



RA CONSULTING

## Testing Expo 2010

# Comparison of OBD II Scan-Tool diagnostics for light-duty vehicles and heavy-duty trucks

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### Agenda

- Basics of OBD II Scan-Tool diagnostics
- Communication concept of J1979 and J1939
- Implementation in Silver Scan-Tool
- OBD related standards for J1979 and J1939
- Emission test cycles
- Compliance Test J1699 and J1939-84



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### **SAE J1978      OB2 II Scan Tool**

This document is intended to satisfy the requirements of an OB2 scan tool as required by U.S. On-Board Diagnostic (OB2) regulations.

The document specifies:

- a. A means of establishing communications between an OB2-equipped vehicle and external test equipment.
- b. A set of diagnostic services to be provided by the external test equipment in order to exercise the services defined in SAE J1979.
- c. Conformance criteria for the external test equipment.



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### **Requirements for an OBDII Scan-Tool to CCR 1968.2 and CCR 1971.1**

- Readiness Status
- Data Stream
- Freeze Frame
- Fault Codes (pending, confirmed, permanent)
- Test Results
- Vehicle Information (CALID, CVN, VIN, ECUNAME, ESN)
- In-Use Performance Ratio Tracking
- Engine Run Time Tracking



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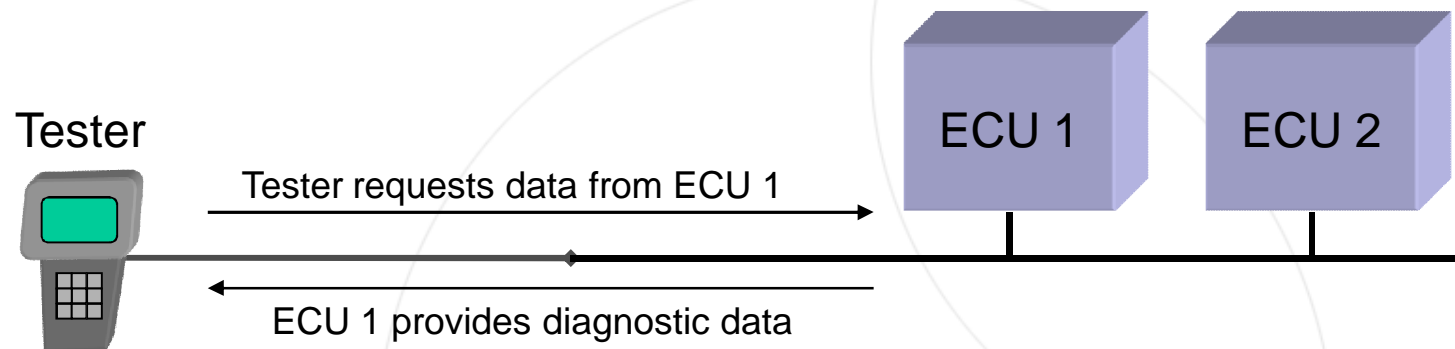
## Comparison of OBD related diagnostic services of J1979 and J1939

	J1979	J1939
Current diagnostic data	Mode 1	J1939. 71
Readiness Status	Mode 1	DM 5, DM 21, DM 26
Lamp Status	Mode 1	DM 1, DM 12, DM 23
AECD Timers	Mode 1	DM 33
Freeze Frame Data	Mode 2	DM 4, DM 25
Confirmed Diagnostic Trouble Codes	Mode 3	DM 1, DM 12, DM 23
Clear Diagnostic Information	Mode 4	DM3, DM11
Report O2 Sensor Test Results	Mode 5	DM 8
Request Test Results	Mode 6	DM 8
Pending Diagnostic Trouble Codes	Mode 7	DM 6
Request control of system, test or component	Mode 8	DM 7
Monitor Performance Ratio	Mode 9	DM 20
Report VIN, CID, and CVN	Mode 9	PGN 65260, DM19
Permanent Diagnostic Trouble Codes	Mode A	DM 28



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## J1979 Diagnostic Communication Model



### Tester

- “ requests Data
- “ has to know ID of ECU to get data from
- “ does not listen to normal bus traffic

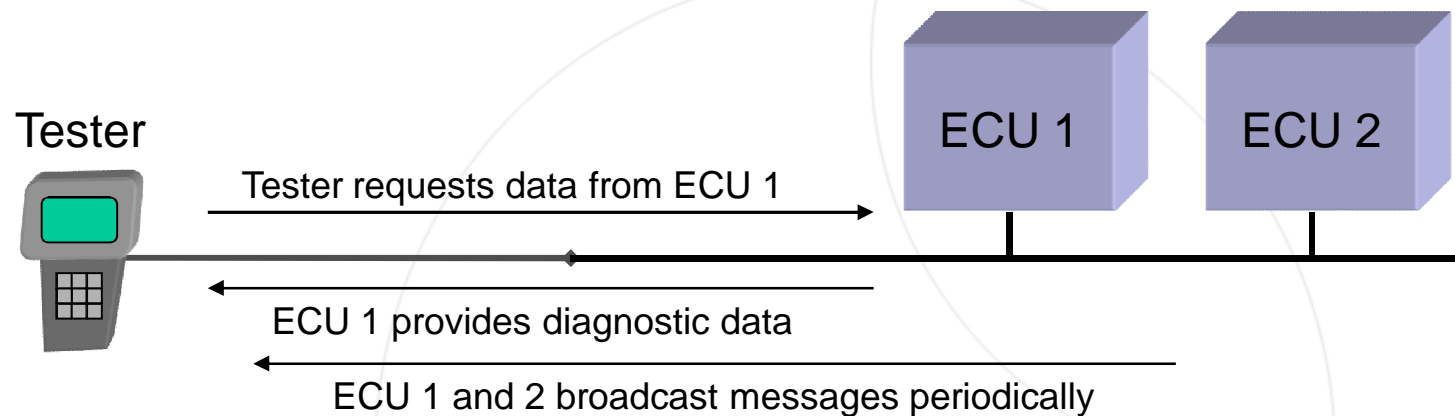
### ECUs

- “ listen for requests from Tester
- “ provide diagnostic data only on request
- “ never send a diagnostic request
- “ after assembly may never be used again



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## J1939 Diagnostic Communication Model



### Tester

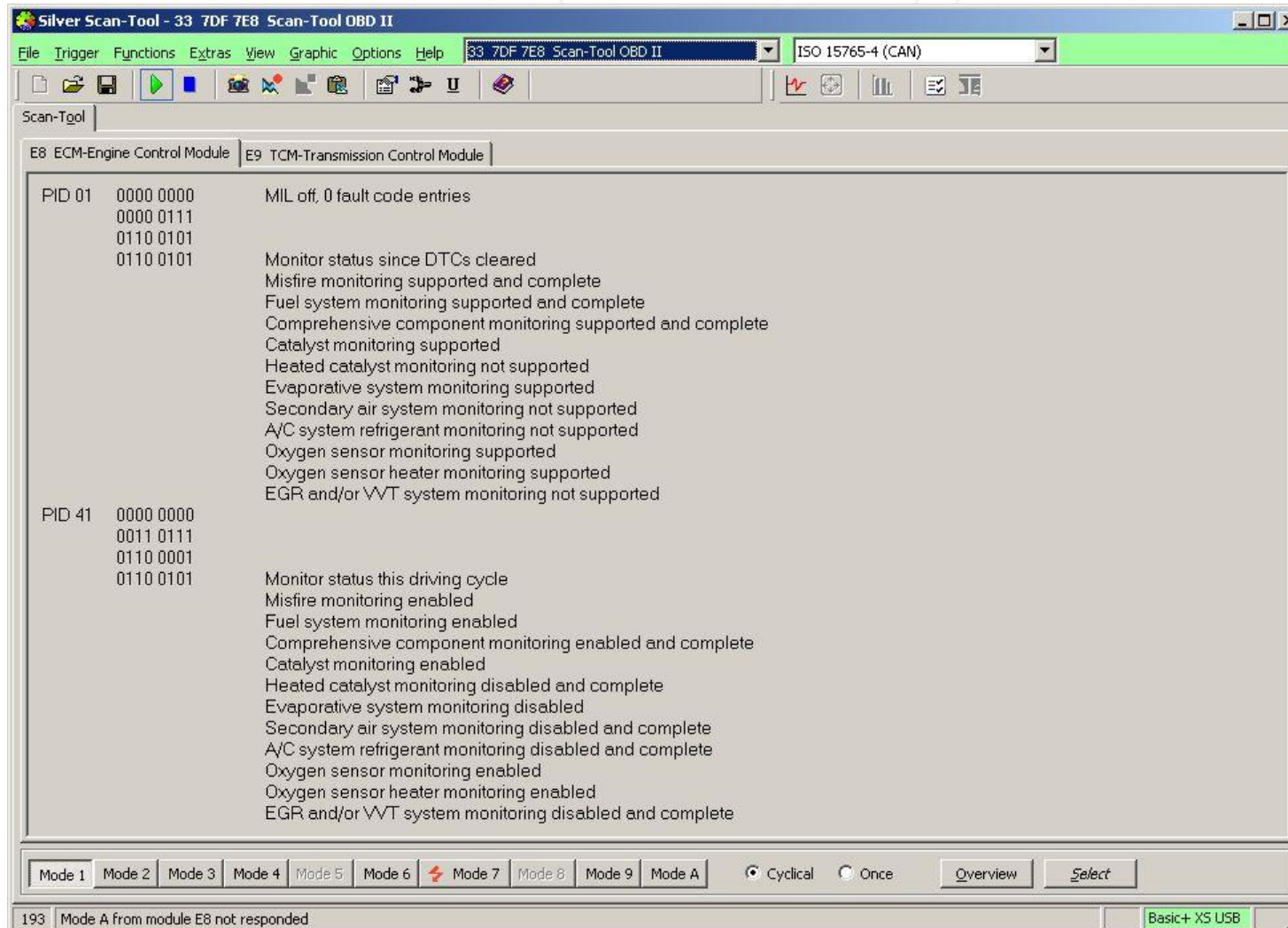
- “ must request data it wants if not broadcast
- “ must know ID of ECU to get data from
- “ provides data requested
- “ may listen to broadcast messages (e.g. DM 1)

### ECUs

- “ listen for requests from tester
- “ provide diagnostic data periodically (DM 1)
- “ may send a diagnostic request

# Silver Scan-Tool Mode 1

## Readiness Status in PID 01 und PID 41



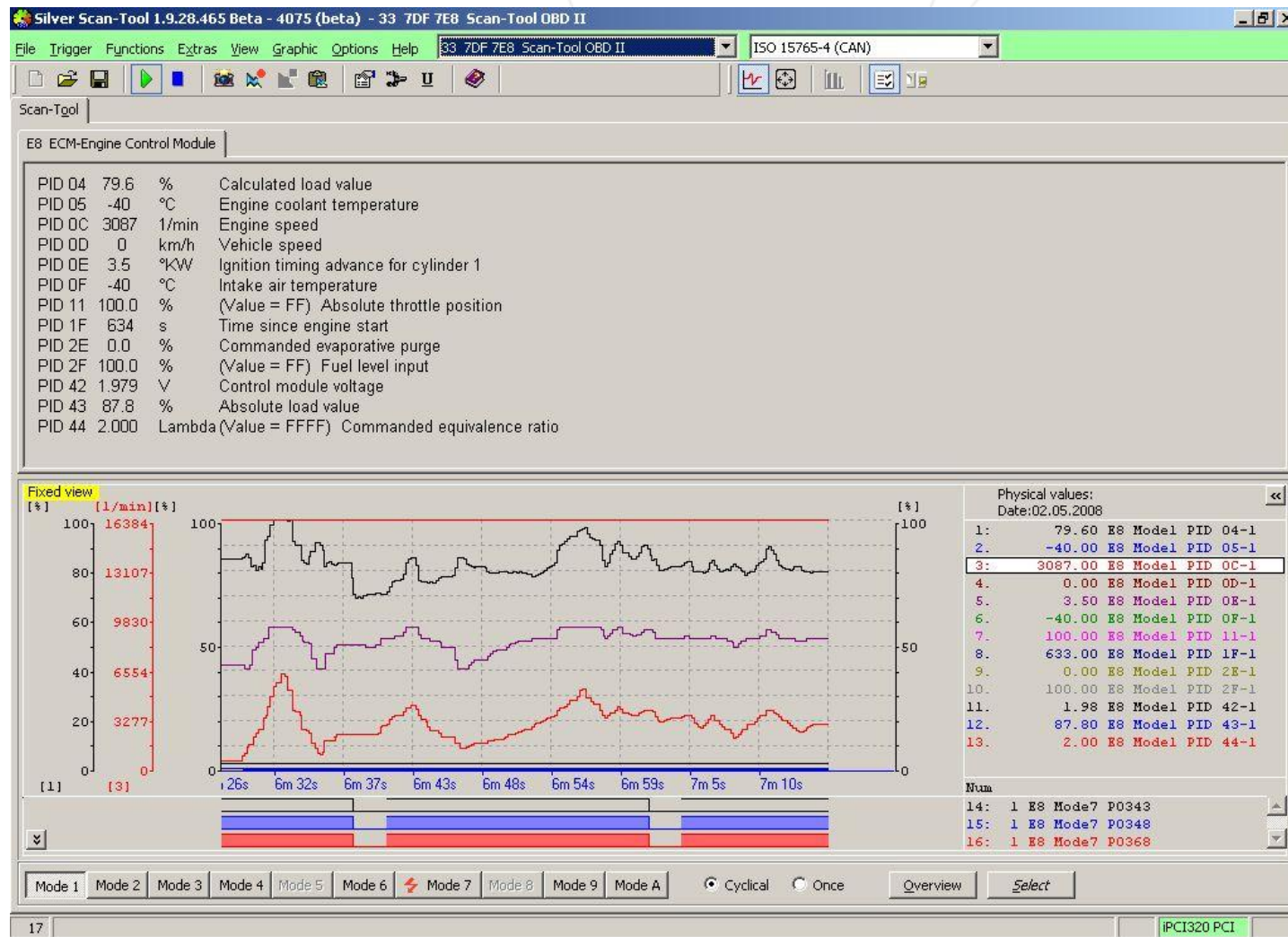
The screenshot shows the Silver Scan-Tool interface with the following details:

- Window Title:** Silver Scan-Tool - 33 7DF 7E8 Scan-Tool OBD II
- Menu Bar:** File, Trigger, Functions, Extras, View, Graphic, Options, Help
- Dropdowns:** 33 7DF 7E8 Scan-Tool OBD II, ISO 15765-4 (CAN)
- Scan-Tool Section:**
  - E8 ECM-Engine Control Module
  - E9 TCM-Transmission Control Module
- PID 01 Data:**
  - 0000 0000 MIL off, 0 fault code entries
  - 0000 0111
  - 0110 0101
  - 0110 0101
- PID 41 Data:**
  - 0000 0000
  - 0011 0111
  - 0110 0001
  - 0110 0101
- Mode Selection:** Mode 1, Mode 2, Mode 3, Mode 4, Mode 5, Mode 6, Mode 7 (selected), Mode 8, Mode 9, Mode A
- Buttons:** Cyclical, Once, Overview, Select
- Status Bar:** 193 Mode A from module E8 not responded, Basic+ XS USB





# Measurement values in Silver Scan-Tool Mode 1 shown as scope graph





# Measurement values in Silver Scan-Tool Mode 1 shown as bar graph

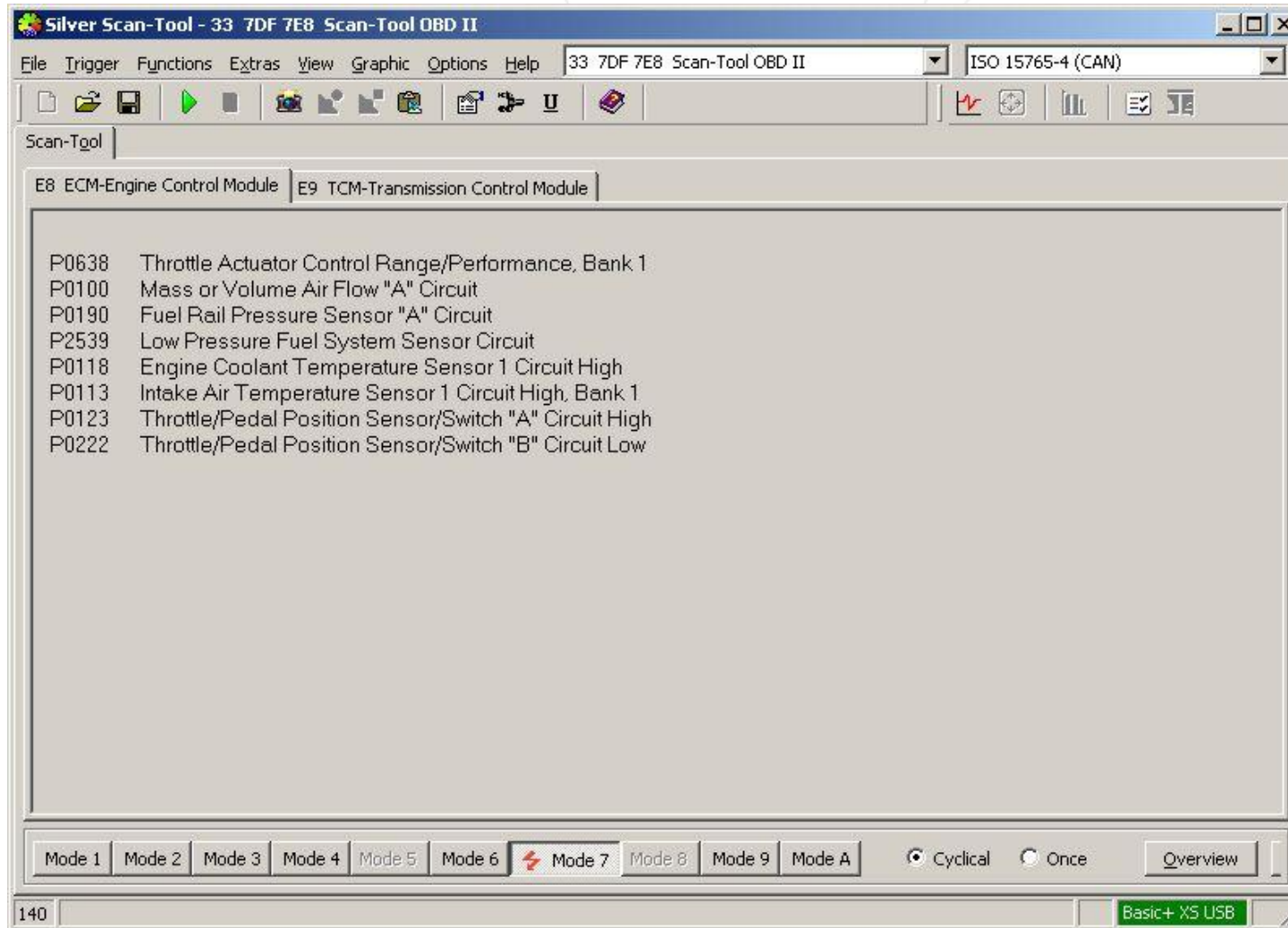
The screenshot displays the Silver Scan-Tool interface for an E8 ECM-Engine Control Module. The top section lists various PID parameters and their values. The bottom section shows a bar graph for selected parameters, with the current value highlighted in a colored bar.

PID	Value	Unit	Description
PID 04	85.5	%	Calculated load value
PID 05	-40	°C	Engine coolant temperature
PID 0C	1236	1/min	Engine speed
PID 0D	0	km/h	Vehicle speed
PID 0E	-10.5	°KW	Ignition timing advance for cylinder 1
PID 0F	-40	°C	Intake air temperature
PID 11	100.0	%	(Value = FF) Absolute throttle position
PID 1F	825	s	Time since engine start
PID 2E	0.0	%	Commanded evaporative purge
PID 2F	100.0	%	(Value = FF) Fuel level input
PID 42	1.979	V	Control module voltage
PID 43	79.6	%	Absolute load value
PID 44	2.000	Lambda	(Value = FFFF) Commanded equivalence ratio

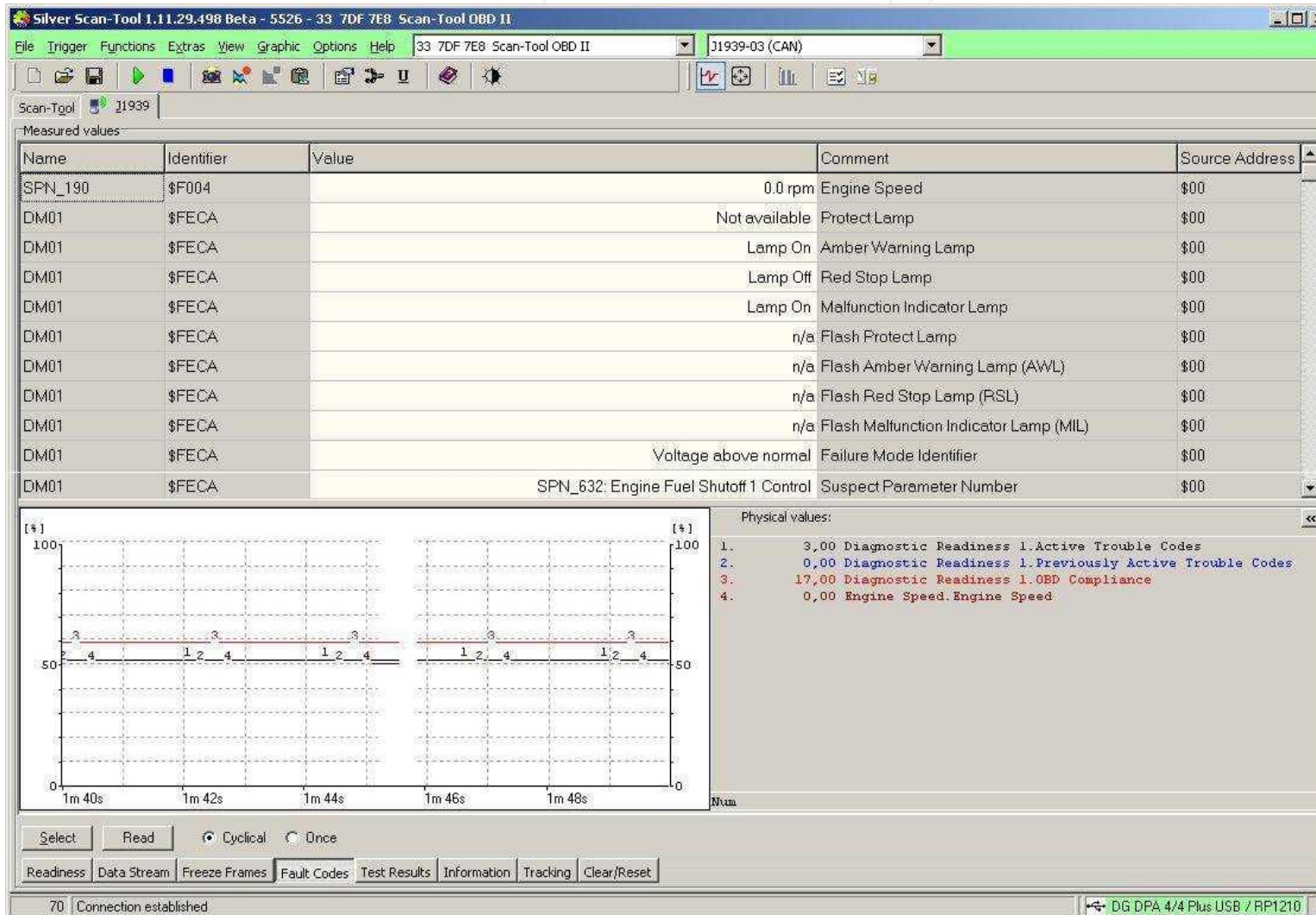
  

Mode	Value	Unit	Description
11 E8 Mode1 PID 42-1 [Control module voltage]	1.979 V	V	Control module voltage
12 E8 Mode1 PID 43-1 [Absolute load value]	79.6 %	%	Absolute load value
13 E8 Mode1 PID 44-1 [Commanded equivalence ratio]	2.000 Lambda	Lambda	Commanded equivalence ratio
14 E8 Mode7 P0343 [Camshaft Position Sensor "A" Circuit High, Bank 1 or Single Sensor]			Camshaft Position Sensor "A" Circuit High, Bank 1 or Single Sensor
15 E8 Mode7 P0348 [Camshaft Position Sensor "A" Circuit High, Bank 2]			Camshaft Position Sensor "A" Circuit High, Bank 2
16 E8 Mode7 P0368 [Camshaft Position Sensor "B" Circuit High, Bank 1]			Camshaft Position Sensor "B" Circuit High, Bank 1
17 E8 Mode7 P0393 [Camshaft Position Sensor "B" Circuit High, Bank 2]			Camshaft Position Sensor "B" Circuit High, Bank 2
18 E8 Mode7 P2176 [Throttle Actuator Control System - Idle Position Not Learned]			Throttle Actuator Control System - Idle Position Not Learned

## Silver Scan-Tool Mode 7 Pending fault codes



## Parameter groups and diagnostic messages in J1939 Silver Scan-Tool shown as scope graph



The screenshot displays the Silver Scan-Tool interface for a J1939 CAN bus. The main window shows a table of measured values and a scope graph below it.

Name	Identifier	Value	Comment	Source Address
SPN_190	\$F004	0.0 rpm	Engine Speed	\$00
DM01	\$FECA	Not available	Protect Lamp	\$00
DM01	\$FECA	Lamp On	Amber Warning Lamp	\$00
DM01	\$FECA	Lamp Off	Red Stop Lamp	\$00
DM01	\$FECA	Lamp On	Malfunction Indicator Lamp	\$00
DM01	\$FECA	n/a	Flash Protect Lamp	\$00
DM01	\$FECA	n/a	Flash Amber Warning Lamp (AWL)	\$00
DM01	\$FECA	n/a	Flash Red Stop Lamp (RSL)	\$00
DM01	\$FECA	n/a	Flash Malfunction Indicator Lamp (MIL)	\$00
DM01	\$FECA	Voltage above normal	Failure Mode Identifier	\$00
DM01	\$FECA	SPN_632: Engine Fuel Shutoff 1 Control	Suspect Parameter Number	\$00

Below the table, there are two scope graphs showing signal activity over time (from 1m 40s to 1m 48s). The graphs show a signal that is mostly flat at 50% but has several small spikes. The right graph shows a signal that is mostly flat at 50% but has several small spikes.

Physical values:

- 3,00 Diagnostic Readiness 1.Active Trouble Codes
- 0,00 Diagnostic Readiness 1.Previously Active Trouble Codes
- 17,00 Diagnostic Readiness 1.OBD Compliance
- 0,00 Engine Speed.Engine Speed

At the bottom of the interface, there are buttons for "Select", "Read", "Cyclical", and "Once". Below these are tabs for "Readiness", "Data Stream", "Freeze Frames", "Fault Codes", "Test Results", "Information", "Tracking", and "Clear/Reset". The status bar at the bottom shows "70 | Connection established" and "DG DPA 4/4 Plus USB / RP1210".



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### Comparison of OBD related standards for J1979 and J1939

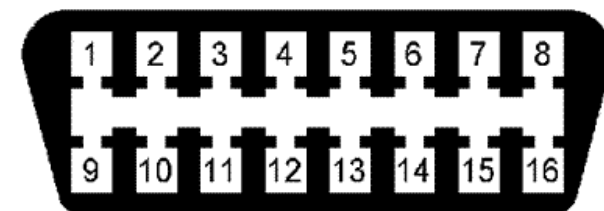
OBD II Requirements	LD cars	HD trucks
Diagnostic Services	J1979	J1939-73
Diagnostic Trouble Codes	J2012	J1939-73, -71
Monitoring Parameters	J1979	J1939-71
Diagnostic Lamps	J1979	J1939-73
Diagnostic Off-Board Connector	J1962	J1939-13
Data Link: Electrical, Message Formatting, Addressing	ISO 15765-4, J1850, ISO 9141. 2, ISO 14230-4	J1939-11, -15, -21, -81
Scan Tool Requirements	J1978	J1978
Communication Interface	J2534	RP1210
Compliance Test Cases	J1699	J1939-84



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## J1962 Diagnostic Connector

Pin	Circuit Description
2	J1850 Bus (+)
4	Chassis ground
5	Signal ground
6	CAN High
7	ISO 9141-2 K / ISO 14230
10	J1850 Bus (-)
14	CAN Low
15	ISO 9141-2 L / ISO 14230
16	Battery (+)-Voltage
7 free for use by OEM	





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## J1939-13 Diagnostic Connector

<b>Pin</b>	<b>Circuit Description</b>
1/A	Battery (-)
2/B	Battery (+) (allows 12 and 24 volt systems)
3/C	CAN_H Tractor Bus (J1939)
4/D	CAN_L Tractor Bus (J1939)
5/E	CAN_SHLD (J1939-11) or No Connect (J1939-12)
6/F	J1708 (+)
7/G	J1708 (-)
8/H	Proprietary OEM Use or Implement Bus CAN_H
9/J	Proprietary OEM Use or Implement Bus CAN_L





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### California Code Regulation 1968.2 and 1971.1

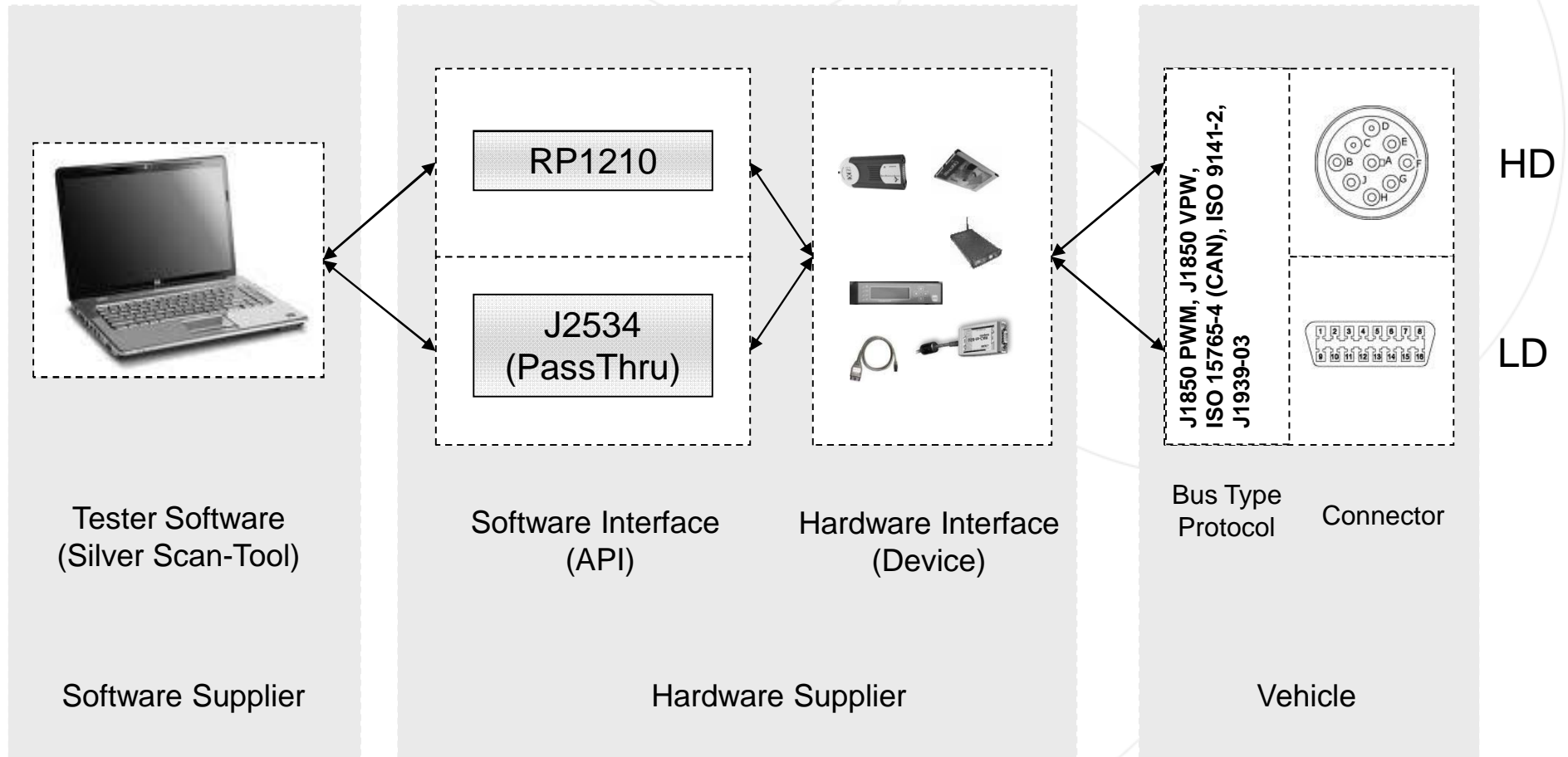
2. A standard data link connector conforming to SAE J1962 or SAE J1939-13 specifications shall be incorporated in each vehicle.
  - 2.1 The connector shall be located in the driver's side foot-well region of the vehicle interior...
  - 2.2 If the connector is covered, the cover must be removable by hand without the use of any tools





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## Standardized Communication Interfaces





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### Protocol support of SAE J2534 and RP1210 communication API for diagnostic devices

	SAE J2534	RP 1210 A	RP 1210 C
J 1708		X	X
J 1850 PWM	X	X	X
J 1850 VPW	X		
J 1939		X	X
ISO 9141	X		X
ISO 14230-4	X		X
ISO 15765-4	X		X
CAN	X	X	X
J 2610 SCI	X		
Baudrate on CAN	125, 250, 500	250	variable



# Testing Expo 2010

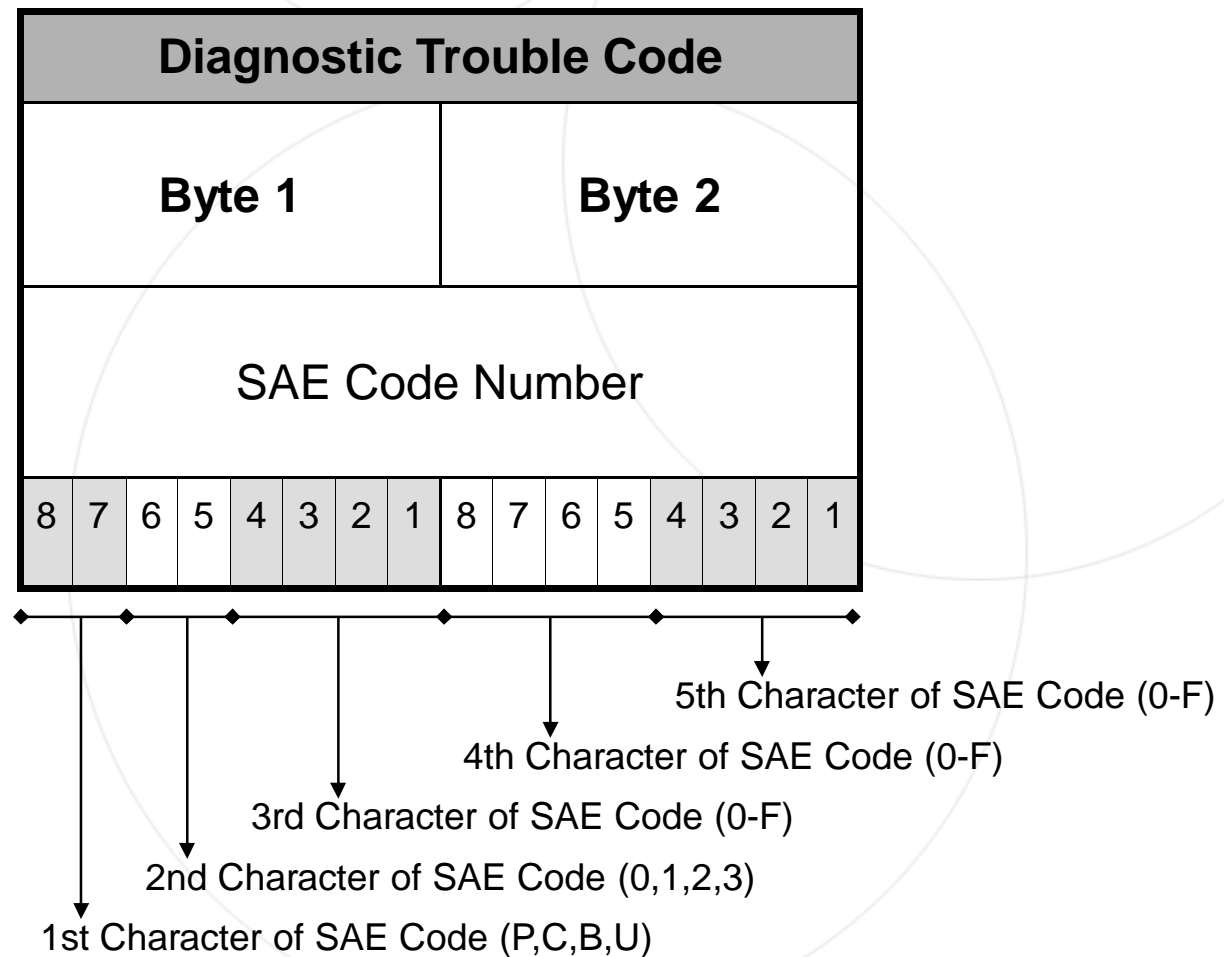
## Selection of J2534 / RP1210 devices in Silver Scan-Tool

Interface	Interface type	Manufacturer
McS1	PassThru	EEPod LLC
Puma 2	PassThru	Movimento
Garuda	PassThru 04.04	Dearborn Electronics India Pvt Ltd.
Px-2	PassThru 04.04	Dearborn Group Technology, Inc.
VSI-2534	PassThru 04.04	Dearborn Group Technology, Inc.
CarDAQ PLUS	PassThru 04.04	Drew Technologies Inc.
Mongoose ISO/CAN	PassThru 04.04	Drew Technologies Inc.
McS1	PassThru 04.04	EEPod LLC
ES581	PassThru 04.04	ETAS
Basic+ X5	PassThru 04.04	I+ME Actia GmbH
CAT	PassThru 04.04	I+ME Actia GmbH
Lite X5	PassThru 04.04	I+ME Actia GmbH
PassThru+ X5	PassThru 04.04	I+ME Actia GmbH
PassThru+ X5 (Bluetooth)	PassThru 04.04	I+ME Actia GmbH
PassThru+ X5 2G	PassThru 04.04	I+ME Actia GmbH
PassThru+ X5 2G (Bluetooth)	PassThru 04.04	I+ME Actia GmbH
Intrepid	PassThru 04.04	Intrepid
Puma 2	PassThru 04.04	Movimento
CCP-Interface	CCP	RA Consulting
EDIC_D_PDU_API_1_04_20	PDU-API	Softing AG
D_PDU_API_SAMTEC	PDU-API	samtec gmbh (Filderstadt, Germany)
INLINES USB	RP1210	Cummins, Inc.
DG DPA 4/4 Plus USB	RP1210	Dearborn Group RP1210A
AVIT-xx	RP1210	Drew Technologies Inc.
AVIT26k-xx	RP1210	Drew Technologies Inc.
CarDAQ-Plusxx	RP1210	Drew Technologies Inc.
FlasherProxx	RP1210	Drew Technologies Inc.
Mongoose GM	RP1210	Drew Technologies Inc.
Mongoose VPW-CAN	RP1210	Drew Technologies Inc.
PassThruProxx	RP1210	Drew Technologies Inc.
TVIT	RP1210	Drew Technologies Inc.
Puma, USB 0	RP1210	Movimento
Puma, USB 1	RP1210	Movimento
Puma, WLAN	RP1210	Movimento



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## J1979 Diagnostic Trouble Codes





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## J1939 Diagnostic Trouble Codes

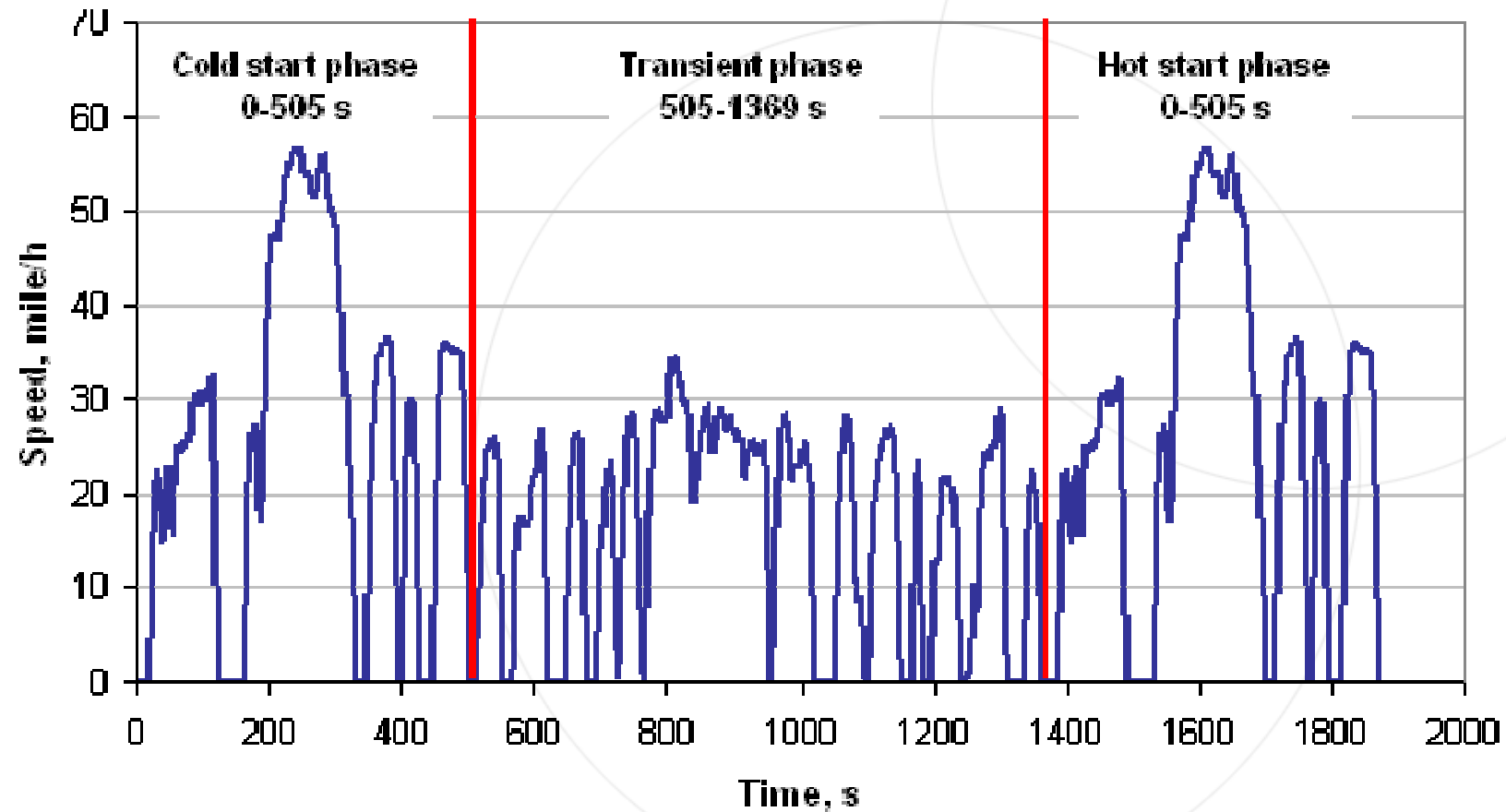
Diagnostic Trouble Code																															
Byte 1								Byte 2								Byte 3								Byte 4							
Suspect Parameter Number (SPN)																FMI				C	OC										
8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1

↔ Conversion Method Bit Affects the Interpretation of the Byte Ordering of the SPN (0 since 1996) J1939

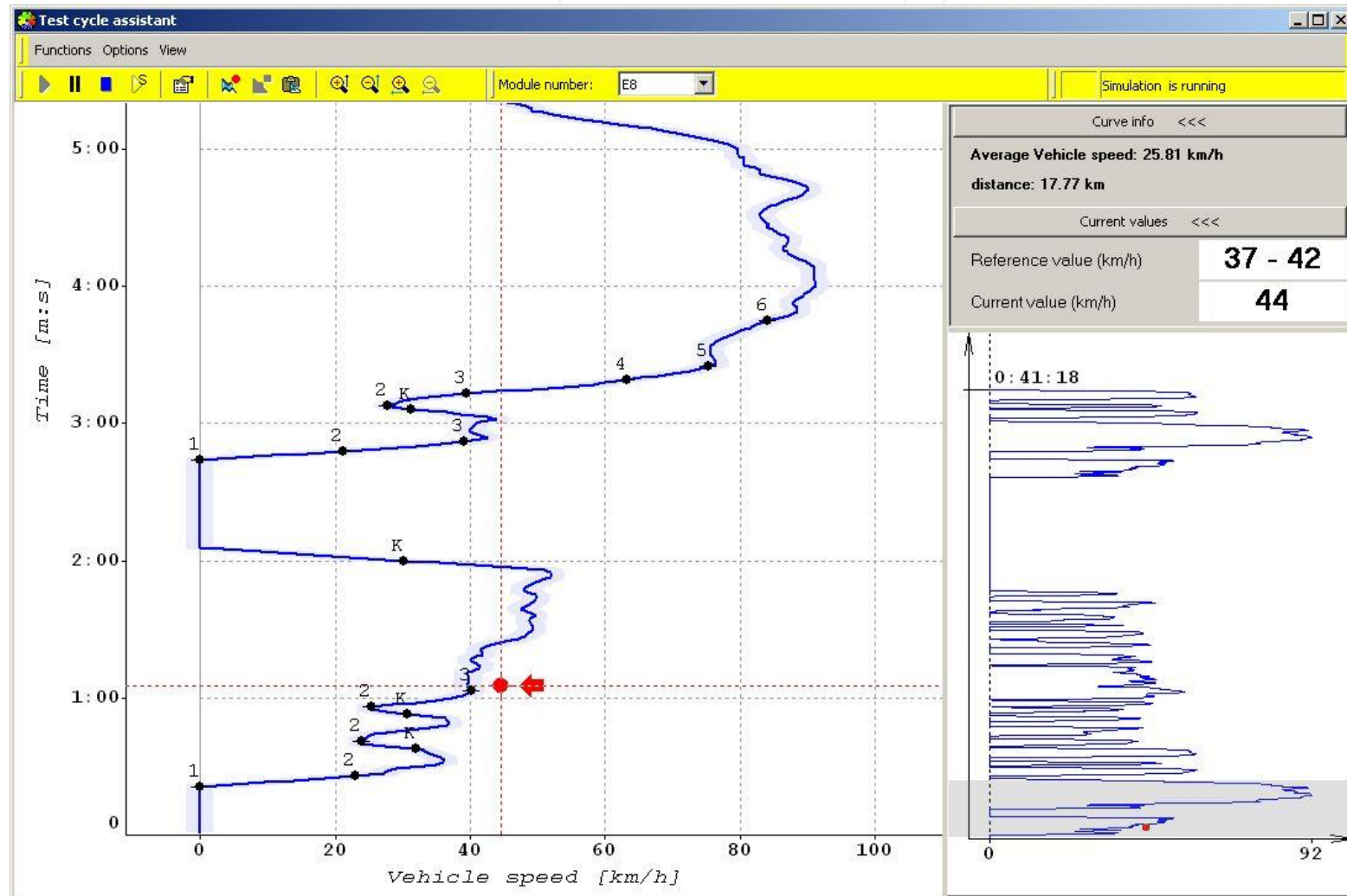


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## Light-Duty FTP-75 Emission Test Cycle



# Test cycle assistant in Silver Scan-Tool using FTP-75 emission test cycle





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### **Compliance test cases according to SAE J1699**

*"The main purpose of this Recommended Practice is to verify that vehicles are capable of communicating a minimum subset of information, in accordance with the diagnostic test services specified in SAE J1979"*

*"Any software meeting these specifications will utilize the vehicle interface that is defined in SAE J2534 %o*

- " Test procedure for OBD Scan-Tool Communication
- " Simple plausibility check for measurement values and fault outputs
- " No validation of the ECUs self diagnosis
- " Static and dynamic test type
- " Officially accepted test tool is a command line program developed as open source
- " Test protocol is a cryptic text file which is hard to interpret





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### Sequence of a SAE J1699 compliance test

static	<b>5</b>	Test vehicle with no malfunctions, no DTCs set	<b>(22)</b>
	<b>6</b>	Test vehicle with a pending code by inducing a fault	<b>(5)</b>
	<b>7</b>	Test vehicle with a confirmed code by retaining fault	<b>(5)</b>
	<b>8</b>	Test vehicle with fault repaired	<b>(6)</b>
	<b>9</b>	Test vehicle with no faults after 3 driving cycles completed	<b>(6 / 23)</b>
dynamic	<b>10</b>	Test vehicle with no faults to verify in-use performance counters, Service \$06, and Service \$01	<b>(13)</b>
	<b>11</b>	Test vehicle with no faults to verify in-use performance counters, Service \$06, and I/M Readiness	<b>(11)</b>

# SAE J1699/3 dynamic test report formatted with Silver Scan-Tool

SAE J1699 Logfile - Mozilla Firefox

SAE J1699 Logfile

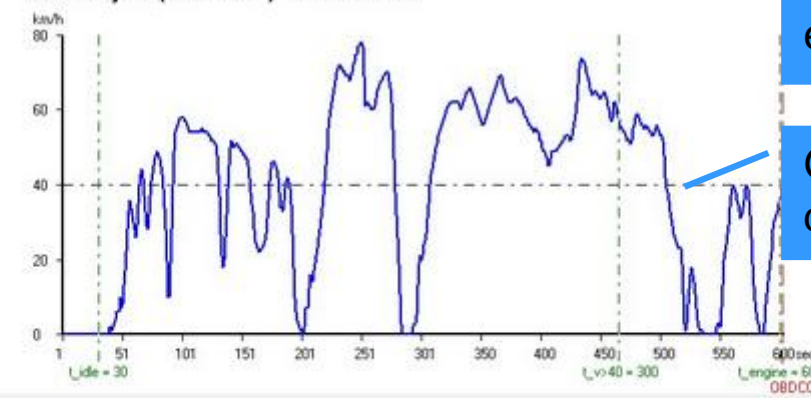
**Datum/Uhrzeit:**  
**J1699-Version:**  
**Pass-Thru Device:**  
**Logdatei:**  
**Ausgabedatei:**  
**Fahrgestellnummer:**  
**Kommentar:**

**Inhalt**  
[Testergebnis](#)  
[Pass-Thru Device](#)  
[Protokollübersicht](#)  
[Fehler und Warnungen](#)  
[Test 10 \(Zyklus 1\)](#)  
[Test 11 \(Zyklus 1\)](#)  
[Test 10 \(Zyklus 2\)](#)  
[Test 11 \(Zyklus 2\)](#)  
[Test 10 \(Zyklus 3\)](#)  
[Test 11 \(Zyklus 3\)](#)  
[Test 10 \(Zyklus 4\)](#)  
[Test 11 \(Zyklus 4\)](#)  
[Modal 7E9 Transmission](#)  
[Modal 7E8 Engine1](#)

- calculated ratio -	1.455	1.441	1.441	1.417		
secondary air numerator	0	0	0	0	0	0
secondary air denominator	0	0	0	0	0	0
- calculated ratio -	7.999	7.999	7.999	7.999	7.999	7.999
EVAP numerator	0	0	0	0	1	1
EVAP denominator	15	16	16	16	16	18
- calculated ratio -	0.000	0.000	0.000	0.000	0.000	0.056

**Fahrzyklus** CARB cycle (Test 10.11)

**CARB cycle (Test 10.11) - module 7E8**



Fertig

Clear failure classification (if possible)

Detailed list of failures

Separate info table for each ECU

Graphical display of CARB driving cycle



## SAE J1699/3 test report for Readiness Status formatted with Silver Scan-Tool

Readiness		Test 5.6			
Monitor	PID 01		PID 41		
	supported	complete	enabled	complete	
	Misfire monitoring	yes	yes	yes	yes
Fuel system monitoring	yes	yes	yes	yes	
Comprehensive component monitoring	yes	yes	yes	yes	
Catalyst monitoring	yes	no	yes	no	
Heated catalyst monitoring	no	yes	no	yes	
Evaporative system monitoring	yes	no	no	no	
Secondary air system monitoring	no	yes	no	yes	
A/C system refrigerant monitoring	no	yes	no	yes	
Oxygen sensor monitoring	yes	no	yes	no	
Oxygen sensor heater monitoring	yes	no	yes	no	
EGR and/or VVT system monitoring	yes	no	yes	no	

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 - Customers are our best reference -

Right Solution

Right Place

Right Time

Right Price

Automotive ...



Industrie / Maschinenbau ...



Dienstleister ...



Sonstige ...

