Controller Area Network
CAN
These technical training materials are current as of the date noted on the materials, and may be revised or updated without notice. Always check for revised or updated information.

To help avoid personal injury to you or others, and to avoid damage to the vehicle on which you are working, you must always refer to the latest Mercedes-Benz Technical Publication and follow all pertinent instructions when testing, diagnosing or making repair. Illustrations and descriptions in this training reference are based on preliminary information and may not correspond to the final US version vehicles. Refer to the official introduction manual and WIS when available.

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Objectives

- Explain advantages of CAN networks
- Explain how CAN networks operate
- Describe location of CAN connectors
- Explain CAN diagnosis techniques
- Provide reference information on other models
  *(reference section at back of handout)*
What is a CAN System?

A CAN system is:

- A digital communication link between multiple Electronic Control Modules (ECM)
- A 2 wire, bi-directional communication link with data transmitted according to priority
- Message specific addressing
Advantages

- Cost
- Improved immunity to electrical interference
- Fewer connectors
- Fewer pins on control modules
- Weight savings
- Fewer sensors
- Improved diagnosis facilities
- Rapid transmission rates
Types of CAN Communication

Mercedes-Benz uses several CAN networks. Depending on model and year the following may be used.

**CAN C - Engine CAN (also known as chassis CAN)**
Fast communication speeds 125 kbps or 500 kbps

**CAN B - Interior CAN (also known as body CAN)**
Communication speed 83 kbps

Information from CAN C can be sent to control modules on the CAN B or vice versa via the Electronic Ignition Switch (EIS). The EIS is the only control module* that can transfer the messages and is known as the gateway.
Without CAN

- Coolant sensor 1
  - Control module 1 (e.g. fuel system)
- Coolant sensor 2
  - Control module 2 (e.g. climate control)
- Coolant sensor 3
  - Control module 3 (e.g. ignition)
CAN Bus

Sensor 1 → Control module 1

Control module 2  Control module 3  Control module 4  Control module 5  Control module 6
CAN B Example

Controlling R.R. window from L.F. door
CAN High & Low

The CAN wiring consist of 2 wires called CAN High (CAN H) and CAN Low (CAN L).

All the control modules are connected in a parallel circuit using either Z splices or plug connector blocks (X30/_).

For the remainder of this presentation and shop modules, we will concentrate on the CAN B network as used in W203 / W220).
CAN H

- CAN-H has a voltage of approx. 0.025 volts when dormant
- Rises to base voltage of 0.65 volts when communicating
- Data seen as voltage levels going “high”
CAN L

- CAN-L has a voltage of 11.0 volts dormant
- Base voltage drops to 4.65 volts when active
- Data seen as voltage level going “low”

~11 volt

~4.65 volt
CAN B High & Low

~11 volt

~4.65 volt

~0.65 volt

~0.025 volt
Safety Concept

CAN L still communicates (single line operation)

CAN H shorted to ground, cannot communicate
Wake-up Signal

- EIS is the master of the CAN
- EIS wakes up the control modules on the CAN

Door switch
Rear SAM
EIS

WAKE UP !! / Door open
Tools For Diagnosing CAN B

- Ohm meter
- Volt meter
- Oscilloscope
- CAN B test harness
- SDS
- WIS

Note: The red lead is not always the CAN H
W203 CAN B (MY 2001)

Note: Always refer to the wiring diagram for your model and year.

1. early
   - GN/WT
   - GN

2. late
   - RD
   - BN/BK
   - BN

CAN H wires are BN/RD
CAN L wires are BN except where indicated
W203 CAN B Connector X30/6

- N73 - EIS
- N72/1 - UCP
- A1 - ICM
- N22 - AAC
- N70 - OCP
- N10/1 - Front SAM
W203 CAN B Connector X30/7

- N10/1 - Front SAM
- A40/3 - COMAND
- A2 - Radio
- N69/1 - DCM-FL
- N69/3 - DCM-RL
- N10/2 - Rear SAM
- N32/1 - ESA-FL
W203 CAN B Connector X30/4

- N69/2  - DCM-FR
- N69/4  - DCM-RR
- N2/7   - SRS
- A35/17 - TELE AID
- N32/2  - ESA-FR
CAN B Malfunctions

• Shorted CAN B

• Constantly active CAN B

• Incorrect version coding
Shorted CAN B

When both the High and Low CAN B are shorted to ground or positive no communication is possible between control units.

This can happen if:

a. Control unit shorted
b. Wiring harness shorted

How could we determine if the CAN B is shorted?

a. Monitor CAN B voltage out of EIS
b. Monitor CAN B oscilloscope pattern out of EIS
c. Monitor the DAS (SDS)
Constantly Active CAN B

CAN B needs to go into a dormant state when the ignition switch is in the 0 position. EIS is the control unit in charge of activation and deactivation of the CAN B.

If a control unit in the CAN B keeps sending a signal the EIS will not request the CAN B to go into a dormant state.

How can we determine if the CAN B has not gone into a dormant state?

a. Monitor CAN B activity with an oscilloscope
b. Monitor CAN B voltage
Diagnostic Exercise For CAN B

The following diagnostic exercise involves a W203 with a shorted control unit.
W203 CAN B

X30/6 (dash)

X30/7 (left)

X30/4

N73 N70 N22 A1 N72/1 N10/1

N10/2 A40/3 N32/1 N69/1 N69/3

N69/2 N32/2 N2/7 A35/17
Diagnostic Exercise For CAN B
Disconnect CAN wire
Re-connect CAN wire
Disconnect CAN wire

Re-connect CAN wires until network instable again
Model series/mo: 203.064
ECU channel 1
EZY2

CAN bus control units: All

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Specified value</th>
<th>Actual values</th>
</tr>
</thead>
<tbody>
<tr>
<td>520</td>
<td>Status of the CAN databus</td>
<td></td>
<td>INSTABLE</td>
</tr>
</tbody>
</table>

Diagram showing connections and labels.
Model series/mo... 203.064
ECU channel 1 EZS2
CAN bus control units: All

<table>
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<tbody>
<tr>
<td>520</td>
<td>Status of the CAN databus</td>
<td></td>
<td>STABLE</td>
</tr>
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</table>
Diagnostic Exercise For CAN B

Press the F2 key for a list of control units that the EIS can communicate with
### Diagnostic Exercise For CAN B

<table>
<thead>
<tr>
<th>No.</th>
<th>Name</th>
<th>Specified value</th>
<th>Actual values</th>
</tr>
</thead>
<tbody>
<tr>
<td>093</td>
<td>CAN communication with control module Keyless Go</td>
<td>✔</td>
<td>- / - , NOT FITTED or FAULTY</td>
</tr>
<tr>
<td>094</td>
<td>CAN communication with control module TPC</td>
<td>✔</td>
<td>- / - , NOT FITTED or FAULTY</td>
</tr>
<tr>
<td>095</td>
<td>CAN communication with control module STH</td>
<td>✔</td>
<td>- / - , NOT FITTED or FAULTY</td>
</tr>
<tr>
<td>096</td>
<td>CAN communication with control module TELE AID or E-Call</td>
<td>✔</td>
<td>✔</td>
</tr>
<tr>
<td>076</td>
<td>CAN communication with control module SVMCM</td>
<td>✔</td>
<td>- / - , NOT FITTED or FAULTY</td>
</tr>
<tr>
<td>099</td>
<td>CAN communication with control module LCP</td>
<td>✔</td>
<td>- / - , NOT FITTED or FAULTY</td>
</tr>
<tr>
<td>079</td>
<td>CAN communication with control module DCM:RL</td>
<td>✔</td>
<td>- / - , NOT FITTED or FAULTY</td>
</tr>
</tbody>
</table>
Reference Materials for Further Reading

WIS documents:

GF00.19-P-0001PP  Extended vehicle network function
SN00.19-P-0004GH  Complete networking (163 as of 9/01)
GF54.00-P-0004A   Data bus system function
GF54.00-P-0005A   CAN data bus, function
GF54.00-P-0005-01A  CAN data bus data telegram
GF54.00-P-0005-02A  CAN data bus specification
GF54.00-P-0005-04A  CAN data bus applications
GF54.00-P-0999ZZ  CAN data bus, contents, function description
Additional Information for Other Models
CAN B Voltages W203, C215 & W220

- CAN H active: 0.65V, dormant: 0.025V
- CAN L active: 4.65V, dormant: 11.0V

CAN B Voltages W202, C208 & W210

- CAN H active: 1.8V, dormant 0.025V
- CAN L active: 3.2V, dormant 4.8V
CAN B on W203 with connector X35/2

(Vehicles from approx. 06/02)

Note: Always refer to the wiring diagram for your model and year.

Brown and Brown with Red tracer
X35/2

Location: Right front sill
C215 CAN B

X30/5

X30/6

X30/4

A37  A40/3  N32/1  N69/1

N73  N80  N22  A1  N72/1  N10/7  N10/6

W  W  W

G  W  Y

Green Band  White Band  Yellow Band

N88

N10/8  N69/5  N62  N22/6  N32/2  N69/2  N70
Location of X30’s for C215 & W220

X30/6

X30/4

X30/5
C215 / W220 Connector X30/6

- Wires with the green band go to N73 (EIS)
- Wires with the white band go to N10/6 (Left SAM)
C215 / W220 Connector X30/5

- Wires with the white band go to N10/6 (Left SAM)
- Wires with the yellow band go to X30/4
Control Units Connected to X30/6 C215 / W220

- N73 - Electronic Ignition Switch
- N80 - Steering Column Module
- N22 - Automatic Air Conditioning
- A1 - Instrument Cluster
- N72/1 - Upper Control Panel
- N10/7 - Right SAM
- N10/6 - Left SAM
Control Units Connected to X30/5
C215 / W220

• A37    - PSE
• A40/3  - COMAND
• N22/4  - Rear automatic air conditioning
• N32/1  - Electric seat adjustment left
• N69/1  - Door control module 1
• N69/3  - Door control module 2
• N10/6  - Left SAM
Control Units Connected to X30/4 C215 / W220

- N10/8  - Rear SAM
- N70    - Overhead control panel (Via N10/8)
- N69/2  - Door control module 2
- N69/4  - Door control module 4
- N62    - Parktronics
- N32/2  - Electric seat adjustment right
- N25/6  - Electric seat adjustment rear
- N88    - Tire pressure monitoring
- N69/5  - KeyLess Go
W202, 208, 210 CAN B

• Electronic Ignition Switch  
  EIS - N73

• Signal Acquisition and Actuation Module  
  SAM - N10/1

• Door Control Modules  
  DCM’s - 1 for each door N69/1-4

• Pneumatic System Equipment  
  PSE - A37

• Electronic Seat Adjustment  
  ESA’s - N32/1&2

• Overhead Control Panel  
  OCP - N70

• Lower Control Panel  
  LCP - N72

X30/7 - Right front door sill
W210 CAN B
W202, 208 & 210 CAN B

LOW SLEEP VOLTAGE 4.8V

LOW AWAKE VOLTAGE 3.2V

(CAN Message)

HIGH AWAKE VOLTAGE 1.8V

(CAN Message)

HIGH SLEEP VOLTAGE 0.2V

CAN HI

CAN LOW
G Class (463) Networking

- Interior CAN-B
  - N72/1
  - N70
  - N22
  - N69/1
  - N69/2
  - N69/3
  - N69/4
  - N32/1
  - N32/2
  - N10/1
  - N10/2

- Not on CAN BUS
  - N25/6
  - N30/2

- N25/6, Rear seat heater module
- N30/2, Differential lock module

- Engine CAN-C
  - N3/10
  - N47/7
  - N15/3
  - N15/5
  - N15/7
  - N2/7

- X11/4

- D2B

- A1
  - A40/3
  - A35/11
  - A2/6
All CAN H wires are red
All CAN L wires are brown
except where noted

CAN B Diagram for 463
463 CAN B Connector Locations

X30/6 under drivers dash

X30/4 and X30/7 in passenger kick panel

CAN wires are labeled with a tag on X30/4 & X30/7
463 CAN C Connector

Location: Right side of center console
R230 CAN B Connector X30/15

Inside driver’s side door sill (next to X30/18)

- EIS (N73)
- IC (A1)
- SCM (N80)
- DCM-L (N69/1)
- SAM-FL (N10/10)
- AAC (N22)
- LCP (N72)
- ESA-L (N32/1)

MCS-L (N35/15)
R230 CAN B Connector X30/16

SAM-FR (N10/11)
OCP (N70)
DCM-R (N69/2)
SD (N55)
ESA-R (N32/2)  
MCS-R (A35/16)
R230 CAN B Connector X30/17

Behind passenger seat, next to SAM

RVC (N52)
SAM-Rear (N10/8)
PTS (N62)
TPC (N88)
KG (N69/5)
BNS (N82/1)
TELE AID (A35/8)
COMAND (A2)
PSE (A37)
R230 CAN C Connector X30/18

Inside driver's side door sill (next to X30/15)

- EIS (N73)
- IC (A1)
- SCM (N80)
- ECM (N3/10)
- DTR (N63/1)
- ABC (N5/12)
- ESM (N15/5)
- ETC (N15/3)
- ESP (N47-5)

SBC (A73n1)
W211 Networking Diagram

- CAN C
  - X30/5
  - N3/10
  - N47/5
  - N15/5
  - N15/3
  - N51
  - N71
  - N63/1
  - N69/1
  - N69/3
  - N25/7
  - N32/1
  - N32/19
  - N72

- CAN B
  - N93
  - N80
  - A1
  - N73
  - N99
  - N22
  - N10/1
  - X30/6
  - X30/7
  - N69/1
  - N69/3
  - N25/7
  - N32/1
  - N32/19
  - N72
  - N10/2

- CAN D
  - N93
  - N10/1
  - X11/4

- MOST
  - N112
  - N112 - Communication Platform (TeleAid)
  - N70
  - N62
  - N88
  - N121

- CAN B
  - Interior bus
- CAN C
  - Engine bus
- CAN D
  - Diagnosis bus
- MOST
  - Audio Bus

LCP if vehicle equipped with DTR / SAS
W211 Networking Legend

**CAN C**

N3/10 ME-SFI Control Module
N15/3 ETC - Electronic Transmission Control
N15/5 ESM - Electronic Selector Module
N47/5 ESP - Electronic Stability Program
N51 SAS - Semi-Active Air Suspension
N63/1 DTR - Distronic Control Module
N71 HRA - Headlamp Range Adjustment
N93 CGW - Central Gateway Module

**CAN B**

M40/1 Pneumatic Pump of Dynamic Seat
N2/7 Supplemental Restraint System
N10/1 SAM-D - Driver-side
N10/2 SAM-R - Rear
N10/11 SAM-P - Passenger-side
N22 AAC - Automatic Air Conditioning Control
N25/7 HS and Seat Ventilation Control Module
N32/1 ESA - Left Front Seat Adjustment
N32/2 ESA - Right Front Seat Adjustment

**CAN C & B**

N32/19 Left Front Dynamic Seat Control
N32/22 Right Front Dynamic Seat Control
N62 PTS - Parktronic Control
N69/1 DCM - Left Front Door Control Module
N69/2 DCM - Right Front Door Control Module
N69/3 DCM - Left Rear Door Control Module
N69/4 DCM - Right Rear Door Control Module
N70 OCP - Overhead Control Panel
N72/1 UCP - Upper Control Panel
N82 BCM - Battery Control Module
N88 TPC - Tire Pressure Monitor Control Module
N93/1 AGW - Audio Gateway Control Module
N99 SWH - Steering Wheel Heater
N121 RTL - Remote Trunk Locking Control Module

A1 ICM - Instrument Cluster
N73 EIS - Electronic Ignition Switch Control
N80 SCM - Steering Column Module
N93 CGM - Central Gateway Module
CAN C Connector (X30/5)

Location: Drivers rocker panel wiring trough
CAN B Connector (X30/4)

Location: Right side passenger footwell
CAN B Connector (X30/6)

Location: Passenger side HVAC case
CAN B Connector (X30/7)

Location: Drivers rocker panel wiring trough
SAM-Rear (N10/2)

Several control modules are connected to the CAN B network via N10/2.

Location: Left side trunk
W211 CAN D

- Is the diagnostic link between Central Gateway Module (N93), Communications Platform (N112) and SDS / DAS

- CAN D voltage
  - High = 2.5v
  - Low = 2.5v

- CAN D voltage awake
  - High = activity to 3.5v
  - Low = activity to 1.5v

- All modules on CAN B are diagnosed by SDS / DAS through CAN D