



Silver Scan-Tool for the testing of OBD functionality

Peter Stoß
Senior Manager RA Automotive

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RA Consulting GmbH

Zeiloch 6a

D-76646 Bruchsal

Tel +49 (0)7251 3862-0

Fax +49 (0)7251 3862-11

eMail: info@rac.de



Agenda

- Introduction
- Important ISO and SAE standards
- Functions of an OBD Scan-Tool
- Communication interfaces according to SAE J2534
- Practical experience using SAE J2534
- SAE J1699 compliance test – Procedure and analysis
- Summary and perspective

OBD II Scan-Tool

SAE J1978 OBD II Scan Tool

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

The document specifies:

- a. A means of establishing communications between an OBD-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.



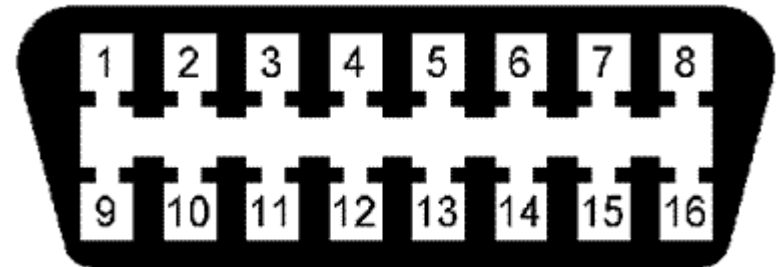
Important ISO and SAE standards

- SAE J1699** OBD II Compliance Test Cases
- SAE J1850** Class B Data Communications Network Interface
- SAE J1939** Recommended Practice for a Serial Control and Communications Vehicle Network
- SAE J1962** Diagnostic Connector Equivalent to ISO/DIS 15031-3
- SAE J1978** OBD II Scan Tool - Equivalent to ISO/DIS 15031-4
- SAE J1979** E/E Diagnostic Test Modes - Equivalent to ISO/DIS 15031-5
- SAE J2012** Diagnostic Trouble Code Definitions Equivalent to ISO/DIS 15031-6
- SAE J2534** Recommended Practice for Pass-Thru Vehicle Programming

- ISO 9141** CARB requirements for interchange of digital information
- ISO 11898** Controller area network (CAN) for high-speed communication
- ISO 14229** Unified diagnostic services (UDS) - Specification and requirements
- ISO 14230** Diagnostic systems - Keyword Protocol 2000
- ISO 15031** Communication between vehicle and external equipment for emissions-related diagnostics
- ISO 15765** Diagnostics on Controller Area Networks (CAN)

The most important standards for an OBD Scan-Tool

- Communication Protocol
 - ISO 9141 (K-Line)
 - ISO 14230 (KWP2000)
 - SAE J1850
 - ISO 15765 (Diagnosis on CAN)
 - ISO/DIS 14229-1 (UDS)
- OBD
 - ISO 15031 (OBD)
 - SAE J1978 (Scan Tool)
 - SAE J1979 (OBD)
 - SAE J1962 (Connector)
 - SAE J2534 (Pass-Thru)
 - SAE J1699 (Compliance Test)



16 Pins, 7 free for use by OEM:

Pin 2 - J1850 Bus (+)

Pin 4 - Chassis ground

Pin 5 - Signal ground

Pin 6 - CAN High

Pin 7 - ISO 9141-2 K / ISO 14230

Pin 10 - J1850 Bus (-)

Pin 14 - CAN Low

Pin 15 - ISO 9141-2 L / ISO 14230

Pin 16 - Battery (+)-Voltage

The most important standards in the ISO/OSI layer model

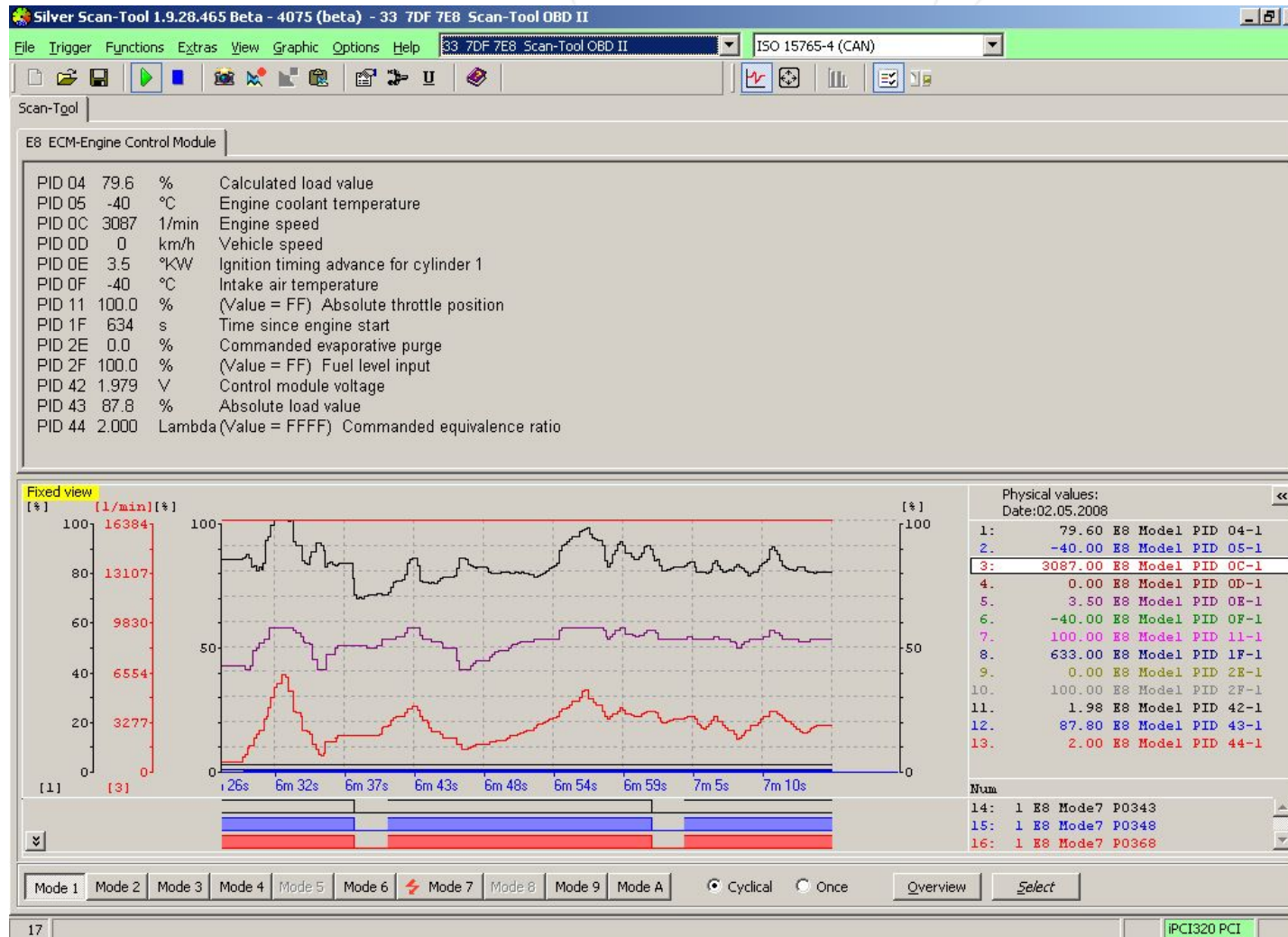
Layer		Aufgabe	Emission related diagnostics					
7	Application	Allgemein verwendbare Dienste für den Anwender, z.B. Fehlerspeichers lesen	SAE J1979 / ISO 15031-5			ISO/PAS 27145-3 ISO 14229-1	SAE J1939-71/73	SAE J1699
6	Presentation		-	-	-	ISO/PAS 27145-2		
5	Session		-	-	ISO 15765-4			
4	Transport	Aufteilung und Zusammensetzen der Daten mehrerer Botschaften (Segmentierung)	-	-	-			
3	Network	Routing, Adressvergabe, Teilnehmererkennung und -überwachung	-	-	ISO 15765-2 ISO 15765-4	ISO/PAS 27145-4	SAE J2534	
2	Data Link	Botschaftsaufbau, Buszugriff, Fehlersicherung, Flusskontrolle	ISO 9141 ISO 14230-1	SAE J1850	ISO 11898 ISO 15765-4			
1	Physical	Elektrische Signalpegel, Bitcodierung	ISO 9141 ISO 14230-1	SAE J1850	ISO 11898 ISO 15765-4	SAE J1708 SAE J1587		
0	Mechanical	Steckverbinder und Kabel	-	-	-	-	-	



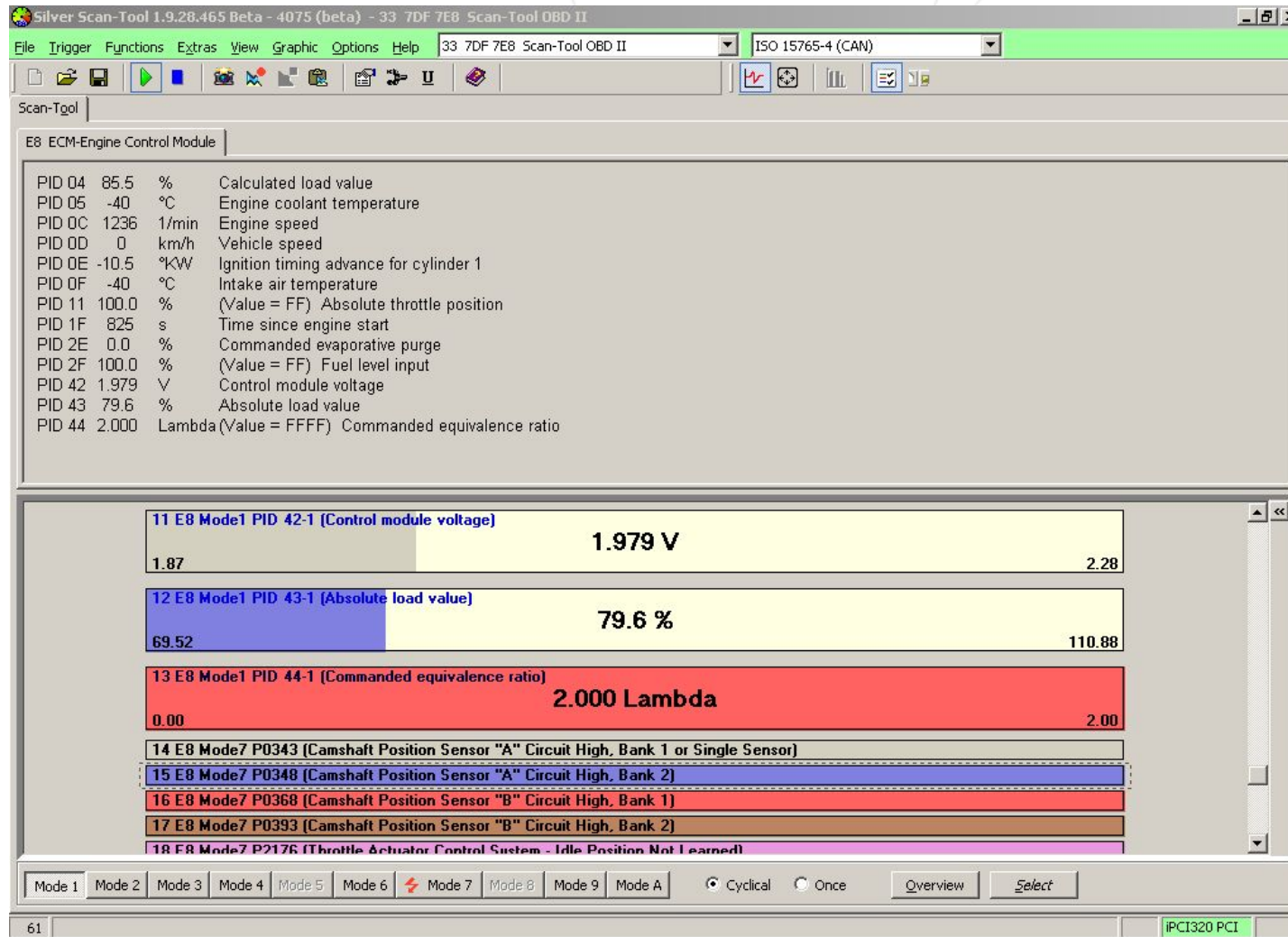
Services in OBD Scan-Tool

- Mode \$01 - Request current power train diagnostic data
- Mode \$02 - Request current power train freeze frame data
- Mode \$03 - Request confirmed emission-related DTCs
- Mode \$04 - Clear emission-related diagnostic information
- Mode \$05 - Request oxygen sensor monitoring test results
- Mode \$06 - Request monitoring test results for specific monitored systems
- Mode \$07 - Request pending emission-related DTCs
- Mode \$08 - Request control of on-board system, test or component
- Mode \$09 - Request vehicle information
- Mode \$0A - Request emission-related DTCs with permanent status

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



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



Mandatory parameters in Mode 1

For all vehicles:

- calculated load value
- number of stored confirmed fault codes
- engine coolant temperature
- engine speed
- absolute throttle position
- vehicle speed
- OBD requirements
- MIL status

For all vehicles so equipped:

- fuel control system status
- fuel trim
- fuel pressure
- ignition timing advance
- intake air temperature
- manifold absolute pressure
- air flow rate from mass air flow sensor
- secondary air status
- oxygen sensor output
- air/fuel ratio sensor output

Parameters in Mode 1 for 2005 model year

For all 2005 model year vehicles using ISO-CAN:

- absolute load
- fuel level
- relative throttle position
- barometric pressure
- engine control module system voltage
- commanded equivalence ratio
- catalyst temperature
- monitor status for each monitor used for readiness status
- time elapsed since engine start
- distance traveled while MIL activated
- distance traveled since fault memory last cleared
- number of warm-up cycles since fault memory last cleared

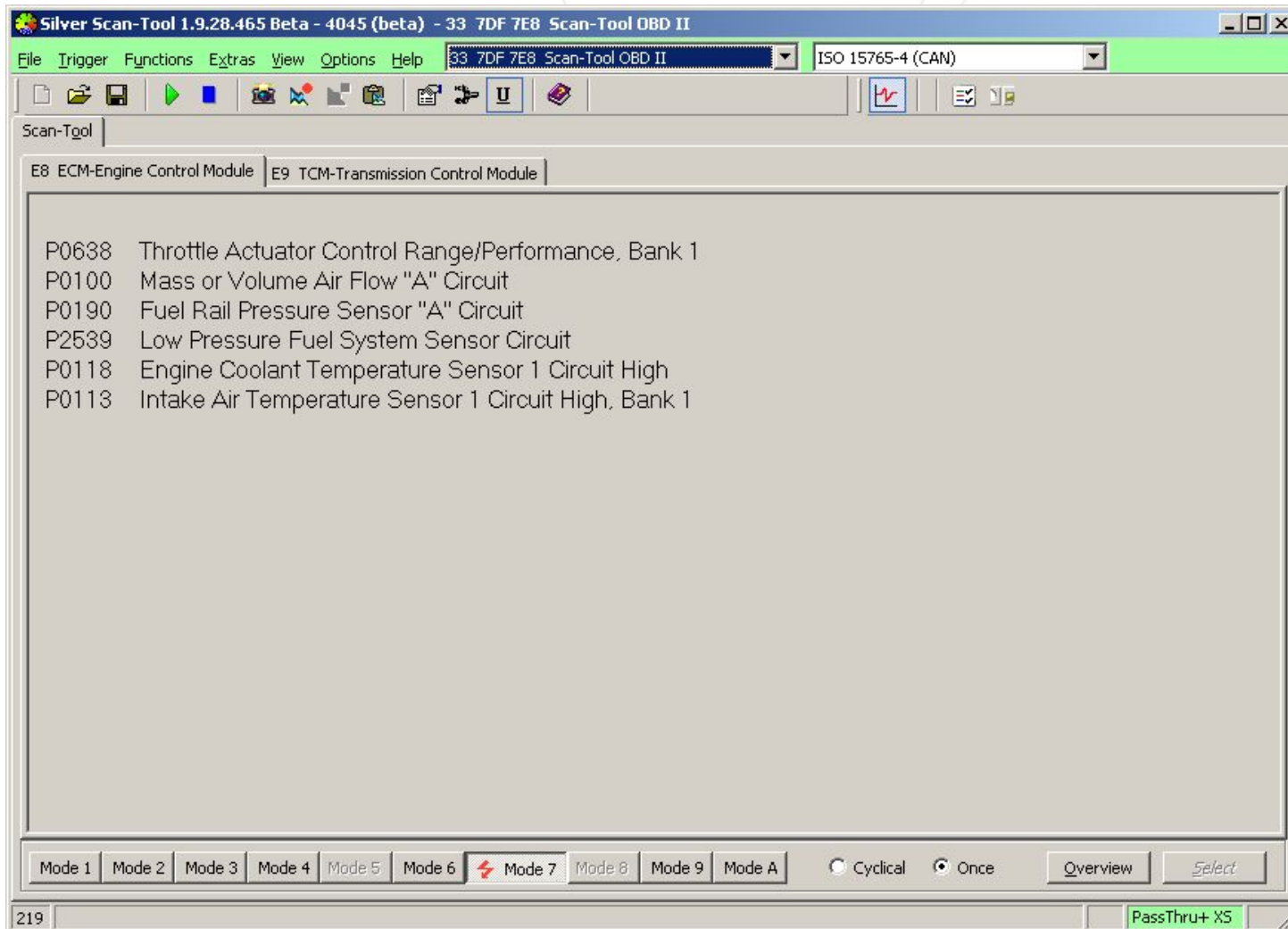
Parameters in Mode 1 for 2005 model year

For all 2005 model year vehicles so equipped using ISO-CAN:

- ambient air temperature
- evaporative system vapor pressure
- commanded purge valve duty cycle/position
- commanded EGR valve duty cycle/position
- EGR error between actual and commanded
- PTO status (active or not active)
- redundant absolute throttle position
- absolute pedal position
- redundant absolute pedal position
- commanded throttle motor position

Silver Scan-Tool Mode 7

Pending fault codes



The screenshot shows the Silver Scan-Tool 1.9.28.465 Beta interface. The title bar reads "Silver Scan-Tool 1.9.28.465 Beta - 4045 (beta) - 33 7DF 7E8 Scan-Tool OBD II". The menu bar includes File, Trigger, Functions, Extras, View, Options, and Help. The toolbar contains various icons for file operations and diagnostics. The main window is titled "Scan-Tool" and has two tabs: "E8 ECM-Engine Control Module" and "E9 TCM-Transmission Control Module". The E8 tab is active, displaying a list of pending fault codes:

- P0638 Throttle Actuator Control Range/Performance, Bank 1
- P0100 Mass or Volume Air Flow "A" Circuit
- P0190 Fuel Rail Pressure Sensor "A" Circuit
- P2539 Low Pressure Fuel System Sensor Circuit
- P0118 Engine Coolant Temperature Sensor 1 Circuit High
- P0113 Intake Air Temperature Sensor 1 Circuit High, Bank 1

At the bottom of the window, there is a mode selection bar with buttons for Mode 1 through Mode A. Mode 7 is currently selected and highlighted with a red lightning bolt icon. To the right of the mode buttons are radio buttons for "Cyclical" and "Once", with "Once" being selected. Further right are "Overview" and "Select" buttons. The status bar at the bottom left shows the number "219" and the text "PassThru+ XS" on the right.

Fault code groupings

Powertrain system groupings

- P0XXX ISO/SAE controlled
- P1XXX manufacturer control
- P2XXX ISO/SAE controlled
- P3XXX manufacturer controlled and ISO/SAE reserved

Chassis system groupings

- C0XXX ISO/SAE controlled
- C1XXX manufacturer controlled
- C2XXX manufacturer controlled
- C3XXX reserved by document



Fault code groupings

Body system groupings

- B0XXX ISO/SAE controlled
- B1XXX manufacturer controlled
- B2XXX manufacturer controlled
- B3XXX reserved by document

Network groupings

- U0XXX ISO/SAE controlled
- U1XXX manufacturer controlled
- U2XXX manufacturer controlled
- U3XXX reserved

Silver Scan-Tool Mode 6

Monitoring test results

Silver Scan-Tool 1.9.28.465 Beta - 4045 (beta) - 33 7DF 7E8 Scan-Tool OBD II

File Trigger Functions Extras View Options Help 33 7DF 7E8 Scan-Tool OBD II ISO 15765-4 (CAN)

Scan-Tool

E8 ECM-Engine Control Module | E9 TCM-Transmission Control Module

Monitor ID	Test ID	Unit ID	Test value	Min value	Max value	Unit	Comment
01	83	05	0.0000	0.0000	0.0000		Oxygen Sensor Monitor Bank 1 - Sensor 1
02	01	0A	621.1	621.1	621.1	mV	Oxygen Sensor Monitor Bank 1 - Sensor 2
02	02	0A	621.1	621.1	621.1	mV	Oxygen Sensor Monitor Bank 1 - Sensor 2
02	07	0A	0.0	0.0	0.0	mV	Oxygen Sensor Monitor Bank 1 - Sensor 2
02	08	0A	0.0	0.0	0.0	mV	Oxygen Sensor Monitor Bank 1 - Sensor 2
02	81	0A	0.0	0.0	0.0	mV	Oxygen Sensor Monitor Bank 1 - Sensor 2
02	82	0A	0.0	0.0	0.0	mV	Oxygen Sensor Monitor Bank 1 - Sensor 2
02	83	0A	0.0	0.0	0.0	mV	Oxygen Sensor Monitor Bank 1 - Sensor 2
41	85	16	-40.0	-40.0	-40.0	°C	Oxygen Sensor Heater Monitor Bank 1 - Sensor 1
42	81	14	0	0	0	Ohm	Oxygen Sensor Heater Monitor Bank 1 - Sensor 2

Mode 1 Mode 2 Mode 3 Mode 4 Mode 5 Mode 6 Mode 7 Mode 8 Mode 9 Mode A

Cyclical Once

Overview Select

224 PassThru+ X5

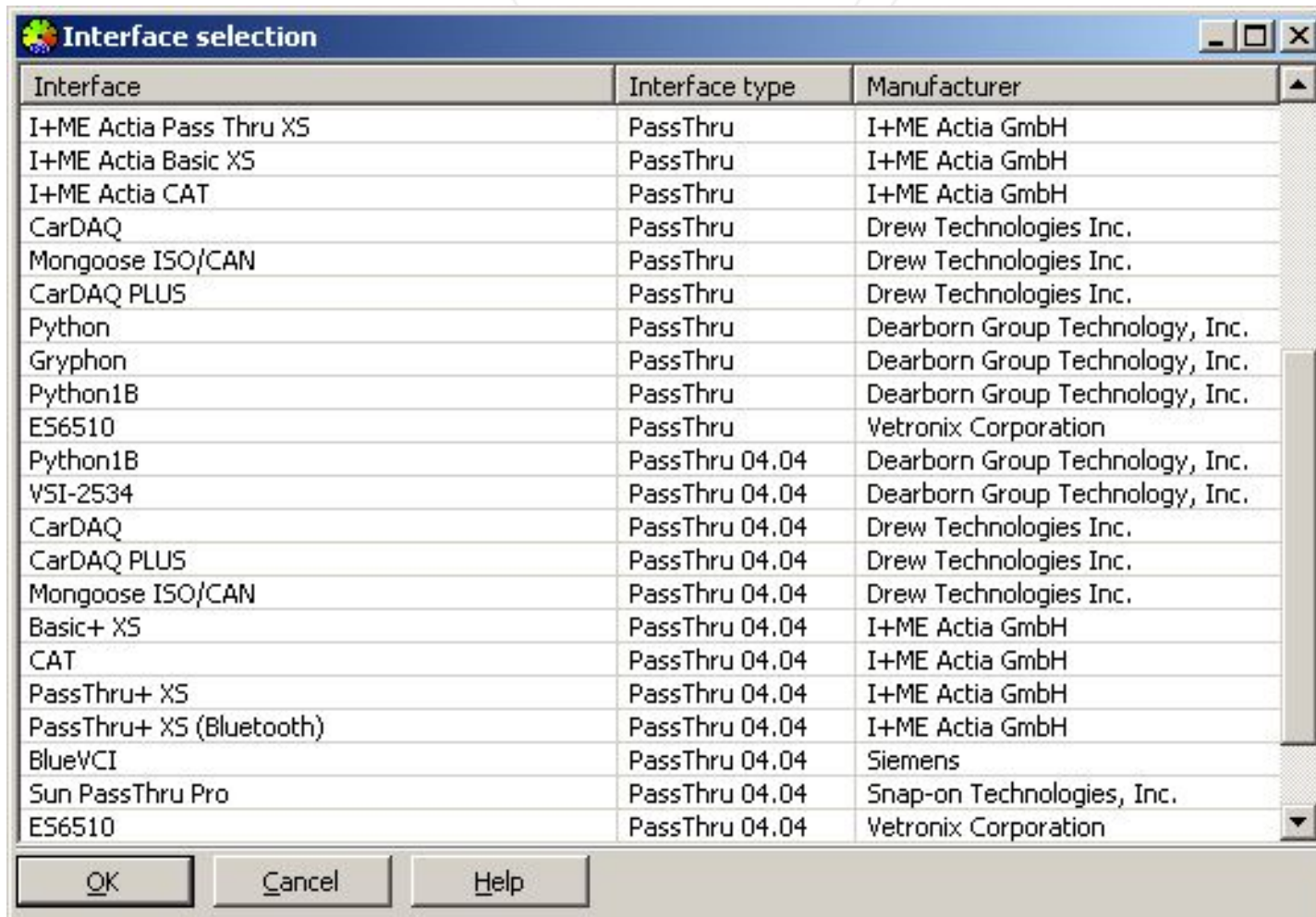
Diagnostic interface according to SAE J2534 Pass-Thru

SAE J2534 - Pass-Thru Vehicle Programming

- Standard interface for the flash programming of emission related ECUs
- Diagnostic protocols ISO9141, ISO14230-4, J1850 PWM (Ford), J1850 VPW (GM), CAN, ISO 15765-4, J2610 SCI (DC)
- Standardised driver for Windows PC
- Two revisions of J2534, 02.02 and 04.04
- Silver Scan-Tool supports all J2534 devices for both revisions



Diagnostic interface according to SAE J2534 Pass-Thru



The screenshot shows a dialog box titled "Interface selection" with a table of diagnostic interfaces. The table has three columns: "Interface", "Interface type", and "Manufacturer". The list includes various interfaces such as I+ME Actia Pass Thru XS, CarDAQ, and ES6510, with different interface types and manufacturers.

Interface	Interface type	Manufacturer
I+ME Actia Pass Thru XS	PassThru	I+ME Actia GmbH
I+ME Actia Basic XS	PassThru	I+ME Actia GmbH
I+ME Actia CAT	PassThru	I+ME Actia GmbH
CarDAQ	PassThru	Drew Technologies Inc.
Mongoose ISO/CAN	PassThru	Drew Technologies Inc.
CarDAQ PLUS	PassThru	Drew Technologies Inc.
Python	PassThru	Dearborn Group Technology, Inc.
Gryphon	PassThru	Dearborn Group Technology, Inc.
Python1B	PassThru	Dearborn Group Technology, Inc.
ES6510	PassThru	Vetronix Corporation
Python1B	PassThru 04.04	Dearborn Group Technology, Inc.
VSI-2534	PassThru 04.04	Dearborn Group Technology, Inc.
CarDAQ	PassThru 04.04	Drew Technologies Inc.
CarDAQ PLUS	PassThru 04.04	Drew Technologies Inc.
Mongoose ISO/CAN	PassThru 04.04	Drew Technologies Inc.
Basic+ XS	PassThru 04.04	I+ME Actia GmbH
CAT	PassThru 04.04	I+ME Actia GmbH
PassThru+ XS	PassThru 04.04	I+ME Actia GmbH
PassThru+ XS (Bluetooth)	PassThru 04.04	I+ME Actia GmbH
BlueVCI	PassThru 04.04	Siemens
Sun PassThru Pro	PassThru 04.04	Snap-on Technologies, Inc.
ES6510	PassThru 04.04	Vetronix Corporation

Buttons: OK, Cancel, Help



SAE J2534 Pass-Thru command set

PassThruOpen	Establish a connection with a Pass-Thru device.
PassThruClose	Terminate a connection with a Pass-Thru device.
PassThruConnect	Establish a connection with a protocol channel.
PassThruDisconnect	Terminate a connection with a protocol channel.
PassThruReadMsgs	Read message(s) from a protocol channel.
PassThruWriteMsgs	Write message(s) to a protocol channel.
PassThruStartPeriodicMsg	Start sending a message at a specified time interval
PassThruStopPeriodicMsg	Stop a periodic message.
PassThruStartMsgFilter	Start filtering incoming messages on a protocol channel.
PassThruStopMsgFilter	Stops filtering incoming messages on a protocol channel.
PassThruSetProgrammingVoltage	Set a programming voltage on a specific pin.
PassThruReadVersion	Reads the version information for the DLL and API.
PassThruGetLastError	Gets the text description of the last error.
PassThruIoctl	General I/O control functions for reading/writing protocol configuration.



Compliance test cases according to SAE J1699

- Starting with the 2005 model year, the California Air Resource Board (CARB) has introduced this certification to ensure the flawless functioning of the communication interface between emission-related on-board vehicle diagnostics and scan tester.
- The SAE J1699/3 standard defines a number of tests that verify the implementation of the CARB/EPA OBD II.
- Starting with the 2005 model year, all vehicles must pass these tests before they can be certified for sale in the state of California.
- To check communication with one or more ECU's, the J1699/3 tests utilize a pass-thru device that confirms to the SAE J2534 standard.
- There is only one J1699 testing software accepted by CARB. This DOS software has been founded by some OEM and is provided as general public license („Open-Source Software“) by the SAE J1699 committee.
- RA implemented windows based remote control-, visualisation- and GUI-software modules, which are integrated in DiagRA D and Silver Scan Tool.

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 "

- 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 recognised test tool is an Open-Source program under DOS
- Test protocol is a cryptic text file which is hard to interpret

Sequence of a SAE J1699 compliance test

static test

5. Test vehicle with no malfunctions, no DTCs set (20/22)
6. Test vehicle with a pending code by inducing a fault (5)
7. Test vehicle with a confirmed code by retaining fault (5)
8. Test vehicle with fault repaired (5/6)
9. Test vehicle with no faults after 3 driving cycles completed (6/23)

dynamic test

10. Test vehicle with no faults to verify in-use performance counters, Service \$06, and Service \$01 (13)
11. Test vehicle with no faults to verify in-use performance counters, Service \$06, and I/M Readiness (11)

GUI of J1699 compliance test in Silver Scan-Tool

J1699-3 Remote Control

J1699-3 version
13.08.00

PassThru device
PassThru+ XS

model year
2005

number of OBD II ECUs
2

vehicle make
Volkswagen

model of vehicle
My vehicle

your name
Peter Stoß

J1699-3 test in progress...

5.6 Verify Service \$01 Data - Request current powertrain diagnostic data, engine off

instruction

done

question

FAILURE: Invalid SID \$1 PID \$05 Data
Failure detected, Continue?

Yes to all
Yes
No

```

INFORMATION: Verify Link Active
INFORMATION: Link Active on OBD ISO15765 protocol, ECU 7E8
INFORMATION: Link Active on OBD ISO15765 protocol, ECU 7E9

INFORMATION: Link Active
INFORMATION: FUELSYS1 = $00 FUELSYS2 = $00
INFORMATION: LOAD_PCT = 0 %
INFORMATION: LOAD_PCT = 0 %
INFORMATION: ECT = -40 C
FAILURE: ECU 7E8 ECT exceeded normal range
INFORMATION: ECT = -40 C
FAILURE: ECU 7E9 ECT exceeded normal range
FAILURE: Invalid SID $1 PID $05 Data

PROMPT: Failure detected, Continue?
(Enter Yes, No or All yes):
  
```

abort

J1699-3 test in progress...

5.1 Perform MIL bulb check, engine off

instruction

00:00:10

done

question

Was the MIL ON for at least fifteen (15) seconds?

Yes to all
Yes
No

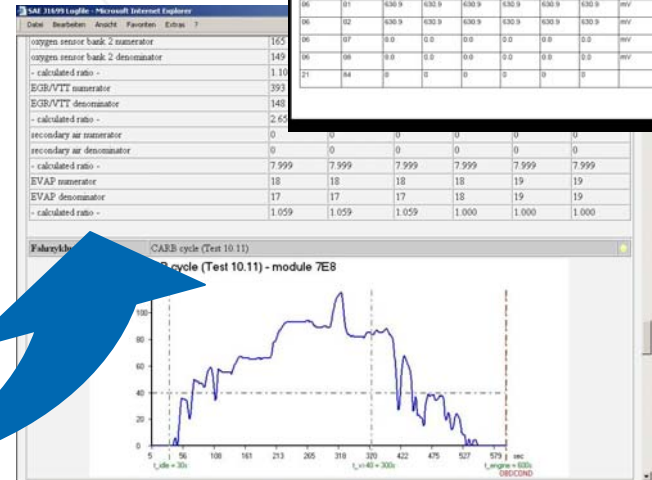
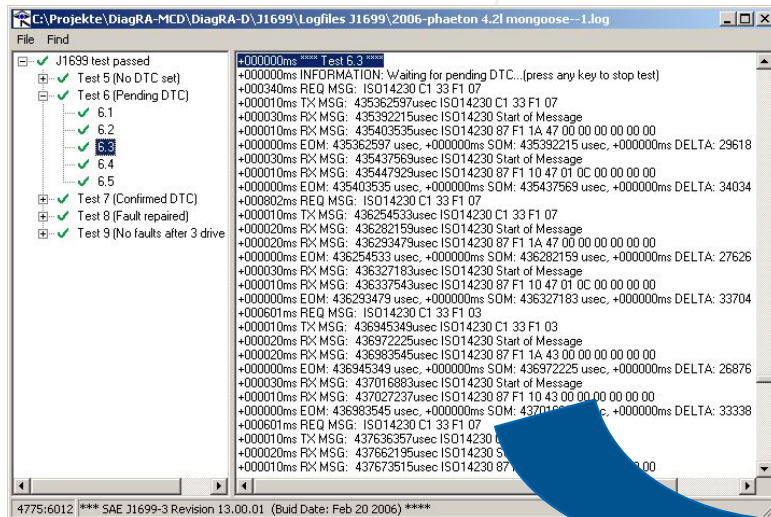
```

is vehicle (1 to 8)? 2
ECUs are on this vehicle (1 to 8)?
on ignition (i.e. diesel)? NO
...
(15) seconds (Press Enter):
crank engine.
...
(15) seconds? (Enter Yes or No):
  
```

abort

Interpretation of SAE J1699 log files

- Import and analysis of J1699 log files
- Structuring and formatting of the contained test results
- Output in XML-format for post-processing and archiving
- Transformation in HTML for browser display
- Transformation in PDF including the entire log file
- Viewer for J1699 log files with navigation



Modus 2 (Aktuelle Betriebsbedingungen)							TBR
Mod (hex)	Test 6	Test 7	Test 8	Test 9	Einheit	Beschreibung	TBR
02	00000						Fahrzyklus

Modus 4 (Testergebnisse nicht kontinuierlicher Prüfungen)								TBR	
Mod (hex)	TD (hex)	Messwert (Messwert)	Min. Wert (Messwert)	Max. Wert (Messwert)	Messwert (Leertext)	Min. Wert (Leertext)	Max. Wert (Leertext)	Einheit	Beschreibung
01	03	0.000	0.000	0.000	0.000	0.000	0.000		(Hohes) Oxygen Sensor Monitor Bank 1 - Sensor 1
01	04	0.000	0.000	0.000	0.000	0.000	0.000		(Hohes) Oxygen Sensor Monitor Bank 1 - Sensor 2
02	01	630.9	630.9	630.9	630.9	630.9	630.9	rev	(Vollwert) Oxygen Sensor Monitor Bank 1 - Sensor 1
02	02	630.9	630.9	630.9	630.9	630.9	630.9	rev	(Vollwert) Oxygen Sensor Monitor Bank 1 - Sensor 2
02	07	0.0	0.0	0.0	0.0	0.0	0.0	rev	(Vollwert) Oxygen Sensor Monitor Bank 1 - Sensor 1
02	08	0.0	0.0	0.0	0.0	0.0	0.0	rev	(Vollwert) Oxygen Sensor Monitor Bank 1 - Sensor 2
05	03	0.000	0.000	0.000	0.000	0.000	0.000		(Hohes) Oxygen Sensor Monitor Bank 2 - Sensor 1
05	04	0.000	0.000	0.000	0.000	0.000	0.000		(Hohes) Oxygen Sensor Monitor Bank 2 - Sensor 2
06	01	630.9	630.9	630.9	630.9	630.9	630.9	rev	(Vollwert) Oxygen Sensor Monitor Bank 2 - Sensor 1
06	02	630.9	630.9	630.9	630.9	630.9	630.9	rev	(Vollwert) Oxygen Sensor Monitor Bank 2 - Sensor 2
06	07	0.0	0.0	0.0	0.0	0.0	0.0	rev	(Vollwert) Oxygen Sensor Monitor Bank 2 - Sensor 1
06	08	0.0	0.0	0.0	0.0	0.0	0.0	rev	(Vollwert) Oxygen Sensor Monitor Bank 2 - Sensor 2
21	04	0	0	0	0	0	0		(Hohes) Catalyst Monitor Bank 1

SAE J1699/3 test report

SAE J1699 Logfile - Mozilla Firefox

SAE J1699 Logfile

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

Inhalt

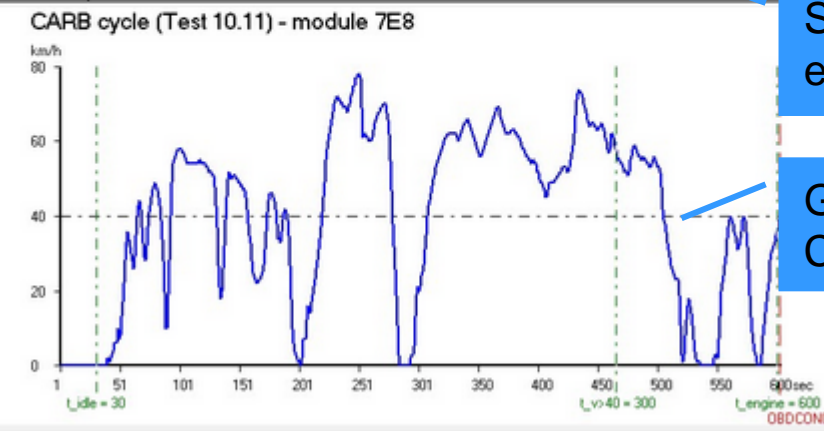
- [Testergebnis](#)
- [Pass-Thru Device](#)
- [Protokollübersicht](#)
- [Fehler und Warnungen](#)
- [Test 10 \(Zyklus 1\)](#)
- [Test 11 \(Zyklus 1\)](#)
- [Test 10 \(Zyklus 2\)](#)
- [Test 11 \(Zyklus 2\)](#)
- [Test 10 \(Zyklus 3\)](#)
- [Test 11 \(Zyklus 3\)](#)
- [Test 10 \(Zyklus 4\)](#)
- [Test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

Fertig

- calculated ratio -	1.455	1.441	1.441	1.441	1.417	1.325	1.325
secondary air numerator	0	0	0	0	0	0	0
secondary air denominator	0	0	0	0	0	0	0
- calculated ratio -	7.999	7.999	7.999	7.999	7.999	7.999	7.999
EVAP numerator	0	0	0	0	0	1	1
EVAP denominator	15	16	16	16	16	18	18
- calculated ratio -	0.000	0.000	0.000	0.000	0.000	0.056	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 test cycle

RA Consulting GmbH

- Customers are our best reference -

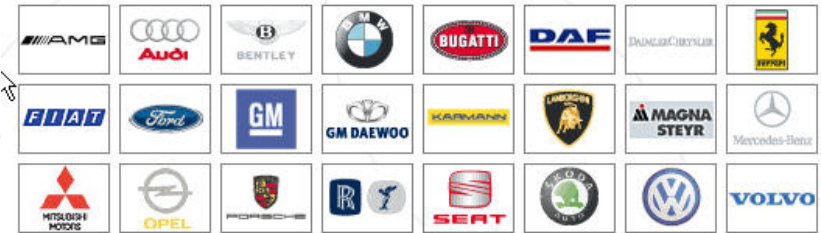
Right Solution

Right Place

Right Time

Right Price

Automotive ...



Industrie / Maschinenbau ...



Dienstleister ...



Sonstige ...

