The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
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SURFACE VEHICLE STANDARD

SAE J1699®-1

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SAE J1850 Verification Test Procedures

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1. Scope

1.1 Purpose—This SAE Recommended Practice recommends test methods, test procedures, and specific test parameters to help verify that vehicles and test tools can communicate using the SAE J1850. This document only verifies the portion of SAE J1850 that is used for OBD-II communications. The term "test tool" is synonymous with OBD-II Scan tool.

1.2 Application—The procedures, methods, and parameters contained in this document apply to vehicles and test tools which support OBD-II messages, as outlined in SAE J1979. SAE J1699 is intended primarily for use as a design verification aid.

2. References

2.1 Applicable Publications—The following publications form a part of this specification to the extent specified herein. Unless otherwise specified, the latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1699-2—OBD-II Related SAE Specification Verification Test Procedures
SAE J1850 MAY2001—Class B Data Communication Network Interface
SAE J1962 FEB98—Diagnostic Connector
SAE J1978 FEB98—OBD-II Scan Tool
SAE J1979 SEP97—E/E Diagnostic Test Modes

2.2 Related Publications—The following publications are provided for information purposes only and are not a required part of this specification.

2.2.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1213-1 SEP97—Glossary of Vehicle Networks for Multiplexing and Data Communications
SAE J1930 MAY98—Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, & Acronyms
SAE J2178-1 MAR99—Class B Data Communication Network Messages

3. Definitions

3.1 Active State—The state of a bus wire that results when one or more nodes have "turned on" their physical layer circuitry. This is V_{oh} volts for Bus + (PWM and VPW) and V_{ol} volts for Bus - (PWM only). Refer to Table 4 (PWM DC Parameters) and Table 6 (VPW DC Parameters) in SAE J1850 for the values of V_{oh} and V_{ol}. The active state voltage level is determined by the source voltage of the physical layer drive circuitry.

3.2 Arbitration—The process of resolving which frame, or In-Frame Response data, continues to be transmitted when two or more nodes begin transmitting frames, or In-Frame Response data, simultaneously.

3.3 Dominant Bit—A bit which wins arbitration when contending for the bus. For SAE J1850, a logic "0" is the dominant bit.

3.4 Dual Wire—Two wires that are routed adjacently throughout the vehicle and can be either a twisted or a parallel pair of wires.

3.5 Fault Tolerance—The ability of a system to survive a certain number of failures with allowance for possible down-graded performance while maintaining message transmission capability at the specified data rate.

3.6 Frame—One complete transmission of information, which may or may not include an "in-frame response." For this network, each frame contains one and only one message. A frame is delineated by the Start of Frame (SOF) and End of Frame (EOF) symbols.

3.7 Maximum OBD-II Scan Tool Load—The maximum electrical load that the OBD-II Scan tool may have. $C_{load\ max}$ is 500 pF and $R_{load\ min}$ is 10.6 kΩ.

3.8 Maximum Vehicle Load—The maximum electrical load that the vehicle network may have. Refer to SAE J1850 for the values of $C_{load\ max}$ and $R_{load\ min}$. The electrical load of the OBD-II Scan Tool must be subtracted from C_{load} max and R_{load} min.

3.9 Minimum Vehicle Load—The minimum electrical load that the vehicle network may have. Refer to SAE J1850 for the values of $C_{load\ min}$ and $R_{load\ max}$. The electrical load of the OBD-II Scan Tool must be subtracted from $C_{load\ min}$ and $R_{load\ max}$.

3.10 Message—All of the data bytes contained in a frame. The message is what remains after the frame symbols have been removed from the frame. As such, the message is the sequence of bytes contained in the frame.

3.11 Passive State—The state of a bus wire which results when all nodes have "turned off" their physical layer circuitry. This is V_{ol} volts for Bus + (PWM and VPW) and V_{oh} volts for Bus - (PWM only). Refer to Table 4 (PWM DC Parameters) and Table 6 (VPW DC Parameters) of SAE J1850 for the values of V_{oh} and V_{ol}. The passive state voltage level is determined by the reference voltage of the bus wire termination resistor(s).

3.12 Pulse Width Modulation (PWM)—A data bit format, where the width of a pulse of constant voltage or current determines the value (typically one or zero) of the data transmitted.

3.13 Recessive Bit—A bit which loses arbitration when contending for the bus with a dominant bit. For SAE J1850, a logic "1" is the recessive bit.

3.14 Variable Pulse Width (VPW) Modulation—A method of using both the state of the bus and the width of the pulse to encode bit information. This encoding technique is used to reduce the number of bus transitions for a given bit rate. One embodiment would define a "ONE" (1) as a short active pulse or a long passive pulse while a "ZERO" (0) would be defined as a long active pulse or a short passive pulse. Since a frame is comprised of random 1's and 0's, general byte or frame times cannot be predicted in advance.

3.15 Unit Load—The electrical loading effect of each device connected to the network will be measured in terms of unit loads. A unit load is a nominal value which, if all nodes correspond to one unit load, will allow the maximum specified number of nodes to be connected to the network. There is no requirement that a given node must be equal to a standard unit load, but the combination of all load values must not exceed the limits for any given system.

4. *Abbreviations and Acronyms*

CRC	Cyclic Redundancy Check
DUT	Device Under Test (either the OBD-II Scan Tool or the Vehicle)
EOD	End of Data
EOF	End of Frame
IFR	In-Frame Response (Byte/Bytes)
IFS	Inter-Frame Separation
NAD	Network Access Device
OBD-II	On-Board Diagnostics version two
PWM	Pulse Width Modulation
PID	Parameter ID
SOF	Start of Frame
VPW	Variable Pulse Width

5. *General Information*

5.1 Test Procedure Overview—The procedures contained in this document are intended to test a subset of the SAE J1850 specification. The following is a short synopsis of the purpose of each of the tests.

5.1.1 INVALID CRC TEST—Verifies that the module under test generates correct CRCs. Also, verifies that the module discards any message sent to it with an incorrect CRC.

5.1.2 MESSAGE STRUCTURE TEST—Verifies that the DUT uses all required frame elements in the proper order, and that it is capable of recognizing and responding to network traffic.

5.1.3 BUS ARBITRATION TEST—This test confirms the DUT arbitrates for bus control during message header transmission.

5.1.4 BUS FAULT TEST—Verifies that the DUT meets all failure modes specified by SAE J1850 as required modes and optional modes (if applicable).

5.1.5 SYMBOL PARAMETER LIMITS—Verifies that the DUT shall receive and transmit symbols within specified SAE J1850 limits.

5.2 Generic Test Conditions—The tests shall be performed under conditions considered to be a typical garage environment. The environment shall not exceed the temperature extremes of either the device under test or any of the pieces of test instrumentation. Test personnel may want to record the temperature and humidity the test procedures were performed under. The test sequence is arbitrary.

5.2.1 DIGITAL SCOPE REQUIREMENTS

a. Record 20 ms of network traffic
b. 20 pF (max)
c. 1 MΩ (min)
d. 2 channel 100 MHz digital storage scope (min)
e. Pre-trigger input
f. Hewlett-Packard 54600B or equivalent

5.2.2 POWER SUPPLY REQUIREMENTS—All power supplies specified in this document are industry standard.

5.2.2.1 PS#1—The power supply shall be capable of supplying 0 to 24 V DC at 5 A or HP 6543A equivalent.

5.2.2.2 PS# 2—Refer to the Voltage Ground Offset device description for power supply requirements or HP 6023A equivalent.

5.2.2.3 PS#3—The power supply shall be capable of supplying 0 to 12 V DC at 0.5 A or HP 6543A equivalent.

5.2.2.4 PS#4—Refer to the Small Signal Voltage Ground Offset device description for power supply requirements or HP 6543A equivalent.

5.2.3 DIGITAL VOLT OHM METER (DVOM) REQUIREMENTS—Industry standard DVOM or Fluke 87 equivalent.

5.2.4 GROUND OFFSET VOLTAGE DEVICE—The Ground Offset Voltage device, shown in Figure 1, introduces a voltage offset in the test fixtures. PS #2 provides current in the 0.1 Ω resistor thereby producing a voltage rise from point (+) to point (–).

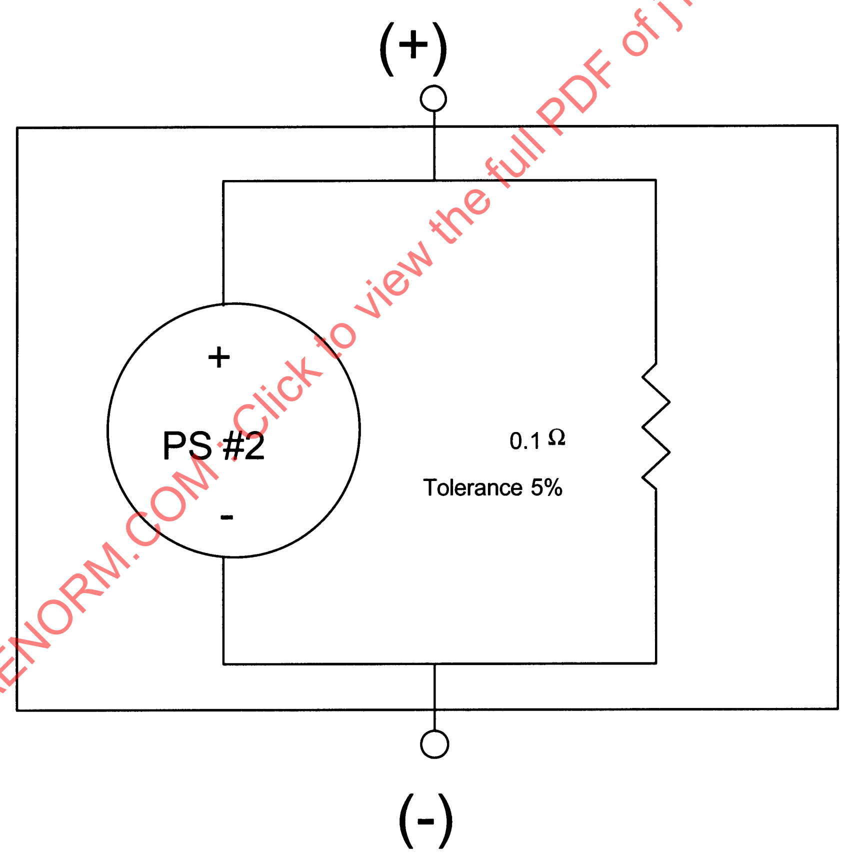

FIGURE 1—GROUND OFFSET VOLTAGE DEVICE

The Ground Offset Voltage device must be able to achieve a maximum of 1.9 V. The current calculation follows in Equation 1:

$$\text{Current} = \frac{\text{Voltage}}{\text{Resistance}} = \frac{1.9}{0.1\Omega} = 19\text{A} \quad \text{(Eq. 1)}$$

PS #2 must be capable of supplying 20 A at 1.9 V. The power rating for the resistor is determined by Equation 2:

$$\text{Watts} = \text{Volts} \times \text{Current} = 1.9\text{V} \times 19\text{A} = 36.1\text{W} \quad \text{(Eq. 2)}$$

The wattage rating on the resistor should be at least 50 W to account for temperature increases.

If the Ground Offset Voltage needs to be zero, remove the Ground Offset Voltage Device and short the (+) and (–) point together in the test fixture.

5.2.5 SMALL SIGNAL GROUND OFFSET VOLTAGE DEVICE—The Small Signal Ground Offset Voltage device, shown in Figure 2, introduces a voltage offset in PWM signal. PS #4 provides current in the 1.0 Ω resistor thereby producing a voltage rise from point (+) to point (–).

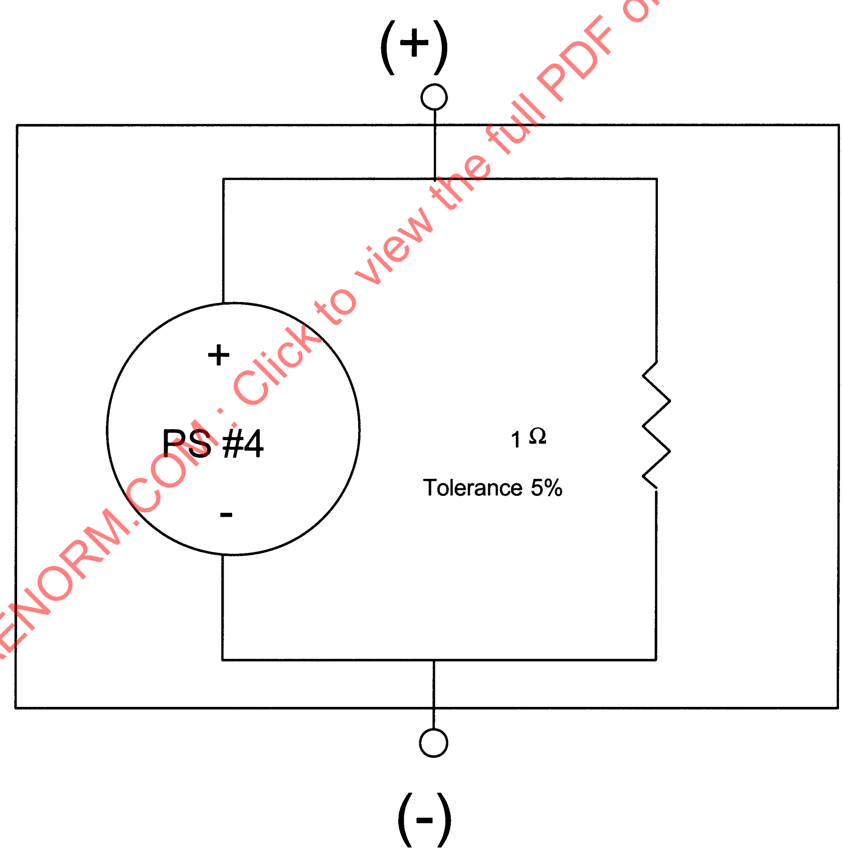

FIGURE 2—SMALL SIGNAL GROUND OFFSET VOLTAGE DEVICE

The Small Signal Ground Offset Voltage device must be able to achieve a maximum of 4.0 V. The current calculation follows in Equation 3:

$$\text{Current} = \frac{\text{Voltage}}{\text{Resistance}} = \frac{4.0}{1.0\Omega} = 4\text{A} \qquad \text{(Eq. 3)}$$

PS #4 must be capable of supplying 4.0 A at 4.0 V. The power rating for the resistor is determined by Equation 4:

$$\text{Watts} = \text{Volts} \times \text{Current} = 4.0\text{V} \times 4.0\text{A} = 16.0\text{W} \qquad \text{(Eq. 4)}$$

The wattage rating on the resistor should be at least 20 W to account for temperature increases.

If the Small Signal Ground Offset Voltage needs to be zero, remove the Ground Offset Voltage Device and short the (+) and (–) point together in the test fixture.

5.2.6 VPW BUS RX/TX CIRCUIT—Figure 3 shows the schematic for the VPW Bus Transceiver. This circuit is not representative of a vehicle module physical layer. Resistors are 5% tolerant and 1/2 W unless otherwise specified.

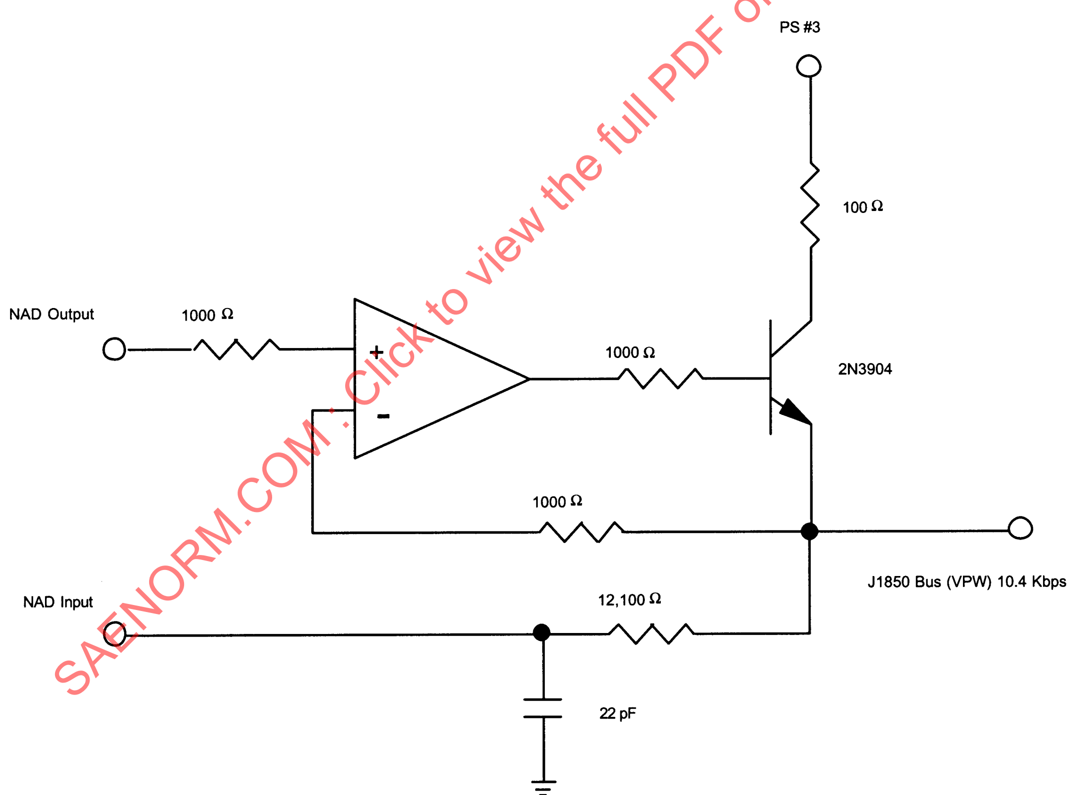

FIGURE 3—VPW BUS RX/TX CIRCUIT

5.2.7 PWM Bus RX/TX Circuit—Figure 4 shows the schematic for the PWM transceiver. This circuit is not representative of a vehicle module physical layer. Resistors are 5% tolerant and 1/2 W unless otherwise specified. "R" is an open circuit for testing the vehicle and is 85 to 378 Ω if testing the OBD-II Scan Tool. PS #3 and the Small Signal Offset Voltage Device will be used to vary the voltage level of the PWM signals.

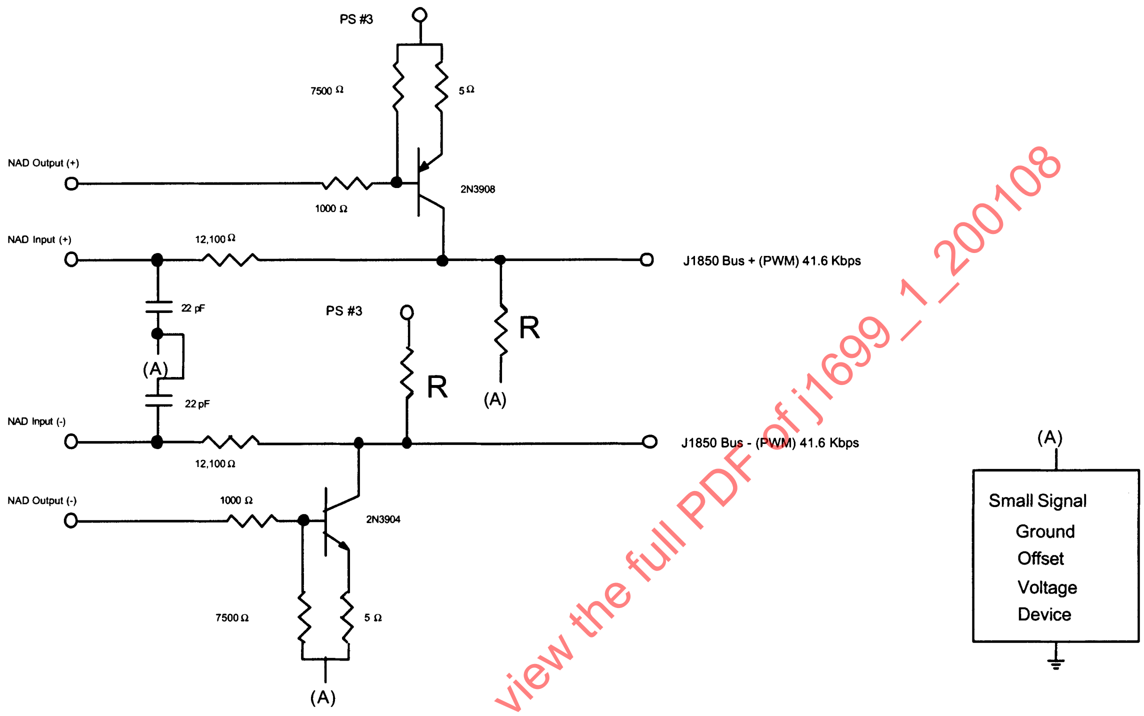

FIGURE 4—PWM BUS RX/TX CIRCUIT

5.2.8 PWM Scope Input Filter—Figure 5 shows the schematic for the PWM low pass input filter. The 3 db cutoff frequency is 3.76 MHz. Resistors are 5% tolerant and 1/2 W unless otherwise specified. Capacitors have a 10% tolerance unless otherwise specified.

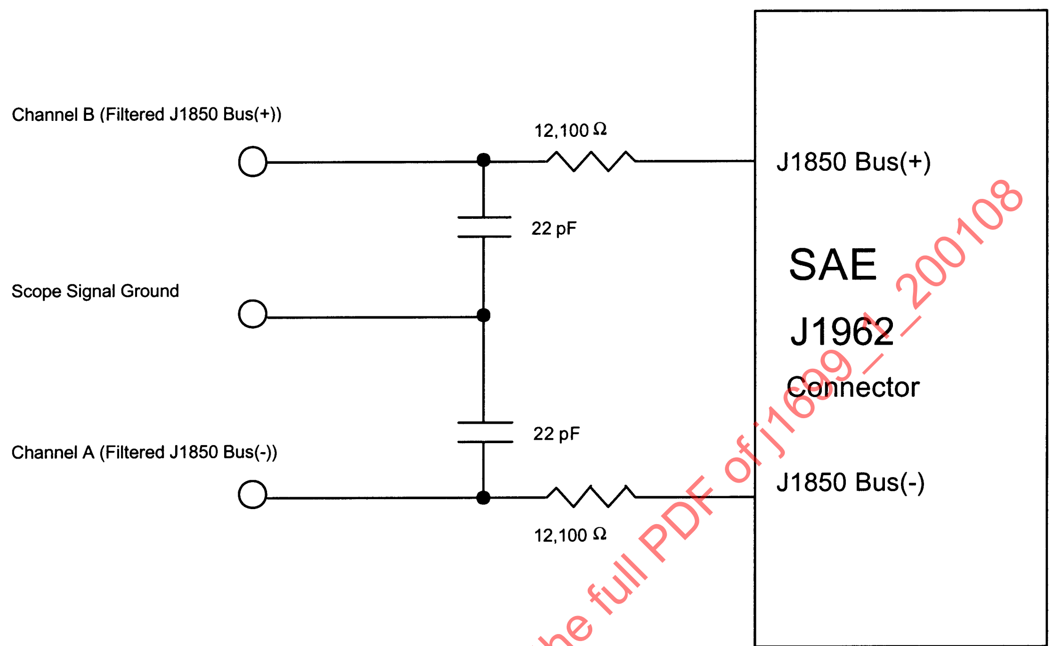

FIGURE 5—PWM SCOPE INPUT FILTER

5.2.9 Network Access Device Requirements (NAD)—This device must be able to transmit and receive all SAE J1850 frame elements.

a. Capable of SAE J1699 Test Methods Functions Including:

1. Generate invalid CRC (see 6.4.1)
2. Generate J1850 Message Structure (see 7.4)
3. Force Bus Arbitration (see Section 8)
4. Continue to operate during bus faults (see Section 9)
5. Vary J1850 symbol parameters (see Section 10)
6. Display and store all Bus traffic
7. Support SAE J1850 interfaces
8. External trigger output for; arbitration test shall be within 1 µs of the arbitration event and scope trace trigger
9. Indicate valid/invalid CRC
10. Ability to filter network messages

5.2.10 NETWORK LOAD DEVICE FOR PWM AND VPW—Figure 6 shows the schematic for the PWM and VPW network load circuits. See SAE J1850 for the values of R and C loads.

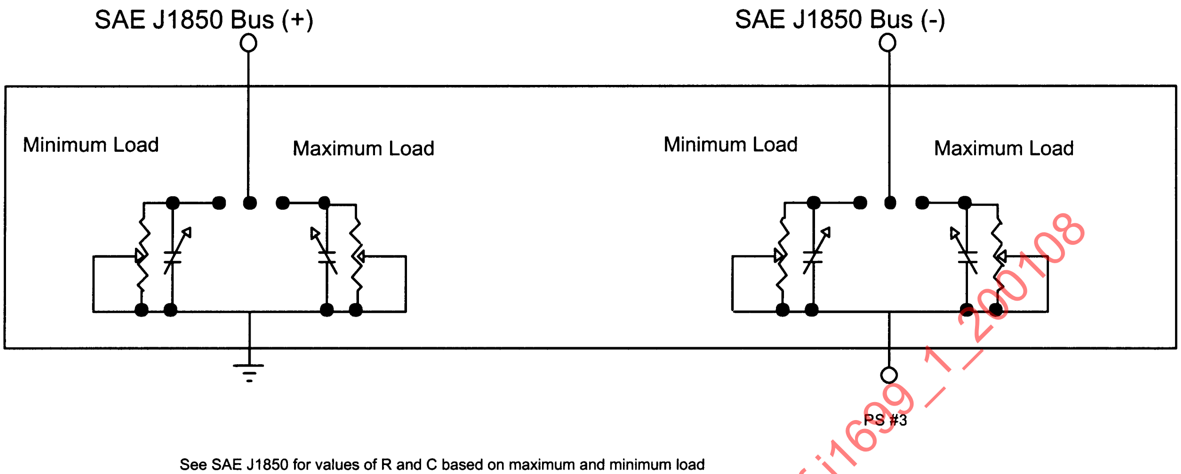

FIGURE 6—SAE J1850 NETWORK LOAD BOX

6. Invalid CRC Test

6.1 Purpose—Verifies that the DUT generates correct CRCs. Also, verifies that the module discards any message sent to it with an incorrect CRC.

6.2 Equipment

a. A NAD
b. Digital oscilloscope (optional)
c. Network Load Device
d. PS#1
e. Ground Offset Voltage Device

6.3 Test Setup

6.3.1 Make connections as shown in Figures 7, 8, and 9.

6.3.2 Set PS#1 to 13.5 V.

6.3.3 Set the Ground Offset Voltage Device to 0 V.

6.3.4 Set PS#3 to 5.0 V for PWM and 12 V for VPW setups.

6.3.5 Set the Small Signal Ground Offset Voltage Device to 0 V.

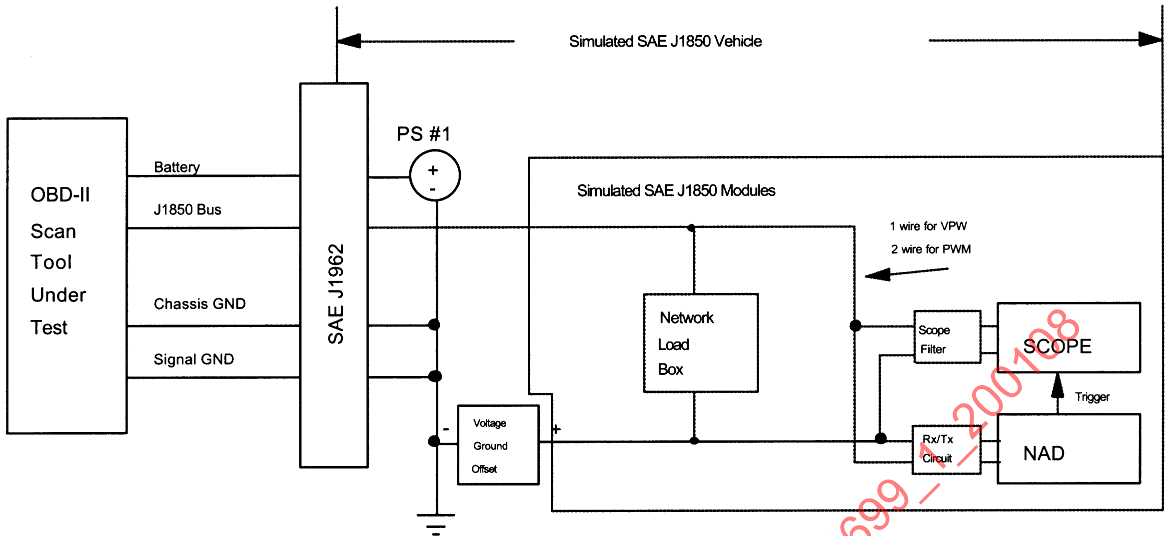

FIGURE 7—OBD-II SCAN TOOL, NEGATIVE GROUND OFFSET FROM SAE J1962 CONNECTOR

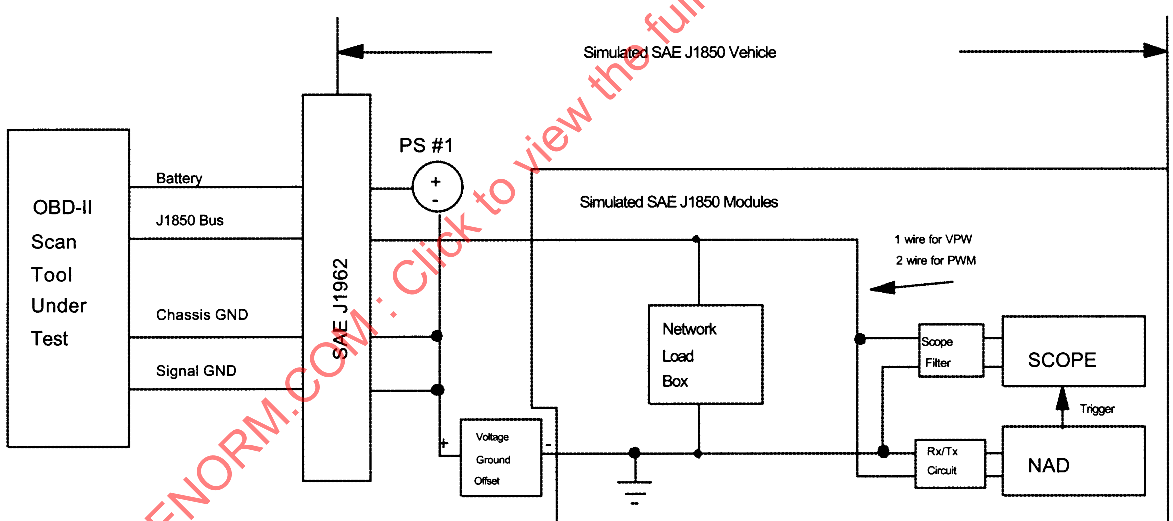

FIGURE 8—OBD-II SCAN TOOL, POSITIVE GROUND OFFSET FROM SAE J1962 CONNECTOR

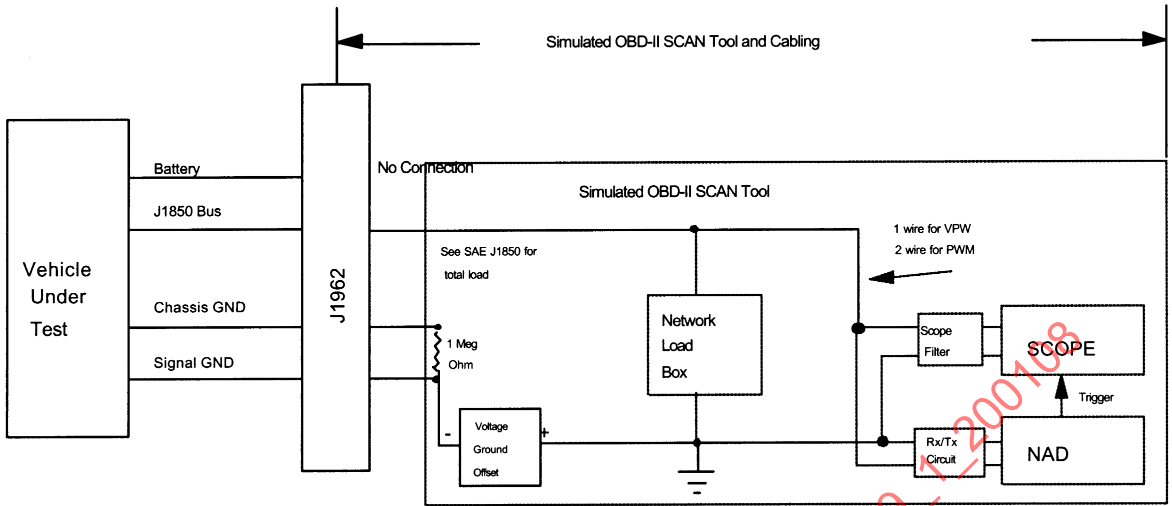

FIGURE 9—VEHICLE, NEGATIVE GROUND FROM THE SAE J1962 CONNECTOR

6.3.6 When the DUT is an OBD-II Scan Tool, connect the maximum vehicle load as shown in Figures 7 and 8 with a 0.9 V ground offset for PWM or 1.9 V ground offset for VPW.

6.3.7 When the DUT is a vehicle, connect the off vehicle maximum load (see SAE J1850: off vehicle load resistance and load capacitance case for the OBD-II Scan Tool load) as shown in Figure 9 with a 0.1 V ground offset.

NOTE— Testing for a vehicle, positive offset from the SAE J1962 connector is not required.

6.4 Procedure

6.4.1 OBD-II SCAN TOOL AS THE DUT

6.4.1.1 DUT CRC Generation—Configure the DUT to send an SAE J1979 Mode $01 Request Current Powertrain Diagnostic Data, PID 00 [the format and data bytes of this message are shown in Figure 10]. Transmit the message and use the NAD to view the transmitted data bytes. The CRC is the last byte of the transmitted message (before any IFR if present).

SAE J1979 Mode $01 Request Current Powertrain Diagnostic Data, PID 00

	P/T	Target	Source	Mode	D1	D2	D3	D4	D5
VPW	68	6A	F?	01	00	-	-	-	-
PWM	61	6A	F?	01	00	-	-	-	-

SAE J1979 Mode $01 Report Current Powertrain Diagnostic Data, PID 00

	P/T	Target	Source	Mode	D1	D2	D3	D4	D5
VPW	48	6B	??	01	00	??	??	??	??
PWM	41	6B	??	01	00	??	??	??	??

FIGURE 10—MESSAGES FOR COMPLIANCE TESTING

6.4.1.2 *DUT CRC Reception*—Configure the DUT to transmit an SAE J1979 Mode $01 Request Current Powertrain Diagnostic Data PID 00, and setup the NAD to respond with the appropriate response, but with an incorrect CRC byte. The DUT should not accept the response as valid.

6.4.2 VEHICLE AS THE DUT

6.4.2.1 *DUT CRC Generation*—Configure the NAD to send the DUT an SAE J1979 Mode $01 Request for Current Powertrain Diagnostic Data, PID 00. Use the NAD to view the response transmitted by the DUT. Ensure that the CRC is correct for the transmitted response message. Refer to SAE J1850 for CRC calculations.

6.4.2.2 *DUT CRC Reception*—Configure the NAD to send the DUT an SAE J1979 Mode $01 Request Current Powertrain Diagnostic Data, PID 00 with an incorrect CRC byte. The DUT should ignore the request message, and therefore not respond.

7. Message Structure Test

7.1 Purpose—Verifies that the DUT uses all required frame elements in the proper order, and that it is capable of recognizing and responding to network traffic.

7.2 Equipment

a. A NAD
b. Digital oscilloscope (optional)
c. Network Load Device
d. PS#1
e. Ground Offset Voltage Device

7.3 Test Setup

7.3.1 Make connections as shown in Figures 7, 8, and 9.

7.3.2 Set PS#1 to 13.5 V.

7.3.3 Set the Ground Offset Voltage Device to 0 V.

7.3.4 Set PS#3 to 5.0 V for PWM and 12 V for VPW setups.

7.3.5 Set the Small Signal Ground Offset Voltage Device to 0 V.

7.3.6 When the DUT is an OBD-II Scan Tool, connect the maximum vehicle load as shown in Figures 7 and 8 with a 0.9 V ground offset for PWM or 1.9 V ground offset for VPW.

7.4 Procedure

7.4.1 OBD-II SCAN TOOL - TRANSMITTED FRAME SYMBOL INSPECTION—Force the DUT to transmit the Request for SAE J1979 Powertrain Data, PID 00 [the format and data bytes of this message are shown in Figure 10]. Acquire the waveform of the DUT message transmission and verify that each of the necessary symbols is present in the frame. See 6.6 of SAE J1850 for symbols meanings.

7.4.2 VEHICLE - TRANSMITTED FRAME SYMBOL INSPECTION—Force the DUT to respond to the Request for SAE J1979 Powertrain Data, PID 00 [the format and data bytes of this message are shown in Figure 10]. Acquire the waveform of the DUT message transmission and verify that each of the necessary symbols is present in the frame. See 6.6 of SAE J1850 for symbol meanings.

8. Bus Arbitration Test

8.1 Purpose—This test confirms the DUT arbitrates for bus control during message header transmission. The NAD will generate a Dominant bit when the DUT is transmitting a Recessive bit. The DUT should stop transmitting until the EOF time-out is reached. Refer to SAE J1850 for EOF times.

8.2 Equipment

a. A NAD
b. Digital oscilloscope
c. Network Load Device
d. PS#1
e. Ground Offset Voltage Device

8.3 Test Setup

8.3.1 Make connections as shown in Figures 7, 8, and 9.

8.3.2 Set PS#1 to 13.5 V.

8.3.3 Set the Ground Offset Voltage Device to 0 V.

8.3.4 Set PS#3 to 5.0 V for PWM and 12 V for VPW setups.

8.3.5 Set the Small Signal Ground Offset Voltage Device to 0 V.

8.3.6 When the DUT is an OBD-II Scan Tool, connect the maximum vehicle load as shown in Figures 7 and 8 with a 0.9 V ground offset for PWM or 1.9 V ground offset for VPW.

8.4 Theory of Operation—Arbitration is caused when a Dominant bit and a Recessive bit are transmitted at the same time. The NAD shall transmit a Dominant bit at the same time the DUT is transmitting a Recessive bit. The NAD shall test each byte of the response message that is possible to test. (If the DUT is a vehicle; start testing at the third byte. If the DUT is an OBD-II Scan Tool; start testing at the first byte.)

The question marks found in Figure 10 are determined by the NAD, by forcing the OBD-II Scan Tool to transmit the Request message (if DUT is an OBD-II Scan Tool) or the NAD transmits a Request message to the DUT (if DUT is a vehicle).

The third byte of a response message or a request message is always the same from the DUT. Arbitration testing may begin with this byte and end on the CRC byte. The arbitration pulse width shall be varied based on the SAE J1850 parameters. The maximum, nominal, and minimum receive value shall be used.

The NAD will monitor the bus looking for the characteristic message and watch the bits to determine when to send out the active bit. Figure 11 shows the sequence of bytes and the forced arbitration events on the third byte of the response message. The NAD must synchronize and respond in less than 24 µs after the Target ID has been detected.

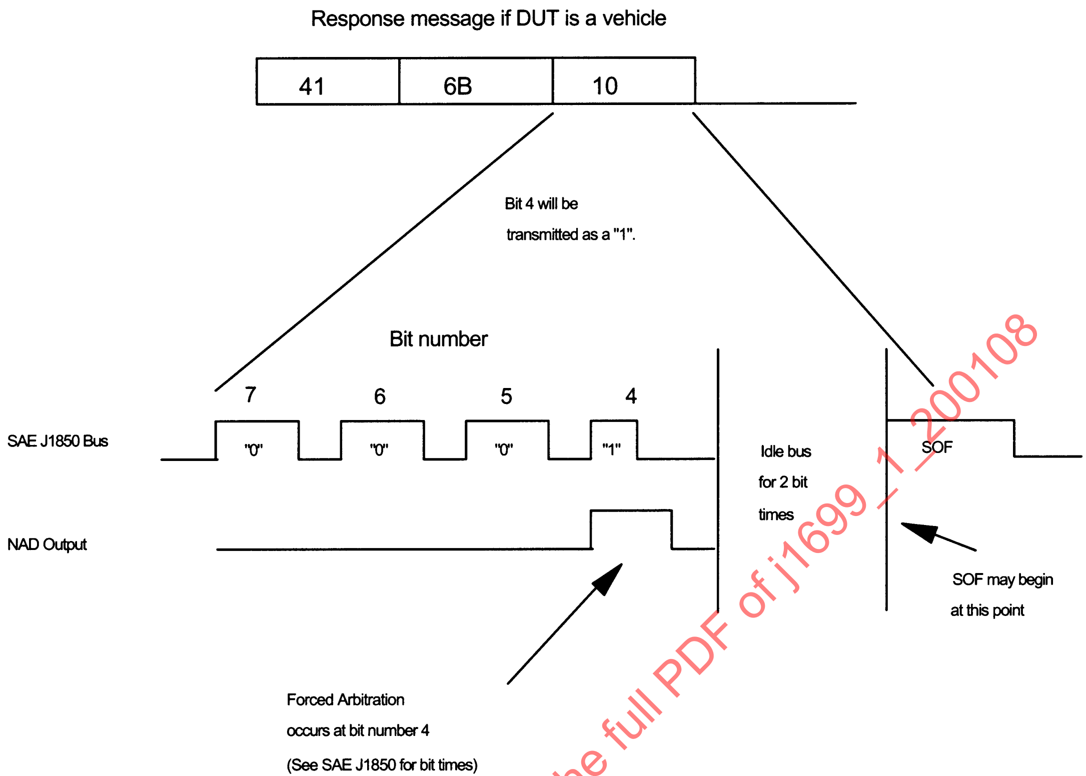

FIGURE 11—FORCED ARBITRATION ON THE THIRD BYTE OF RESPONSE MESSAGE BIT NUMBER 4

8.5 Procedure

8.5.1 OBD-II SCAN TOOL AS THE DUT—(Use Figure 7)

8.5.1.1 Set up the DUT to transmit a Request for SAE J1979 Powertrain data, PID 00 [the format and data bytes of this message are shown in Figure 10].

8.5.1.2 Program the NAD to transmit an arbitration pulse at the correct bit. See Figure 8. Also, vary the pulse width to the maximum and minimum as specified in SAE J1850.

8.5.1.3 Verify the DUT stops transmitting.

8.5.2 VEHICLE AS THE DUT—(Use Figure 9)

8.5.2.1 Configure the NAD to transmit a request for SAE J1979 Powertrain data, PID 00 [the format and data bytes of this message are shown in Figure 10].

8.5.2.2 Program the NAD to transmit an arbitration pulse at the correct bit.

8.5.2.3 Verify the DUT stops transmitting.

9. Bus Fault Test

9.1 Purpose—This test will verify that the DUT withstands all failure modes specified by SAE J1850 as required modes.

9.2 Equipment

a. A NAD
b. Digital oscilloscope (optional)
c. Network Load Device
d. PS#1
e. Ground Offset Voltage Device

9.3 Test Setup

9.3.1 Make connections as shown in Figures 7, 8, and 9.

9.3.2 Set PS#1 to 13.5 V.

9.3.3 Set the Ground Offset Voltage Device to 0 V.

9.3.4 Set PS#3 to 5.0 V for PWM and 12 V for VPW setups.

9.3.5 Set the Small Signal Ground Offset Voltage Device to 0 V.

9.3.6 When the DUT is an OBD-II Scan Tool, connect the maximum vehicle load as shown in Figures 7 and 8 with a 0.9 V ground offset for PWM or 1.9 V ground offset for VPW.

9.4 Procedure

9.4.1 Program the NAD to continuously transmit a request for SAE J1979 Mode $01 Request Current Powertrain Diagnostic Data, PID 00 message if the DUT is a vehicle. If the DUT is an OBD-II Scan Tool, force the OBD-II Scan Tool to transmit messages.

9.4.2 (DUT is an OBD-II Scan tool) Disconnect power at the DUT - NAD should continue transmitting and the symbols should be within limits specified in SAE J1850. Connect power back to the DUT (see SAE J1850 6.9.1 [a]).

9.4.3 Short the SAE J1850 bus to ground - data communications may be lost; however, the DUT should not be damaged due to the short to ground. Remove short to ground (see SAE J1850, 6.9.1 [b]).

9.4.4 Short the SAE J1850 bus to battery voltage - data communications may be lost; however, the DUT should not be damaged due to the short to battery. Remove short to battery (see SAE J1850, 6.9.1 [c]).

9.4.5 (DUT is an OBD-II Scan tool) Disconnect the ground at the DUT - the NAD should continue transmitting and the symbols should be within limits specified in SAE J1850. Connect ground back to the DUT (see SAE J1850, 6.9.1 [d]).

10. Symbol Parameter Limits

10.1 Purpose—The purpose of this test is to verify that the OBD-II Scan Tool or Vehicle Network receives and transmits symbols to the limits specified SAE J1850.

10.2 Equipment

a. A NAD
b. Digital oscilloscope
c. Network Load Device
d. PS#1
e. Ground Offset Voltage Device

10.3 Test Setup

10.3.1 Make connections as shown in Figures 7, 8, and 9.

10.3.2 Set PS#1 to 13.5 V.

10.3.3 When the DUT is an OBD-II Scan Tool, connect the maximum vehicle load as shown in Figures 7 and 8 with a 0.9 V ground offset for PWM or 1.9 V ground offset for VPW.

10.4 Test Setups

a. The load capacitance and resistance shall be measured per Appendix C.
b. OBD-II Scan Tool testing shall be performed with a Minimum Vehicle bus load and a Maximum Vehicle bus load.
c. Vehicle testing shall be performed with Maximum OBD-II Scan tool load.
d. The oscilloscope shall be set up to trigger on the received message.

10.4.1 TEST SETUP 1—Connected as shown in Figure 7, this setup is used to test an OBD-II Scan Tool. The OBD-II Scan Tool is connected to a simulated SAE J1850 vehicle through the SAE J1962 connector. In this setup, there is a DC offset between the SAE J1962 connector and the equipment simulating the SAE J1850 modules. The offset is such that the simulated SAE J1850 modules have a positive DC voltage offset from the SAE J1962 connector.

10.4.2 TEST SETUP 2—Connected as shown in Figure 8, this setup is used to test an OBD-II Scan Tool. The OBD-II Scan Tool is connected to a simulated SAE J1850 vehicle through the SAE J1962 connector. In this setup, there is a DC offset between the SAE J1962 connector and the equipment simulating the J1850 modules. The offset is such that the simulated SAE J1850 modules have a negative DC voltage offset from the SAE J1962 connector.

10.4.3 TEST SETUP 3—Connected as shown in Figure 9, this setup is used to test an SAE J1850 vehicle. The vehicle is connected to a simulated OBD-II Scan Tool through the SAE J1962 connector. In this setup, there is a DC offset between the SAE J1962 connector and the simulated OBD-II Scan Tool. The offset is such that the simulated OBD-II Scan Tool has a positive DC voltage from the SAE J1962 connector.

10.5 Procedure

10.5.1 The NAD shall be configured to transmit the same message at a 100 µs repetition rate changing the waveform characteristics with each transmission. The waveform characteristics shall be every combination of the parameters in Figure 12.

	Min	Nominal	Max
PS #1 Supply Voltage (from SAE J1978)	8.0 V		18.0 V
Ground Offset Voltage for Scan Tool Testing (VPW) (Figure 2 and Figure 1)		1.9 V	
Ground Offset Voltage for Scan Tool Testing (PWM) (Figure 2 and Figure 1)		0.9 V	
Ground Offset Voltage for Vehicle Testing (VPW or PWM) (Figure 3)		0.1 V	
Symbol Widths	Nominal Transmit Values per SAE J1850		
Signal Transition Time	--	--	18 µs (per SAE J1850)
Bus Symbol Voltage (For VPW, set PS#3 to)	6.25 V (per SAE J1850)	--	8 V (per SAE J1850)

FIGURE 12—EXAMPLE SAE J1850 AC AND DC PARAMETERS

The following is an example. Using the example AC and DC SAE J1850 parameters in Figure 12 and the configuration found in Figure 7, the following parameters will be set to test VPW and the OBD-II Scan Tool as the DUT:

a. PS #1 = 9.0 V
b. Maximum Vehicle load
c. Voltage Ground Offset = 1.9 V
d. Symbol transition = 18 µs
e. Bus Symbol Voltage = 6.25 V

10.5.1.1 From the SAE J1850 document (Minimum values)

a. Short pulse time = 49 µs
b. Long pulse time = 112 µs
c. SOF/EOD time = 182 µs
d. EOF time = 261 µs
e. Break time = 300 µs
f. IFS time = 300 µs

10.5.2 The NAD shall transmit the test message with the symbol parameters outlined in SAE J1850 if the DUT is a vehicle. If the DUT is an OBD-II Scan Tool, force it to send a message. The DUT message shall be captured on the digital scope.

10.5.3 If the DUT is a vehicle, the DUT response to the transmitted test message confirms that the DUT received the transmitted message properly. If the DUT is an OBD-II Scan tool, its displaying of the received message confirms correct reception.

10.5.4 The symbols from the captured message, which was sent by the DUT, shall be measured and compared to the requirements found in the SAE J1850 document.

10.5.5 For an OBD-II Scan Tool perform Test setup 1 and Test setup 2 in 10.3.

10.5.6 For a vehicle perform Test setup 3 in 10.3.

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APPENDIX A

OBD-II SCAN TOOL SIGNAL GROUND AND CHASSIS GROUND TEST

A.1 Purpose—This test verifies that there is at least 1.0 MΩ between the signal ground and chassis ground pins in the OBD-II Scan Tool.

A.2 Equipment—DVOM

A.3 Test Setup—Disconnect the OBD-II Scan Tool from the simulated SAE J1850 modules.

A.4 Procedure—Measure the resistance between the OBD-II Scan Tool's signal ground and chassis ground. The resistance must be equal to or greater than 1 MΩ with the OBD-II Scan tool powered. The Ohm Meter measurement should be made in both directions to determine if there are any diode effects.

APPENDIX B

SAE J1962 ELECTRICAL POWER LOAD TEST

B.1 Purpose—This test verifies that the vehicle can supply enough power to the OBD-II Scan Tool and that the OBD-II Scan Tool doesn't consume excess power. Refer to electrical requirements for pin 4, pin 5 and pin 16 in SAE J1962 for more information.

B.2 Equipment

a. Digital Volt Ohm Meter
b. Two load resistors R_1 and R_2 (100 W)
c. PS#1

B.3 Test Setup—Figure B1 shows the test setup for the vehicle's SAE J1962 interface connection that provides power to the OBD-II Scan Tool; $I_1 + I_2 \leq 4.0$ A (see SAE J1962).

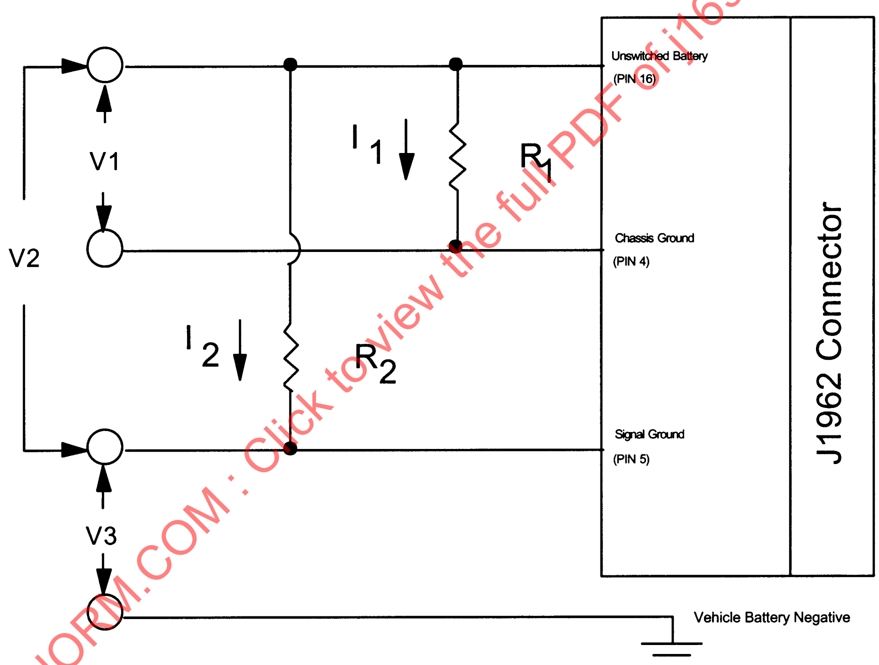

FIGURE B1—TEST SETUP FOR OBD-II SCAN TOOL POWER LOAD INTERFACE

B.4 Procedure for Testing the Vehicle Side

B.4.1 Use the setup shown in Figure B1.

B.4.2 Select the values of R_1 and R_2 to meet the current values specified in SAE J1962.

B.4.3 With the vehicle ignition switch in the RUN position, measure voltage V_1, V_2, and V_3.

B.4.4 V_1 and V_2 must be between 8.0 and 18.0 V (see SAE J1978).

B.4.5 V_3 must be less than 0.650 V for PWM and less than 1.650 V for VPW (see SAE J1850).