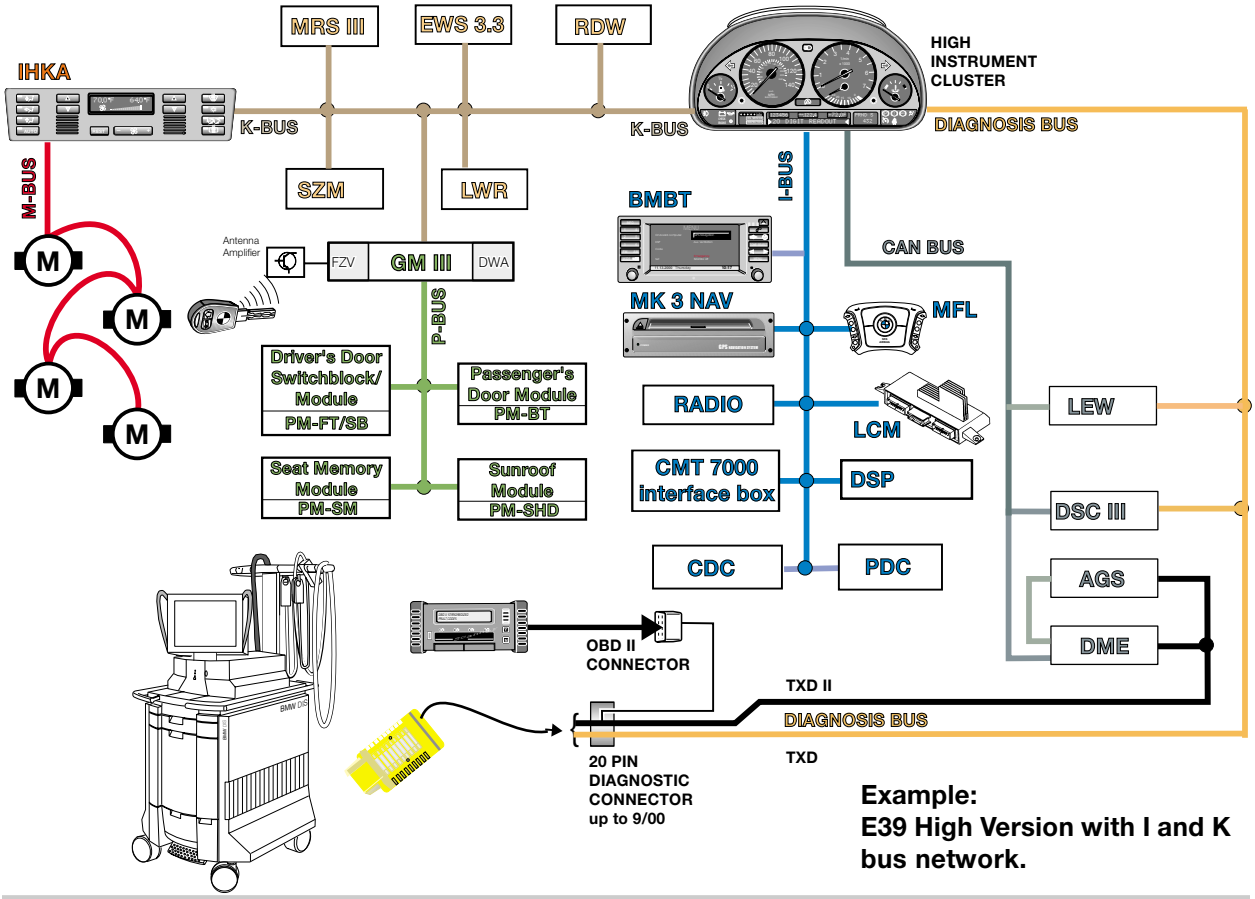
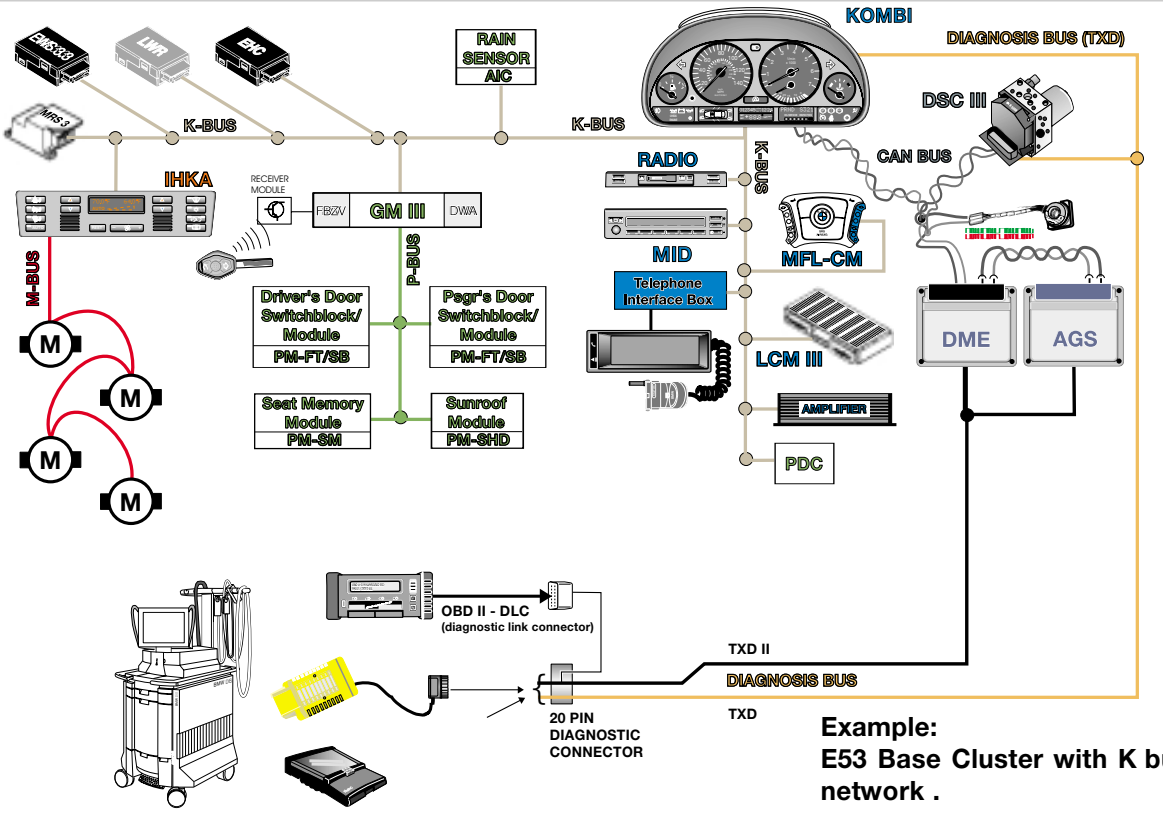
I/K Bus Topology



Example:
E39 High Version with I and K bus network.



Example:
E53 Base Cluster with K bus network .

The I/K bus consists of a single copper wire. The wire color of the I and K bus is uniform throughout the vehicle with: I-bus WS/GR/GE and the K-bus WS/RT/GE **(Note: 2001 E39s with base Kombi have changed K-bus wire color to the same as the I-bus, WS/GR/GE)**.

Due to the linear structure of the network, the I/K bus is available for other modules in the event of a disconnected or failed control unit. Just as the CAN bus, this is referred to as a "Tree" structure with each control unit occupying a branch. The I/K-bus provides the diagnostic connection to the control units located on those busses (except IKE/KOMBI).

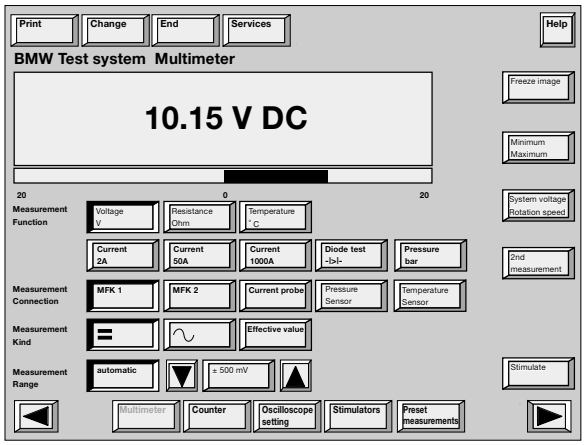
Always refer to the ETM to determine the exact wiring configuration and color for a specific model.

Troubleshooting the I/K bus

The failure of communication on the I/K bus can be caused by several sources:

- Failure of the bus cable.
- Failure of one of the control units attached to the bus.
- Failure of the voltage supply to individual modules.
- Interference in the bus cables.

The I/K bus is active when KL R is switched on, it remains active until 60 seconds after the last message. If the key is switched off (KL30) the bus may be activated for a time by individual users via a "wake-up" message.



Unlike the CAN bus where each control unit (subscriber) provides voltage for communication, the I/K-busses use only determined **Master** or **Stand-by Controllers** to supply $B^+$for communication. The voltage level on the I/K bus must be above 7V. The nominal value should be close to the system voltage of the vehicle.

Just like the CAN bus, the fact that voltage is present does not mean that the bus is fault free, it just means that the voltage level is sufficient to support communication.

Control units that provide operating voltage to the I/K bus are:

On E38 and E39/E53 High version vehicles:
- The LCM is the Master Controller of the I-bus. The IKE and MID/BMBT are Stand-by Controllers.

- The GM is the Master Controller of the K-bus.

On E46, E52 and E39/E53 Base version vehicles:
- The GM is the Master Controller for vehicles equipped with only the K-bus.

- The LCM/LSZ is the Stand-by Controller.

Failure of the Bus cable
The following faults can occur to the I/K bus wiring:

- Short Circuit to B^+
- Short Circuit to B^-
- Bus line down (open)
- Defective plug connections (damaged, corroded, or improperly crimped)

Short Circuit to B+: Modules that send a message see that the message was not received and that the bus remains high. However, subscribers are unable to decide whether the fault is due to a shorted line or a defect in the communication interface. The module will repeat its message 5 times before discontinuing and faulting. The module will continue to operate as normal minus any commands that could not be delivered by the bus.

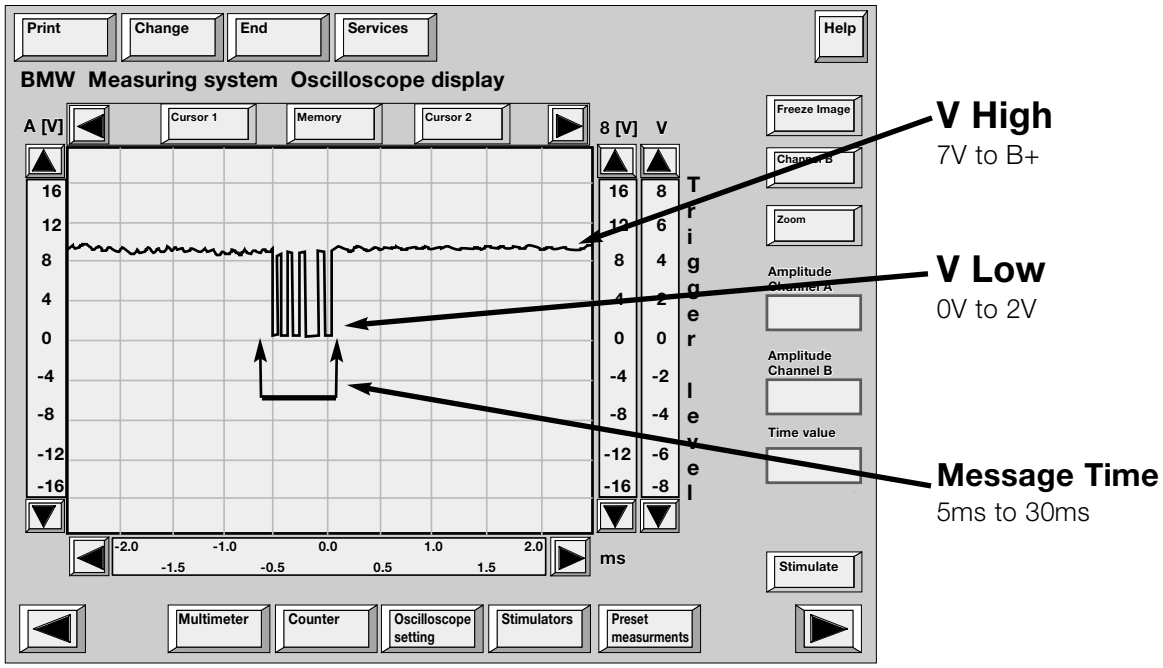
Short Circuit to B-: The subscribers do not interpret a low bus line as a fault but just as a bus line deactivation. The Master and Standby controllers do detect the short and enter it as a bus fault. (No communication).

Bus Line Down: The bus line may be open at any of several locations. As long as the Master or Stand-by is still connected, communication can occur with any modules still remaining. The fault situation will be the same as if the disconnected modules were defective themselves.

Checking the bus line is carried out just like any other wiring. Perform continuity tests between the connections of different modules (all modules disconnected) without forgetting to make sure that the bus has not shorted to ground or another wire. **It is recommended to use the "Wire Test" in "Preset Measurements" which is more sensitive than just a resistance check.**

If Voltage level and the wire test are O.K then looking at the communication signal may be useful. In order to get a signal, operate different devices on the I/K bus (e.g. MID/MFL) to stimulate conversations.

The following are some examples of scope patterns that may be observed when checking the I/K bus.



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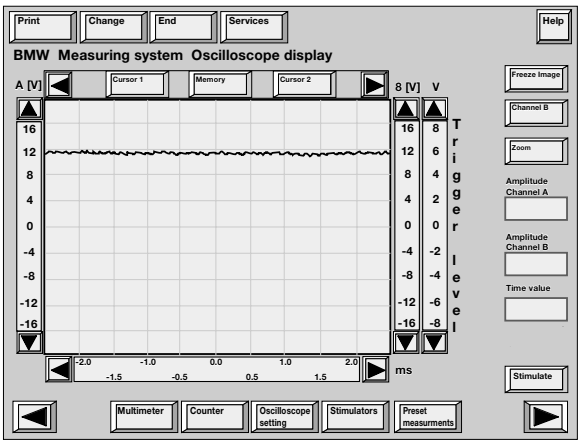
Example of correctly operating I/K bus *during* communication

Correct communication on the I/K bus occurs in sporadic bursts with periods of steady voltage around 12V.



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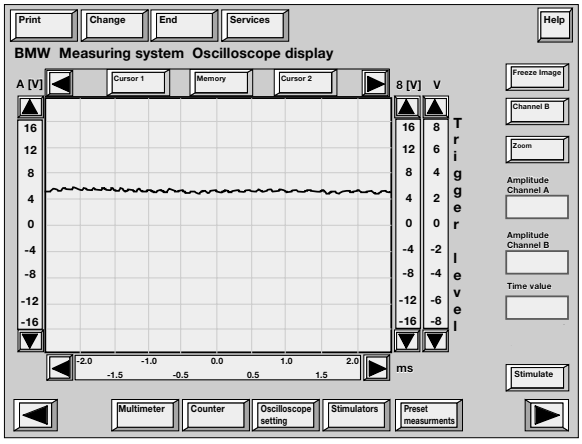
Flat line at 12 volts

No communication is currently taking place. The bus may be temporarily offline or shorted to B+.



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Flat line at 5 volts

No output voltage from the Master or Standby controllers. Bus line may be open or control unit may be defective.

Failure of one of the control units attached to the I/K bus.
Each control unit connected to the bus has an integrated communication module that makes it possible for that control unit to exchange information. Failure of a control unit normally triggers a fault code in the other control units connected to the bus.

As a quick check for the I/K-bus, activate the four way flashers. The flash indicators must light up in the instrument cluster. Switch on the Radio, and adjust volume using the MFL or MID/BMBT, the volume must change accordingly.

On High version vehicles press the recirculation button on the MFL, The IHKA should respond to the request. This test checks the gateway link as well as the the I and K bus communication.

If the tests prove O.K, this means that communication on the bus is O.K. Any faults still existing can only be related to faults specific to a control unit or a local I/K-bus wiring defect to a module.

There are instances where failures may be software related. A faulted module may paralyze or take down the entire bus. This scenario would be evident by functions not being carried out and and possible faults stored.

In order to isolate the defective control unit, the control units can be disconnected one at a time. Repeat the bus test after each disconnected control unit. If the disconnected control module is the defective one the faults will only point to communication with that interrupted module and no one else.

Once the module has been replaced (observing current S.I.Bs) and coded, perform the I or K bus Test Module in the Diagnosis Program to ensure that communication is O.K.

Failure of the voltage supply to individual modules.
A slowly dropping battery voltage on a vehicle with discharged battery can lead to sporadic communication faults in various control units on the bus. The reason is that not all control units will switch off communication at the same voltage level leaving some modules still trying to communicate. Always verify a properly charged battery and charging system and fuses before beginning troubleshooting on the bus. Also, do not forget to check for a proper ground to a control unit, this may not allow the bus to see a signal low (0-2V)

Interference in the bus cables.
Interference will have a similar effect to shorting or disturbing the bus wiring. Excessive interference created by a defective alternator or aftermarket devices such as cell phones or amplifiers may induce a voltage into the bus line and disrupt communication. This type of interruption may be intermittent and faults may only be stored in some modules and not in others. These faults are often difficult to reproduce. Isolate any aftermarket wiring in the vehicle and see if the fault returns.