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**SBW and SBW2 Troubleshooting Guide****AES-286**

ECN	REV	REVISION RECORD	DATE	ENGINEER
15099	A	Released to production	6/22/2017	B Gelino
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### **System Operation**

The SBW system consists of a pushbutton, generally located in the cab, and an actuator/sensor located at the transmission. The pushbutton receives the requests from the operator and takes the appropriate action. This can be either a CAN command, activating the motor controller, or both.

When a keypad button is pressed, the pushbutton reads the redundant position sensors and determines which direction the motor will need to turn the transmission's output shaft to select the requested range. This could be either clockwise, counterclockwise, or the motor may not move at all depending on the request. There is a difference in the operation of the system between a 5-speed and a 6-speed transmission. The detailed differences are in the following paragraphs.

### **5-Speed Operation**

The 5-speed systems work with Park and non-park equipped Allison 1000/2000/2400 transmission. At key on, the shifter will display the current range of the transmission in the right (Monitor) display. The selected gear will be blank. When a button is pressed, indication of the request the request is in the left (Select) display. The request for P on park-equipped

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transmissions will not display in the left display. The transmission needs to be programmed for **5, 3, 2, 1** functionality.

After selecting Drive, the display will show **D 1**. The D is displayed after the keypress and the 1 is a CAN message received from the transmission control module (TCM) indicating that the transmission is in first gear. If **D D** is displayed, this is an indication that the shifter did not receive the CAN message from the TCM.

If the down arrow is pressed when the transmission is in Drive, the actuator will not move but the pushbutton turns on an output that goes to the overdrive defeat input of the TCM. This will select the highest range that the transmission will shift up to as 4. Another press moves the transmission shift shaft to the 3 detent. The next two presses select the 2 and 1 detents. The up arrow moves the selector up through the gears in the reverse of the down arrow.

The mode button sends out a request to the TCM for mode 2. The TCM programming defines the function of mode 2. One popular use is as a secondary shift schedule. The request is sent both by an output and over the CAN bus. Check with the manufacturer for mode button use. The Mode 2 request defaults to off when the shifter is first powered up.

A CAN message received from the TCM operates the mode light. It is sent only after a request is received and the transmission changes to secondary mode.

The service light is an indication that there is an issue with the signals received from the actuator. It does not indicate an issue with the transmission.

## **6-Speed Operation**

The 6-speed systems work with Park and non-park equipped Allison 1000/2000/2400 transmission. At key on, the shifter will display the current range of the transmission in the right (Monitor) display and the selected range in the left (Select) display. Both of these messages are received on the CAN bus from the TCM. The request for P on park-equipped transmissions will not display in the left display. The transmission needs to be programmed for **6M1** functionality.

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After selecting Drive, the display will show **6 1**. Both the 6 and the 1 is a CAN message received from the transmission control module (TCM) indicating that the transmission is in first gear and the highest gear that it will shift up to is 6. If **D +** is displayed, this is an indication that the shifter did not receive the CAN message from the TCM.

If the down arrow is pressed when the transmission is in Drive, the actuator will move to the M detent and send a CAN message to the TCM to down shift 1 gear. The display will now show **5 1**. As the up and down buttons are pressed, upshift and downshift commands are sent out on the CAN bus, the actuator does not move the transmission shaft.

The mode button sends out a request to the TCM for mode 2. The TCM programming defines the function of mode 2. One popular use is as a secondary shift schedule. The request is sent both by an output and over the CAN bus. Check with the manufacturer for mode button use. The Mode 2 request defaults to off when the shifter is first powered up.

The mode light is operated by a CAN message received from the CAN bus from the TCM. It is sent by the TCM only after a request is received and the transmission changes to secondary mode.

### **No Display**

Check the power at pins A and H of connector B. If battery voltage is not present, check the wiring and fuses. Check the ground signals at pins D and E of connector B. If they are good, check the ignition input at pin 17 of connector A. If all signals are good, the shifter will need replacement.

If the fuses continue to blow, the most probable cause is an issue with the motor. Unplug the 4-pin (not the 6-pin) actuator connector at the transmission. Power the device up and press Drive or Reverse. If the fuse is still good, we can rule out the wiring and the pushbutton. If that test blows a fuse, make sure the motor wires are not shorting to the chassis. If the wires look good, the pushbutton needs replacement.

If the fuse did not blow, it is probably in the actuator. TO determine if it is binding, remove the shift shaft adapter that connects the motor to the transmission shaft and press reverse with the motor 4-pin harness reconnected but not connected to the transmission. The motor is free to turn at this point. If the motor turns with no issue, it is a binding problem. Follow the procedure

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to reinstall the shift shaft adapter remembering to loosen the cap screw 1 turn so it will not bind.

If the fuse blows when disconnected from the transmission, there is a problem with the actuator and it will need replacement.

### **Issues Obtaining Range (R, N, D)**

If the vehicle is having an issue consistently obtaining a range, the most likely cause is an improperly calibrated actuator. Refer to AES-204 for calibration procedure. Another possible cause could be water intrusion behind the round cover. Remove the cover and inspect for signs of water intrusion. Replace the actuator assembly if there are signs of water. If the area is dry, we first need to determine if the actuator is operating by shifting through the gears with the key on and the engine off. You should be able to hear the actuator clicking through the gears. Removing the round actuator cover and having second person looking for movement during the above test is another way to run the test. If the actuator is not moving and the service light of the shifter is not flashing ½ second on, ½ second off, there could be an issue with the shift motor. The service light will blink short/long (100ms on / 100ms off, 500ms on/ 500ms off) if the actuator does not complete the shift in 10 seconds. The light will flash the above sequence if the actuator did not shift.

To determine if the actuator is getting voltage to turn the motor, unplug connector C and measure the voltage across pin pairs A/B and C/D. The voltage should be 9 to 14 volts. Measurements must take place within 10 seconds of pressing a button that is different from the pushbutton display. (Press R or N if the display is D, Press D or R if the display is N) The pushbutton turns off the actuator signals after 10 seconds. Replace the actuator if the signals are good but there is no movement from the actuator. Note that the movement between gears is about 10 degrees so there will not be a lot of movement.

If there is no voltage at the actuator, there could be an active interlock at the pushbutton. Backing out pins 24 and 23 will temporarily bypass the interlocks. Try shifting with these pins backed out. If this fixes the issue, you will need the vehicle wiring harness diagram to troubleshoot the interlock issue. Skip this step if the pins are not populated.

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If the interlocks are ok, there could be an issue with the wiring. This is less likely as the system can operate on one motor pair (A/B or C/D). Ohm the four wires between the actuator (connector C) and the pushbutton (connector B). The connections are

1. connector B, pin B to connector C, pin A
2. connector B, pin C to connector C, pin B
3. connector B, pin F to connector C, pin C
4. connector B, pin G to connector C, pin D

The pushbutton is faulty and will need replacement if the connections are ok.

### Service Light Codes

The service light is an indication that there is an issue with the signals received from the actuator. It does not indicate an issue with the transmission and the transmission does not store any error codes for our system.

Listed below are the service light flashing patterns, the associated failure, and troubleshooting steps.

**1a. Service light on SOLID:** Single sensor failure. Failure is with either of the sensors or the wiring connecting to them. See troubleshooting for 1a below.

**1b. Service light WINKS (100ms off) every two seconds:** Sensor #1 failure. Failure is with the sensor or the wiring connecting to it. See troubleshooting for 1b below. The system is designed to work with one sensor and should be functioning normally during the above scenario.

**1c. Service light WINKS (100ms off) twice every two seconds:** Sensor #2 failure. Failure is with the sensor or the wiring connecting to it. See troubleshooting for 1c below. The system is designed to work with one sensor and should be functioning normally during the above scenario.

**2. Service light BLINKS (500ms on / 500ms off):** Either both sensors have failed or the two sensor readings differ by more than the allowable range. See troubleshooting for 2 below.

**3. Service Light BLINK\_SHORT\_LONG (100ms on / 100ms off/ 500ms on/ 500ms off):** 10-second motor timeout. See troubleshooting for 3 below.

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**Troubleshooting for 1a. Service light on SOLID:**

With the key on and the engine off, unplug the 6-pin connector at the actuator. Using a meter, measure the voltage across pins A and B. The voltage should be 5 volts. If it does not measure 5 volts, the issue is with one of these two wires. A less likely issue is that the pushbutton is not outputting the 5 volts and will need replacement.

If the 5 volts is present across pins A and B, use the meter and check the voltage across pins E and F. The voltage should be 5 volts. If it does not measure 5 volts, the issue is with one of these two wires. A less likely issue is that the pushbutton is not outputting the 5 volts and will need replacement.

If both the 5 volt signals are good, the problem has to be related to the signals coming back from the position sensors. Turn the ignition off. Unplug connector A (24-way) at the pushbutton and check continuity from pin 18 at connector A to pin C at connector D. If these are good, check continuity from pin 6 at connector A and pin D at connector D. An alternate way to check these signals is to back out pins 6 and 18 of connector A and plug everything back in. Turn on the ignition, measure the voltage on pin 6 with respect to ground, and pin 18 with respect to ground. The output should be between 0.5 and 4.5 volts. The reading will be close to 2.5 volts on both sensors when the transmission is in Neutral.

If any of the signals are bad, the most likely culprit is the wiring or pins in the connector.

If the signals are all good, the pushbutton will need replacement.

**Troubleshooting for 1b. Service light WINKS (100ms off) every two seconds:**

With the key on and the engine off, unplug the 6-pin connector at the actuator. Using a meter, measure the voltage across pins A and B. The voltage should be 5 volts. If it does not measure 5 volts, the issue is with one of these two wires. A less likely issue is that the pushbutton is not outputting the 5 volts and will need replacement.

If the 5 volt signal is good, the problem has to be related to the signal coming back from position sensor 1. Turn the ignition off. Unplug connector A (24-way) at the pushbutton and check continuity from pin 18 at connector A and pin C at connector D.

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An alternate way to check this signal is to back out pin 18 of connector A and plug everything back in. Turn on the ignition, measure the voltage on pin 18 with respect to ground. The output should be between 0.5 and 4.5 volts. (The reading will be close to 2.5 volts when the transmission is in Neutral).

If any of the signals are bad, the most likely culprit is the wiring or pins in the connector.

If the signals are all good, the pushbutton will need replacement.

### **Troubleshooting for 1c. Service light WINKS (100ms off) twice every two seconds:**

With the key on and the engine off, unplug the 6-pin connector at the actuator. Using a meter, measure the voltage across pins E and F. The voltage should be 5 volts. If it does not measure 5 volts, the issue is with one of these two wires. A less likely issue is that the pushbutton is not outputting the 5 volts and will need replacement.

If the 5 volt signal is good, the problem has to be related to the signal coming back from position sensor 1. Turn the ignition off. Unplug connector A (24-way) at the pushbutton and check continuity from pin 6 at connector A and pin C at connector D.

An alternate way to check this signal is to back out pin 6 of connector A and plug everything back in. Turn on the ignition, measure the voltage on pin 6 with respect to ground. The output should be between 0.5 and 4.5 volts. (The reading will be close to 2.5 volts when the transmission is in Neutral).

If any of the signals are bad, the most likely culprit is the wiring or pins in the connector.

If the signals are all good, the pushbutton will need replacement.

### **Troubleshooting for 2. Service light BLINKS (500ms on / 500ms off):**

Check the wiring and the connector pins on the 6-pin connector at the actuator and the sensor pins at the pushbutton (pins 6,7,8,18,19, and 20). If they are good, check the 5 volt supplies to the actuator. With the key on and the engine off, unplug the 6-pin connector at the actuator. Using a meter, measure the voltage across pins A and B. The voltage should be 5 (+/- 0.1) volts. If it does not measure 5 volts, the issue is with one of these two wires. A less likely issue is that the pushbutton is not outputting the 5 volts and will need replacement. A

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continuity check from pin 19 to pin A and pin 7 and pin B should help determine wiring issues. A less likely issue is that the pushbutton is not outputting the 5 volts and will need replacement.

If the 5 volts is present across pins A and B, use the meter and check the voltage across pins E and F. The voltage should be 5 (+/-0.1) volts. If it does not measure 5 volts, the issue is with one of these two wires. A continuity check from pin 20 to pin F and pin 8 and pin E should help determine wiring issues. A less likely issue is that the pushbutton is not outputting the 5 volts and will need replacement.

If the 5 volt signals above are good, Check the readings back from the actuator to the pushbutton. Plug the 6 way connector back in at the actuator, back out pins 6 and 18 at the pushbutton, plug the 24-way connector back in, power up the shifter and measure the voltage on pins 6 and 18 with respect to chassis ground. The readings at pin 6 and pin 18 at the pushbutton should be very close to each other. If these are not very close to each other (within 0.2 volts) but are in the range of 0.8 to 4.3 volts, there is an issue with the sensor and the actuator assembly will need replacement.

### **Troubleshooting for 3:**

To determine if the actuator is getting voltage to turn the motor, unplug connector C and measure the voltage across pin pairs A/B and C/D. The voltage should be 9 to 14 volts. Measurements must take place within 10 seconds of pressing a button that is different from the pushbutton display. (Press R or N if the display is D, Press D or R if the display is N) The pushbutton turns off the actuator signals after 10 seconds. Replace the actuator if the signals are good but there is no movement from the actuator. Note that the movement between gears is about 10 degrees so there will not be a lot of movement.

### **Blank selected (left) character at startup**

A blank selected character at startup is normal for a 5-speed shifter.

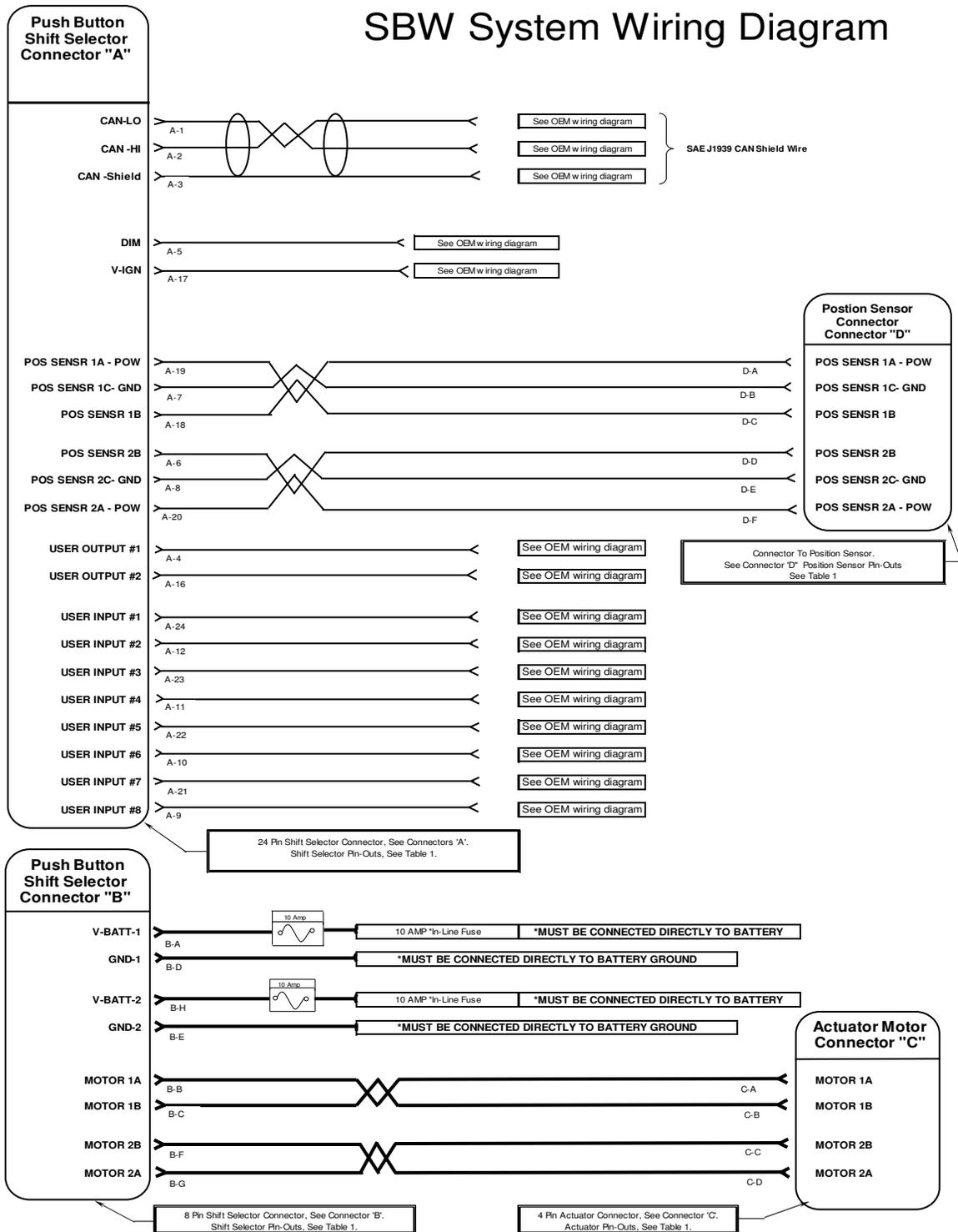
### **Shifter displays DD instead of D1 (5-speed) or D+ instead of 61 (6-speed)**

This indicates a J1939 signal timeout. 5-speed shifters will operate normally except there will be no indication of current gear. 6-speed shifters will not be able to hold any gears because downshifting happens over the J1939 bus. The transmission will shift normally. 6-speed shifters will not be able to show the current gear.

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# SBW System Wiring Diagram



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