventilation status diagrams of each interface for the transfer case in different gear positions are shown. This serves as a reference for assembly, maintenance, and troubleshooting of the pneumatic circuit.

The diagrams show the assembly of one normally open air valve and two normally closed air valves.

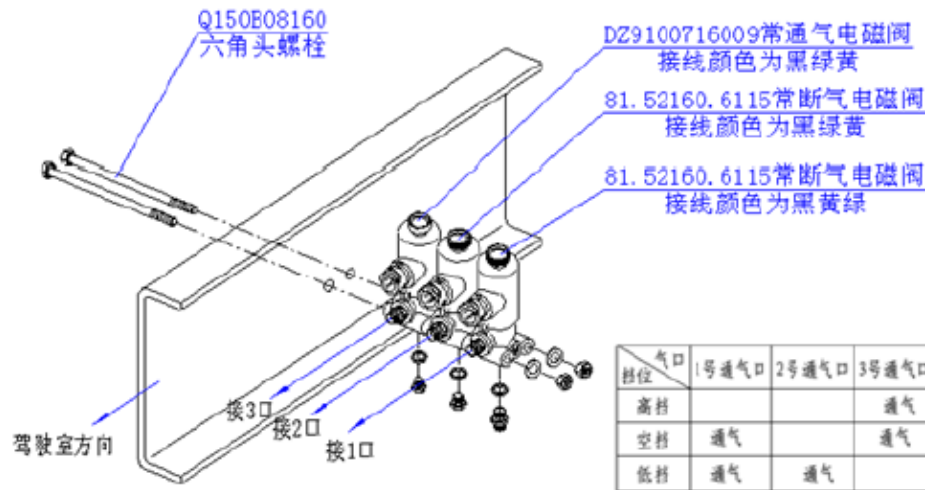




(a) 老式电磁阀

图 (3-58) 分动器电磁阀示意图 (前置式)

Figure (3-58) Transfer Case Electromagnetic Valve Diagram (Front-mounted)



(b) 新式电磁阀

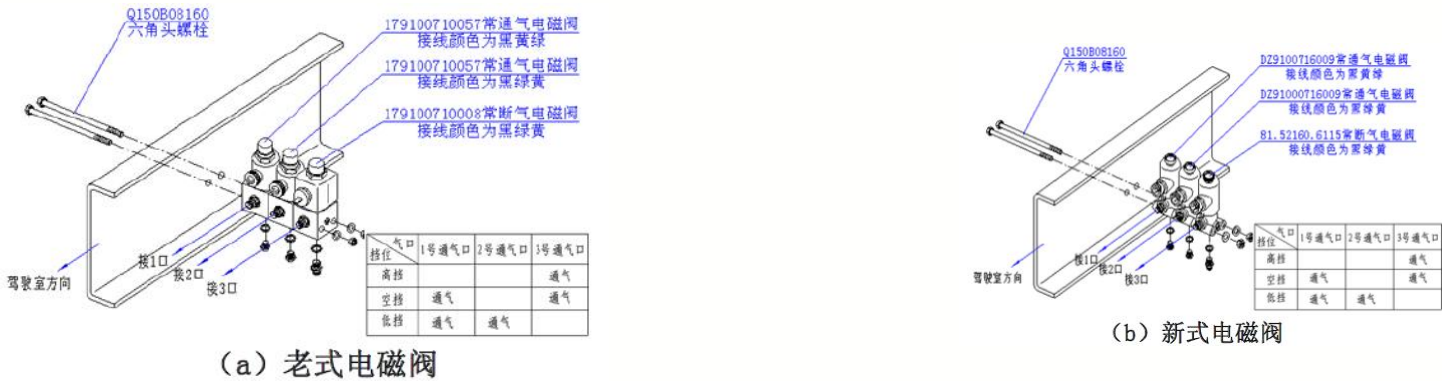
图 (3-58) 分动器电磁阀示意图 (前置式)

Figure (3-58) Schematic Diagram of Transfer Case Electromagnetic Valves (Front-mounted)



第二种：前置式控制时气管路连接在实际装配中有时设计要求装配2 个常通气电磁阀和1 个常断气电磁阀，这时装配示意图如图（3-59）所示。图（3-59）a是老式电磁阀，图（3-59）b是新式电磁阀。

The second type: When front-mounted control is required, the pneumatic circuit connection in actual assembly sometimes necessitates the installation of 2 normally open air valves and 1 normally closed air valve as per design requirements. In such cases, the assembly schematic is depicted in Figure (3-59). Figure (3-59) a shows the old-style electromagnetic valve, while Figure (3-59) b shows the new-style electromagnetic valve



图（3-59）分动器电磁阀示意图（前置式）



第三种：后置式操纵气缸控制时气管路连接，实际装配时还会使用2 个常通气电磁阀和1个常断气电磁阀，这时装配示意图如图（3-60）所示。

The third type: When rear-mounted operating cylinder control is required, the pneumatic circuit connection in actual assembly also involves the use of 2 normally open air valves and 1 normally closed air valve. In such cases, the assembly schematic is depicted in Figure (3-60).

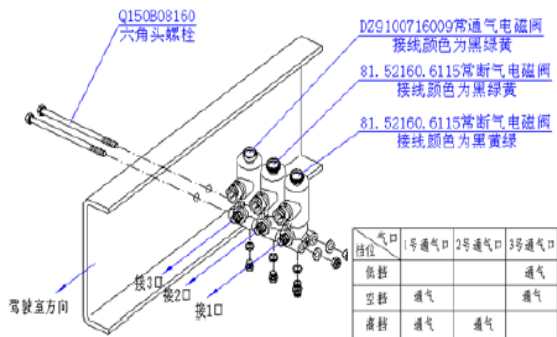


图（3-60）分动器电磁阀示意图（后置式）



第四种：后置式操纵气缸控制时气管路连接，实际装配时还会使用1 个常通气电磁阀和2 个常断气电磁阀气电磁阀，这时装配示意图如图（3-61）所示。

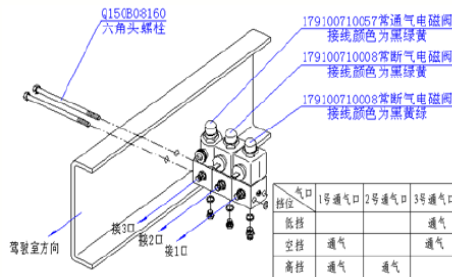
The fourth type: When rear-mounted operating cylinder control is required, the pneumatic circuit connection in actual assembly also involves the use of 1 normally open air valve and 2 normally closed air valves. In such cases, the assembly schematic is depicted in Figure (3-61).



(b) 新式电磁阀

分动器操纵相对较繁琐，在实际装配过程中电磁阀装配、分动器气管路连接在不同的位置，所以装配时一定要按图中所示的电磁阀顺序，端口定义进行装配。

Controlling the transfer case is relatively complex. During actual assembly, the placement of electromagnetic valves and the connection of pneumatic lines for the transfer case may vary. Therefore, during assembly, it is essential to follow the sequence of electromagnetic valves and port definitions as shown in the diagram.



(a) 老式电磁阀

图（3-61）分动器电磁阀示意图（后置式）



3、德龙F2000分动器电路控制简介：

3.1.图（4-13）中所示为德龙F2000车型分动器后置操纵电器原理图，后置式操纵气缸应用在ZQC1200、ZQC1600、ZQC2000 分动器上，图中为2 个常通气电磁阀（Y9）和1 个常断气电磁阀（Y7），按图中控制原理电磁阀不通电时，分动器工作在高档状态（高档为公路档、低档为越野档）。

图（4-12）所示为德龙F2000车型分动器控制翘板开关。

Delong F2000 Transfer Case Circuit Control Overview: 3.1. The diagram (4-13) illustrates the electrical schematic for the transfer case control of the Delong F2000 model, featuring rear-mounted operating cylinder. The rear-mounted operating cylinder is utilized in ZQC1200, ZQC1600, and ZQC2000 transfer cases. The diagram depicts 2 normally open air valves (Y9) and 1 normally closed air valve (Y7). According to the control principle shown in the diagram, when the electromagnetic valves are not energized, the transfer case operates in high gear mode (where high gear refers to highway mode, and low gear refers to off-road mode). Diagram (4-12) illustrates the control toggle switch for the transfer case of the Delong F2000 model.



图4-12分动器控制翘板开关



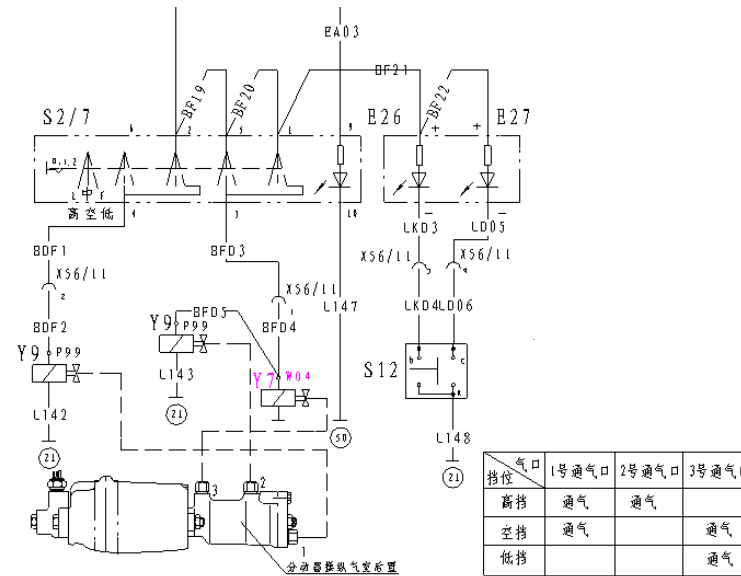


图 (4-13) 分动器后置操纵

S2/7-分动器控制翘板开关 E26-分动器越野档指示灯 E27-分动器公路档指示灯 S12-高低档信号开关 Y9-常通气电磁阀
 Y7-常断气电磁阀

S2/7 - Transfer Case Control Toggle Switch E26 - Transfer Case Off-road Mode Indicator Light E27 - Transfer Case Highway Mode Indicator Light S12 - High-Low Gear Signal Switch Y9 - Normally Open Air Valve (Constant Vent) Y7 - Normally Closed Air Valve (Constant Close)



3.2.图（4-14）中所示为德龙F2000车型分动器前置操纵电器原理图，前置式操纵气缸一般应用在ZQC800 或ZQC1200 分动器上，图中为2 个常断气电磁阀（Y7）和1 个常通气电磁阀（Y9），按图中控制原理电磁阀不通电时，分动器工作在高档状态，（高档为公路档、低档为越野档）

图中罗列了分动器不同挡位时，各端口的通气状态，电磁阀的工作状态。

The diagram (4-14) illustrates the electrical schematic for the transfer case control of the Delong F2000 model, featuring front-mounted operating cylinder. The front-mounted operating cylinder is generally used in ZQC800 or ZQC1200 transfer cases. The diagram depicts 2 normally closed air valves (Y7) and 1 normally open air valve (Y9). According to the control principle shown in the diagram, when the electromagnetic valves are not energized, the transfer case operates in high gear mode (where high gear refers to highway mode, and low gear refers to off-road mode).

The diagram also lists the ventilation status of each port for different gear positions of the transfer case, along with the working status of the electromagnetic valves.

S2/7-分动器控制翘板开关

E26-分动器越野档指示灯

E27-分动器公路档指示灯

S12-高低档信号开关

Y9-常通气电磁阀

Y7-常断气电磁阀

S2/7 - Transfer Case Control Toggle Switch

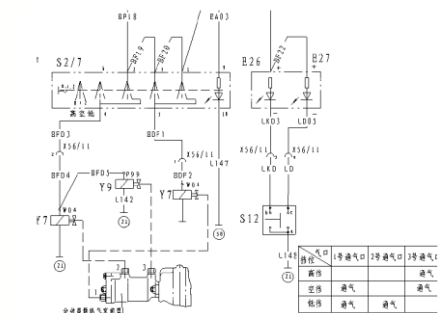
E26 - Transfer Case Off-road Mode Indicator Light

E27 - Transfer Case Highway Mode Indicator Light

S12 - High-Low Gear Signal Switch

Y9 - Normally Open Air Valve (Constant Vent)

Y7 - Normally Closed Air Valve (Constant Close)



图（4-14）分动器前置操纵

4、全轮驱动控制：

当车辆行驶在泥泞路面或阻力较大的爬坡状态时，驾驶人员把全轮驱动开关按下，电磁阀得电后压缩空气通向分动器挂挡气缸，此时通过分动器内部的机械传动实现全轮驱动。

注意：全轮驱动时前驱动轴与后驱动轴是一根“死轴”，实际上就是机械的硬连接，因此其任何瞬间前驱动轴与后驱动轴的转速都是绝对一致的，也就是说，这种分动箱其前驱动与后驱动之间没有差速作用，全轮驱动时发动机的任何动力都是前后平均分配。为了确保车辆安全，全轮驱动工作时的车速要求不大于40公里/小时。

当车辆恢复到正常路面行驶时，驾驶人员应关闭全轮驱动开关，前轮驱动桥通过分动器内部的差速机构实现与中后桥之间的差速运转。

All-Wheel Drive Control:

When the vehicle is traveling on muddy roads or in conditions with high resistance, such as climbing slopes, the driver presses the all-wheel drive switch. When the electromagnetic valve receives power, compressed air is directed to the transfer case engagement cylinder. At this point, all-wheel drive is achieved through the mechanical transmission inside the transfer case.

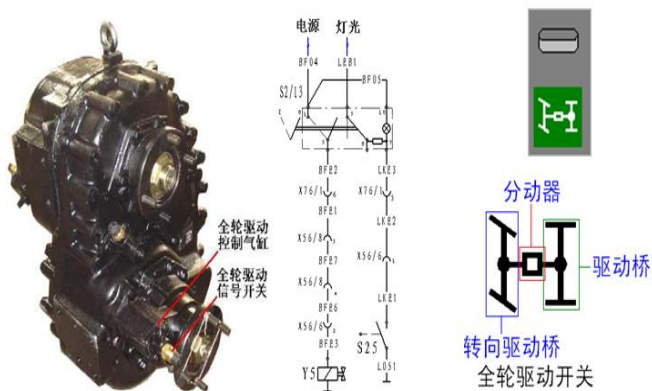
Note: When in all-wheel drive mode, the front and rear drive axles are mechanically linked, essentially forming a "dead axle." Consequently, at any moment, the speeds of the front and rear drive axles are exactly the same. This means that there is no differential action between the front and rear drives in this type of transfer case, and any engine power during all-wheel drive mode is evenly distributed between the front and rear axles. To ensure vehicle safety, the speed limit when operating in all-wheel drive mode should not exceed 40 kilometers per hour.

When the vehicle returns to normal road conditions, the driver should deactivate the all-wheel drive switch. The front axle differential mechanism within the transfer case then allows for differential operation between the front axle and the middle/rear axle.



全轮驱动控制原理图如图（3-8）所示。

The schematic diagram for all-wheel drive control is illustrated in Figure (3-8).



图（3-8）全轮驱动原理图

The schematic diagram for all-wheel drive control

S2/13-全轮驱动翘板开关 Y5-全轮驱动
电磁阀 S25-全轮驱动信号开关
X76-翘板开关插接器 X56-驾驶室与
底盘线束插接器
S2/13 - All-Wheel Drive Toggle Switch Y5 -
All-Wheel Drive Electromagnetic Valve S25
- All-Wheel Drive Signal Switch X76 -
Toggle Switch Connector X56 - Cab and
Chassis Wiring Harness Connector

