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MOST Bus Diagnosis

Initial Print Date:03/02 Revision Date:08/02

MOST Bus Diagnosis

Model: E65 - E66

Production Date: Start of Production

Objectives:

After completing this module you should be able to:

- Understand the reason for optical busses.
- Know how optical busses transfer information.
- Relate the direction and flow of information on the MOST Bus.
- Perform diagnosis and troubleshooting of MOST Bus.

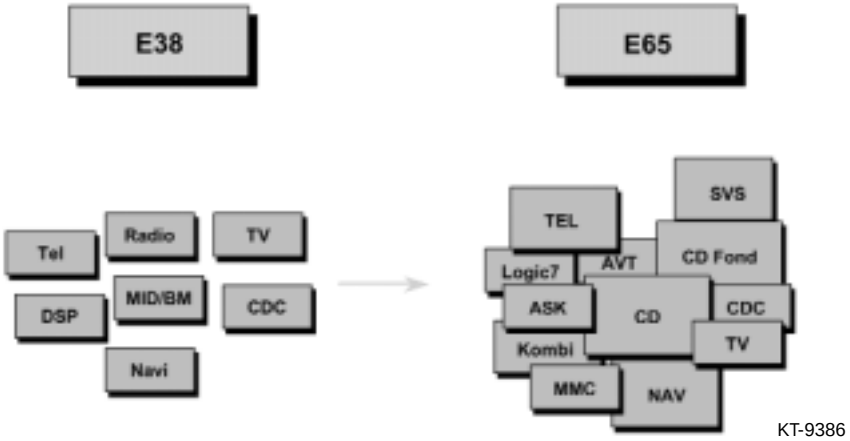
System Overview

MOST Technology

Until very recently, only very few entertainment-related control units were networked. In the course of the development, the number of components increased continuously.

In addition, the scope of functions of individual components has been extended considerably. In particular, however, completely new logical networking means that all the components are growing to become a system: individual functions work together and produce a high-quality overall system. This results in significant growth in system complexity.

This new dimension of system complexity can no longer be managed using the existing bus systems.



MOST Multimedia Network

MOST technology meets 2 essential requirements:

1. The MOST bus transports control data as well as data from audio, video, navigation and other services (SMS=Short Message Service, TMC =Traffic Message Channel, in other markets).

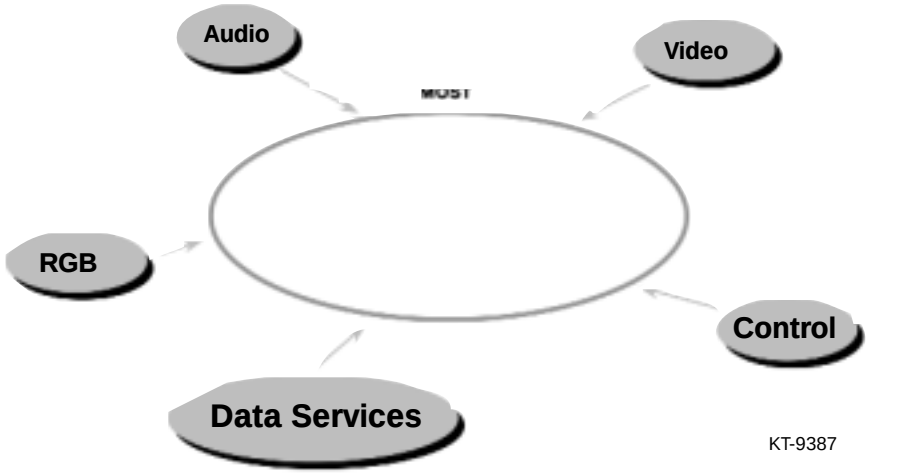
2. MOST technology provides a logical framework model for control of the variety and complexity of data: the MOST Application Framework. The MOST Application Framework organizes the functions of the overall system.

MOST is able to control and dynamically manage functions that are distributed in the vehicle.

Principle of a Multimedia Network

An important feature of a multimedia network is that it transports not only control data and sensor data, e.g. like the CAN bus and I bus (instrumentation bus). A multimedia network can also carry digital audio and video signals and graphics as well as other data services.

Information transmitted on MOST network



Advantages of the Multimedia Network

All data can be transported across a shared network. This offers the following benefits:

- Additional signal wiring harnesses are eliminated.
- The only addition many control units need is the power supply.
- As each participant (= each control unit) has access to all the data, cost-intensive assemblies for signal distribution can be eliminated.

Different data formats also have different requirements for transmission regarding both mechanism (synchronous or asynchronous data) and the required band-width (baud or bits/second). The MOST format is able to meet these requirements to a satisfactory extent.

Functional Description

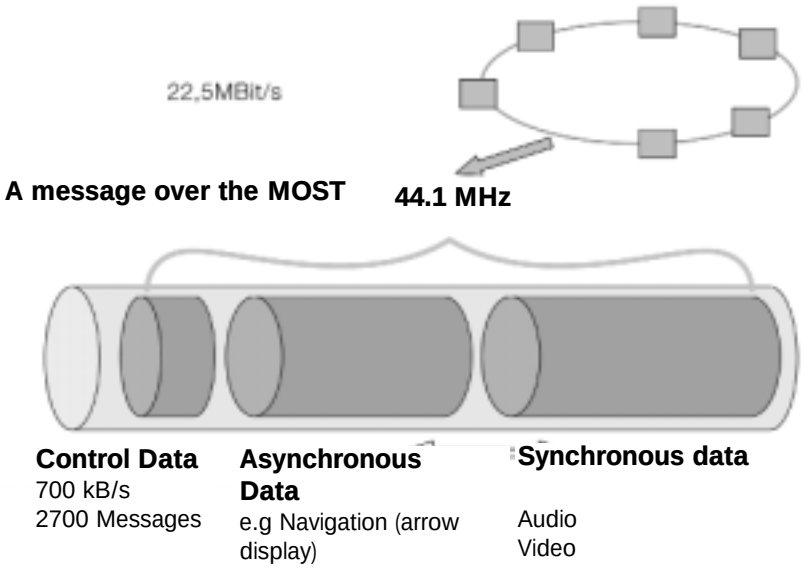
Data Transport

MOST currently offers a band-width of 22.5 Mbits/s . In the next generation, the band-width will be increased to 50 and then later to 150 Mbits/s (as of approx. 2002).

In order to meet the different requirements of the applications regarding data transport, each MOST message is divided into three parts:

- Control data
- Asynchronous data: e.g. navigation system, arrow representation
- Synchronous data: e.g. audio, video signals

Data Transport on the MOST



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The control data controls the functions and devices in the network. The information can be compared to CAN bus data.

The control data has a band-width of 700 Kbit/s. That corresponds to around 2700 messages per second.

For the data transmission of synchronous and/or asynchronous data, there is a total of 60 bytes. The limit is variable: e.g. 20 bytes of synchronous data and 40 bytes of asynchronous data.

Optical Bus

The MOST bus is a plastic optical waveguide. The MOST bus is coded in green in the E65 (Repair cables are black in color). The light wavelength is 650 nm (red light). The MOST bus requires the following converter components:

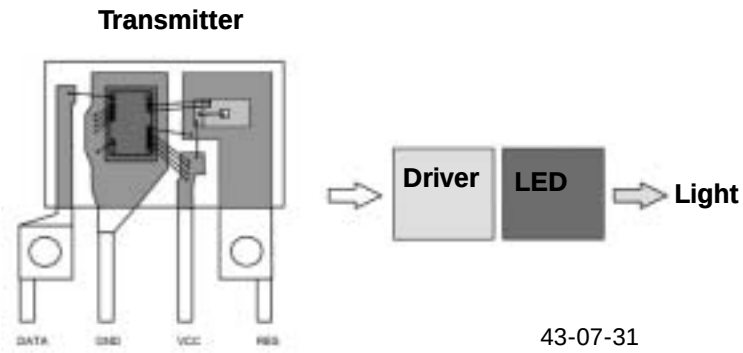
- Optical transmitter
- Optical receiver

Each control unit of the MOST framework contains a transmitter and a receiver. The transmitter and receiver have been developed by BMW. The low closed circuit (rest) current properties of the transmitter and receiver enable optical wake-up by the MOST bus.

Optical Transmitter

A driver is fitted in the transmitter. The driver energizes an LED (light-emitting diode).

The LED transmits light signals on the MOST bus (650 nm light, i.e. red visible light). The repeat frequency is 44.1 MHz.



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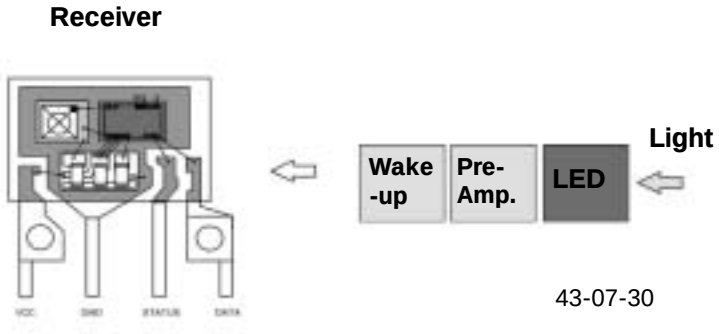
The sensing frequency on a CD player and for audio is 44.1 MHz; this means than no additional buffer is required, yet another reason why this bus system is so efficient for multimedia.

Optical Receiver

The receiver receives the data from the MOST bus. The receiver consists of:

- An LED
- A pre-amplifier
- A wake-up circuit
- An interface that converts the optical signal into an electrical signal



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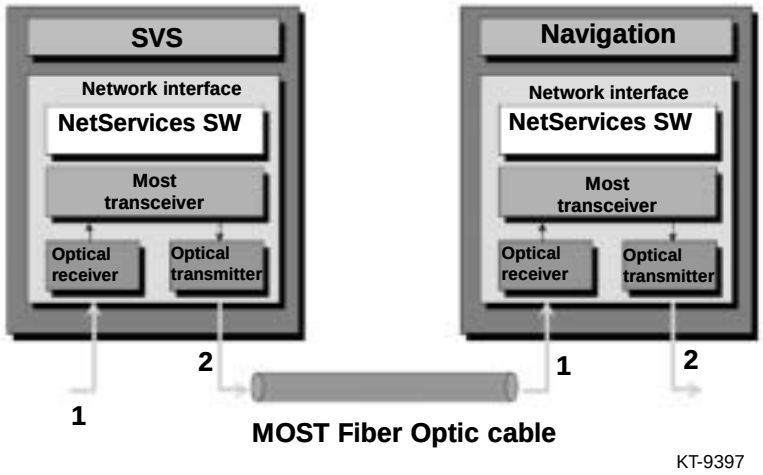
The receiver contains a diode that converts the optical signal into an electrical signal. This signal is amplified and further processed at the MOST network interface.

Control Unit/Control Unit Connection

The MOST ring is composed of optical point-to-point connections between 2 control units. Each control unit has a network interface. The network interface consists of:

Example



- An opto-electrical converter (optical waveguide receiver, already mentioned).
- An opto-electrical converter (optical waveguide transmitter, already mentioned).
- A MOST transceiver (interface between the optical waveguide receiver/transmitter and the electronic network driver).
- A network driver, the so-called NetServices.

The NetServices run on a microcontroller (main computer in the control unit)

On the application level, a control unit in the MOST framework contains stand-alone function units, so-called function blocks. Examples of function blocks include:

- Tuners
- Amplifiers
- CD players

A control unit can contain several function blocks at one time, e.g. the AVT contains the functions:

- Antenna
- Amplifier
- Tuner

Interfaces

The following contains a brief summary of the tasks of the connected control units in the MOST framework:

Control Display

The Control Display is the system master of all MOST bus functions and serves as the power master. It wakes up the bus and is responsible for switching it off (power down). The DIS Plus and GT1 will show a Control Display and a Control Display (Gateway).

Audio System Controller (ASK)

The audio system controller has the following controller functions:

Network Master

The ASK performs the role of network master for the MOST bus. The functions of the network master are the following:

- Wake-up, initialization, power-down
  The network master wakes up the bus and has the task of achieving an orderly initialization of the network. The ASK can operate with KLR off. To turn it on, push in the volume/ON/OFF knob. Adjustments and control is carried out by using the Controller and Control Display.
  Another task of the network master is to control the power-down process. Each power-down is initiated and started by the ASK.

- Configuration control
  The network master detects the exact system configuration each time that the network is started and compares it to the stored coded configuration.

- Control of the network operation
  The network master controls the MOST transceiver of the slave equipment for correct operation. The equipment which is not operating properly will be released by a reset or switched to low power mode so that they do not affect bus communication.

- Fault code memory
  The network master includes the fault code memory of the MOST network. It stores all the faults occurring during the network operation as well as deviations from the nominal configuration.

Audio Master
As audio master, the ASK has the task to collect and process all the audio signals of the vehicle and to distribute them to their destinations.
The ASK controls all the acoustic requests from the Control Display. The changes in the level of a signal is not sudden, but smooth, e.g. during suppression, insertion and fading out or temporary suppression of the signal at the destination: Because of this, a high-quality acoustic sound is obtained.
The ASK also assumes the generation and preparation of different acoustic signals, e.g. PDC signals and warnings. In the event of a request for a warning or caution signal from a control unit, the ASK provides a clean acoustic change of the signals.

- Audio data
  All audio data from any control unit are converted by the ASK into digital audio AF format at a sampling rate of 44.1 MHz.

- Categorization of audio sources
  All possible audio sources are divided into different groups according to priority. Warning signals have priority over any other audio source. Mixing of lower priority audio signals (e.g. navigation, radio) is possible.

- Generation of acoustic gongs
  These are acoustic alarm signals which help the driver perceive sounds according to a system. The different sounds, requested by the different control units, (e.g. gongs, PDC, etc.), must be generated only in association with a visual indication. These come from the instrument cluster and the Control Display.

The following sounds can be generated in the ASK.
- Beeping for the PDC.
- Various Check Control and warning gongs.

Note:
A maximum of three sounds can be produced at once. Sounds are produced in order of importance. Sounds requested exceeding three will be lost.

Connection Master
As connection master, the ASK must provide channels to the equipment connected to the bus and distribute the audio signals on the outputs (loudspeakers).

The connection master also controls the basic Hi-Fi or the LOGIC 7 Hi-Fi amplifiers.

CD Changer Audio (CDC)
The CD changer is a slave control unit in the MOST framework.

Navigation System (NAV 01)
The control unit of the navigation system has controller tasks and slave functions in the MOST framework.

Slave Control Units
The following control units are slave control units:
- Kombi (control unit of the instrument cluster)
- AVT
- LOGIC7
- SVS Speech processing system
- Telephone
- MMC

Component Locations

Located in the dashboard assembly:

- Control Display
- CD Changer
- ASK
- Kombi
- OPPS Connector

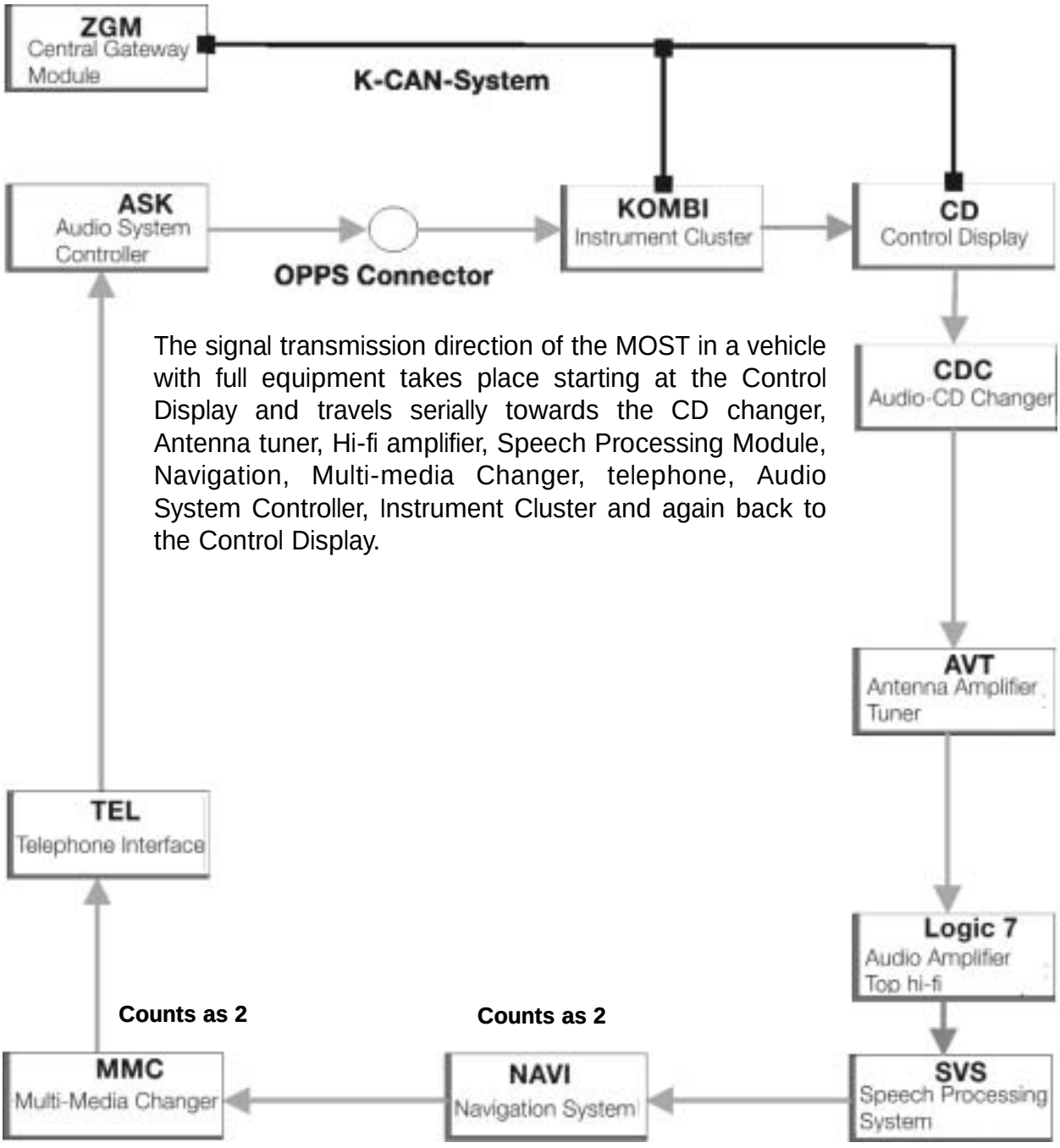
Located in the luggage compartment, rear left:

- Logic 7
- SVS
- NAV
- MMC
- Telephone

Located in the C pillar left side:

- AVT

Communication Direction in MOST structure



The signal transmission direction of the MOST in a vehicle with full equipment takes place starting at the Control Display and travels serially towards the CD changer, Antenna tuner, Hi-fi amplifier, Speech Processing Module, Navigation, Multi-media Changer, telephone, Audio System Controller, Instrument Cluster and again back to the Control Display.

Important!!! The component sequence of the MOST controllers in the ETM is incorrect when it comes to signal transmission direction. The correct sequence is indicated above!

Diagnosis

It is important to remember that on the MOST network, messages can only be transmitted provided the bus ring is complete and fully functional. If there is a ring fault in the MOST network, the diagnostic system only communicates with the instrument cluster and the Control Display because both of these modules are directly connected to the K-CAN System Bus.

The fiber optic signals on the MOST network always travel in one direction and only in one direction. Signals always originate at the Control Display and travel to the CD changer, AVT, Logic 7 (if equipped), SVS, NAV, MultiMediaChanger (if equipped), Telephone, ASK, Kombi and back to the Control Display.

The MOST bus allows intersystem fault memory entries in the individual control modules. A feature of the system faults is that faults may be entered in a control module although the control module is OK. Conclusions may be drawn about the cause of the fault, using the fault information stored in all the control modules.

The possible system faults are:

- Optical wave guide communication fault (All MOST Control Module) FC 111
- A Control Module does not switch a light off (All MOST Control Modules)
- Network wake-up unsuccessful (Control Display (Gateway), ASK, Telephone Only) FC E18D
- Ring fault diagnosis run (Control Display (Gateway) and Kombi Only) FC E190

The Control Display functions are split between acting as a Gateway and Displaying information. The Gateway function serves as the interface between the MOST and the K-CAN System buses. Although the Control Display is one control module, two control module names are displayed in the DIS Plus:

- CD Control Display (Gateway)
- CD Control Display

The faults stored in the Control Display are distributed between the Control Display Gateway and Control Display according to the function of the fault.

Optical Wave Guide Communication Fault

This fault (FC 111) indicates a problem with optical transmission. Insufficient light is being received by one of the modules in the ring. The loss of light may be caused by:

- Defective optical wave guide, Harness twisted too tightly (Min. bend radius 50mm.)
- Light output or reception sensitivity of a diode is too low
- Connector not installed correctly
- Voltage fluctuation while powering up a control module

If the fault is stored, the system triggers a reset and starts up again. The music is switched off briefly and the display screen of the Control Display continues to operate.

To find the module responsible for the fault, the fault memory of the modules must be read in MOST ring order.
Fault lies between the module with the fault code (B) and the preceding module (A).

If the voltage has dipped below 9v, the fault may be incorrectly stored. If the voltage is low perform the following test after connecting a battery charger.

1. Clear the fault memory in control module B.
2. Lower the light output in control module A.
3. Read out the fault memory in the MOST ring in order.
4. If control module B is again the first to store the fault, it can be assumed the fault lies between control modules A and B.

Then, check control modules A and B for loose connections and check the optical wave guide for kinks. If the visual inspection is OK, the fault can be located using the OPPS tester or optionally performing the following tests.

- Remove the input optical wave guide from control module B and confirm the presence of light.
  If light is present, install by-pass optical wave guide in place of control module A, clear fault codes in module B and perform ring break test. If MOST network operates properly, then control module A is at fault and must be replaced.
  If MOST network still has a fault, put module A back in the network and by-pass module B. Clear faults and again perform ring break test. If MOST network operates now problem is with control module B and it must be replaced.
- If light is not present at input of module B, perform by-pass of module A as above.

Note: AMP Butt connector # 1355734-1

The possible fault scenarios are:

- Transmit diode in module A bad
- Receive diode in module B bad
- Optical wave guide fault between modules A and B
- Software error or fault in module A or B

Control Module Does Not Switch Off Light

When the MOST network is requested to sleep, the Control Display switches off the light in the MOST ring. The lack of light input is a signal to the individual control modules to switch off their light output and enter sleep mode.
If a control module does not switch off its light, all down stream control modules register the fault “A Control Module is not switching light off.”

Important:
*Failure of a control module to turn its light off, will cause the MOST network **NOT** to enter sleep mode. If the MOST network fails to sleep, the rest of the car will not be able to enter sleep mode. **This will lead to battery discharge**.*

To diagnose:

- Read out fault memory in MOST ring order

The fault lies in the control module that precedes the module where the fault is first stored.
Always confirm the problem by first clearing the fault and performing the diagnosis a second time. If the same results occur, replace the defective control module.

Network Wakeup Unsuccessful

This fault indicates a problem with the optical transmission. An insufficient volume of light is coming through one position of the ring and may be caused by:

- Control Module is receiving no voltage
- Optical Wave Guide harness defective
- Optical Element in a control module defective (transmit or receive)
- Connector not installed correctly

A distinction must be made as to whether the fault is currently present or sporadic.
For faults currently present, run the **Ring Break Diagnosis** Test Plan.
For sporadic faults perform the **Luminous Power Reduction** Test Plan.

Ring Break Diagnosis Carried Out (FC E190)

Reading out the fault memory of the Control Display (Gateway) after performing the Ring Fault Diagnostic, results in a fault of Ring Fault Diagnosis Carried Out being stored.
This fault memory is not a true fault memory entry, but only an output of additional information for relative node position.

Testing

Light Output Reduction

Reducing the light output of individual control modules is a convenient method of determining the area of a defect.

Switch on the radio.

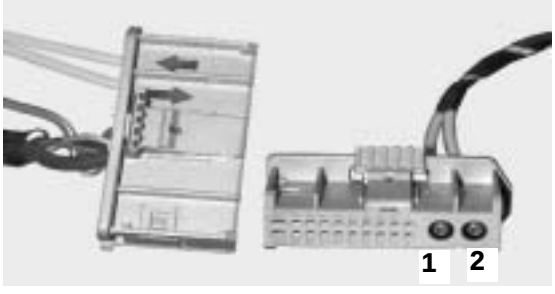
In Control Module functions, begin to activate luminous power reduction in the individual control module. (In this test the light output of the selected control module is reduced for 5 seconds and then automatically reset to normal output)

If the optical transmission for control module **A** to the next control module in the ring (control module **B**) is OK, a slight noise may occur when the light output is reduced however the radio will continue to play.

If the radio goes off and comes back on again(radio volume may be reduced) in 5 to 10 seconds, the optical transmission between control modules **A** and **B** is defective.

If the visual inspection is OK, the fault can be located using the OPPS tester or optionally performing the following tests.

- Remove the input optical wave guide from control module **B** and confirm the presence of light.
  If light is present, install by-pass optical wave guide in place of control module **A**, clear fault codes in module **B**. If MOST network operates properly, then control module **A** is at fault and must be replaced.
  If MOST network still has a fault, put module **A** back in the network and by-pass module **B**. Clear faults.
  If MOST network operates now problem is with control module **B** and it must be replaced.



- If light is not present at input of module **B**, perform ring break diagnostics.

Ring Break Test

If there is a break in the ring (a defect between two control modules) the following fault patterns may occur:

- Transmit diode of the transmitting control module defective
- Power supply of the transmitting control module defective
- Internal control module fault of the transmitting control module
- Receiver diode of the receiving control module defective
- Power supply of the receiving control module defective
- Internal control module fault of the receiving control module
- Optical wave guide between transmitting and receiving control module defective

These faults may occur alone or in combination. To diagnose a ring break, the first step is to locate the two control modules between which the transmission failure has occurred.

This is accomplished with the ring break diagnostic function. Once the two control modules have been identified and the diagnostics have been performed, remember to check the power supply and ground circuit of both modules before condemning a module.

Testing of the transmit/receive diodes will be possible using the OPPS tester.

Perform Ring Break Test

The ring break test mode is entered automatically when the power to all the modules in the MOST network is switched off and then switched back on. The most effective method of switching the power off and on is to disconnect the battery negative terminal for 45 seconds. This time will allow the capacitors of all the control modules to dissipate.

When the battery is reconnected the control modules wake up and in MOST network order transmit a light signal to the next module. Each module checks to see if it has received a light signal from the previous module. If the control module does NOT receive a light input signal it still transmits a signal to the next module. A relative node number of 0 is stored in the control module that did not receive a signal but that transmitted one.

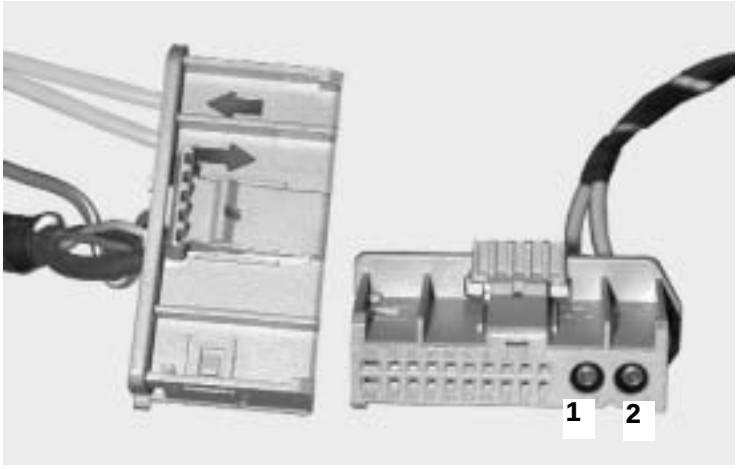
The Control Display receives the light signal back and identifies which modules responded. Go to “Control Unit Functions” Control Display Gateway and read fault memory.

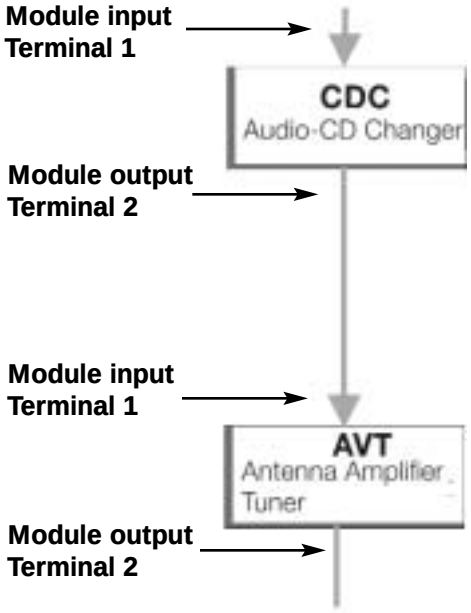
The Control Display will display a relative node number. This number will indicate how many modules communicated after the module which set the relative node number of 0.
To find the control module with the relative node number of 0, count from the input side of the Control Display (counting the Control Display as 0) towards the control modules. When arriving at the control module with the number as displayed as the relative node number in the DISplus, the last known communicating module has been found.

Example:

While performing the ring break diagnostics the Control Display has set a relative node number of 2. Count the Control Display a 0, the Kombi will be 1 and the ASK will be 2.
The ring break occurs between the ASK and the module which precedes it, the telephone module.

Important
When counting control modules, the multimedia changer (if equipped) and the Nav system must be counted as two control modules.
In order to perform the count correctly the equipment on the vehicle must first be identified.
When using the MOST network diagram in the DISplus, connector number 1 of the optical waves are inputs and connector number 2 are outputs.





Workshop Hint

For repair of MOST optical wave guide use special tools:
61-4-320 Crimping Tool Kit
Refer to **EPC 61_1578** for specific optical wave guide repair parts.

Workshop Hint

When preparing to initiate a Ring Break Test it is very important that the removal and reinstallation of the battery cable be quick and without hesitation.
Hesitation removing or replacing the battery cable may cause voltage spikes that will render the Ring Break Test void.

Status Wakeup

MOST control modules require high current during standby operation and must be disconnected or put in sleep mode to prevent the vehicle battery from being discharged. In case of a fault on the the MOST network that continuously wakes up, the entire MOST bus will be woken up. The Control Display will wake up the CAN Bus and all the vehicle busses will be woken up. This will lead to battery discharge.
It is of great benefit to know which module initiated the wake up call. In order to find out which MOST node woke up the MOST bus, the following procedure is performed:

In Control Unit Functions, press “STATUS WAKEUP”

Three different response are possible:

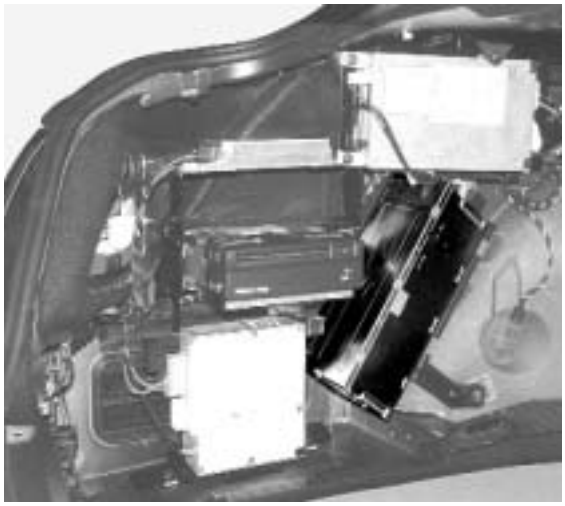
- Control Module woke up
- Control Module woken up
- Control Module not initialized

The Control Module with the status “Control Module woke up” is the module that woke up the rest of the MOST bus.

This diagnosis only informs which control module woke, not the reason for the wake up, diagnostic testing should be performed on the control module and related equipment.

Hints for Vehicle Equipment Identification

- CDC - Look on passenger side of dashboard above glovebox.
- Logic 7 - Look for speaker grills on rear doors
  Look on left side of trunk for large amp.
- MMC - Look on left side of trunk.



Workshop Hint

Telephone modules may be swapped from vehicle to vehicle for testing purposes, however if the original telephone module is not returned to the original vehicle the Emergency functions will not operated properly.
In case of an accident, information regarding location and VIN will not be correct therfore help will not be dispatched.

OPPS Diagnostics

Customer Complaint: Navigation and Radio not functioning, CD appears to be locked up.

Diagnosis: Perform Short Test Using Standard Diagnostic Head

Which MOST bus components are found?_____

How are these components found by the DisPlus?_____

What procedure will be used to diagnose the MOST Bus?_____

_____

What happens when this diagnostic procedure is used?_____

If a Ring Break Test is performed, what node number is given?_____

At this point what diagnostic path would be followed?_____

_____

Diagnosis with OPPS

Connect the OPPS to the vehicle using the proper Diagnostic cable PN _____. (Don't forget, some diagnostic operations will occur in the luggage compartment)

Attach the OPPS to the OPPS connector in the vehicle using fiber optic cable PN _____.

Perform Short Test

Which MOST Bus components are found?_____
Is this different than in the previous test? Why?_____

_____

Follow the DisPlus Test Plan Procedures for testing the light output of suspect components.

What diagnostic path is followed now? Why?_____

_____

_____

Review Questions

1. The MOST messages are divided into three parts. Name the three parts.

2. What component in a control unit converts the electrical signals into optical signals?

3. Name the functions of the Network Master of the MOST network.

4. What is the maximum number of sounds that may be produced simultaneously?

5. Name the control units of a typical MOST bus in the direction of flow of the optical signal.

6. When performing a Luminous Power Reduction, the radio goes off and comes back on at a lower volume, what could be the problem?

7. Using the schematic on page 11(a fully optioned vehicle), the Control Display shows a relative node number of 8. Which control module is identified as the last known communicating module?