INTERBUS

Conformance Test

Test Setups

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Test Setups for INTERBUS Basic Tests

Description of the Test Setup

A Generation 4 "IBS PC ISA SC/I-T" controller board has been selected for the test setup. An Optomux interface converter is used to establish an optical fiber connection.
Alternatively, an "IBS PC ISA/SC/RI-LK" controller board is also supported by the software. The optical fiber connections are already integrated in this board.
An IBM-compatible PC with an ISA interface is needed to operate this board. Additional conditions are set by the "ENVI 2" test program.

The structure of the conformance test for devices with a transmission rate of 500 kbaud is defined as follows:

Two ST stations are set up on each rack. Both stations supply the first station via a terminal block for an ST bus terminal and an ST 24 DI 16-4, and via an ST 24 DO 16/3 to the second station. The two I/O modules are connected with 1:1 on the application side and are used to determine data distortion.
Alternatively, an optical fiber bus terminal module or a copper version can be mounted in place of the bus terminal modules. If the copper version is used a PSM -EG-RS422/LWL-K must also be used.
In the INTERBUS configuration the test object is placed between the two stations and is connected to the stations via two 10 meter (32.81 ft.) long INTERBUS cables.
Separate "test blocks" for Loop or for Inline can be used instead of the test object.

The structure of the 2 Mbaud version is defined as follows:

One Rugged Line module of type IBS RL24-DIO 8/8/8-LK-2MBD and another of type IBS RL 24-DI 16/8-LK-2MBD are set up on the rack and are equipped with optical fiber interfaces.
The IBS RL24-DIO 8/8/8-LK-2MBD inputs and outputs for the 500 kbaud version of the 1:1 reference setup are connected with one another. The IBS RL 24 ADAP-LK/T (or -T/LK) adapter is also used for the copper version as a converter for connecting the control PC.

The basic setups are illustrated in the following diagrams.

Reference Setups for 500 kbaud INTERBUS Devices

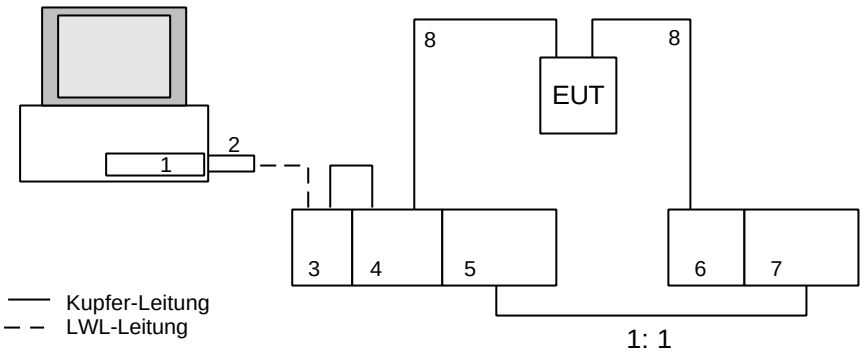


Figure 0-1 : Test setup for devices with RS-485 interface

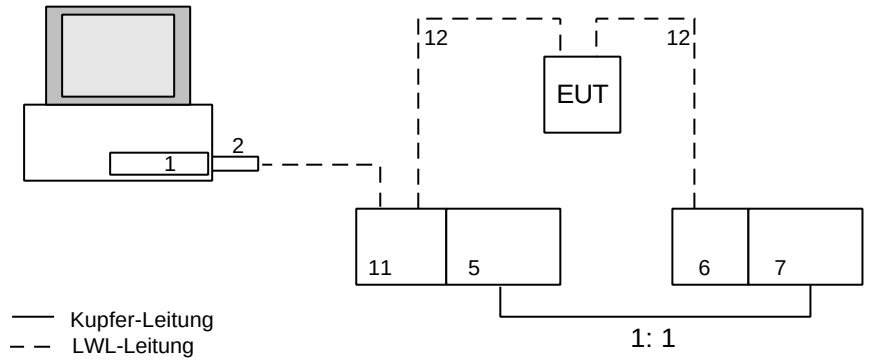


Figure 0-2 : Test setup for devices with optical fiber interface

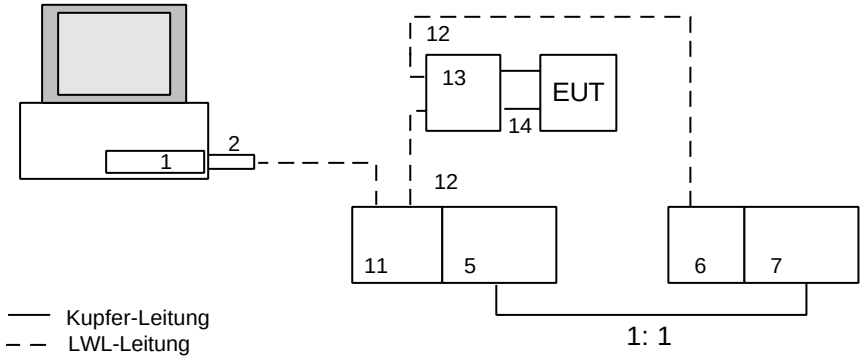


Figure 0-3 : Test setup for Loop 2/Inline slave devices

Reference Setups for 2 Mbaud INTERBUS Devices

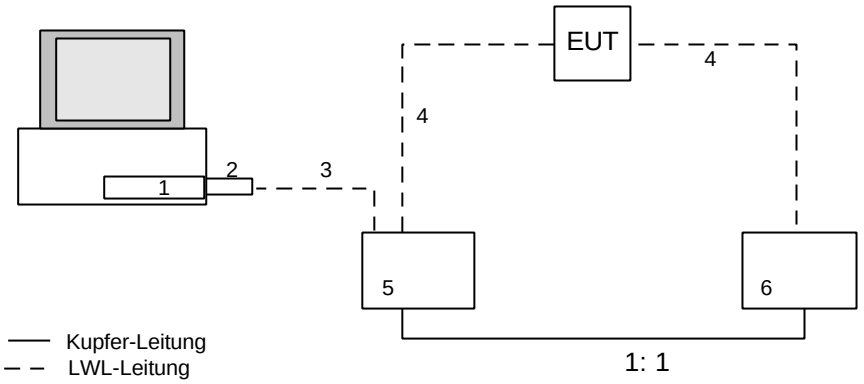


Figure 0-4 : Test setup for Rugged Line devices with optical fiber interface

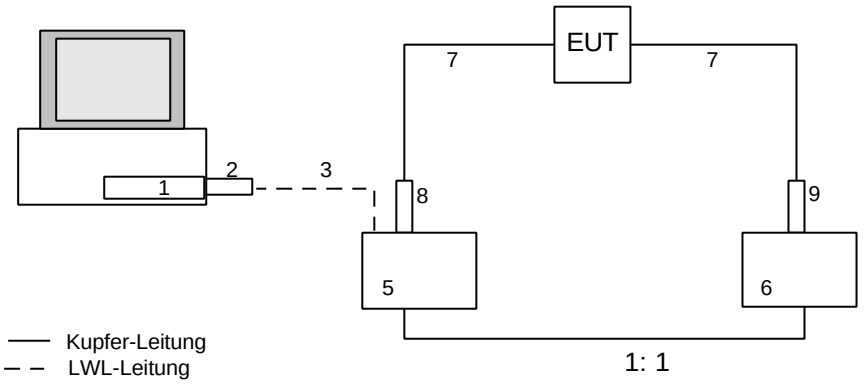


Figure 0-5 : Test setup for Rugged Line devices with RS-485 interface

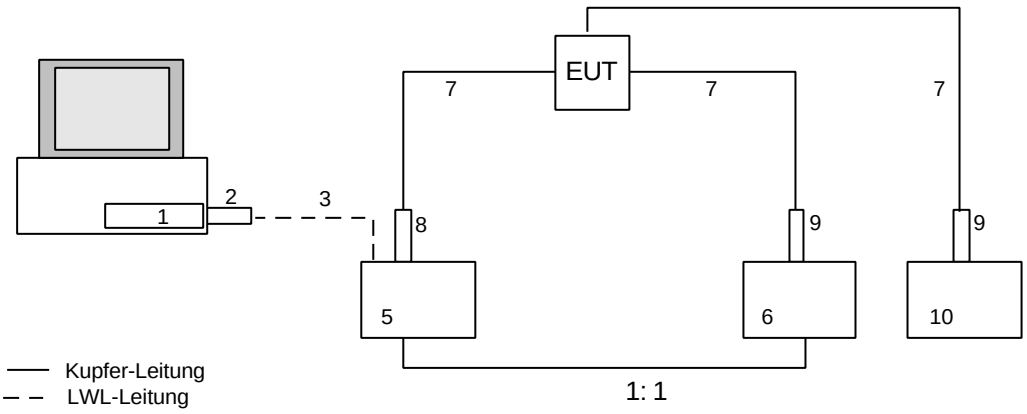


Figure 0-6 : Test setup for Rugged Line devices with RS-485 interface and remote bus branch

Reference Lists

Device Lists for the 500 kbaud Conformance Test Setup

No.	Designation	Order No.
1	IBS PC ISA SC/I-T	2750112
2	IBS OPTOSUB-MA/M/L-LK	2750112
3	PSM-EG-RS422/LWL-K	2761376
4	IBS ST 24 BK-T	2754367
5	IB ST 24 DI16/4	2754338
6	IBS ST 24 BK-T	2754367
7	IB ST 24 DO16/3	2754914
8	IBS RBC 10M-KONFEK-T	2750293
9	OPTOSUB-PLUS- K/IN	2799584
10	IBS OPTOSUB-MA/M/L-LK	2750112
11	IBS ST 24 BK-LK	2754435
12	PSM-LWL/KDHEAVY-2/70	
13	IBS L2 IP 24 BK-T	2732376
14	IBSL SLC CU2/1,5-10	

Table 0-1: Device list for the 500 kbaud test setup

Device Lists for the 2 Mbaud Conformance Test Setup

No.	Designation	Order No.
1	IBS PC ISA SC/I-T	2750112
2	IBS OPTOSUB 2MBd	2731458
3	Optical fiber conection to PC	
4	PSM-LWL/KDHEAVY-2/50	
5	IBS RL24-DIO 8/8/8-LK-2MBD	2731571
6	IBS RL24-DIO 8/8/8-LK-2MBD	2731571
7	IBS RBC 10 m	28 06 286
8	IBS RL 24 ADAP-LK/T	2725040
9	IBS RL 24 ADAP-T/LK	2725037
10	IBS RL 24 DI 16/8-LK-2MBD	2731584

Table 0-2: Device list for the 2 Mbaud test setup

Carrying out the Test

The ENVI 2 test program from the Fraunhofer Institute is used to carry out the test, which documents the test results in detail.
Burst couplings are enabled by the incoming and outgoing bus cable, the voltage supply, and the inputs and outputs.
All of the interfaces on the test object must be in use during the test.

The inputs are monitored by the ENVI 2 software and the fluctuations of the analog inputs are recorded.

A standard test setup for monitoring the outputs is not useful due to the amount of output data. A more comprehensive and expensive test setup is needed, and the operational safety of the test object is already tested during CE identification.

In the INTERBUS conformance test, interference on the inputs or outputs is useful when testing data distortion in the system, which is carried out in the test setup by the DI and DO modules.

The test program should evaluate the transmission rate to determine which test setup should be used for the test object. This means that with a transmission rate of 500 kbaud the reference setup of the ST series is used to evaluate the test results for the 2 Mbaud Rugged Line reference setup.

Test Setup

The test setup, test equipment, and test procedures are described in IEC 61000-4-4 and must be adhered to.

General Information About the Test Setup

All modifications to the test setup, e.g., the use of replacement modules or cabling, repairs to modules, etc. must be recorded in a log book.

After the interference has been measured a function test must be carried out on the test object.

The coupling clamp must always be supplied from the side that is specified in the test setups.

The test object is connected to PE according to the installation instructions.
- The grounding cable must be a minimum of 0.2 m (0.66 ft.) and a maximum of 0.5 m (1.64 ft.) long.
- The cross-section of the grounding cables must be a minimum of 1.5 mm² (16 AWG) and a maximum of 2.5 mm² (14 AWG).
- Only bushel connectors can be used to connect to the main plate.
- Devices installed on and grounded by a DIN rail establish a PE connection to the standard rail via a terminal block.

The test object is supplied with the nominal voltage (e.g., 24 V).

The cables that are used must be noted for all tests. It is always possible to use the cable described in the previous test setup.

The test setups described can be used for testing the supply voltage. The test voltage is supplied by the coupling network for the burst generator. The connection cable for the coupling clamp must also be removed from the generator.

If there are several supply voltages, they must be tested individually. The other voltages are placed together and supplied via an additional power supply unit.

If there are several voltage supplies that are not electrically isolated and have the same voltage, there must only be interference on the signals that are different.

The test setups for the majority of test objects differ mainly in the INTERBUS interface as well as the type of inputs and outputs. This is why all the test setups are illustrated in the following. Only those corresponding to the relevant product should be carried out.

Test Setup for 500 kbaud Test Objects With RS-485 Interface

The copper-connected INTERBUS interfaces and the voltage supply and the I/O devices are tested here. The corresponding remote bus cable, on which there is no interference, should be connected via the main plate on the return path of the test object.

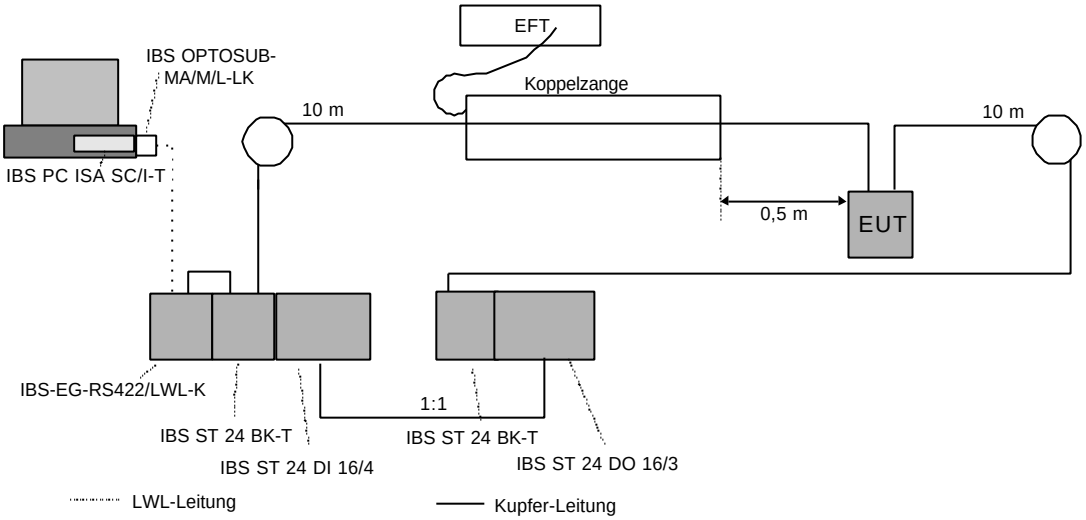


Figure 0-1 : Interference on the incoming remote bus (RS-485)

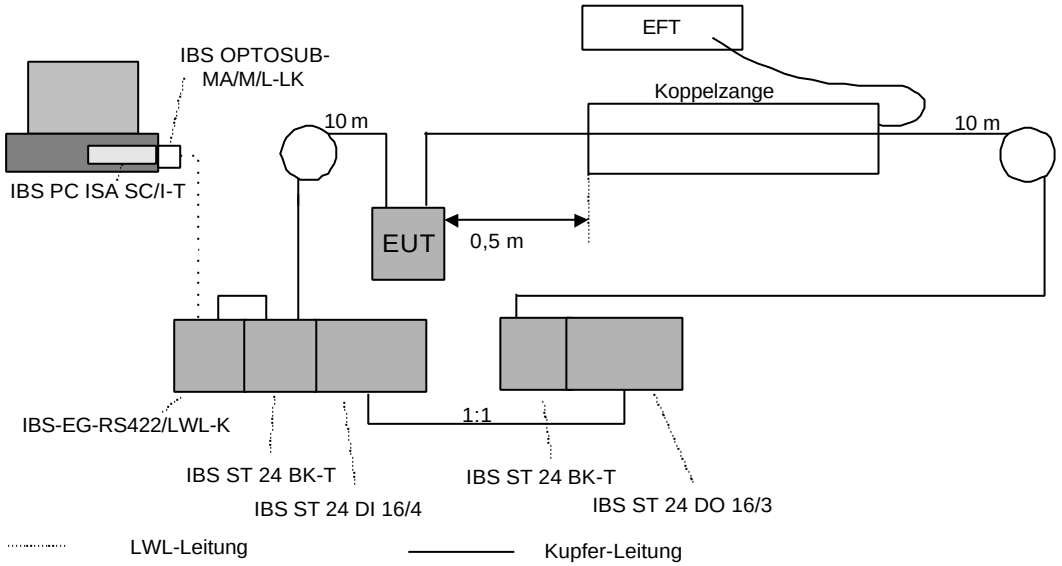


Figure 0-2 : Interference on the outgoing remote bus (RS-485)

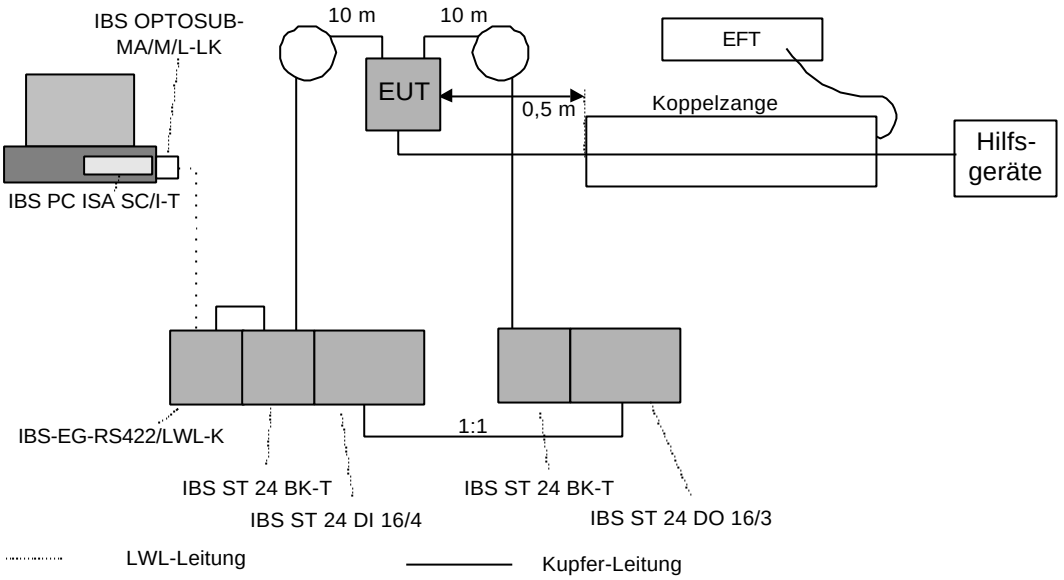


Figure 0-3 : Interference on the inputs or outputs

A test object must have a static bit pattern for data errors to be detected during the noise immunity test. Inputs or outputs must be set to ON as well as OFF for digital devices.
An input or output value is set in the middle of the range for analog devices (e.g., 5 V is used for an AI with 0-10 V).

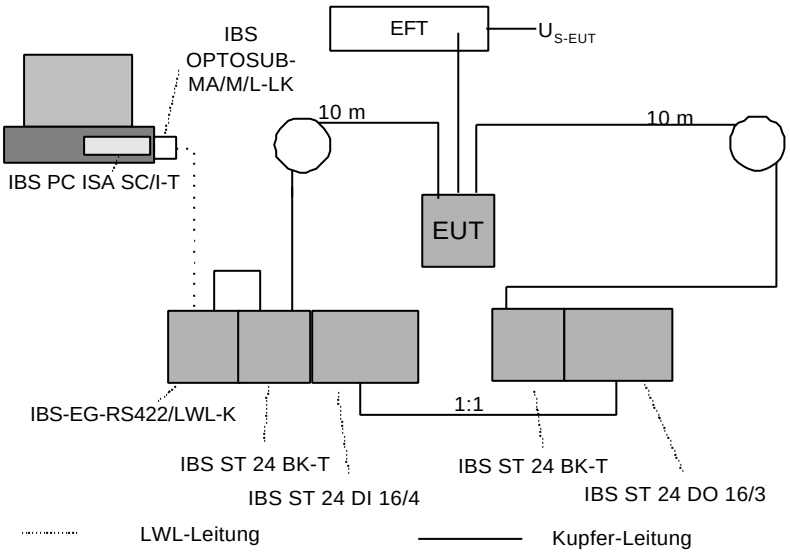


Figure 0-4 : Interference on the voltage supply

Test Setup for 500 kbaud Test Objects With Optical Fiber Interface

The voltage supply and I/O devices are tested here. The setups are intended only as an extension to the description of the test setups in section 2.3.

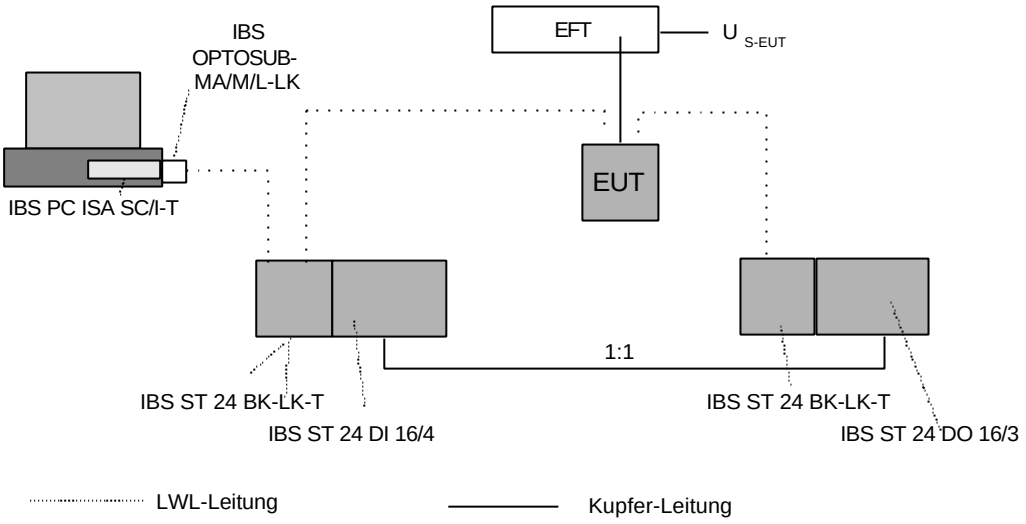


Figure 0-5 : Interference on the voltage supply (optical fiber)

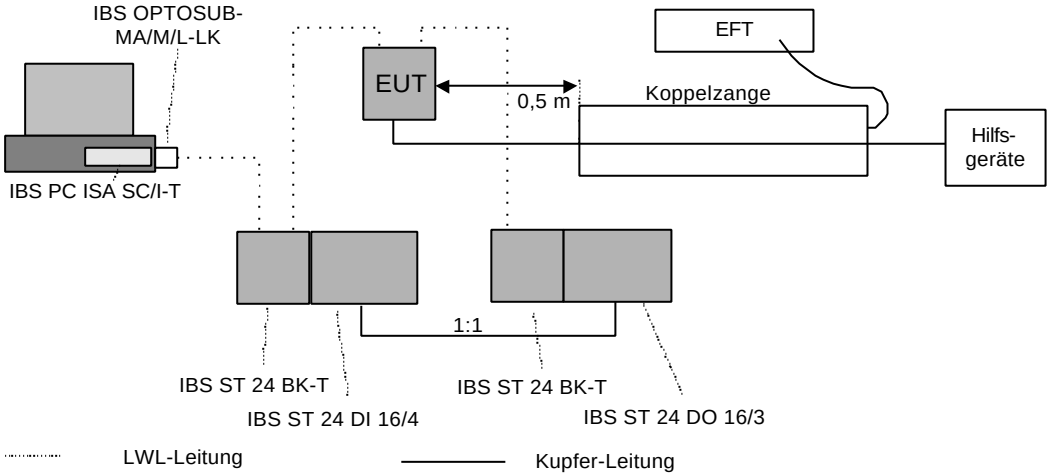


Figure 0-6 : Interference on the I/O cables (optical fiber)

A test object must have a static bit pattern for data errors to be detected during the noise immunity test. Inputs or outputs must be set to ON as well as OFF for digital devices.
An input or output value is set in the middle of the range for analog devices (e.g., 5 V is used for an AI with 0-10 V).

Test Setup for 2 Mbaud Test Objects With RS-485 Interface

The noise immunity test for 2 Mbaud devices is identical in principle to that for 500 kbaud devices.
Therefore, only an example of the test of the incoming RS-485 interface of 2 Mbaud devices is illustrated here.
The interference coupling to the outgoing interface, the supply, and the data inputs and outputs are identical to those shown in the diagram for 500 kbaud devices.

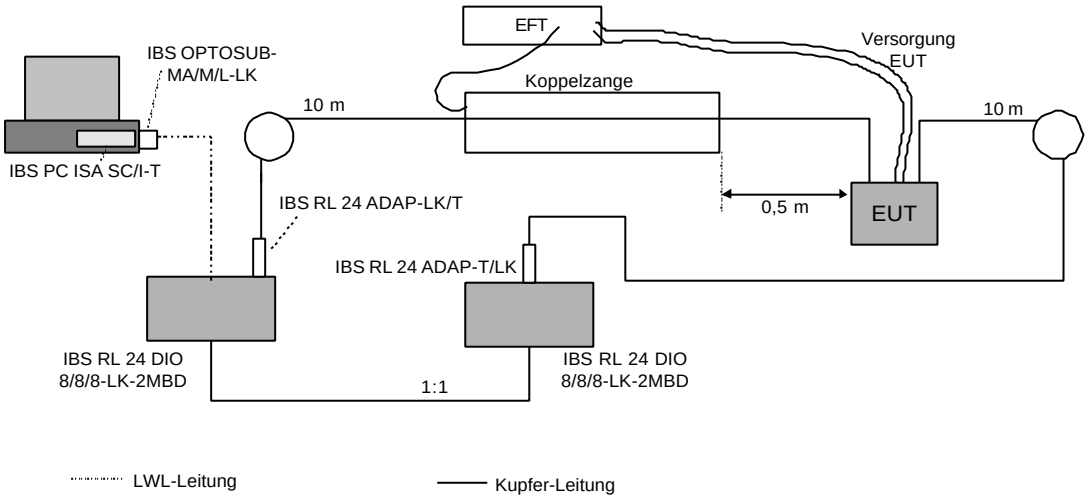


Figure 0-7 : Interference on the incoming remote bus (RS-422), for 2 Mbaud - test setup

Test Setups for Optical Fibers

Device Interfaces With IP 67 Rugged Line Technology

Preliminary Remark

According to the certification test instructions for HFBR1517 and HFBR1505C optical fiber transmitters, in addition to the circuit, the level and peak wavelengths of the transmitter, the receiver sensitivity and the FO1...FO3 display LEDs are also tested.
The necessary equipment must be provided for this.

Test Environment

INTERBUS Devices

There are two OPTOSUBS-OPC for the test environment, one for 500 kbaud and another for 2 Mbaud, and three optical fiber bus terminal modules for the simultaneous testing of all the interfaces of the test object. These test bus terminal modules have data rate switching, and generate the optical power for each Poti in a limited framework.

Optical Fiber Cable

Test objects with various connection methods are tested. This is why two different types of cable are used.

IP 20 Protection

The appropriate connection method for this degree of protection is INTERBUS FSMA. Cable types include the following:

1x 5 m (16.40 ft.) optical fiber POF cable with FSMA connectors for connection between Optosub and bus terminal module 1.
3x 2m (6.56 ft.) optical fiber POF cable with FSMA connectors for connection between devices.
1x Optical fiber POF cable as attenuation cable (60 m [196.85 ft.]) with FSMA connectors for measuring sensitivity.

IP 67

The appropriate connection method for this degree of protection is INTERBUS Rugged Line. Cable types include the following:

1x IP 67 Rugged Line reference cable (Rugged Line connector and FSMA connector)
1x 2 m (6.56 ft.) optical fiber POF cable with Rugged Line connector (voltage supply line [2 m (6.56 ft)] with banana connector) and FSMA connector.
2x 2 m (6.56 ft.) optical fiber POF cable with Rugged Line connector (no voltage supply line) and FSMA connector.
1x Optical fiber POF cable as attenuation cable (60 m [196.85]) with Rugged Line connector (voltage supply line [2 m (6.56 ft)] with banana connector) and FSMA connector for measuring sensitivity.

Connecting Voltage Supply Lines

The voltage supply lines are connected as follows:

Wire no. 1:	+24V (US1)
Wire no. 2:	GND (US1)
Wire no. 3:	+24V (US2)
Wire no. 4:	GND (US2)
Yellow wire:	FE

Combi cable wires are also marked accordingly.

Accessories

Additional accessories are available for assembling the Rugged Line connector and controling of the display LEDs. These include:

1x IP 67 Rugged Line tool for cable assembly (IBS RL FOC)
1x Reference source for the IP 67 Rugged Line reference cable test
1x Rugged Line measuring adapter for the Optical Power Meter OPM4 (for measuring sensitivity)
1x Rugged Line reference cable

To control the display of the FO1...FO3 LEDs the attenuation of the optical fiber path is increased until the LED lights up. This is done using a mechanical attenuator. It is used to manually increase the distance between the two FSMA connectors, which consequently increases the attenuation of the optical fiber path.

1x FSMA attenuator for testing FO1...FO3 LEDs
6x FSMA coupling

Manufacture and Testing of a Rugged Line Reference Cable

Materials Needed for Manufacture

Cable	1 m (3.28 ft.) PSM-LWL-RUGGED 980/1000
Connector	F-SMA2 connector from PSM-SET-FSMA/4-KT set
Rugged Line	IBS RL PLUG-LK/POF
Measuring device	PSM-FO-POWERMETER (OPM 4)
Tool	IBS RL FOC
RL reference optical source	
Constant current source	

Cable Assembly

Assemble the 1 m (3.28 ft) Rugged Line cable on one side with the 2 FSMA connectors according to the INTERBUS optical fiber installation guidelines IBS SYS FOC ASSEMBLY. Assemble the other side using the IBS RL PLUG-LK/POF (Rugged Line optical fiber connector) according to the package slip or the Rugged Line User Manual IBS RL SYS PRO UME.

Testing the Reference Cable With the Rugged Line Reference Optical Source

Supply the Rugged Line reference optical source with 60.0 mA (+/- 0.1 mA) via the two banana connectors using a constant current source. Connect the reference cable to be tested to the optical source and measure the optical power P_a and P_b at the end of the cable generated from the FSMA connectors for both connection directions at the reference optical source with the OPM 4 power meter. The cable can be used as a Rugged Line reference cable if both optical power values are greater than the optical power at the reference optical source.

For Rugged Line reference source no. 1020200 this optical power limit value corresponds to -6.7 dBm, i.e., optical power values measured with this optical source must be > -6.7 dBm.

Measuring Sensitivity

Structure

The structure of the system is shown in the diagrams below.

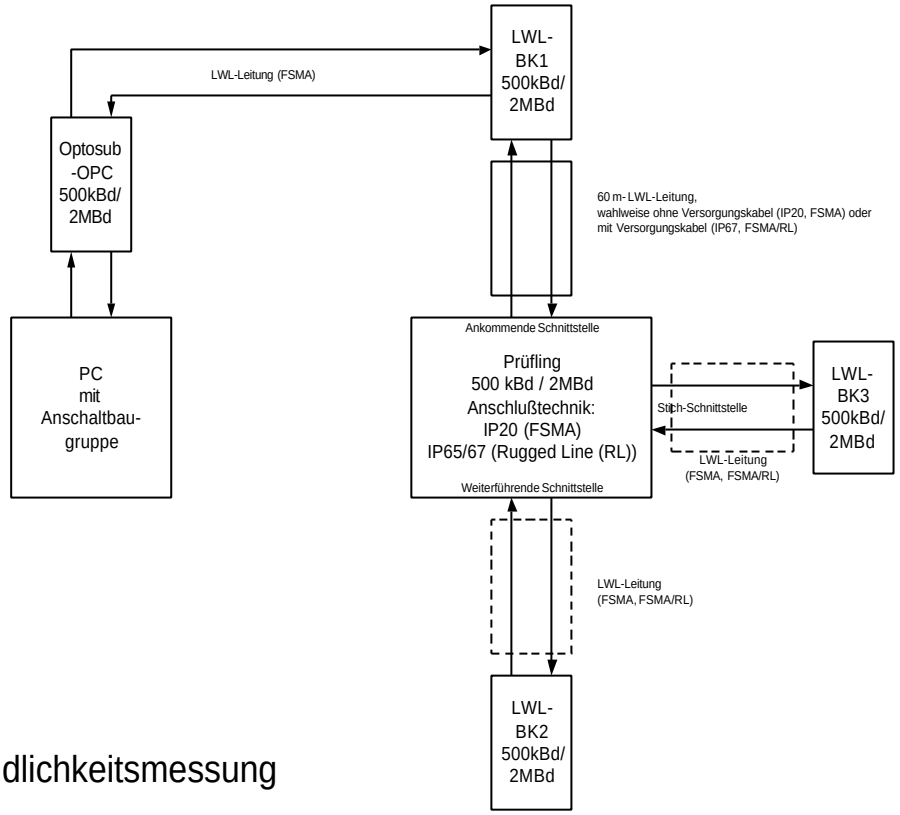
Measuring

Each interface on the test object is measured in the same way, regardless of data rate and connection method. The optical fiber cable to the Optosub is isolated to prevent data transmission and the voltage supply is switched on (Power-UP). This means that there is a constant supply of optical power to the test equipment as well as to the test object. An appropriate attenuation cable (depending on the connections methods - IP 20 or IP 67) (60 m [196.85 ft.]) is connected between the interface to be tested on the test object and the corresponding interface for the test equipment.

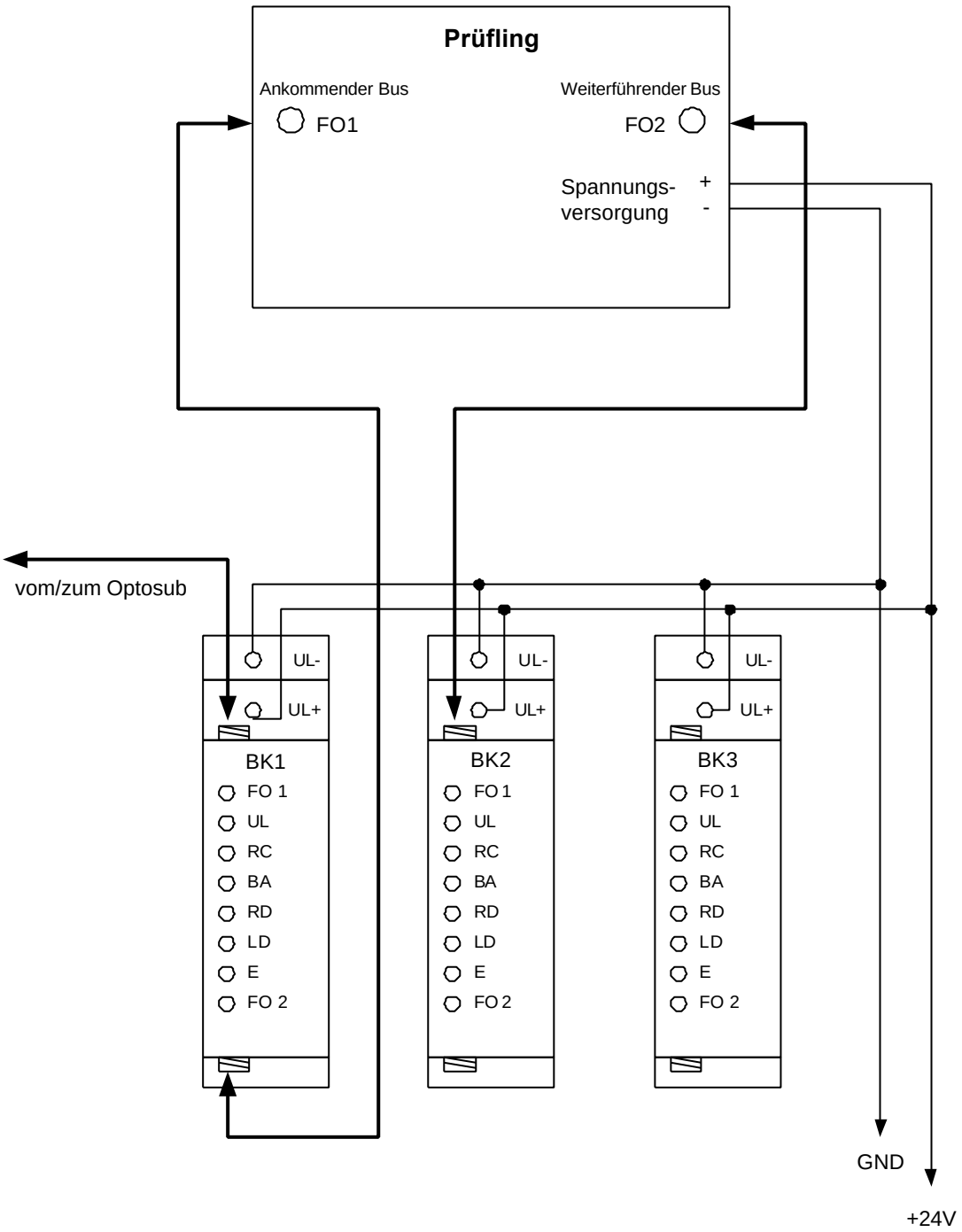
At the end of the cable to the test object the optical power is measured with the optical power meter (OPM 4 with corresponding adapter). When varying the optical power to the test bus terminal module that is transmitting, the optical power is set to -17 dBm +/-0.25 dB. If possible, the lowest value should be used: -17.25 dBm. The cable is then connected with the test object interface, the connection between the Optosub and the first test bus terminal module is reestablished, and INTERBUS is started.

The bus is **set** to the **ACTIVE**, **READY**, and **RUN** states, and is then brought into operation. This process is controlled by the detection of control levels in the data paths being tested. The corresponding control level must not be greater than 14, otherwise the optical diagnostics and control of the system cannot be implemented. For test objects with the Rugged Line interface, which have two connector directions, sensitivity must be measured on each interface. The horizontal direction is measured first, then the vertical direction.

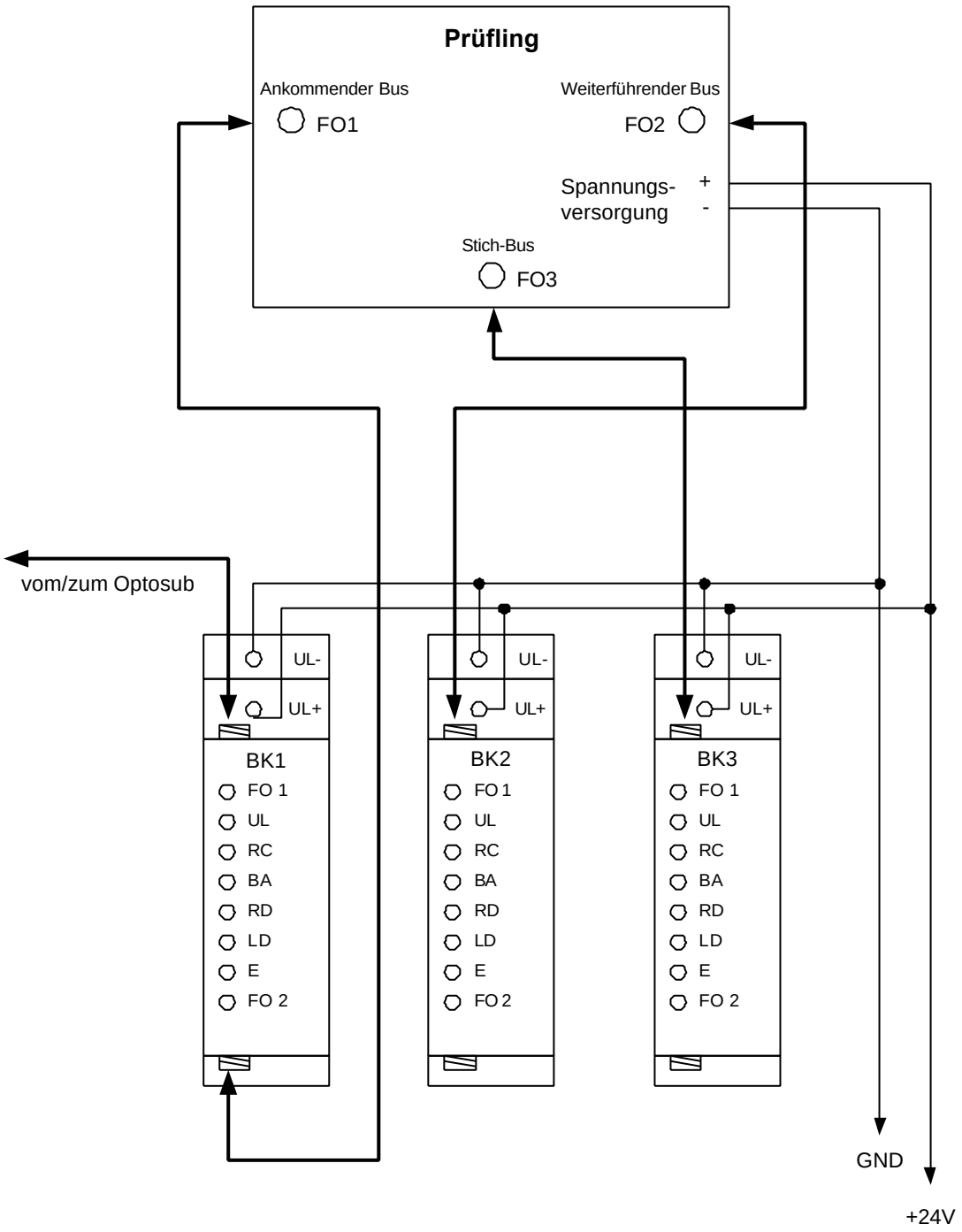
After determining the level of control, data is transmitted error-free in controlled operation for at least one minute. The corresponding FOx LED for the test bus terminal module that is transmitting must not be lit. This procedure must be repeated for each of the interfaces to be tested.



Empfindlichkeitsmessung



Empfindlichkeitsmessung
Aufbau Fernbusteilnehmer mit zwei Schnittstellen



Empfindlichkeitsmessung
Aufbau Fernbusteilnehmer mit drei Schnittstellen

Controlling the Display LEDs for Optical Fiber Diagnostics

Structure

The structure of the system is shown in the following diagrams.

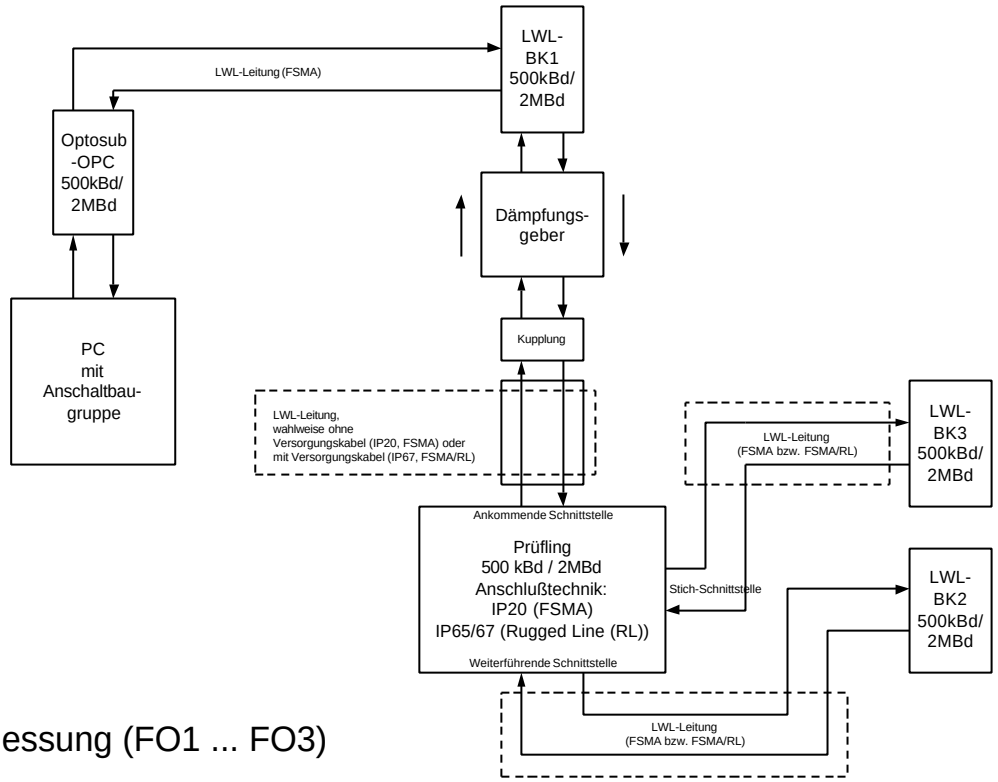
LED Control

INTERBUS optical fiber devices with optical link diagnostics and optical fiber path regulation indicate any deterioration in data transmission externally by increasing the attenuation of the FO1 to FO3 display LEDs. If the LEDs are lit during bus operation, the system reserve is used temporarily. This behavior is also sent as data to the master. The operation of the LEDs must be checked.

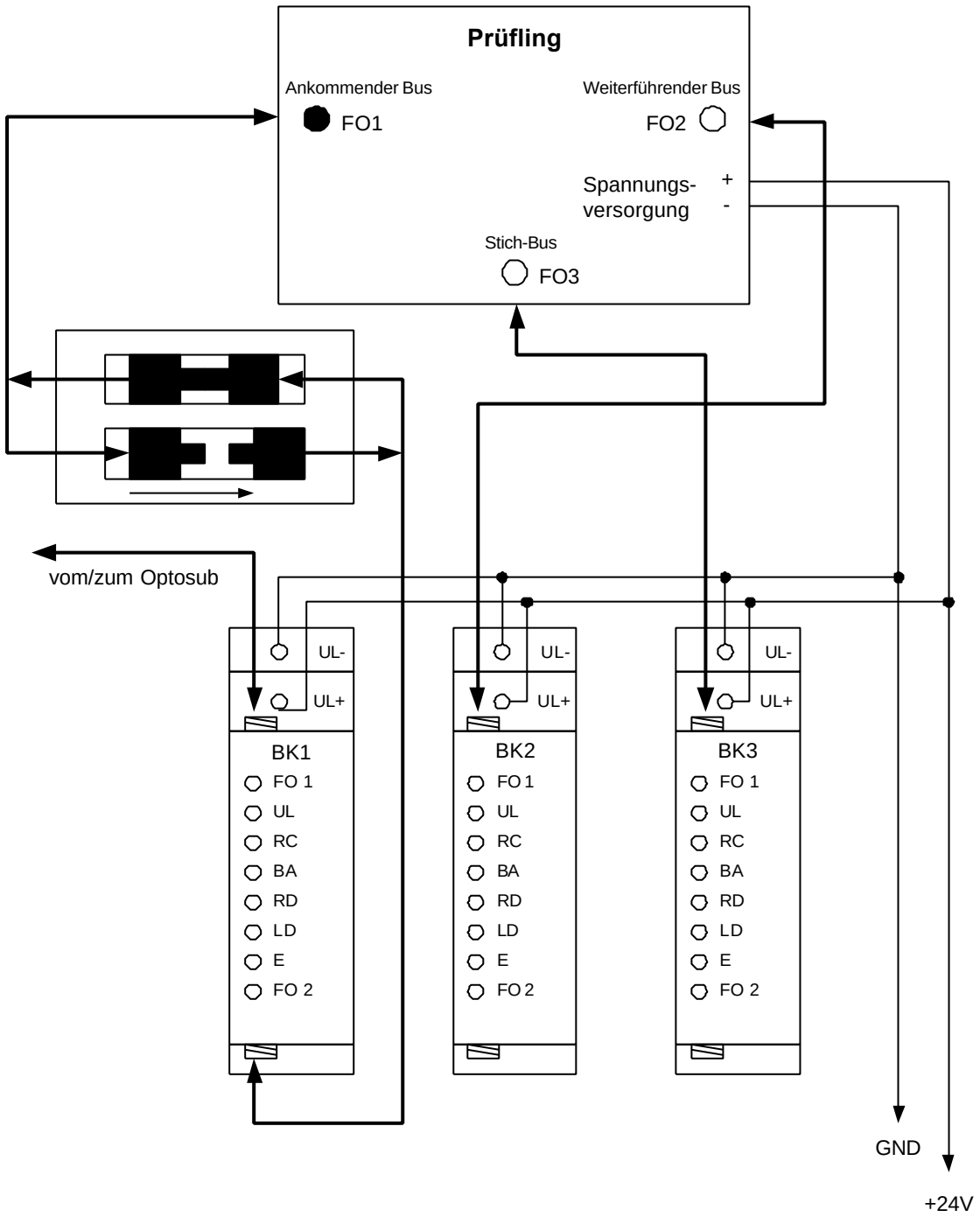
A mechanical attenuator is connected to increase the attenuation between the path of the test bus terminal module and the test object. After INTERBUS startup the path attenuation is increased by increasing the distance in the attenuator. The distance is varied until the display LED lights up. This procedure must be repeated for each of the interfaces to be tested.

An example of how the attenuator is used is shown in the diagram below. The data forward and return path designation correspond to the test object, i.e., the data forward path is the path on which the transmitter sends data to the interface being tested (to the receivers of the test bus terminal module). The data return path is the path on which the transmitter sends data to the test bus terminal module (to the test object receiver). It is not necessary to test the data return path, because the test bus terminal module LEDs are not being tested.

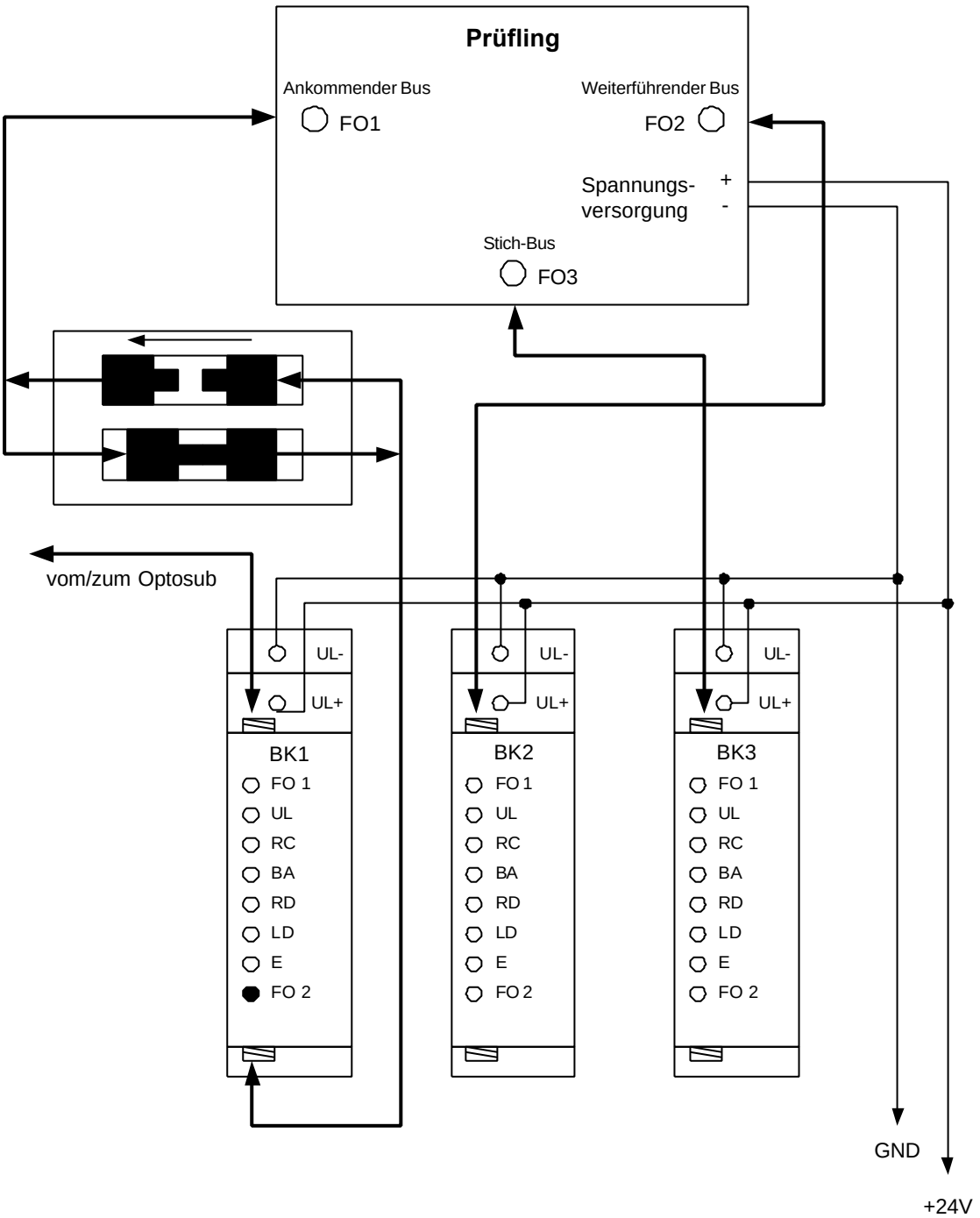
For devices with Rugged Line connection, this test must only be carried out in one connector direction.



LED-Messung (FO1 ... FO3)



Aufbau LED-Überprüfung
Test ankommende Schnittstelle - Datenhinweg



Aufbau LED-Überprüfung
Test ankommende Schnittstelle - Datenrückweg