XENTRY and OBD II Go Deep

The roots of education are bitter, but the fruit is sweet.

-Aristotle

Image, in part, courtesey NASA

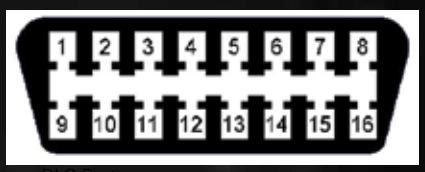
Whenever diagnostic sessions are not progressing well, the choices confronting shop owners and technicians can be daunting. Sometimes that vehicle may appear to "have a mind of its own," but you won't be able to read that mind without the right tools.

Here, we will explore the questions surrounding diagnostic equipment, including XENTRY, in an attempt to aid both the business owner and the learning technician. We'll also look at how the DLC (Diagnostic Link Connector) is evolving at a rapid rate, and why good comprehension of the technology present in Mercedes-Benz vehicles is important.

OBD II and the DLC

In 1996, OBD II was made mandatory for all vehicles sold in the U.S. (in actuality, for all of North America). That also meant that the modern OBD II connection (DLC) became standard. What is not standard are the "proprietary" connections to subsystems. OBD II was designed for engine and transmission diagnostics for the dealer or non-dealer technician, and it offers an array of "modes" that are related to emissions, testing, and diagnosis.

OBD II pinout and terminal assignments



DLC Port

1. Manufacturer specific
2. Bus positive Line of SAE-J1850
3. Manufacturer specific
4. Chassis ground
5. Signal ground
6. CAN high (ISO 15765-4 and SAE-J2234)
7. K line for ISO 9141-2 and ISO 14230-4
8. Manufacturer specific
9. Manufacturer specific
10. Bus negative Line of SAE-J1850
11. Manufacturer specific
12. Manufacturer specific
13. Manufacturer specific
14. CAN low (ISO 15765-4 and SAE-J2234)
15. L line for ISO 9141-2 and ISO 14230-4
16. Battery voltage at all times

As the OBD II protocol matured, so did the array of modes and data that was accessed for profoundly complex engine management systems. Manufacturers are required to have their protocols available at the DLC. Those protocols will include CAN, VPW, PWM, and 9141-2 with ISO 14230-4. All North American vehicles will have access to one or more protocols via OBD II. There are, however, specific pins (terminals) at the DLC that are used by the manufacturer for its own purposes. OBD II has no access to those pins.

Well-designed modern OBD II devices can access far more data than the scan tools of the past, but that all depends on the capability of the suppliers and software developers to mathematically calculate the PIDS for display on the scan tool if those PIDS are mandated and available via the carmaker. Current OBD II tools have access to diagnostic data via high-speed CAN.

Even though a modern OBD II scan tool can access the CAN structure, it will have minimal access to the engine and transmission electronics network on any particular make, Mercedes-Benz included. The data will be only what's required by regulations. There are many forms of OBD II scan tools, the most common being the ELM327 or ELM329 comprising a programmed microcontroller. The development of standard OBD II will continue to move forward, but access to Driver Assist Systems may not be possible.

Multiplexers and aftermarket equipment

There is an array of aftermarket tools that claim "complete access" to the vehicle diagnostic port including all internal networks and sub-networks. Unlike OBD II, these types of multiplexers may be able to access the complete network structure if the tool software and firmware is current and correct. Added as well is access and permissions to all installed networks and corresponding sub-networks. Complete and up-to-date access should include more than one CAN network attached to a gateway that supports multiple networks and sub-networks.

These tools, however, have inherited issues with accuracy, guided tests, and poor/insufficient documentation. One common issue is bi-directional control with future support. Another common problem is the association of workshop information with clear parts illustrations. A third typical issue is the association of data provided among controllers and the Central Gateway (CGW). The newest problem with these tools is access to the Ethernet structure. Welcome to DoIP.

XENTRY articles

Refer to these previous articles that have been published about XENTRY in *StarTuned*. They explain XENTRY performance and how to perform the tasks required within a professional workshop environment. They're all informative:

- Newest Features of Versatile XENTRY Diagnostic System (March, 2016)
- The Intelligent Servo Module (December, 2016)
- Why You Need XENTRY (June, 2017 as a sidebar to Using WIS Efficiently)
- Control Unit Programming Now! (December, 2017)

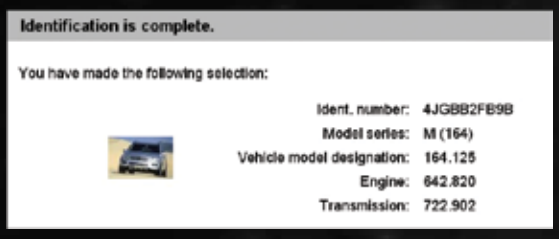
XENTRY at work on communication errors

The copy, captions, and images throughout this article illustrate the complexity of the diagnosis of a mysterious real-world case concerning a 2011 ML 350 BlueTec. The customer's basic complaint was a no-start, which only happened once. But there was more going on: all warning lamps were ON, the warning chime was sounding continuously, and the wipers turned on intermittently. Also, Direct Select was not operating and no selection was showing on the display. Finally, the no-start repeated.

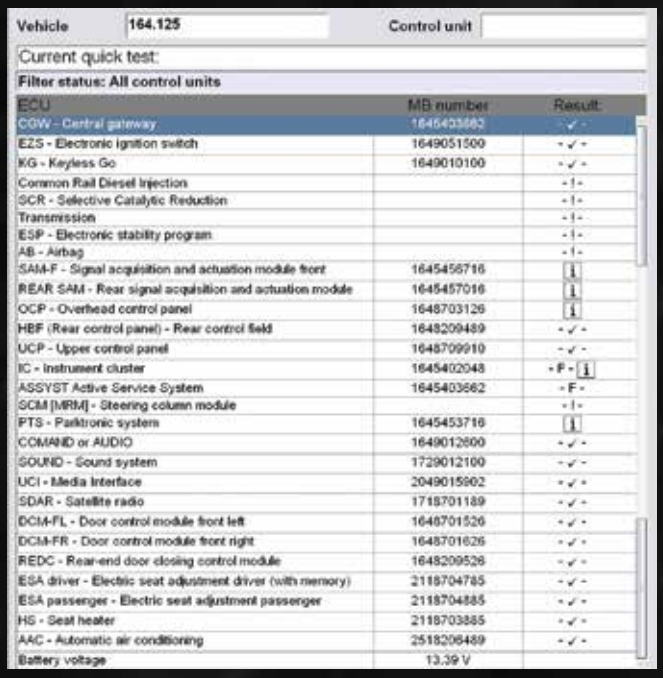
Our diagnostic preparations included a "circle check" of the entire vehicle and testing of both batteries. We made sure our XENTRY was updated, attached a clean and stable power supply, and turned off all electrical consumers. Then, we used the VIN tab to identify the correct model, performed a complete Quick Scan, and saved the primary results.

The following lists all the controllers found "after the fact" with a repair and rescan. This list identifies the controllers that were not communicating with XENTRY and were not in the Quick Scan list:

- ISM – Intelligent Servo Module
- IRS-HLA – Outer left rear intelligent radar sensor system
- IRS-HRA – Outer right rear intelligent radar sensor system
- XALWA-R – Xenon headlamp, right
- XALWA-L – Xenon headlamp, left



Using the VIN tab identifies the correct model.



With a complete XENTRY Quick Scan, all current errors and controllers found present will be on a single screen. Save those messages from XENTRY. This is a combination of two images at the time of the no-start. Notice the controllers: Common Rail Diesel Injection, SCR-Selective Catalytic Reduction, Transmission, ESP (Electronic Stability Program), and AB-Airbag. There's a recorded disruption within the network when the subsequent diagnostic scans change over time. A deep analysis also indicates that multiple controllers are off-line.

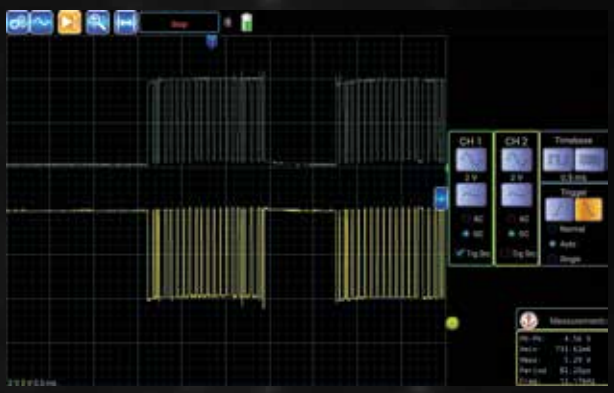
The Quick Scan tells you what controllers are active/recognized on the network with corresponding faults. The primary list of controllers in the image is complete and it appears that there are other controllers not communicating with XENTRY. The count so far is 28 controllers, and six of them have the - ! – in the results column.

- RevETR-LF – Left front reversible emergency tensioning retractor
- RevETR-RF – Right front reversible emergency tensioning retractor
- ASSYST PLUS – Plus Active Service System

There are eight controllers off-line and the total count is 36 for this model.

Vehicle	164.125	Control unit	CGW
Read coding and change if necessary.			
	Coding		
Keyless Go	PRESENT		
Interior motion sensor	NOT PRESENT		
ATA interior motion / towing sensor	PRESENT		
Trailer recognition	NOT PRESENT		
Parktronic system or Parkpilot	PRESENT		
Electronic drive unit	NOT FITTED		
Tire pressure monitor	NOT PRESENT		
Automatic engine start/stop	NOT FITTED		
Blind spot assist	PRESENT		
Power steering	Hydraulic power steering		
Electric suction fan	ACTIVE (Standard)		
Blind spot assist	PRESENT		
Steering version	Standard / Speed-sensitive power steering		
Air suspension	NOT PRESENT		
Transfer case	NOT PRESENT		
Differential lock (FRONT)	NOT PRESENT		
Differential lock (CENTER)	NOT PRESENT		
Differential lock (REAR)	NOT PRESENT		

Intelligent Servo Module, Blind Spot Assist and Xenon headlamps are controllers that were never seen in any of the previous scans, images, or saved documents.



The oscilloscope used for this simple test is Bluetooth-connected to an Android-based tablet. The probes used are 10:1 switched and were set to the 10x position.

The image "CAN B expected" was captured with KOEO while connected between the CGW Gateway and the CAN B connector station. Wire colors are: Brown (CAN L) and Brown/Red (CAN H). The "CAN B expected" image indicates a normal and standard view of a CAN message. This is to be expected and follows the voltage rules on this network. Capture/Save the screen and leave the settings on the scope in the same state.

Move the probes to the CAN C connector station and connect to the wires coming from the CGW Gateway. Wire colors are Green (CAN L) and Green/White (CAN H).

HINT: If there is no M-B number, the controller was never fully interrogated/accessed.

Using the print feature of XENTRY, save the entire initial scan and read the complete document. The investigation begins with the primary scan and all of the associated faults recorded within the first session.

An attempt to "reset/restart" the controllers having communication errors may fail, but maintaining a record for one attempt provides a guide for searching for interrupted or corrupt controllers. Record that session as well and keep the sessions separate. A safe procedure to reset/restart the network is to disconnect XENTRY and the power supply, have the driver window open, and remove the key. Disconnect the negative battery cable and wait 30 minutes. Reconnect the power supply and XENTRY, try the Quick Scan again, and record that attempt.

XENTRY guides go deep

One way of knowing if your theory is correct is by requesting the CGW coding data, or requesting an Interior CAN check. Access the information document on paper, or by way of a PDF (Adobe), and use the search feature.

Hint: The CGW is factory-programmed with all of the installed equipment when this model was built. Request a print and pay attention to what is not installed or not active. When reading the document, the CGW will be known as ECU_ZGW. This model has this equipment available that is of interest:

- ECU_ZGW_DEF_SA: Automatik-Getriebe (C423)@vorhanden
- ECU_ZGW_DEF_SA: Blind Spot Monitoring@available
- ECU_ZGW_DEF_CAN-C: Blind Spot Monitoring@available
- ECU_ZGW_DEF_SA: Xenonlicht (C612)@vorhanden

If a restart is possible, using XENTRY will record all available/active controllers, and this new printout was nine pages long. Most of the faults produced CAN message errors between the controllers such as Engine, Transmission, ABS, SCR, Instruments, Airbag etc. In other words, those controllers would complain about each other's' CAN messages. The remainder of the installed controllers recorded faults, including the "undervoltage supply" fault.

The first restart/saved scan produced 113 faults! Note that the CGW had no faults and does not mean a defect is present.

The controllers that have no recorded faults are:

(1) ASSYST PLUS - PLUS Active Service System

(2) COMAND or AUDIO

(3) UCI - Media Interface

(4) SDAR - Satellite radio

(5) HS - Seat heater

With the recording of multiple faults within multiple controllers, it can be assumed that there may be messages not recognized at the CGW. With XENTRY, the CGW controller can indicate what controllers are present and active.

The path toward the deep

To find out what messages are missing or corrupt:

(1) At the Quick Test screen, choose CGW

(2) Control Unit Adaptations

(3) Read coding and change if necessary

(4) Vehicle-specific data

Scroll though the entire open window and notice all of the equipment with messages attached under the Coding column. Blind Spot Assist and Xenon headlamps are PRESENT. With XENTRY, the entire CGW controller configuration can be viewed along with a list of installed equipment. Requesting a print offers detailed information.

With a Gateway that has no errors, what do the messages look like? Note that one function of the gateway is to pass information to the intended network(s).

Hint: Go back and notice Automatik-Getriebe (C423)@ vorhanden, CAN-C: Blind Spot Monitoring@available with the XENON headlamp system. Keep in mind other non-communicating controllers.

Using WIS to go even deeper

Using the Workshop Information System with XENTRY offers the precise information via VIN and will aid in further diagnosis, functions, tests, and diagrams with proper re-fitment illustrations. WIS and XENTRY are “joined at the “hip.”

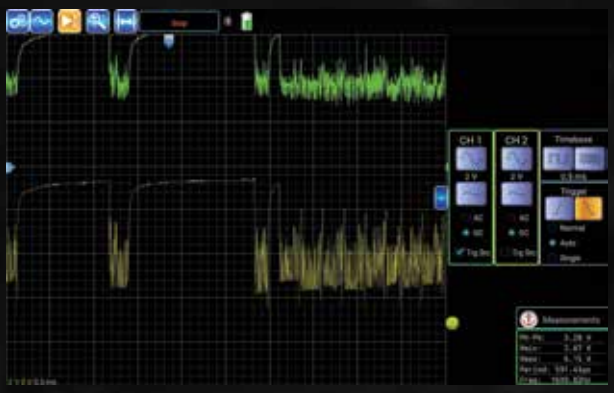
Two networks are of interest:

- CAN C = Engine CAN and known as “chassis CAN.”
- CAN B = Interior CAN and known as” body CAN.”

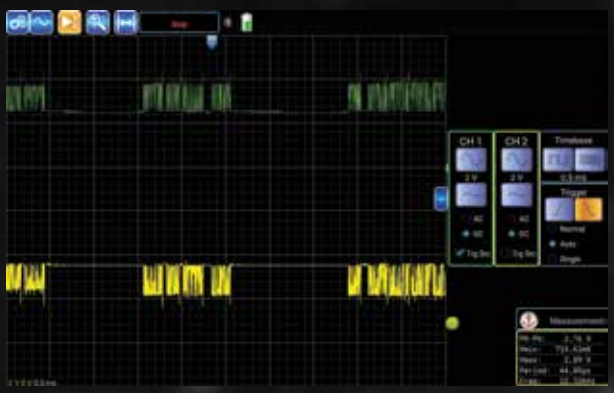
A good place to start especially if you’re new to XENTRY, is to press F6 (Help) and go to Networking topology (CAN, telematics) CAN networking Interior compartment. Look for and view the Arrangement diagram and x30/19 Voltage distributor (CAN C) Right Front.

For the following test, gather the correct schematics and follow the wire positions for CAN B and CAN C. The accompanying image is expected with KOEO while connected between the CGW and the CAN B connector station.

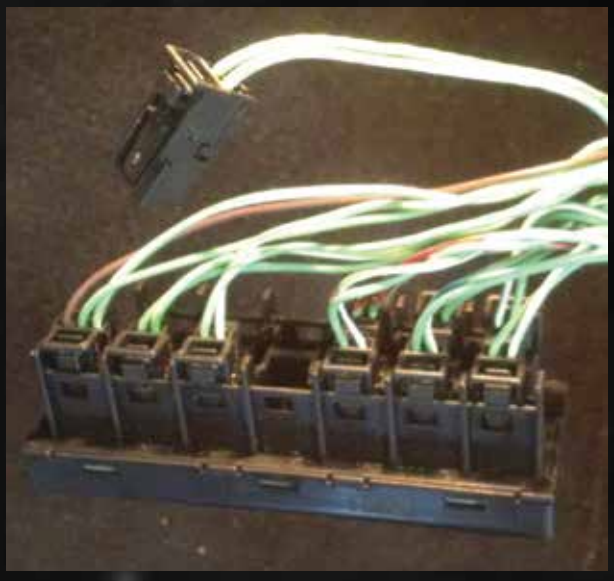
Leave the oscilloscope connected ,cycle the ignition key once, return to XENTRY, and reattach it to the DLC. Perform a Quick Scan and there will be faults generated from all previous tests. Clear all fault recordings generated by XENTRY. Follow the clear-faults procedure



This is not the expected image and is part of the theory as to why there is a disturbance within the network and partial loss of communication. Capture/Save this and other screen images of importance. With the scope operating and leaving the probes connected, remove one connector at a time. If nothing changes, reconnect that connector and move on to the next one while viewing the oscilloscope image. If the image normalizes, leave the connection off and mark/band it for later tests.



This image “CAN C expected image“ is what should be predictable following the voltage rules for this particular CAN system. What is not known currently is who the “bad actor” is after that connector was removed from the network station.



The defective controller unplugged.

Vehicle	164.125	Control unit	
Current quick test:			
Filter status: All control units			
ECU		MB number	Result:
CGW - Central gateway		1645403682	- ✓ -
EZS - Electronic ignition switch		1646051500	- ✓ -
KG - Keyless Go		1646010100	- ✓ -
CDI 6BINSBU6 - Common Rail Diesel Injection		6420010400	- ✓ -
SCR - Selective Catalytic Reduction		1644660054	- ✓ -
ETC - Electronic transmission control		0034460310	- ✓ -
ISM - Intelligent servo module		0054401610	- ✓ -
IRS-HRA - Outer right rear intelligent radar sensor system		0065428115	- F -
ESP - Electronic stability program		1645458232	- ✓ -
AB - Airbag		1648205585	- ✓ -
SAM-F - Signal acquisition and actuation module front		1645456716	- ✓ -
REAR SAM - Rear signal acquisition and actuation module		1645457016	- ✓ -
XALVIA-R - Xenon headlamp, right		1646005100	- ✓ -
XALVIA-L - Xenon headlamp, left		1646005100	- ✓ -
OCP - Overhead control panel		1648703126	- ✓ -
HBF (Rear control panel) - Rear control field		1648209489	- ✓ -
UCP - Upper control panel		1648709910	- ✓ -
RevETR-LF - Left front reversible emergency tensioning retractor		1649012800	- ✓ -
RevETR-RF - Right front reversible emergency tensioning retractor		1649012900	- ✓ -
IC - Instrument cluster		1645402048	- ✓ -
ASSYST Active Service System		1645403682	- ✓ -
ASSYST PLUS - PLUS Active Service System		1645403682	- ✓ -
SCM [MRM] - Steering column module		1645456716	- ✓ -
PTS - Parktronic system		1645453716	- ✓ -
COMAND or AUDIO		1649012600	- ✓ -
SOUND - Sound system		1729012100	- ✓ -
UCI - Media Interface		2049015902	- ✓ -
SDAR - Satellite radio		1718701189	- ✓ -
DCM-FL - Door control module front left		1648701526	- ✓ -
DCM-FR - Door control module front right		1648701626	- ✓ -
REDC - Rear-end door closing control module		1648209526	- ✓ -
ESA driver - Electric seat adjustment driver (with memory)		2118704765	- ✓ -
ESA passenger - Electric seat adjustment passenger		2118704885	- ✓ -
HS - Seat heater		2118703885	- ✓ -
AAC - Automatic air conditioning		2518206489	- ✓ -
Battery voltage		13.39 V	

The count now is 35 controllers with IRS-HLA - Outer left rear intelligent radar sensor system missing within the scan. Follow the fault for IRS-HRA and note the remaining fault. In total, this model will have 36 controllers active.

according to the prompts on the screen. XENTRY will now produce an updated list of controllers and any faults that have returned. Save this updated scan and read it in its entirety. Search for the differences and communication status for all installed controllers.

This case produced five printed pages with no errors. With the information provided earlier, the “bad actor” is now evident.

The resulting scan found two controllers missing:

- IRS-HRA - Outer right rear intelligent radar sensor system
- IRS-HLA - Outer left rear intelligent radar sensor system

Test this again with the oscilloscope by reconnecting the harness to the station. The oscilloscope will react immediately and chances are that the customer’s complaints returned.

The test can be proved with some accuracy with XENTRY identifying non-communicating controllers in the network.

Disconnect the harness at the station again and look for a normal oscilloscope pattern. Inspect both Blind Spot Monitoring modules and harness connections of the vehicle.

Choose either left or right, but disconnect one side and confirm with the oscilloscope. If the correct/defective module is disconnected, the oscilloscope reading the CAN pattern returns to normal and XENTRY will produce a final outcome. On the last Quick Scan, one controller is not recognized because it has been disconnected, but the network is back to normal.

There will be a warning within the instrument cluster that Blind Spot Monitoring will not be available. All other functions should be back to normal with no warning chimes, proper wiper functions, and the Direct Select operating normally.

Well-trained technicians who repair Mercedes-Benz vehicles using the XENTRY system with WIS have a clear advantage and have access to critical programming and adaptations.

Vehicle	164.125	Control unit	IRS-HRA
Event memory			
Code	Text	No.	Status
552002	No CAN message received from component B29/4 (Left rear bumper intelligent radar sensor)	0	Event CURRENT and STORED

Perform a road test with the correct repairs and proper components. Using XENTRY for that last test, ensure no more faults are recorded.