



Indigo as (WWH-)OBD Scan Tool

Vector Webinar

Agenda

► **OBD Introduction**

Diagnostic Protocol

Discover OBD ECUs

Read Diagnostic and Vehicle Data

Fault Memory

Request On-Board Monitoring Test Results

Generic OBD Service Access

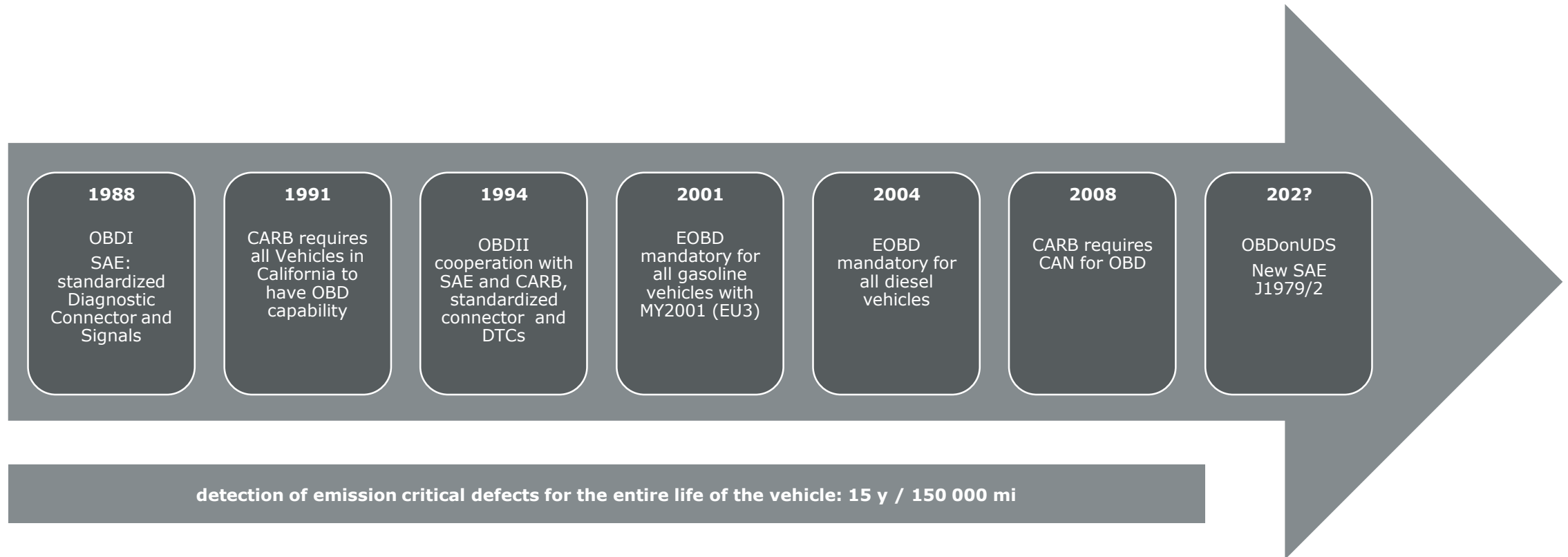
OBD Automation API

Remote Diagnostics

Further Readings

History of OBD

California Environmental Protection Agency **Air Resources Board**



History of OBD

▶ **California Environmental Protection Agency (CARB)**

- ▶ California has the right to set its own legislation concerning OBD
- ▶ Today the OBD requirements defined by the CARB are not only valid for the state California but for the overall US
- ▶ CARB always leads the debate in the US, the other states follow

▶ **European Union (EU)**

- ▶ EU has defined its own set of OBD requirements which are based on the CARB OBD II requirements but are not identical
- ▶ This version of OBD II is called EOBD (European OBD)

History of OBD

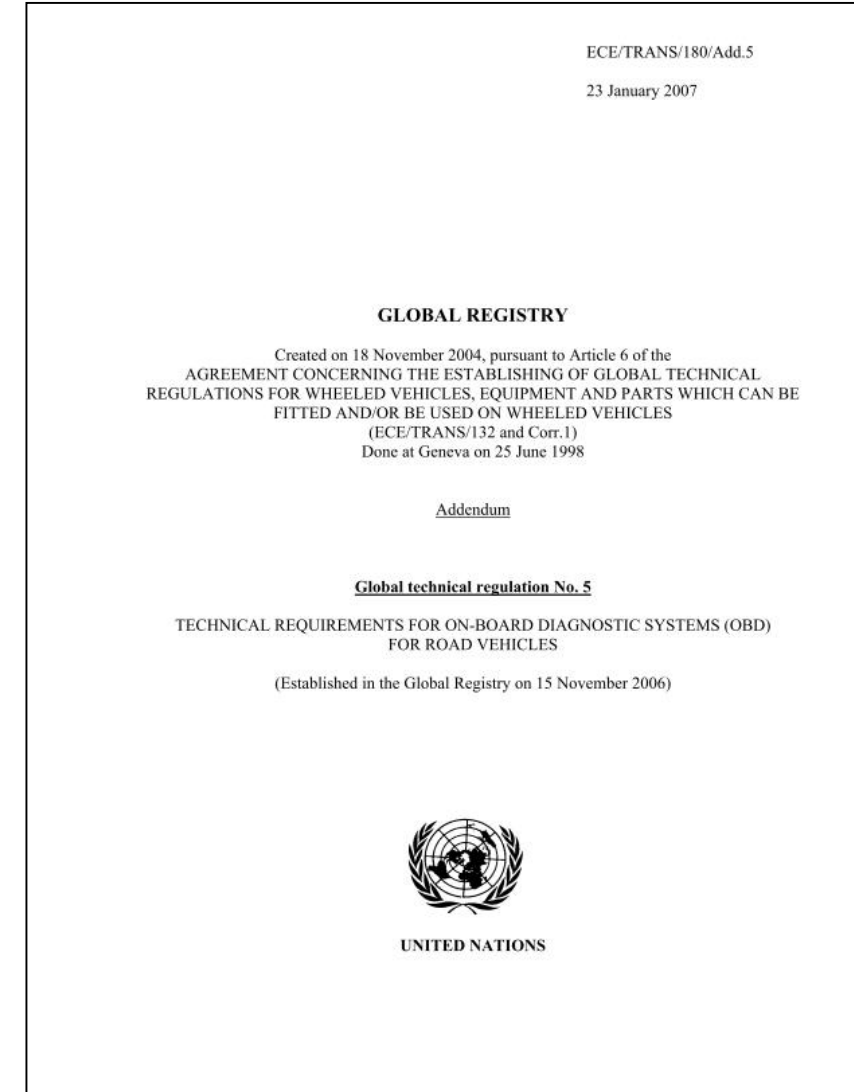
► Different OBD requirements (PID \$1C)

- OBD II (California ARB)
- OBD (Federal EPA)
- OBD and OBD II
- OBD I
- EOBD
- EOBD and OBD II
- EOBD and OBD
- EOBD, OBD and OBD II
- JOBD
- JOBD and OBD II
- JOBD and EOBD
- JOBD, EOBD, and OBD II
- OBD, EOBD and KOBD
- OBD, OBD II, EOBD and KOBD
- Engine Manufacturer Diagnostics (EMD)
- Engine Manufacturer Diagnostics Enhanced (EMD+)
- Heavy Duty On-Board Diagnostics (Child/Partial)
- Heavy Duty On-Board Diagnostics
- World Wide Harmonized OBD
- Heavy Duty Euro OBD Stage I without NOx Control
- Heavy Duty Euro OBD Stage I with NOx Control
- Heavy Duty Euro OBD Stage II without NOx Control
- Heavy Duty Euro OBD Stage II with NOx Control
- Brazil OBD Phase 1
- Brazil OBD Phase 2 and Phase 2+
- Korean OBD
- India OBD I
- India OBD II
- Euro VI
- OBD, OBD II and HD OBD
- Brazil OBD Phase 3

History of OBD

► United Nations (UN)

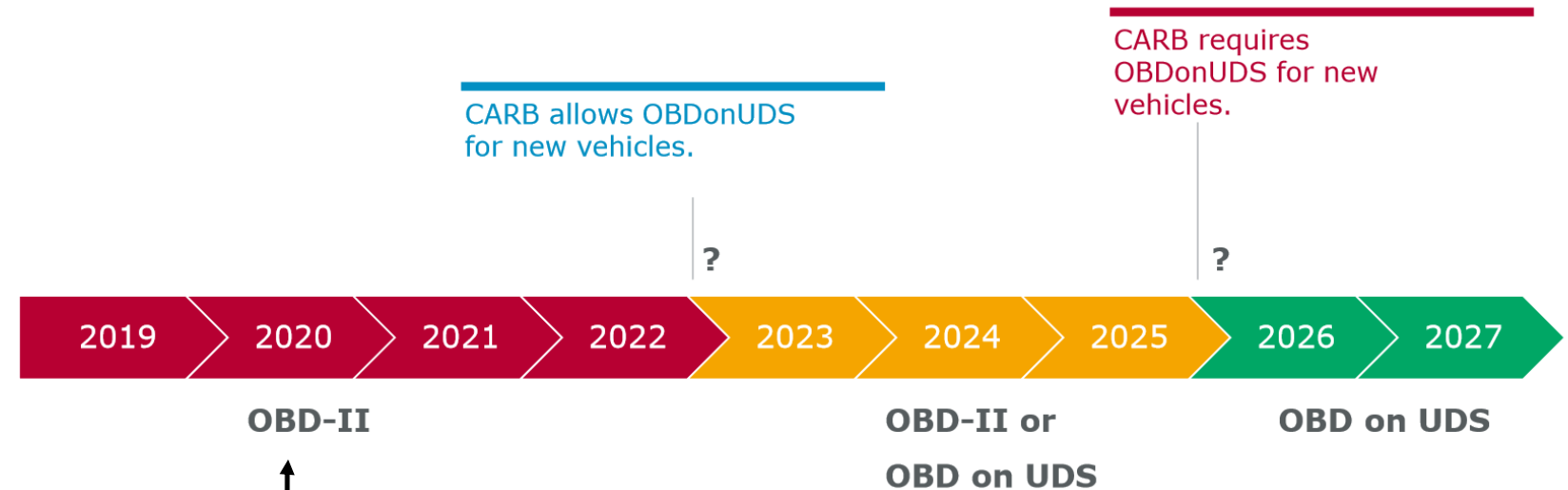
- UN try to consolidate the different OBD standards and issued a legislative document to replace the local legislative documents
- WWH OBD (World Wide Harmonized OBD)



What comes next?

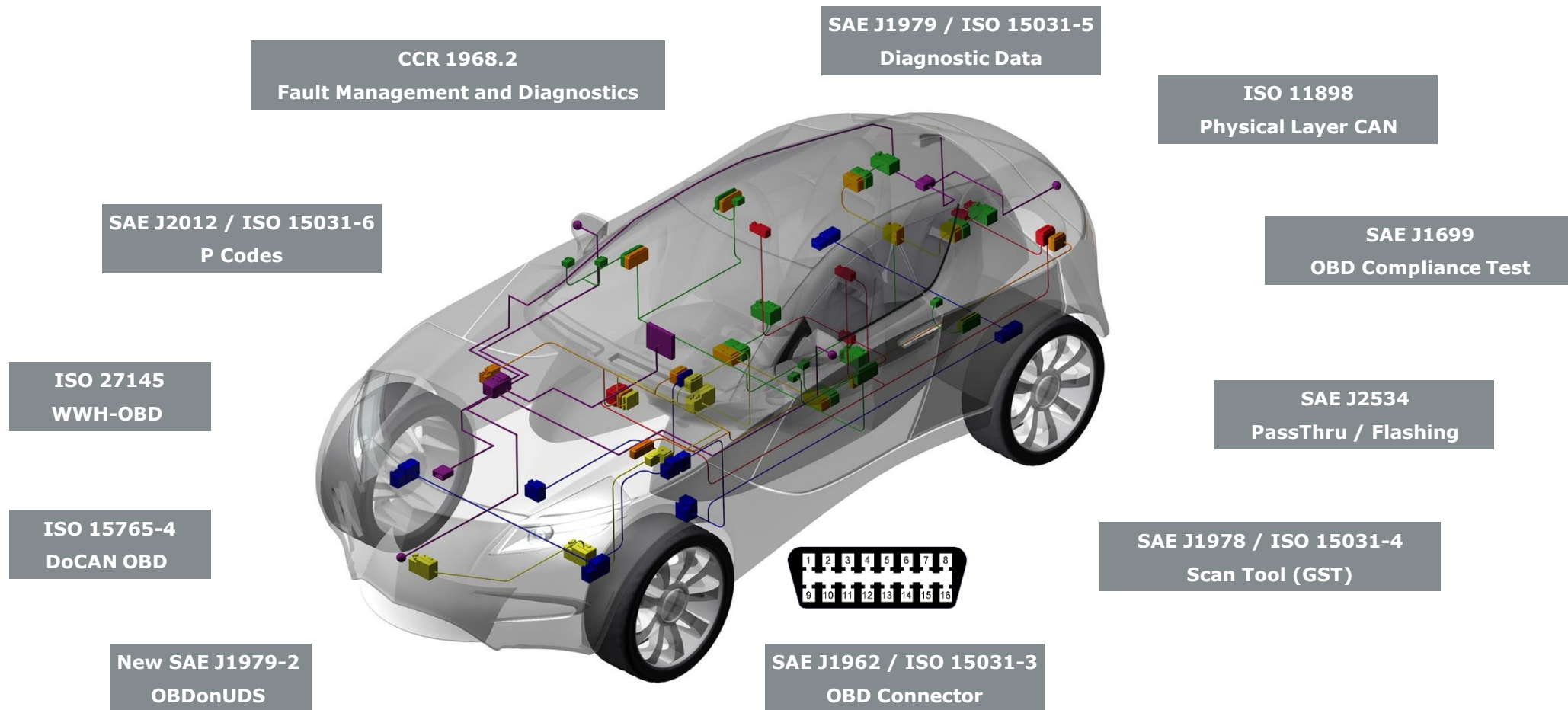
Upcoming SAE J1979-2

- ▶ Classic OBD-II to be replaced by UDS services
- ▶ New subfunctions for fault memory access
- ▶ 10 FreezeFrames
- ▶ IUMPR per DTC
- ▶ ...



Indigo will be OBD on UDS-ready from next version: **Indigo 7**

Standards around OBD



Agenda

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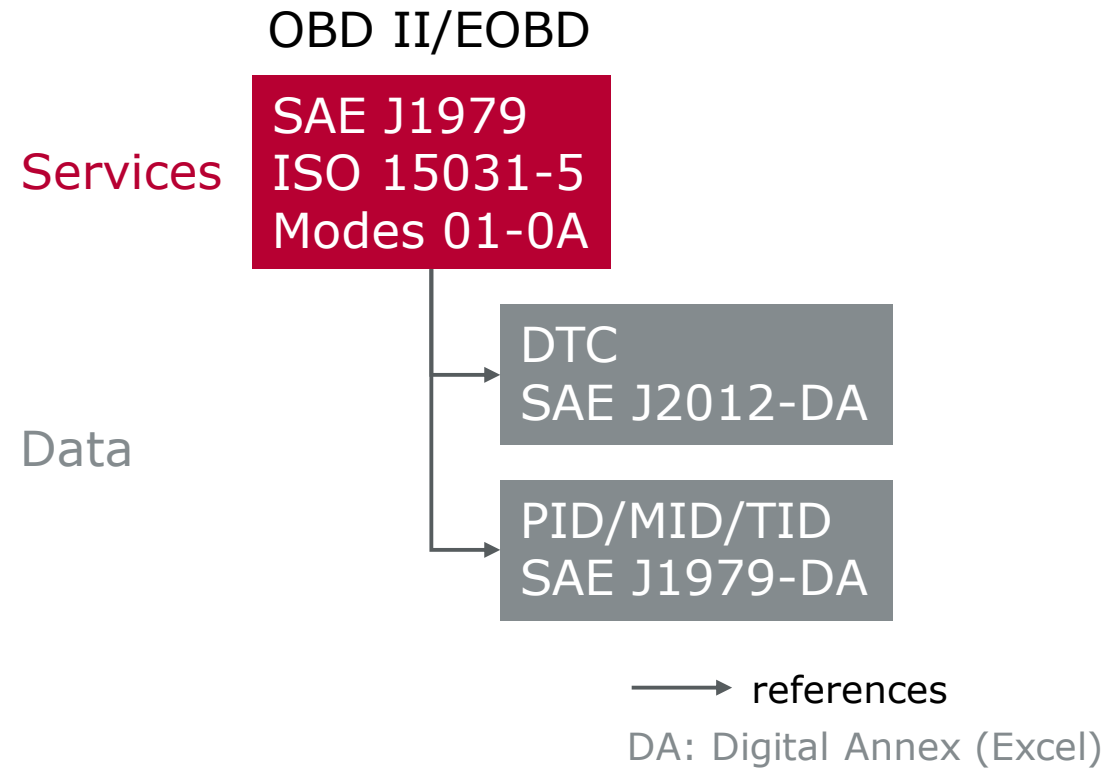
Generic OBD Service Access

OBd Automation API

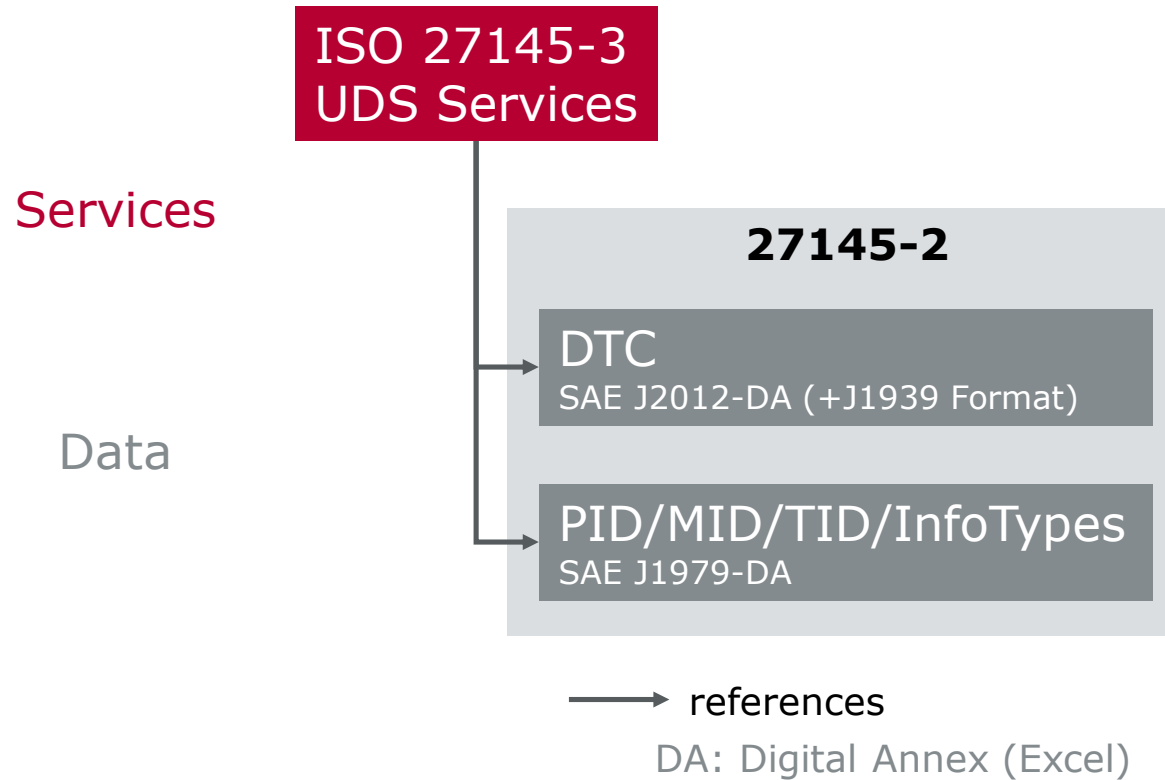
Remote Diagnostics

Further Readings

OBD II



WWH-OBD



- The “Digital Annexes” of SAE J2012 and SAE J1979 are referenced in WWH-OBD

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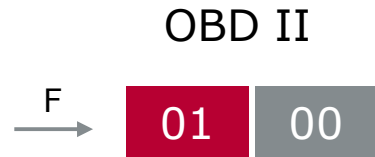
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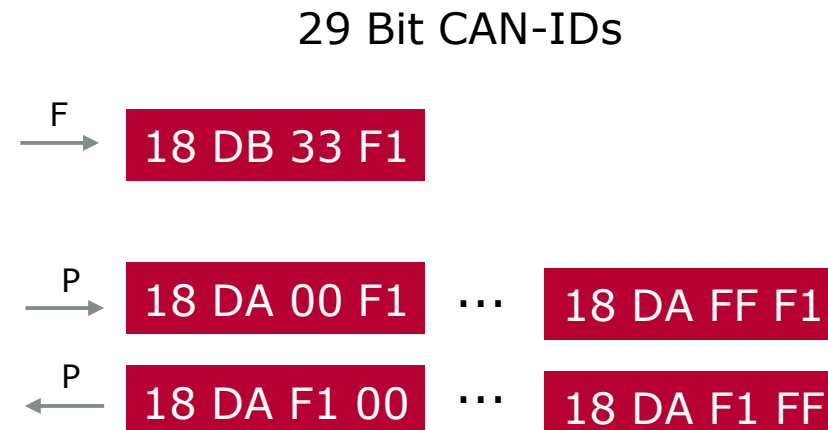
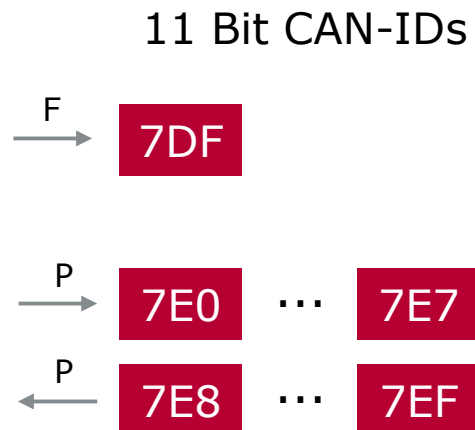
Remote Diagnostics

Further Readings

Discovery Message and CAN IDs



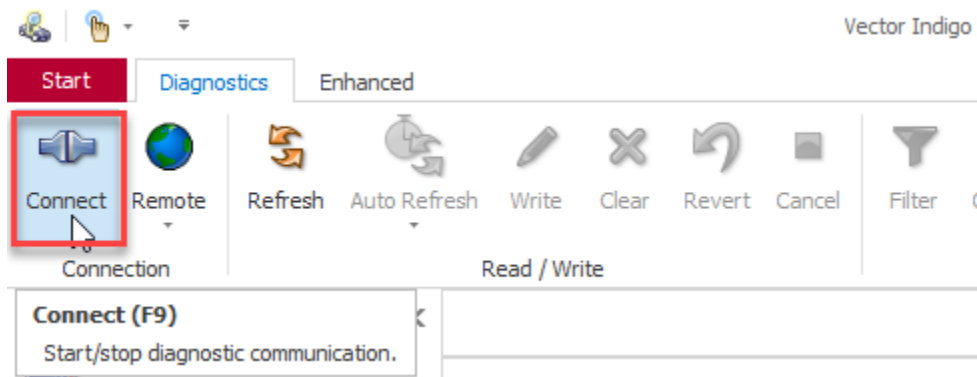
- ▶ Only OBD ECUs send positive responses



Discovery Message and CAN IDs

Indigo

- Simply start connection to run OBD discovery



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Further Readings

Read Current Diagnostic Data

OBD II



WWH-OBD



- ▶ Which data can be read?
 - ▶ Parameter Ids (PIDs) are defined in SAE J1979 DA

[illegible]


Read Current Diagnostic Data

- ▶ System State and Vehicle Readiness: PID \$01
 - ▶ Byte A: System State (DTCs and MIL)
 - ▶ Byte B: Support and Status of Monitors
 - ▶ Byte C: Supported Tests (run at least once per trip)
 - ▶ Byte D: Status of Tests (run at least once per trip)

Indigo: OBD Vehicle Status

OBD Vehicle Status

Malfunction Indicator Light (MIL)



Current	Since MIL activated	Since Clear
MIL Status: On	Travel Distance: 0 km	Travel Distance: 1270 km
DTCs: 3	Travel Time: -	Travel Time: -

Monitor Status Since DTCs Cleared

Monitor	ECM	HPC1-HybridPtCtrl1	TCM	FPCM-FuelPumpCtrl
Continuous Monitoring				
Comprehensive Components	✓ Completed	✓ Completed	✓ Completed	✓ Completed
Fuel System	✓ Completed	⊘ Not Supported	⊘ Not Supported	⊘ Not Supported
Misfire	✓ Completed	⊘ Not Supported	⊘ Not Supported	⊘ Not Supported
Non-Continuous Monitoring				

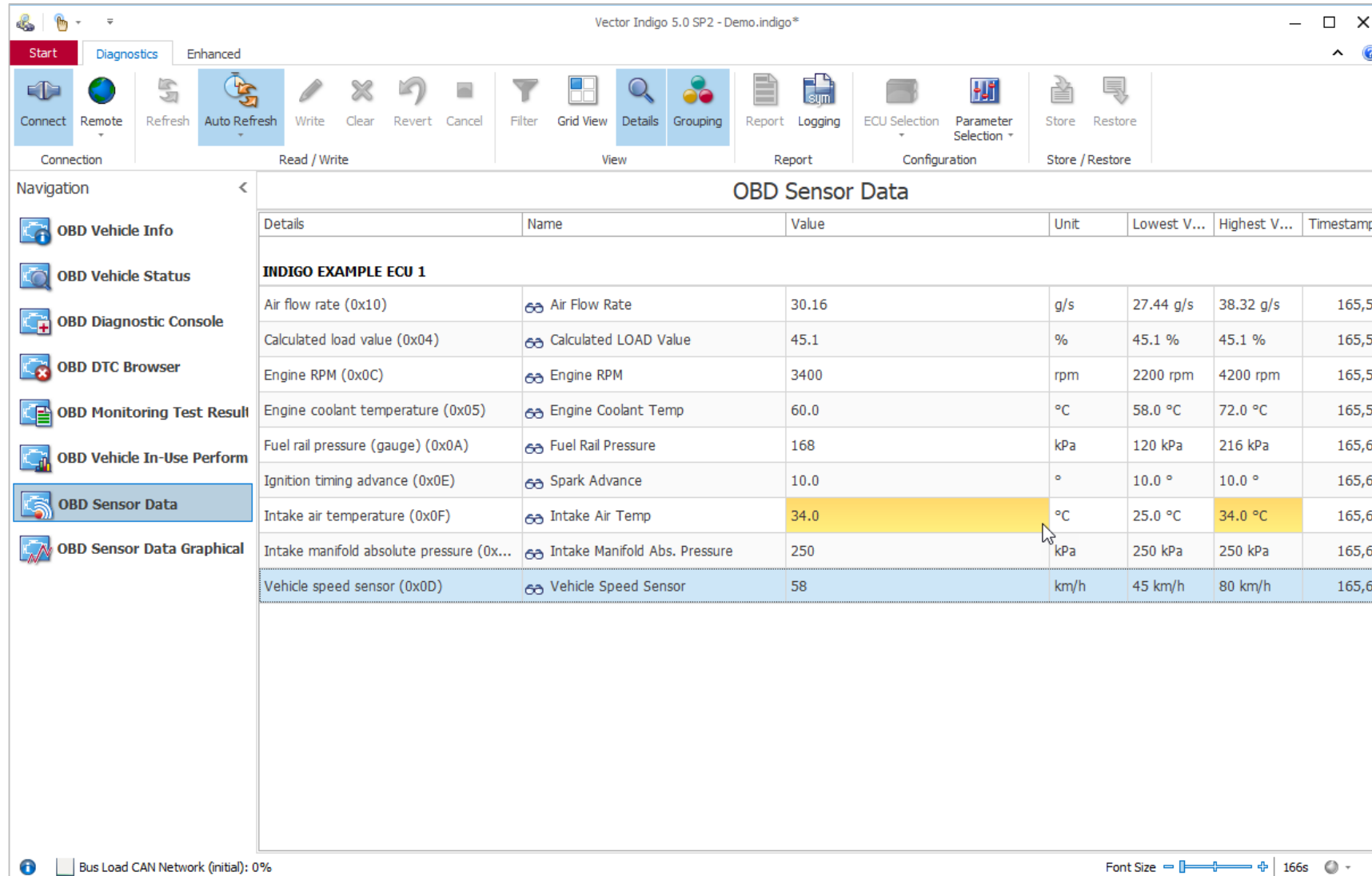
Monitor Status This Driving Cycle

Monitor	ECM	HPC1-HybridPtCtrl1	TCM	FPCM-FuelPumpCtrl
Continuous Monitoring				
Comprehensive Components	✓ Completed	-	-	-
Fuel System	✓ Completed	-	-	-
Misfire	✓ Completed	-	-	-
Non-Continuous Monitoring				

Read Current Diagnostic Data

- ▶ Which data can be read?
 - ▶ Secondary Air Status
 - ▶ Air Flow Rate
 - ▶ Intake Air Temperature
 - ▶ Absolute Throttle Position
 - ▶ O2 Sensors for each block and each bank
 - ▶ OBD Type (OBD II, EOBD, ...)
 - ▶ ...

Indigo: OBD Sensor Data

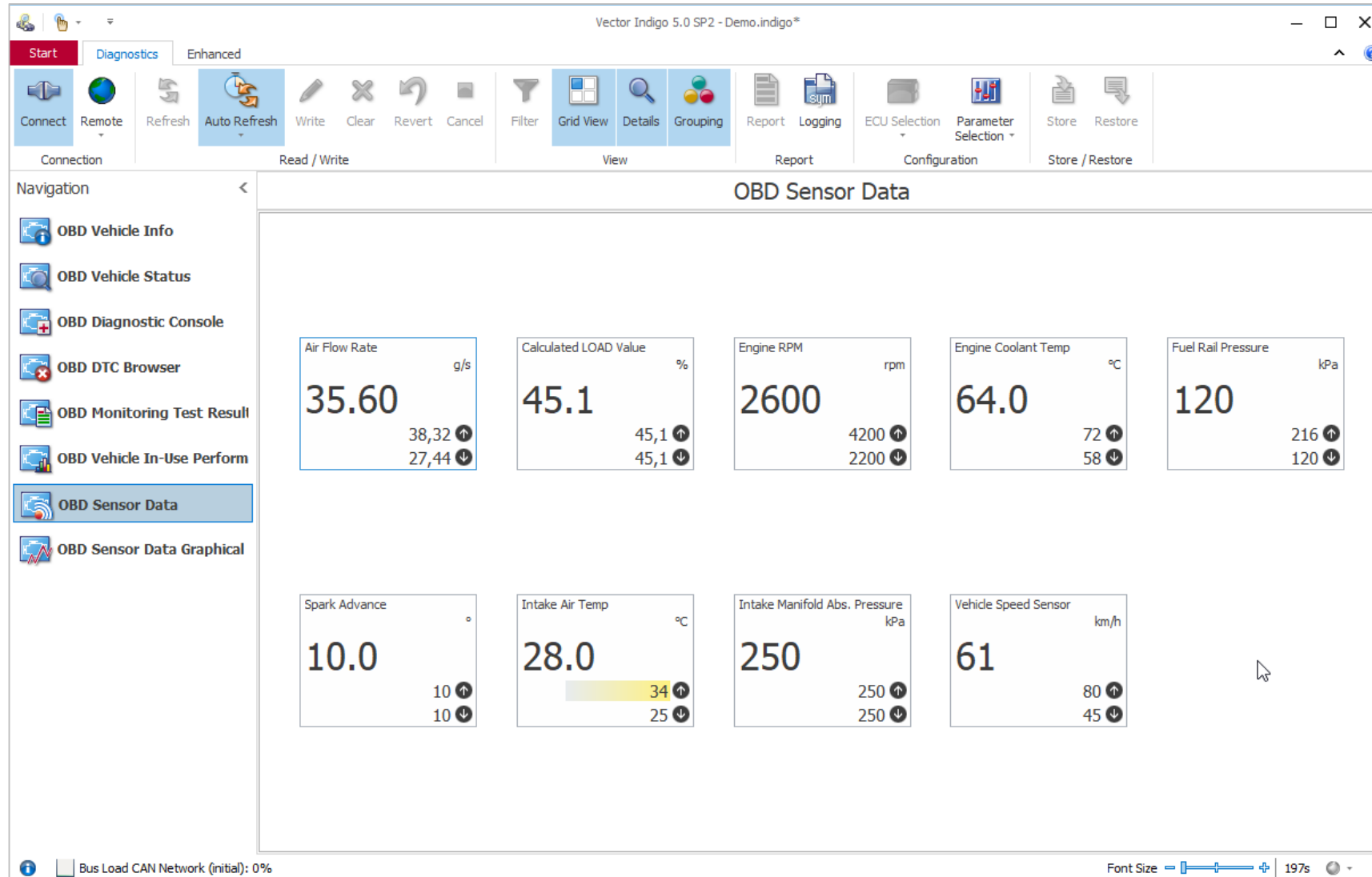


The screenshot displays the Vector Indigo 5.0 SP2 - Demo.indigo* software interface. The main window is titled "OBD Sensor Data". The left sidebar contains a "Navigation" pane with the following items: "OBd Vehicle Info", "OBd Vehicle Status", "OBd Diagnostic Console", "OBd DTC Browser", "OBd Monitoring Test Result", "OBd Vehicle In-Use Perform", "OBd Sensor Data" (selected), and "OBd Sensor Data Graphical". The main area shows a table of sensor data for "INDIGO EXAMPLE ECU 1". The table has columns: Details, Name, Value, Unit, Lowest V..., Highest V..., and Timestamp. The data is as follows:

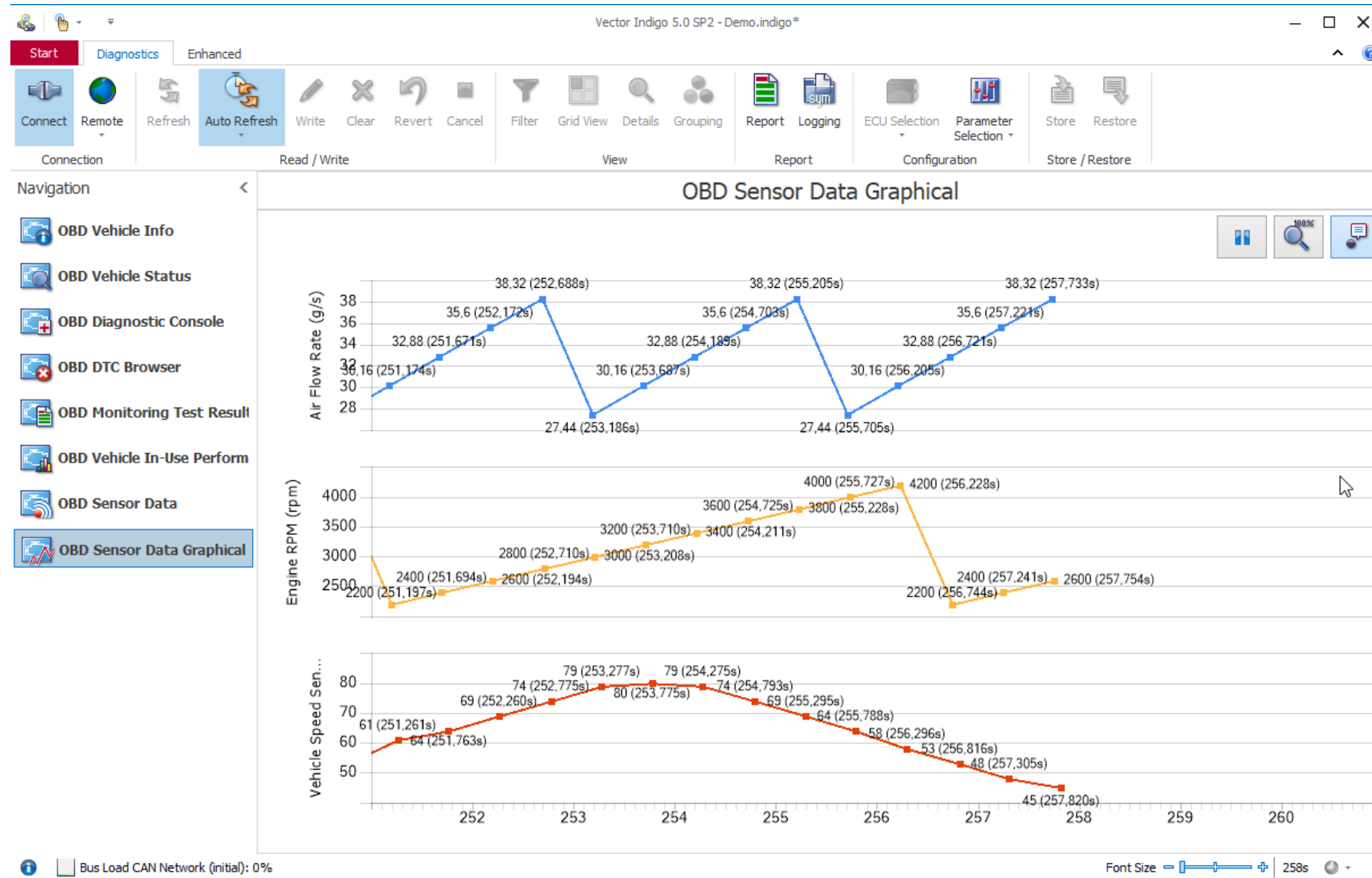
Details	Name	Value	Unit	Lowest V...	Highest V...	Timestamp
INDIGO EXAMPLE ECU 1						
Air flow rate (0x10)	Air Flow Rate	30.16	g/s	27.44 g/s	38.32 g/s	165,5s
Calculated load value (0x04)	Calculated LOAD Value	45.1	%	45.1 %	45.1 %	165,5s
Engine RPM (0x0C)	Engine RPM	3400	rpm	2200 rpm	4200 rpm	165,5s
Engine coolant temperature (0x05)	Engine Coolant Temp	60.0	°C	58.0 °C	72.0 °C	165,5s
Fuel rail pressure (gauge) (0x0A)	Fuel Rail Pressure	168	kPa	120 kPa	216 kPa	165,6s
Ignition timing advance (0x0E)	Spark Advance	10.0	°	10.0 °	10.0 °	165,6s
Intake air temperature (0x0F)	Intake Air Temp	34.0	°C	25.0 °C	34.0 °C	165,6s
Intake manifold absolute pressure (0x...	Intake Manifold Abs. Pressure	250	kPa	250 kPa	250 kPa	165,6s
Vehicle speed sensor (0x0D)	Vehicle Speed Sensor	58	km/h	45 km/h	80 km/h	165,6s

The status bar at the bottom shows "Bus Load CAN Network (initial): 0%" and "Font Size 166s".

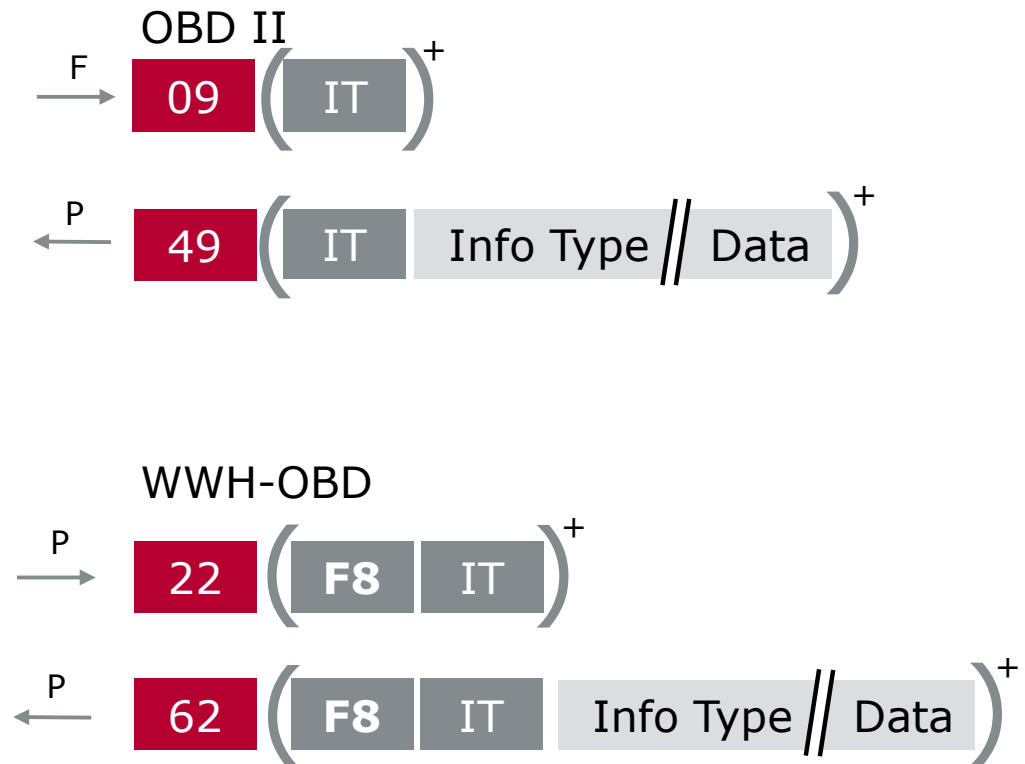
Indigo: OBD Sensor Data



Indigo: OBD Sensor Data



Request Vehicle Information

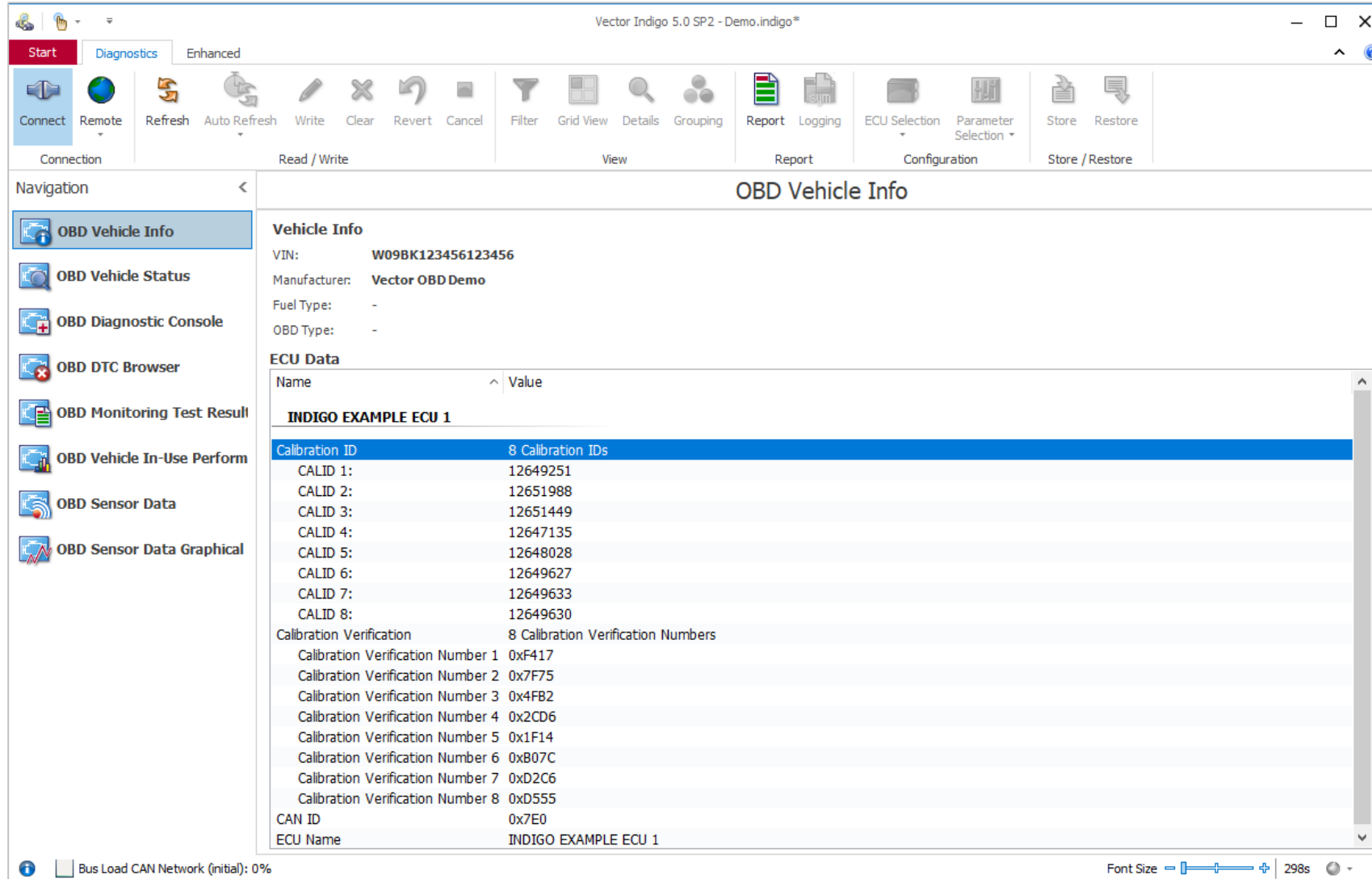


Request Vehicle Information

Examples

IT	Meaning
02	VIN
04	Calibration ID
06	Calibration Verification Number
...	...

Indigo: OBD Vehicle Info



The screenshot displays the Vector Indigo 5.0 SP2 - Demo.indigo* software interface. The top menu bar includes 'Start', 'Diagnostics', and 'Enhanced'. Below this is a toolbar with various icons for connection, read/write, view, report, configuration, and store/restore. The left sidebar shows a navigation menu with options like 'OBD Vehicle Info', 'OBD Vehicle Status', 'OBD Diagnostic Console', 'OBD DTC Browser', 'OBD Monitoring Test Result', 'OBD Vehicle In-Use Perform', 'OBD Sensor Data', and 'OBD Sensor Data Graphical'. The main area is titled 'OBD Vehicle Info' and contains the following information:

Vehicle Info

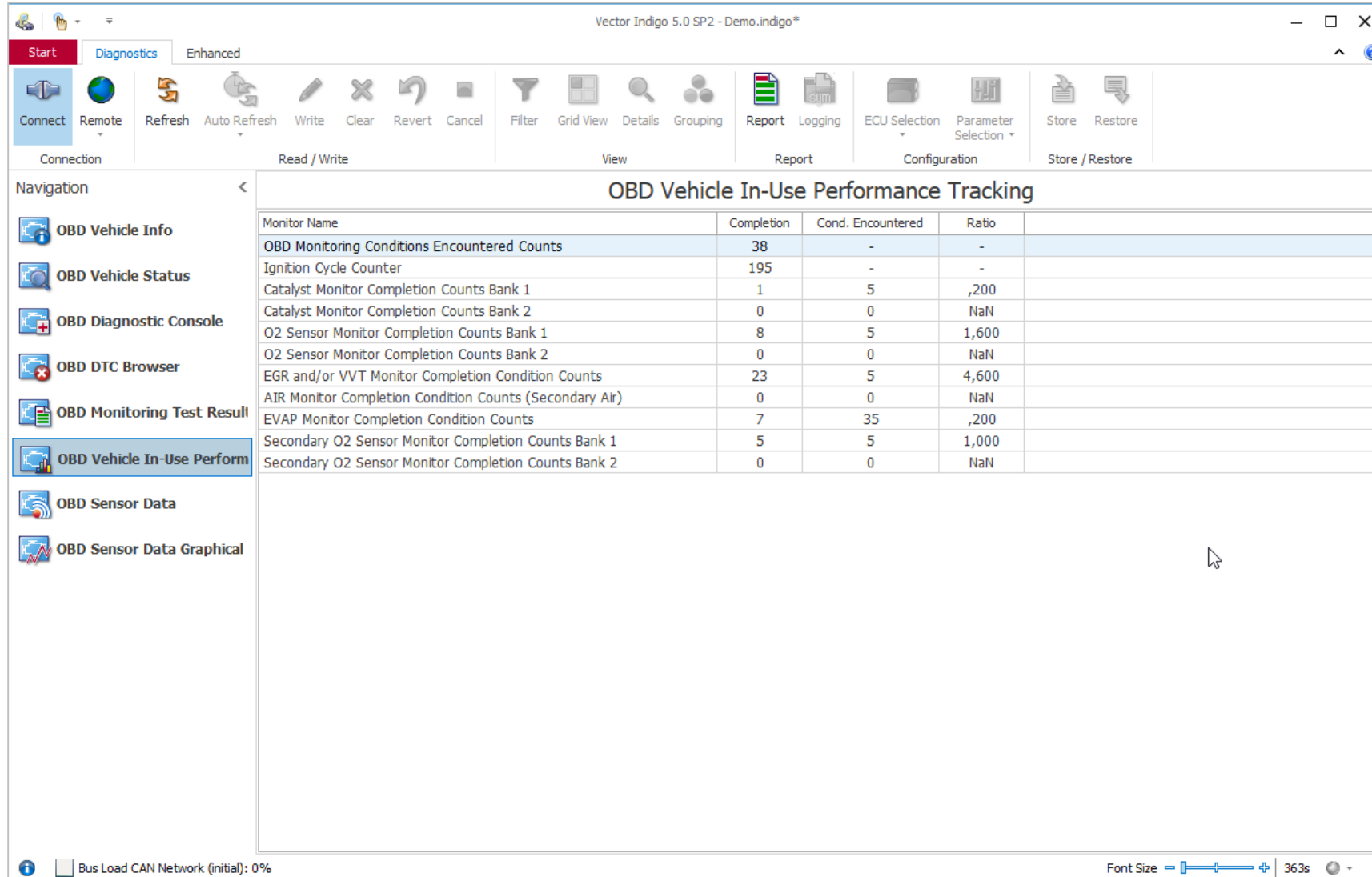
VIN: W09BK123456123456
Manufacturer: Vector OBD Demo
Fuel Type: -
OBD Type: -

ECU Data

Name	Value
INDIGO EXAMPLE ECU 1	
Calibration ID	8 Calibration IDs
CALID 1:	12649251
CALID 2:	12651988
CALID 3:	12651449
CALID 4:	12647135
CALID 5:	12648028
CALID 6:	12649627
CALID 7:	12649633
CALID 8:	12649630
Calibration Verification	8 Calibration Verification Numbers
Calibration Verification Number 1	0xF417
Calibration Verification Number 2	0x7F75
Calibration Verification Number 3	0x4FB2
Calibration Verification Number 4	0x2CD6
Calibration Verification Number 5	0x1F14
Calibration Verification Number 6	0xB07C
Calibration Verification Number 7	0xD2C6
Calibration Verification Number 8	0xD555
CAN ID	0x7E0
ECU Name	INDIGO EXAMPLE ECU 1

At the bottom left, there is a status bar showing 'Bus Load CAN Network (initial): 0%'. At the bottom right, there is a font size slider and a timer showing '298s'.

Indigo: In-Use Performance Tracking



The screenshot displays the Vector Indigo 5.0 SP2 - Demo.indigo* software interface. The main window is titled "OBD Vehicle In-Use Performance Tracking". The interface includes a navigation pane on the left with the following items:

- OBD Vehicle Info
- OBD Vehicle Status
- OBD Diagnostic Console
- OBD DTC Browser
- OBD Monitoring Test Result
- OBD Vehicle In-Use Perform** (selected)
- OBD Sensor Data
- OBD Sensor Data Graphical

The main area shows a table with the following data:

Monitor Name	Completion	Cond. Encountered	Ratio
OBD Monitoring Conditions Encountered Counts	38	-	-
Ignition Cycle Counter	195	-	-
Catalyst Monitor Completion Counts Bank 1	1	5	,200
Catalyst Monitor Completion Counts Bank 2	0	0	NaN
O2 Sensor Monitor Completion Counts Bank 1	8	5	1,600
O2 Sensor Monitor Completion Counts Bank 2	0	0	NaN
EGR and/or VVT Monitor Completion Condition Counts	23	5	4,600
AIR Monitor Completion Condition Counts (Secondary Air)	0	0	NaN
EVAP Monitor Completion Condition Counts	7	35	,200
Secondary O2 Sensor Monitor Completion Counts Bank 1	5	5	1,000
Secondary O2 Sensor Monitor Completion Counts Bank 2	0	0	NaN

The bottom status bar shows "Bus Load CAN Network (initial): 0%" and "Font Size 363s".

Agenda

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► **Fault Memory**

Request On-Board Monitoring Test Results

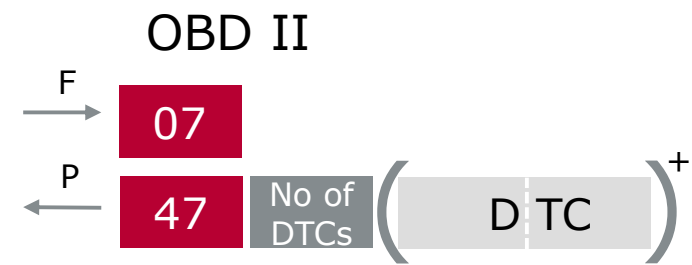
Generic OBD Service Access

OBd Automation API

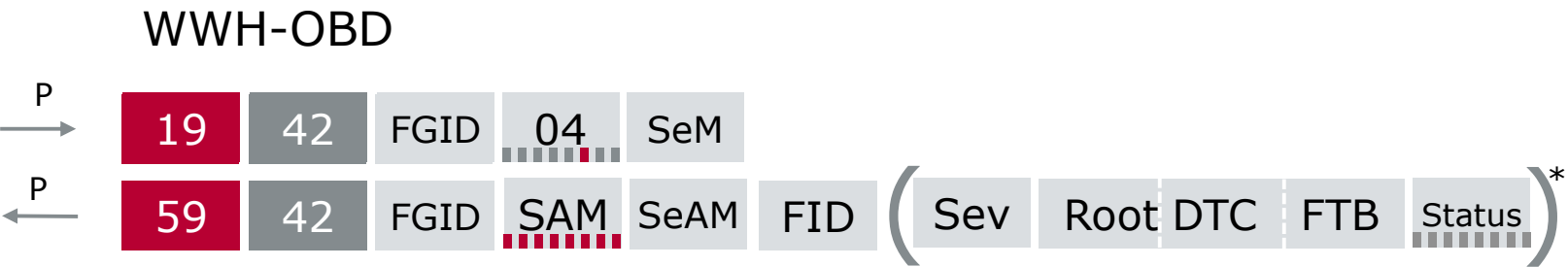
Remote Diagnostics

Further Readings

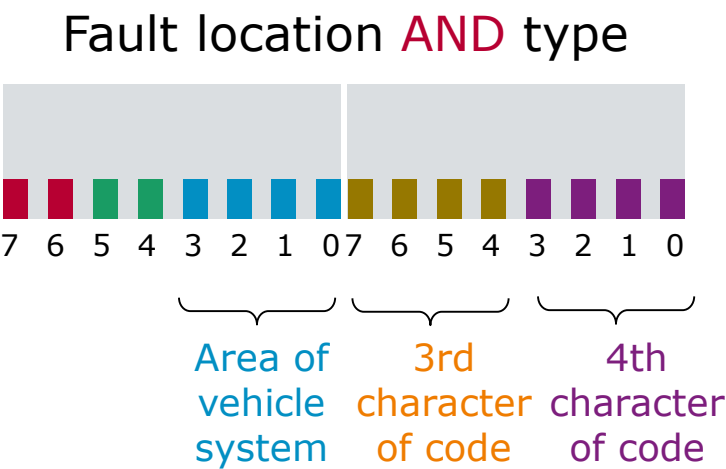
Read Pending DTCs



Value	Description
FGID	Functional Group ID (0x33)
SM	Status Mask
SeM	Severity Mask
SAM	Status Availability Mask
SeAM	Severity Availability Mask
FID	Format Identifier
Sev	Severity



DTC Structure



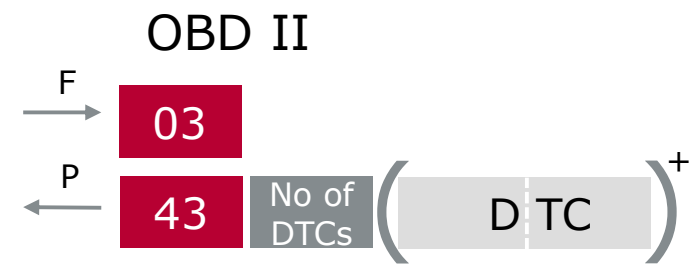
Value	Description
00	Powertrain (P)
01	Chassis (C)
10	Body (B)
11	Network (U)

Value	Description
00	ISO/SAE controlled
01	Manufacturer controlled
10	ISO/SAE controlled
11	ISO/SAE controlled

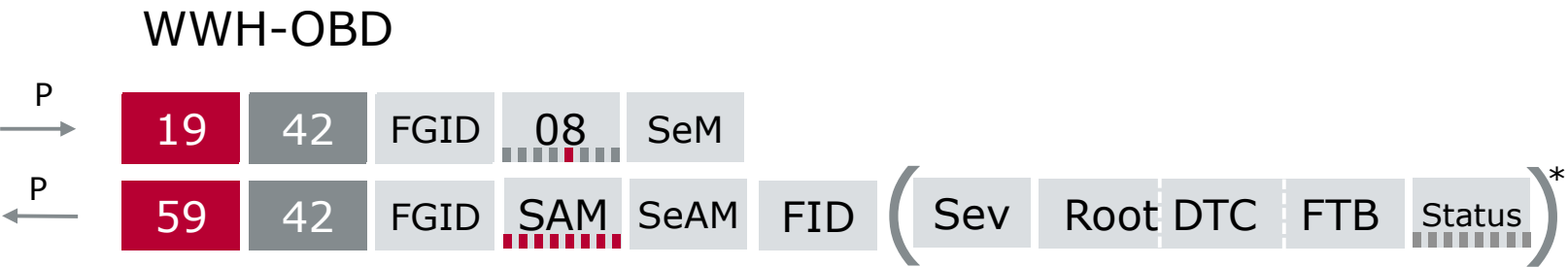
Value	Description
P00-P02	Fuel and air metering
P03	Ignition system or misfire
P04	Auxiliary emission controls
P05	Vehicle speed, idle control, and auxiliary inputs
P06	Computer and auxiliary outputs
P07-P09	Transmission
P0A-P0E	Hybrid Propulsion

Example: **P0070** (0x0070) Ambient Air Temperature Sensor Circuit "A"

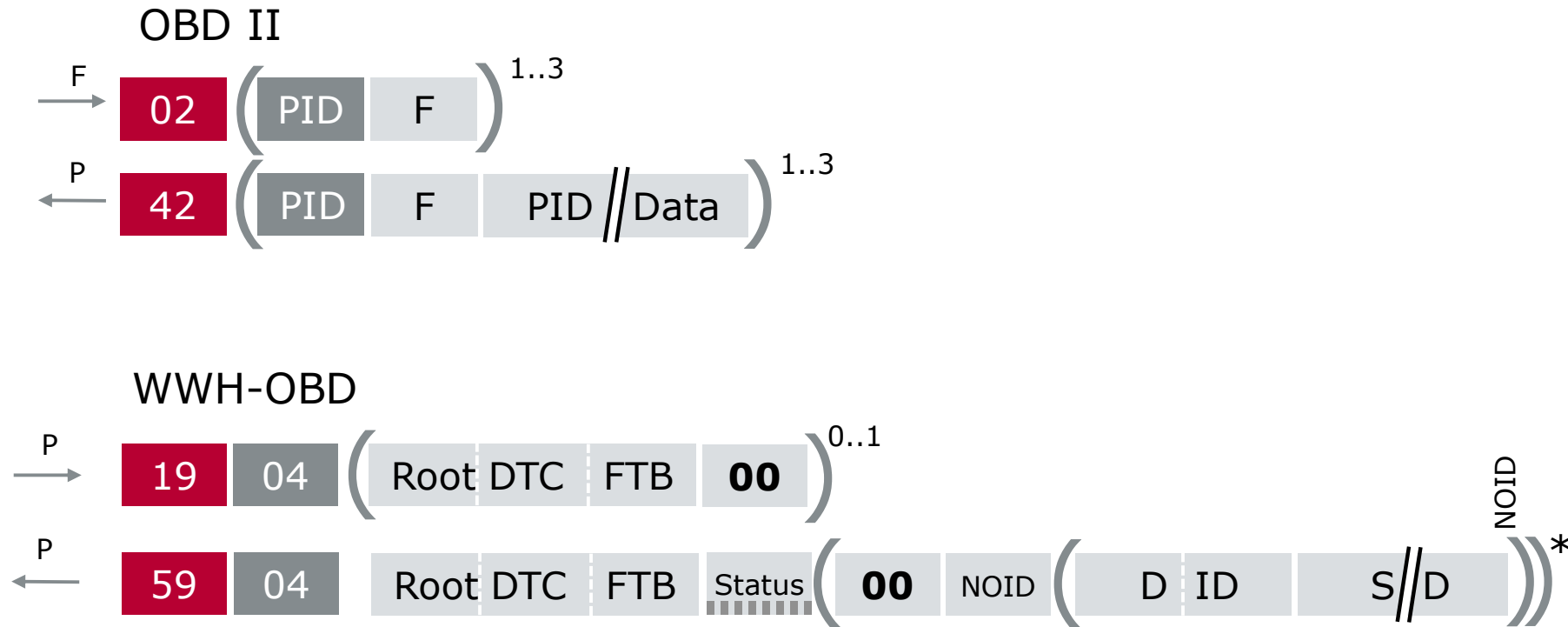
Read Confirmed DTCs



Value	Description
FGID	Functional Group ID (0x33)
SM	Status Mask
SeM	Severity Mask
SAM	Status Availability Mask
SeAM	Severity Availability Mask
FID	Format Identifier
Sev	Severity



Read Freeze Frame Data / Snapshot Data Records

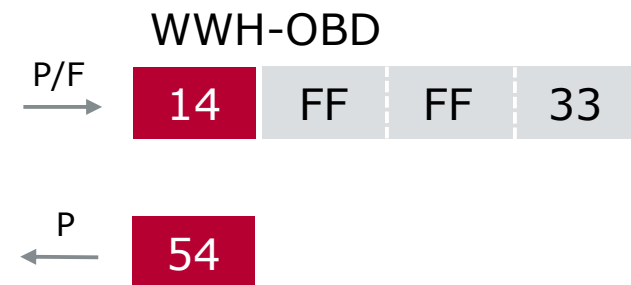
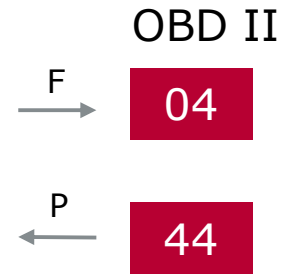


WWH-OBD: 0x19 06 Read Extended Data Record

- ▶ Extended Data Records contain statistical data of DTCs
 - ▶ Example: Occurrence counter or B1 counter



Clear/Reset Emission Related Diagnostic Data



Clear Diagnostic Data

Data	Mode	PID
Number of DTCs	01	01
Freeze Frames	02	
Confirmed DTCs	03	
Pending DTCs	07	
Oxygen Sensor Monitoring Test Results	05	
On-Board Monitoring Test Results for Specific Monitored Systems	06	
I/M Readiness Data	01	01
Distance Traveled While MIL is Activated	01	21
Number of warm-ups since DTCs cleared	01	30
Distance traveled since DTCs cleared	01	31
Monitor status this driving cycle	01	41
Engine run time while MIL activated	01	4D
Engine run time since DTCs cleared	01	4E
EWMA (Exponential Weighted Moving Average) misfire counts	06	0B

Indigo: OBD DTC Browser

- ▶ Read OBD DTCs
 - ▶ Confirmed
 - ▶ Pending
 - ▶ Permanent
- ▶ Read Freeze Frames & Extended Data Records
- ▶ Clear Diagnostic Data
- ▶ Reports

Vector Indigo 5.0 SP2 - Demo.indigo*

OBD DTC Browser

Malfunction Indicator Light (MIL)

Current: MIL Status: On, DTCs: 4

Since MIL activated: Travel Distance: -, Travel Time: -

Since Clear: Travel Distance: -, Travel Time: -

Fault Memory Overview

DTC	Error Text	Confirmed	Pending	Permanent
INDIGO EXAMPLE ECU 1				
P0001	Fuel Volume Regulator "A" Control Circuit/Open	✓	✓	✓
P0473	Exhaust Pressure Sensor "A" Circuit High	✓	✓	✓
P0780	Shift Error	✓	✓	✓
P2293	Fuel Pressure Regulator "B" Performance	✓		

Freeze Frame Data

Name	Value
PID: 0x00 - PID Supported (0x01-0x20)	
PID 0x08 Short Term Fuel Trim - Bank 2 or Bank 2/4	supported
PID 0x07 Long Term Fuel Trim - Bank 1 or Bank 1/3	supported
PID 0x06 Short Term Fuel Trim - Bank 1 or Bank 1/3	supported
PID 0x05 Engine Coolant Temperature	supported
PID 0x04 Calculated LOAD Value	supported
PID 0x03 Fuel System Status	supported

Bus Load CAN Network (Initial): 0%

Font Size: 459s

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Generic OBD Service Access

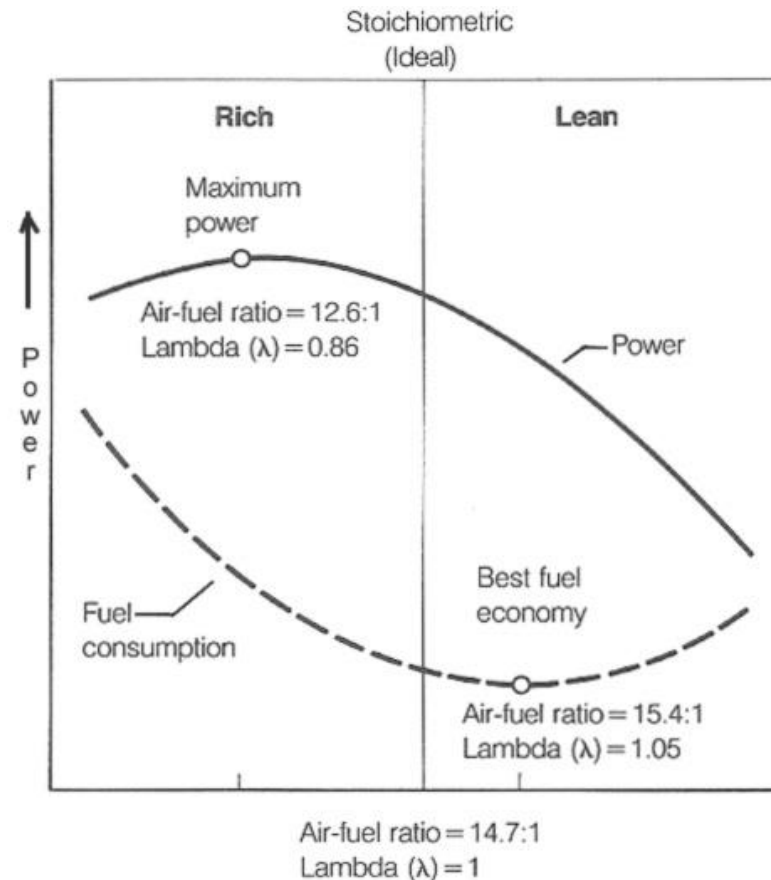
OBd Automation API

Remote Diagnostics

Further Readings

Introduction to O2 sensors

- ▶ Stoichiometric combustion
 - ▶ 1kg GAS (95 ROZ) requires 14,7kg air (14,7 : 1 = Lambda 1)



Source: <https://en.wikipedia.org/wiki/File:Ideal-stoichiometry.jpg>

Introduction to OBD Mode \$06

- ▶ Allow access to results for on-board diagnostic monitoring tests of specific components (continuous / non-continuous monitored)
- ▶ Latest valid test values (results) are retained over multiple ignition OFF cycles
- ▶ Test values (results) are requested by OBD Monitor ID
 - ▶ Always reported with minimum and maximum test limits
- ▶ Many OBD monitors have multiple tests
- ▶ PID \$41: Monitor status this driving cycle

Protocol

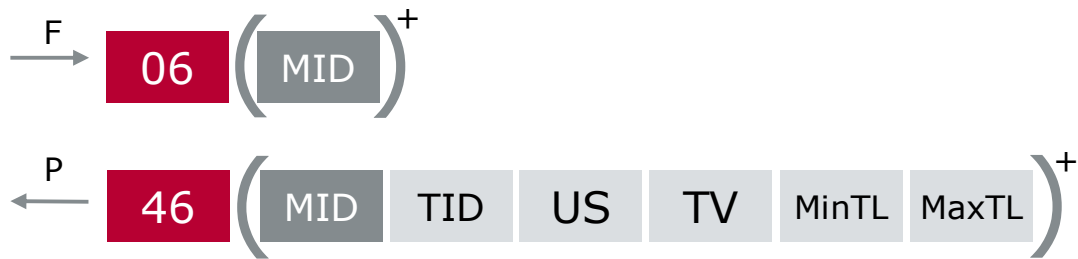
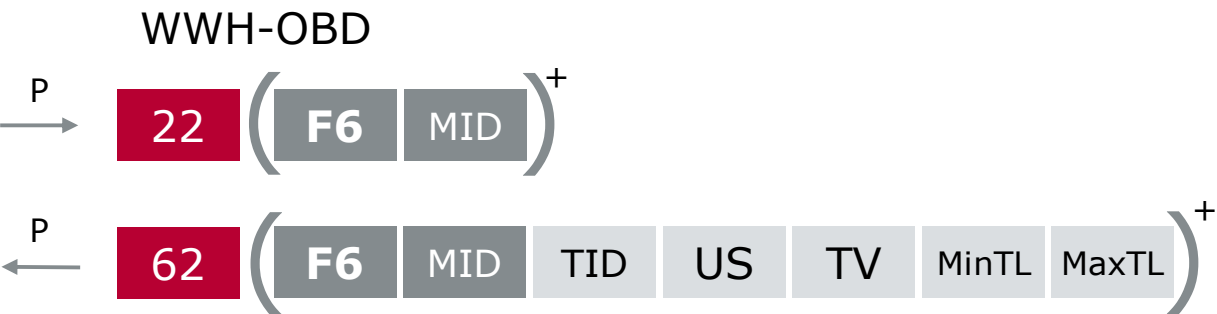
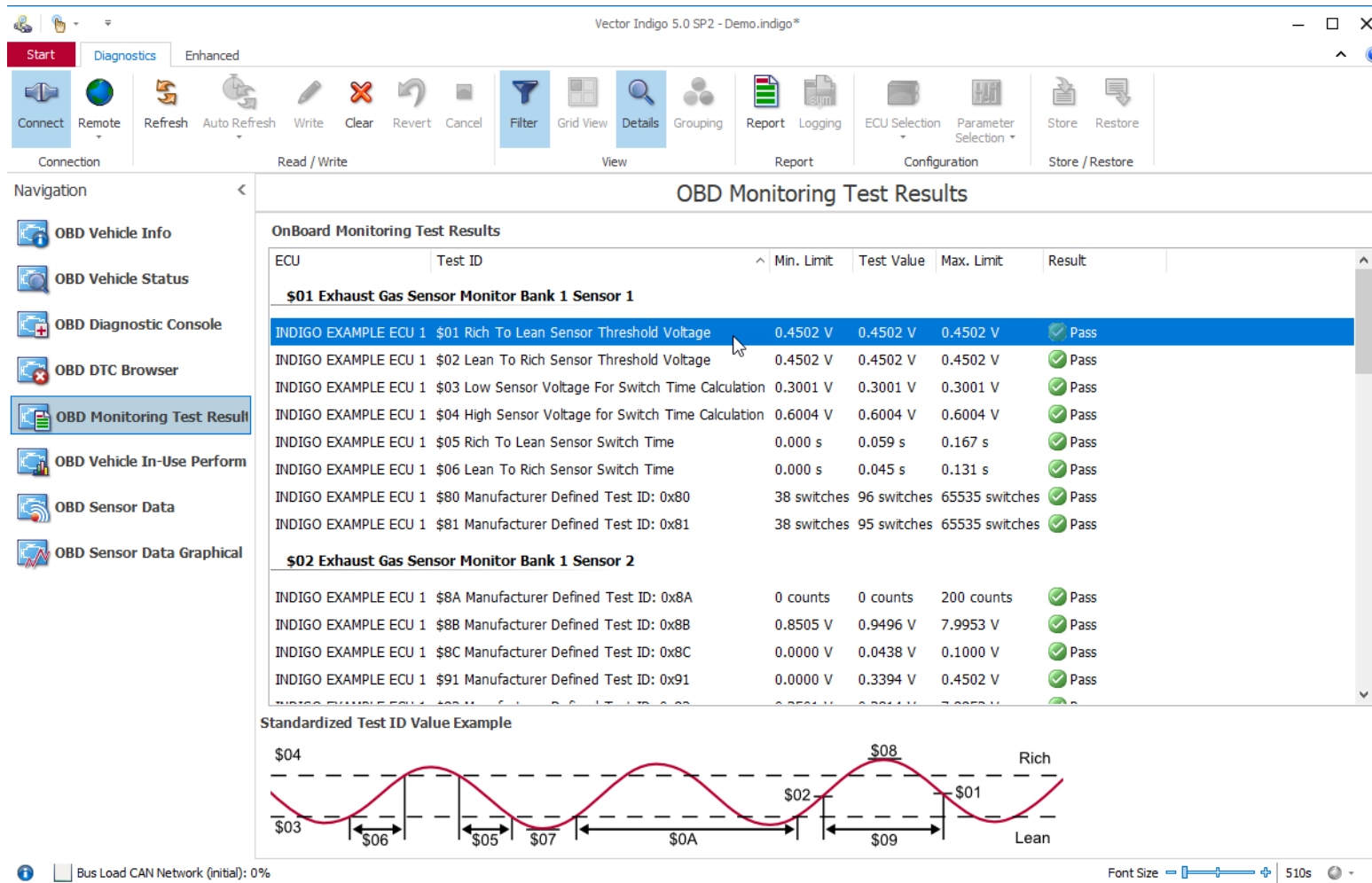


Abb.	Description
MID	Monitor ID
TID	Test ID
US	Unit Scaling
TV	Test Value
MinTL	Min. Test Limit
MaxTL	Max. Test Limit



Indigo: OBD Monitoring Test Results

► OBD Monitoring Test Results Window



Vector Indigo 5.0 SP2 - Demo.indigo*

Start Diagnostics Enhanced

Connect Remote Refresh Auto Refresh Write Clear Revert Cancel Filter Grid View Details Grouping Report Logging ECU Selection Parameter Selection Store Restore

Navigation

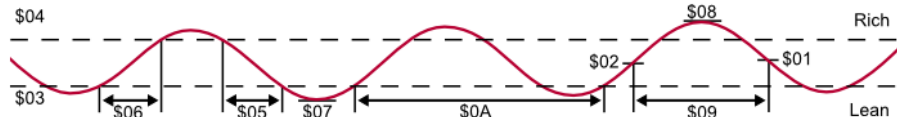
- OBD Vehicle Info
- OBD Vehicle Status
- OBD Diagnostic Console
- OBD DTC Browser
- OBD Monitoring Test Results**
- OBD Vehicle In-Use Perform
- OBD Sensor Data
- OBD Sensor Data Graphical

OBD Monitoring Test Results

OnBoard Monitoring Test Results

ECU	Test ID	Min. Limit	Test Value	Max. Limit	Result
\$01 Exhaust Gas Sensor Monitor Bank 1 Sensor 1					
INDIGO EXAMPLE ECU 1	\$01 Rich To Lean Sensor Threshold Voltage	0.4502 V	0.4502 V	0.4502 V	Pass
INDIGO EXAMPLE ECU 1	\$02 Lean To Rich Sensor Threshold Voltage	0.4502 V	0.4502 V	0.4502 V	Pass
INDIGO EXAMPLE ECU 1	\$03 Low Sensor Voltage For Switch Time Calculation	0.3001 V	0.3001 V	0.3001 V	Pass
INDIGO EXAMPLE ECU 1	\$04 High Sensor Voltage for Switch Time Calculation	0.6004 V	0.6004 V	0.6004 V	Pass
INDIGO EXAMPLE ECU 1	\$05 Rich To Lean Sensor Switch Time	0.000 s	0.059 s	0.167 s	Pass
INDIGO EXAMPLE ECU 1	\$06 Lean To Rich Sensor Switch Time	0.000 s	0.045 s	0.131 s	Pass
INDIGO EXAMPLE ECU 1	\$80 Manufacturer Defined Test ID: 0x80	38 switches	96 switches	65535 switches	Pass
INDIGO EXAMPLE ECU 1	\$81 Manufacturer Defined Test ID: 0x81	38 switches	95 switches	65535 switches	Pass
\$02 Exhaust Gas Sensor Monitor Bank 1 Sensor 2					
INDIGO EXAMPLE ECU 1	\$8A Manufacturer Defined Test ID: 0x8A	0 counts	0 counts	200 counts	Pass
INDIGO EXAMPLE ECU 1	\$8B Manufacturer Defined Test ID: 0x8B	0.8505 V	0.9496 V	7.9953 V	Pass
INDIGO EXAMPLE ECU 1	\$8C Manufacturer Defined Test ID: 0x8C	0.0000 V	0.0438 V	0.1000 V	Pass
INDIGO EXAMPLE ECU 1	\$91 Manufacturer Defined Test ID: 0x91	0.0000 V	0.3394 V	0.4502 V	Pass

Standardized Test ID Value Example



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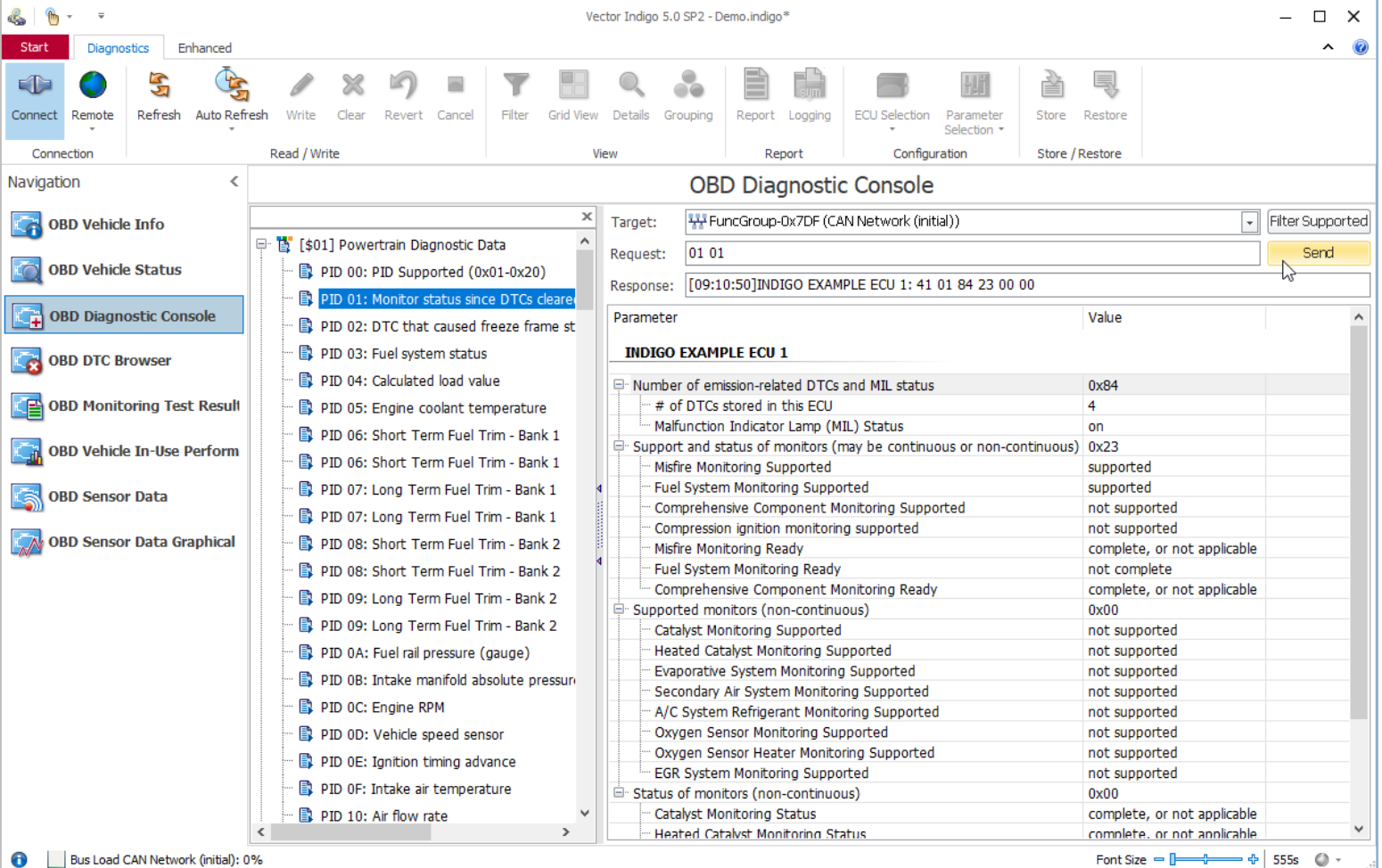
OBD Automation API

Remote Diagnostics

Further Readings

Indigo: OBD Diagnostic Console

- ▶ OBD Diagnostic Console allows sending all OBD request to
 - ▶ An OBD Functional Group (all OBD ECUs)
 - ▶ A selected OBD ECU
- ▶ Filter by supported data
- ▶ Search OBD Service Data
- ▶ Read data cyclically



Vector Indigo 5.0 SP2 - Demo.indigo*

Start Diagnostics Enhanced

Connect Remote Refresh Auto Refresh Write Clear Revert Cancel Filter Grid View Details Grouping Report Logging ECU Selection Parameter Selection Store Restore

Navigation

- OBd Vehicle Info
- OBd Vehicle Status
- OBd Diagnostic Console**
- OBd DTC Browser
- OBd Monitoring Test Result
- OBd Vehicle In-Use Perform
- OBd Sensor Data
- OBd Sensor Data Graphical

OBd Diagnostic Console

Target: FuncGroup-0x7DF (CAN Network (initial)) Filter Supported

Request: 01 01 Send

Response: [09:10:50]INDIGO EXAMPLE ECU 1: 41 01 84 23 00 00

Parameter	Value
INDIGO EXAMPLE ECU 1	
Number of emission-related DTCs and MIL status	0x84
# of DTCs stored in this ECU	4
Malfunction Indicator Lamp (MIL) Status	on
Support and status of monitors (may be continuous or non-continuous)	0x23
Misfire Monitoring Supported	supported
Fuel System Monitoring Supported	supported
Comprehensive Component Monitoring Supported	not supported
Compression ignition monitoring supported	not supported
Misfire Monitoring Ready	complete, or not applicable
Fuel System Monitoring Ready	not complete
Comprehensive Component Monitoring Ready	complete, or not applicable
Supported monitors (non-continuous)	0x00
Catalyst Monitoring Supported	not supported
Heated Catalyst Monitoring Supported	not supported
Evaporative System Monitoring Supported	not supported
Secondary Air System Monitoring Supported	not supported
A/C System Refrigerant Monitoring Supported	not supported
Oxygen Sensor Monitoring Supported	not supported
Oxygen Sensor Heater Monitoring Supported	not supported
EGR System Monitoring Supported	not supported
Status of monitors (non-continuous)	0x00
Catalyst Monitoring Status	complete, or not applicable
Heated Catalyst Monitoring Status	complete, or not applicable

Bus Load CAN Network (initial): 0%

Font Size 555s

Agenda

OBD Introduction

Diagnostic Protocol

Discover OBD ECUs

Read Diagnostic and Vehicle Data

Fault Memory

Request On-Board Monitoring Test Results

Generic OBD Service Access

► **OBD Automation API**

Remote Diagnostics

Further Readings

Introduction

- ▶ Vector.Diagnostics.OBD
 - ▶ Based on Microsoft .NET
 - ▶ Additional library to Vector Diagnostics Scripting Library

- ▶ Read out OBD information with just a view lines of C# code

- ▶ Use Cases
 - ▶ Implement your own OBD logger
 - ▶ Implement your own OBD report in your own format / output
 - ▶ Access OBD PIDs/MIDs/TIDs as well as OBD DTCs and Freeze Frames conveniently

- ▶ Runtime environment
 - ▶ Indigo
 - ▶ vScriptDiagnostics on VN8810

Examples: Reading out IUMPR

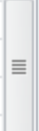
```
// run OBD discovery and detect OBD ECUs
var result = ObdDiscovery.Discover();

// decide whether working with the OBD functional
// group or OBD ECUs via physical communication
var functionalGroup = result.ObdFunctionalGroup;

// read out InfoType $08 - In-Use Performance Tracking
var performanceTracking =
functionalGroup.ReadObdInfoType(ObdInfoTypeCategory.InfoType_08_InUsePerformanceTracking);

// Iterate through the response data and output content
foreach (var obdInfoType in performanceTracking)
{
    Output.WriteLine("ECU: " + obdInfoType.Ecu);
    foreach (var data in obdInfoType.Data)
    {
        Output.WriteLine(string.Format("{0} : Value {1}", data.Name, data.Value));
    }
}
```

Examples: Reading out IUMPR

▶ Start OBD_PerformanceRatio:OBDD_PerformanceRatioScript (finished)	
Message	
ECU: INDIGO EXAMPLE ECU 1	▲
Number of Data Items : Value 20	
OBD Monitoring Conditions Encountered Counts : Value 38	
Ignition Cycle Counter : Value 195	
Catalyst Monitor Completion Counts Bank 1 : Value 1	
Catalyst Monitor Conditions Encountered Counts Bank 1 : Value 5	
Catalyst Monitor Completion Counts Bank 2 : Value 0	
Catalyst Monitor Conditions Encountered Counts Bank 2 : Value 0	
O2 Sensor Monitor Completion Counts Bank 1 : Value 8	
O2 Sensor Monitor Conditions Encountered Counts Bank 1 : Value 5	

Examples: Reading out OnBoard Monitoring Tests

```
var discovery = ObdDiscovery.Discover();
var functionalGroup = discovery.ObdFunctionalGroup;

foreach (ObdMonitoringTestResultCategory obdMonitorId in
Enum.GetValues(typeof(ObdMonitoringTestResultCategory)))
{
    Output.WriteLine("Monitor: " + obdMonitorId);

    //Read out all Monitoring Test Results
    var monitoringTestResultsData = functionalGroup.ReadObdMonitoringTestResult(obdMonitorId);
    foreach (var dataCollection in monitoringTestResultsData)
    {
        foreach (var testResult in dataCollection.ObdMonitoringTestResults)
        {
            Output.WriteLine(string.Format("Test {0}: Minimum : {1} | Maximum: {2} | Value: {3}",
testResult.Name, testResult.MinimumValue, testResult.MaximumValue, testResult.TestValue));
        }
    }
}
```


Examples: Reading out OnBoard Monitoring Tests

▶ Start	OBD_Read_MonitoringTestResults:OBD_Read_MonitoringTestResultsScript (finished)
Message	
Monitor: OBDMID_01_20_supported	
Monitor: ExhaustGasSensorMonitorBank1Sensor1	
Test Exhaust Gas Sensor Monitor Bank 1 Sensor 1: Minimum : 0.4502 Maximum: 0.4502 Value: 0.4502	
Test Exhaust Gas Sensor Monitor Bank 1 Sensor 1: Minimum : 0.4502 Maximum: 0.4502 Value: 0.4502	
Test Exhaust Gas Sensor Monitor Bank 1 Sensor 1: Minimum : 0.3001 Maximum: 0.3001 Value: 0.3001	
Test Exhaust Gas Sensor Monitor Bank 1 Sensor 1: Minimum : 0.6004 Maximum: 0.6004 Value: 0.6004	
Test Exhaust Gas Sensor Monitor Bank 1 Sensor 1: Minimum : 0.000 Maximum: 0.167 Value: 0.059	
Test Exhaust Gas Sensor Monitor Bank 1 Sensor 1: Minimum : 0.000 Maximum: 0.131 Value: 0.045	
Test Exhaust Gas Sensor Monitor Bank 1 Sensor 1: Minimum : 38 Maximum: 65535 Value: 96	
Test Exhaust Gas Sensor Monitor Bank 1 Sensor 1: Minimum : 38 Maximum: 65535 Value: 95	

Agenda

OBd Introduction

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► **Remote Diagnostics**

Further Readings

Use-Cases

► **Issue on test drive**

Issue with a vehicle on test drive: Help from (or for) the developer without the need to travel.

► **Issue in production plant**

Issue with a vehicle, ECU or system in production plant (potentially in another country):
Short-term help from a developer from a distance.

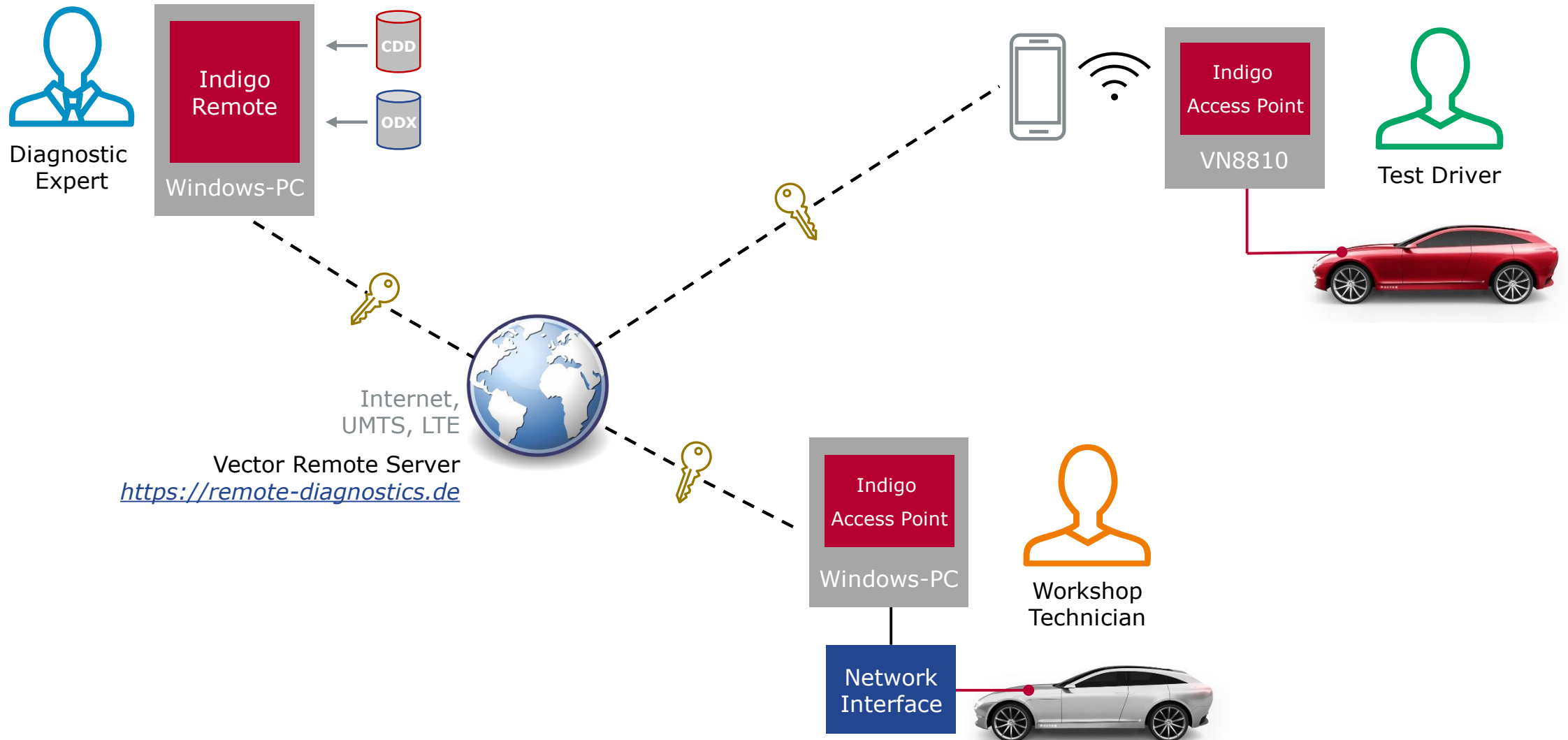
► **Issue in after-sales garage**

Issue with customer's vehicle in after-sales garage:
Short-term help from a "vehicle doctor" or developer from the central facility.

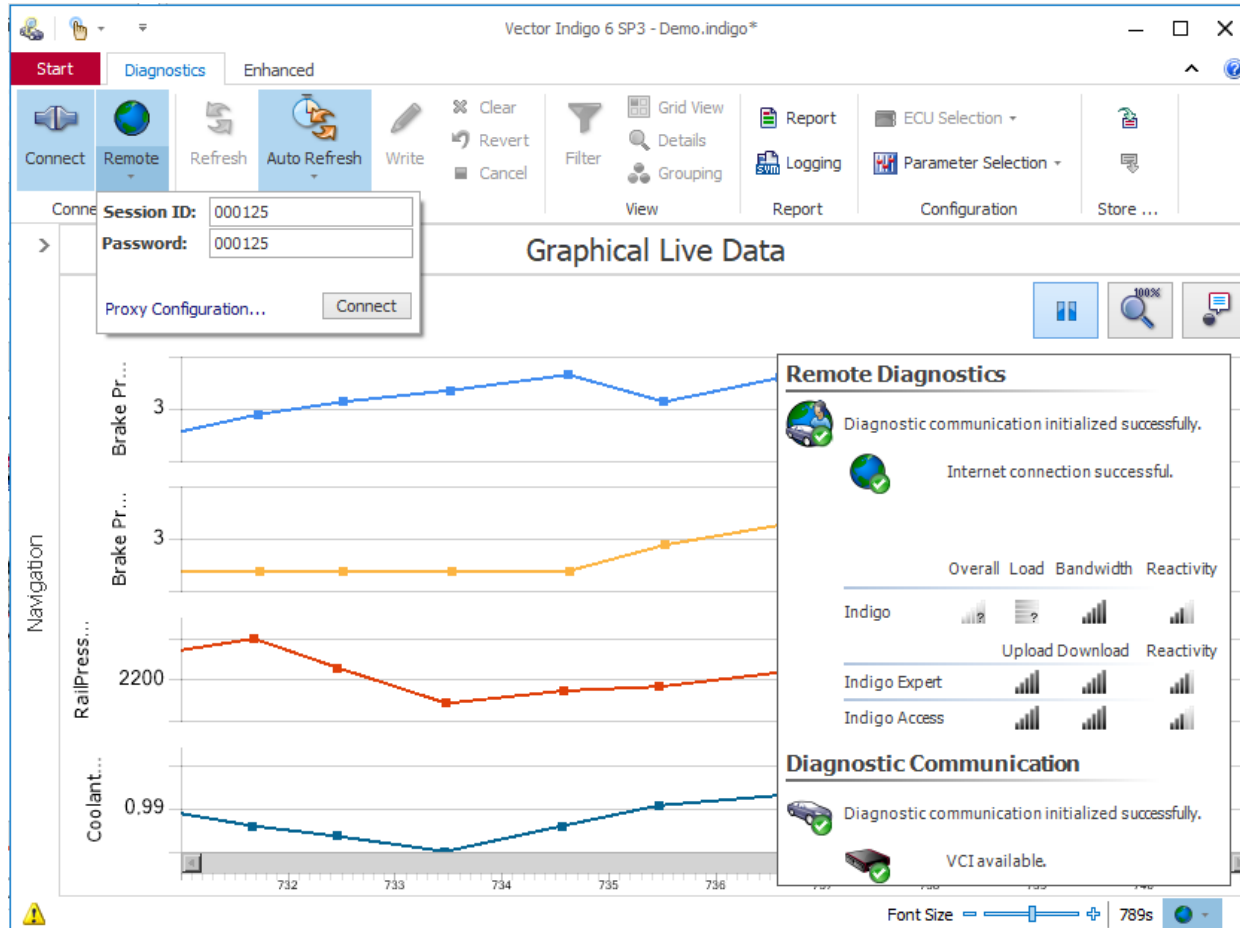
► **Issue with integrated 3rd party system**

Issue with 3rd party system or component in the vehicle (e. g. in OEM cooperation, integrated engine/transmission):
Help from a system expert from a distance.

Indigo Remote System



Indigo Remote user interface



or



Indigo Access Point on PC



Characteristics

- ▶ Works worldwide, just requires broadband connection
LAN, WLAN, UMTS, ... (on vehicle as well as on expert site)
- ▶ Software, diagnostic data, sequences and security algorithms are kept on the diagnostic expert's machine (and are not transported)
Software/data on diagnostic expert's machine can be updated at any time.
No security issues resulting from (transfer of) data to the vehicle specialist's machine.
- ▶ Getting started quick and easy
If not available the Access Point can be downloaded from the server.
The vehicle specialist starts a remote session on the server, the diagnostic expert connects to it.
- ▶ High data transfer speed
"Smart blocks"
- ▶ Supports 3rd party diagnostic hardware
PassThru API (SAE J2534), D-PDU API (ISO 22900-2)

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► **Further Readings**

“Legislated OBD in AUTOSAR and Vector Tools”

Author: Jeff Craig

[https://assets.vector.com/cms/content/events/2019/VA/VECO19/Day_2/Legislated OBD in AUTOSAR and the Rest of the Vector Tool Chain - Jeff Craig.pdf](https://assets.vector.com/cms/content/events/2019/VA/VECO19/Day_2/Legislated_OBD_in_AUTOSAR_and_the_Rest_of_the_Vector_Tool_Chain_-_Jeff_Craig.pdf)

“WWH-OBD – made simple! Implementation of the new WWH-OBD Requirements for OEMs and Suppliers”

Author: Helmut Frank

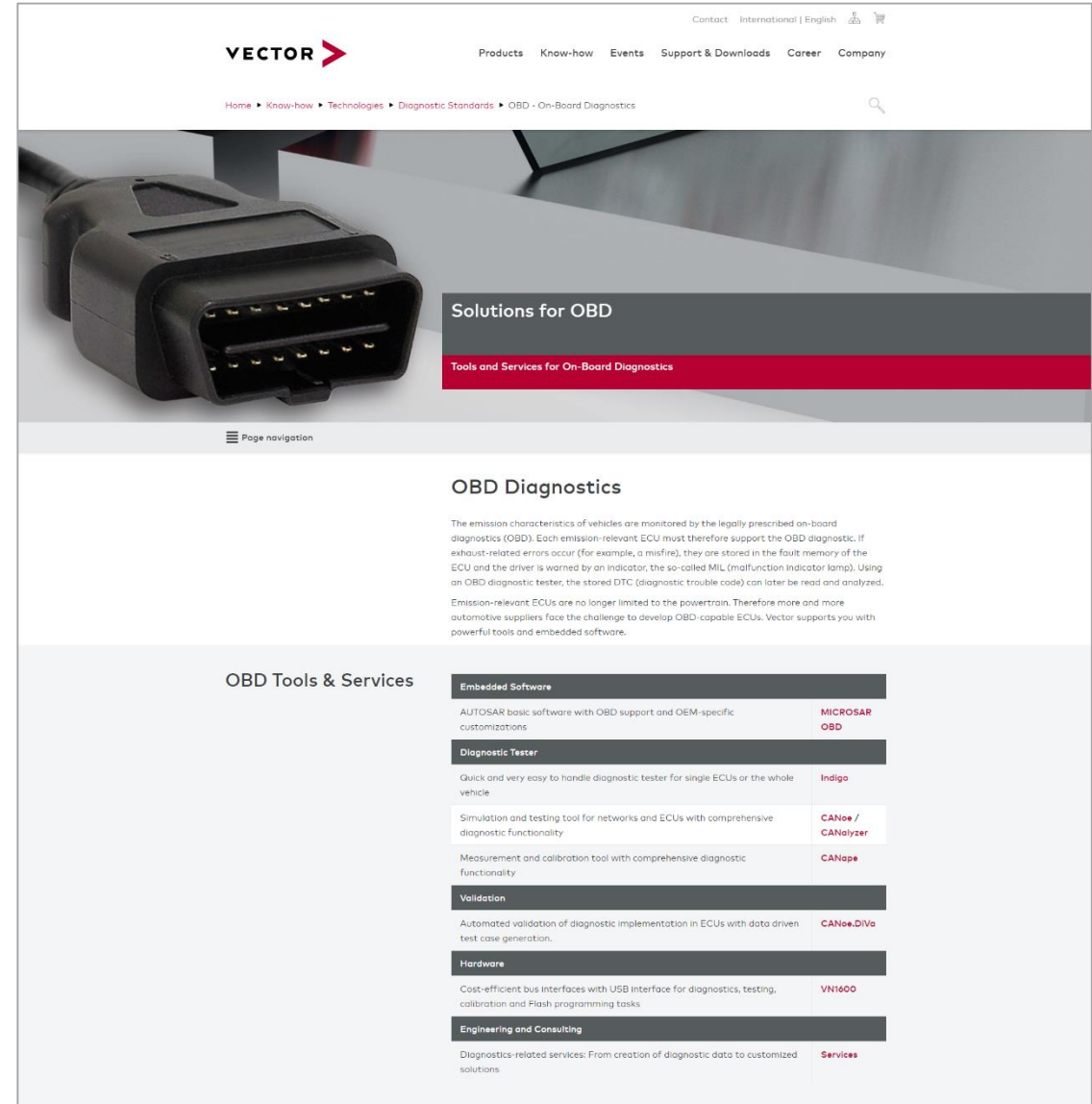
[https://assets.vector.com/cms/content/know-how/technical-articles/diagnostics/WWH OBD AEL 201208 PressArticle EN.pdf](https://assets.vector.com/cms/content/know-how/technical-articles/diagnostics/WWH_OBD_AEL_201208_PressArticle_EN.pdf)

Vector OBD Solution

Vector solutions for OBD

- ▶ Embedded Software
- ▶ Diagnostic Testers
- ▶ Validation
- ▶ Hardware
- ▶ Engineering and Consulting

<http://www.obd-solution.com>



The screenshot shows the Vector OBD Solution website. The header includes the Vector logo, navigation links (Products, Know-how, Events, Support & Downloads, Career, Company), and a search icon. A breadcrumb trail reads: Home > Know-how > Technologies > Diagnostic Standards > OBD - On-Board Diagnostics. The main content area features a large image of an OBD connector. Below it, a red banner reads "Solutions for OBD" and "Tools and Services for On-Board Diagnostics". The "OBD Diagnostics" section explains that emission characteristics are monitored by legally prescribed on-board diagnostics (OBD). The "OBD Tools & Services" section lists various solutions:

Category	Description	Product/Service
Embedded Software	AUTOSAR basic software with OBD support and OEM-specific customizations	MICROSAR OBD
Diagnostic Tester	Quick and very easy to handle diagnostic tester for single ECUs or the whole vehicle	Indigo
	Simulation and testing tool for networks and ECUs with comprehensive diagnostic functionality	CANoe / CANalyzer
	Measurement and calibration tool with comprehensive diagnostic functionality	CANape
Validation	Automated validation of diagnostic implementation in ECUs with data driven test case generation	CANoe.DIVa
Hardware	Cost-efficient bus interfaces with USB interface for diagnostics, testing, calibration and Flash programming tasks	VNI600
Engineering and Consulting	Diagnostics-related services: From creation of diagnostic data to customized solutions	Services

For more information about diagnostics and flashing at Vector please visit:



www.vector.com/diagnostics

www.vector.com/diagnostic-casestudies

www.vector.com/diagnostic-videos

www.vector.com/diagnostic-webinars

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