

OPBM04 Optical Multiplexer Profibus/RS485

Ordering data

Designation	Type	Item no.
Optical multiplexer Profibus/RS485 (standard optics)	OPBM04	141 100 xx AX
Optical multiplexer Profibus/RS485 (BiDi optics)	OPBM04	141 100 52 AX



- Conversion of up to 4 electrical Profibus/RS485 interfaces into one or two optical ones and vice versa
- Use in existing Profibus fieldbus networks
- (Optical) Transmission range up to 15 km
- Two optical ports and four electric ports
- Optical LED status indication
- Insensitivity to EMC
- Type of protection: I M1 Ex ia op is I Ma

Application

The optical Profibus/RS485 multiplexer of type OPBM04 is designed for use in optical fieldbus networks. It allows conversion of up to 4 electrical Profibus/RS485 interfaces into one or two optical ones and vice versa. The use of an intermediate FSK Profibus modem of type PBM01 even allows connecting the OPBM04 to Profibus FSK networks. Thus, the module can be integrated into existing Profibus fieldbus networks or devices with RS485 interface, offering the advantages of the optical transmission technology such as insensitivity to EMC and high transmission range. Likewise, a complete Profibus/RS485 network can be configured with the modules in a linear, star or ring topology as well as any combination of these topologies. To increase the reliability of the fieldbus network in case of failure, the OPBM04 supports designing redundant rings. The OPBM04 has two optical ports and four electrical (RS485) ports. The electrical (copper) ports are connected to two 6-pin plug-in terminal blocks.

The OPBM04 meets category / degree of protection I M1 Ex ia op is I.

Activation of the integrated terminating resistors for the electrical (RS485) ports is possible through switch-on of DIP switches SW1 (Bus 1, Bus 2) and SW2 (Bus 3, Bus 4) which are accessible in the front panel.

In the standard version, the fibre-optic cables (single-mode, 9/125µm, 1310nm) are connected with plug-in systems of type Diamond E2000 (with 8° angled polished contact).

Also available is an OPBM04 version which uses FOC transceiver modules with BiDi optics. These modules use the same fibre (thus one fibre only) for the transmitting and receiving direction by operation with an optical wave length of 1310nm in one direction, and operation with one of 1550nm in the other direction. The connection is established with an SC plug-in connection. Thus, one fibre less is required versus the standard version (Diamond E2000 transceiver module with RX and TX port). In both cases, the optical transmission range is ≥ 15 km.

The OPBM04 automatically detects the data rates 9.6 kbit/s, 19.2 kbit/s, 93.75 kbit/s and 187.5 kbit/s on the copper interfaces. The received data packets are processed in a time frame, thus enabling that the set-up of topologies consisting of any number of OPBM04 modules is possible. The logical states "1" and "0" of the electrical Profibus/RS485 interfaces are multiplexed and transmitted onto the optical interfaces with a "bi-phase" encoding. This encoding allows clock recovery at the receiving end. Various error messages are available as a group signal at a signalling contact (potential-free optocoupler contact). This contact is accessible at terminals K1 and K2. The contact will close, as soon as both optical links function trouble-free and no bus error is detected at the electrical Profibus/RS485 port. The contact will open, if one of the optical links is disrupted or a zero level of excessive duration is detected. The contact will

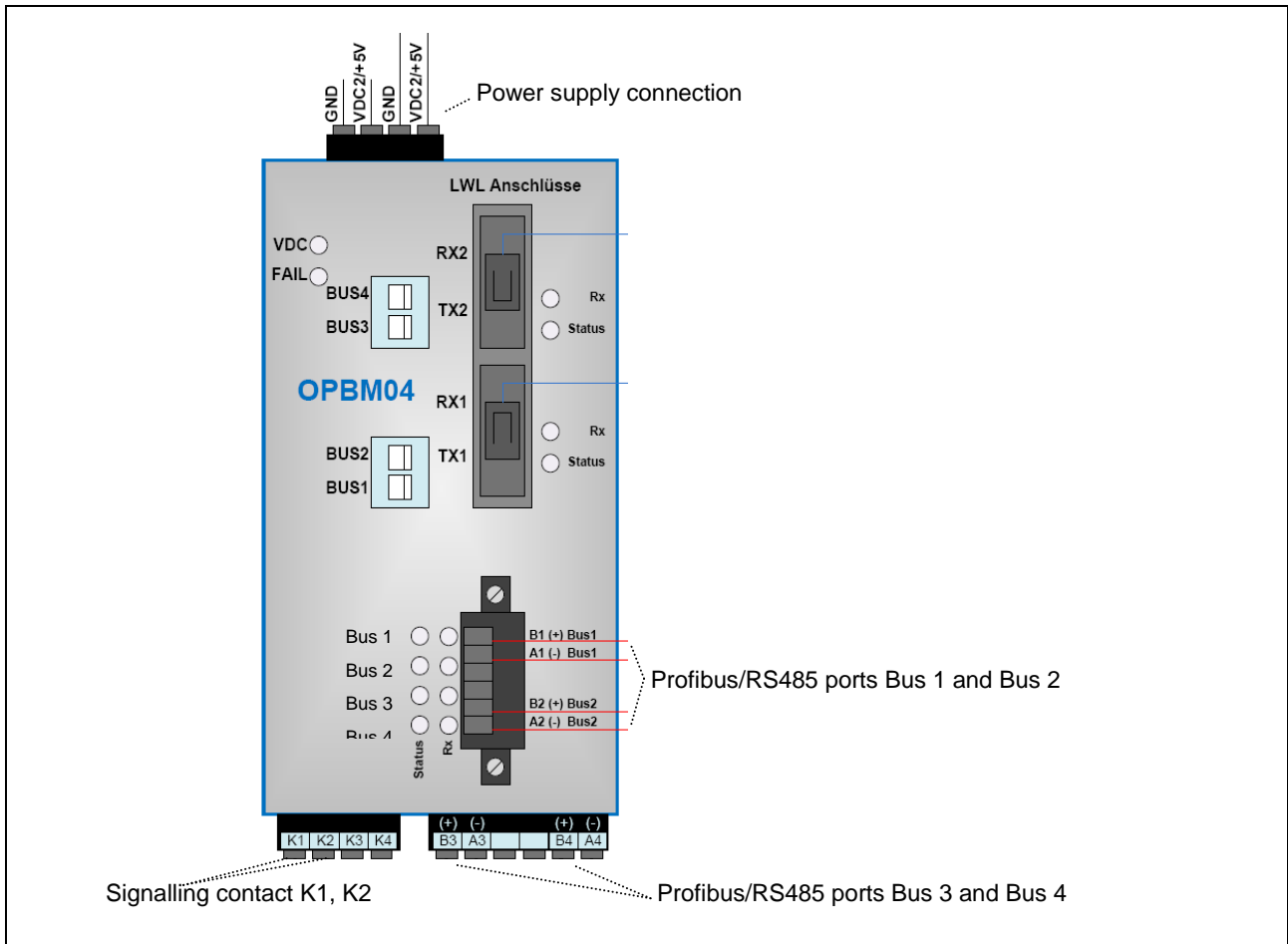
also open, if no 5V supply voltage is applied.

Configuration

The module housing consists of two half shells (material: stainless steel - nrSt) plus one front panel (insulating material) with an adhering printed foil. The two half shells are provided with recesses for the three plug-in terminal blocks for supply voltage connection, optocoupler output contact and Profibus/RS485 bus ports Bus 3 and Bus 4. Inside the housing, the "supply" board is screw-mounted on the left half shell on stud bolts, while the "logics" board is fastened likewise on the right half shell. The two housing half shells are screw-mounted to the front panel by means of 4 bolted joints and connected with each other on the housing rear side by means of another 2 bolted joints. On the housing rear side an aluminium snap-open mechanism for 35mm top-hat rails is fastened.

The front panel features an adhering foil with the imprinted markings for fibre-optic cables, Profibus/RS485 connections BUS1 and BUS2, DIP switches (SW1 and SW2 for activation of the RS485 terminating resistors) as well as display LEDs. The front panel is provided with the corresponding recesses for plug connectors, DIP switches and LEDs. The foil in front of the LEDs is transparent. The 5V power supply shall be connected to the 4-pin plug-in terminal block at the housing top. The two plug-in terminal blocks optocoupler output (4-pin) and Profibus/RS485 BUS 3 and BUS 4 are located at the housing bottom side. They are marked with plastic labels. Likewise, the marking of the module with manufacturer logo, type designation, type of protection, approval number and operating temperature range is given on a plastic label on one of the housing side walls.

Device overview



Initialisation of devices

After switch-on of the devices, the used Profibus data rate is detected. After the data rate is identified, the data transmission is switched on. When slow data rates are used in large ring topologies, it may take several seconds until all devices have identified the data rate and the ring is closed. Likewise after a data rate reset, errors may occur in the data communication until all devices have identified the new data rate.

The Fail-LED will be lit until a data rate is successfully identified for the first time. After successful data rate identification, the Fail-LED will only be lit, if a bus error occurs.

The OPBM04 optical multiplexer Profibus/RS485 is supplied with a nominal voltage of 5 V_{DC} via a 4-pin-in plug terminal (voltage U_i = 5.5 V). The plug-in terminal (V_{DC1}/5V / GND, V_{DC2}/5V / GND) is assigned pairwise to +5V / 0V and thus allows looping through the supply voltage.

The module features the following LEDs to display the different operating states:

V_{DC} (green): The 5V supply voltage is applied.

Fail (red): The red Fail-LED is connected directly to the error output contact (terminals K1 – K2) and is lit when the contact is open. The optocoupler contact will close as soon as both optical links function properly and no bus error is detected at the electrical Profibus/RS485 ports. The optocoupler contact (high resistance) will open, if one of the optical links is disrupted or a zero level of excessive duration or a data packet of excessive length is detected at the electrical port. The optocoupler contact will also open, if no 5V supply voltage is applied.

LEDs assigned to the optical ports:

Rx (yellow): Receipt of data. A received data packet will only be indicated when received for the first time. The LED will not be lit, when the same packet is received from the other direction of the ring. Therefore, perhaps only one of the two Rx LEDs is lit or the Rx LEDs of both optical ports are lit alternately in spite of the ring topology of the OPBM04.

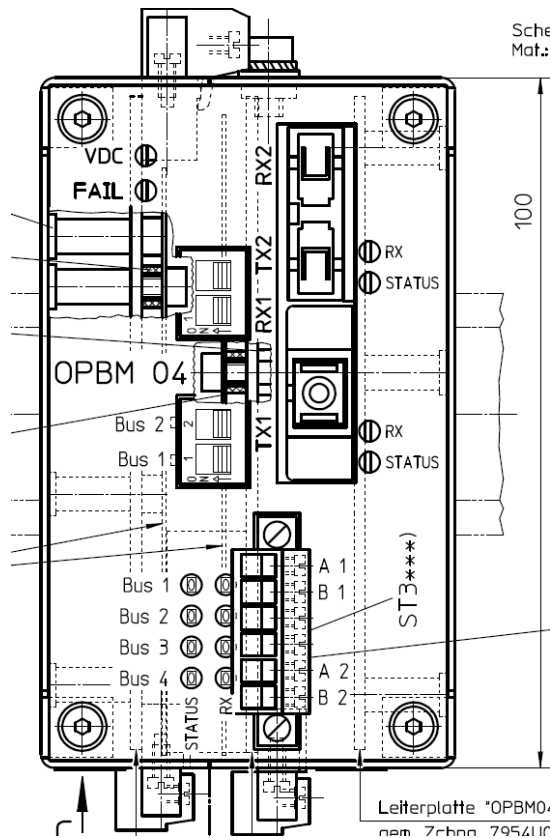
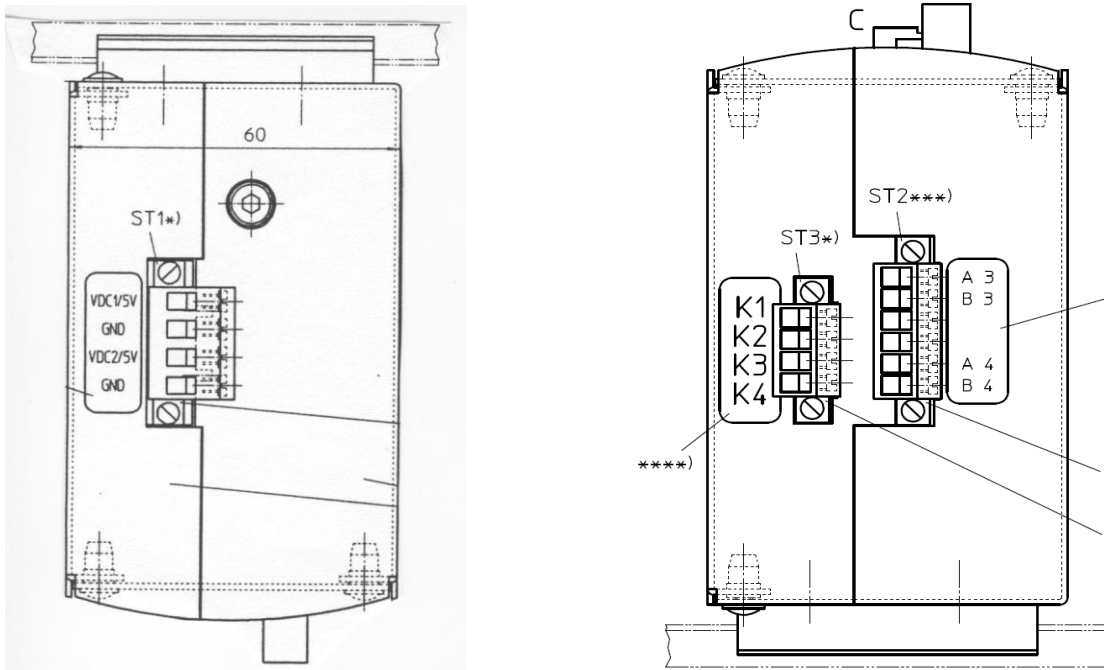
Status LED (red): No optical carrier

LEDs assigned to the four electrical (Profibus/RS485) ports:

Rx (yellow): Receipt of data.

Status LED (red): No data rate has been identified yet or bus error (data packet too long or zero level too long). Mixed up Profibus/RS485 data lines A and B can be identified through a status LED which is lit when the bus termination in OPBM04 is switched off (DIP switches SW1 or SW2).

Device views



Technical data

Designation	Optical Profibus/RS485 Multiplexer
Type	OPBM04
Electrical parameters	
Power supply circuit (4-pin plug-in terminal strip ST1 V _{DC} 1/5V, GND, V _{DC} 2/5V, GND)	
Max. input voltage U _i	5.5 V _{DC}
Max. input current I _i	2.7 A
Max. internal capacitance C _i	196 µF
Max. internal inductance L _i	negligible
Profibus connections	1: B1 (+)/A1 (-) – Kl. 1, Kl. 2 of ST3 2: B2 (+)/A2 (-) – Kl. 5, Kl. 6 of ST3 3: B3 (+)/A3 (-) – Kl. 1, Kl. 2 of ST2 4: B2 (+)/A2 (-) – Kl. 5, Kl. 6 of ST2
Voltage U _i / U ₀	5.5 V _{DC}
Effective internal capacitance C _i	negligible
Effective internal inductance L _i	negligible
Potential-free optocoupler circuit (4-pin plug-in terminal strip K1, K2)	
Max. input voltage U _i	24 V
Max. input power P _i	330 mW
Max. internal capacitance C _i	negligible
Max. internal inductance L _i	negligible
Optical radiant power per each FOC port	1 mW
Ambient temperature range	- 20°C ≤ T _a ≤ + 55°C
Power consumption:	≤ 400 mA
Operating voltage	5 V (± 5%)
Data rate	9.6 kbit/s, 19.2 kbit/s, 93.75 kbit/s and 187.5 kbit/s on RS485 (copper) interfaces
Transmission type	half-duplex
Terminating resistor	switchable: open or wave impedance (R _w + R _{pd} + R _{pu})
Propagation delays	RS485 ↔ FOC: < 3 Tbit Tx ↔ Rx : 11 Tbit
FOC port	E2000 or SC for BiDi optics
Optical fibre	single-mode, 9/125µm
Optical budget	17 dB
FOC range	≥ 15 km (0.4dB/km)
Wave length	1310 nm or 1310nm and 1550nm for BiDi optics
Max. transmission power (operation)	0 dBm
Dimensions	61 x 113 x 115 mm (L x W x D)
Weight:	approx. 0.5 kg
Operating mode	100 % ON time
Service position	at choice
Operating conditions	inside or outside of operating areas susceptible to fire-damp

Technical data (continued)

Temperature range	
- operation	- 20 to + 55°C
- storage	- 25 to + 70°C
- transport	- 25 to + 70°C

Approval:	BVS 10 ATEX E 051 U
Type of protection:	I M 1 Ex ia op is I Ma



Marking

The nameplate is marked as follows:

Company

FHF Bergbautechnik GmbH
42551 Velbert

Type

OPBM04
 I M 1 Ex ia op is I Ma
 BVS 10 ATEX E 051 U
 0158
 F. No.... Test...(ref./initials, month/year)
 $- 20^{\circ}\text{C} \leq T_a \leq + 55^{\circ}\text{C}$

Installation, mounting and advice on use

The OPBM04 optical multiplexer Profibus/RS485 has to be installed in an enclosure which ensures at least an IP54 degree of protection conforming to EN 60529.

The internal wiring (in this enclosure) has to be configured as per section 6.3.11 and 7.6.e of EN 60079-11.

Connecting terminals or plug connectors for the intrinsically safe circuits have to be arranged as per section 6.2.1 and/or 6.2.2 of EN 60079-11. The interconnection with other equipment must be certified separately.

Planning of a ring topology

The following aspects have to be considered when configuring an optical ring with OPM04 modules:

- The minimum response time of all slaves (min TSDR) has to be set to a value of 11 bit times (basic setting) or more.
- The Profibus slot time (TSL) must be set as to ensure that on request of the master, the response of the slaves arrives at the master within the slot time - even in the event of a fault in the fibre optic cable. The minimum slot time in bit times depends on the data rate, the total length of the fibre optic cable and the number of OPM04 modules used within the ring. Calculation of the slot time is possible with the formula:

$$T_{SL} \geq \max_T_{SDR} + L_{FOC} \cdot t_{FOC} + n_{DL} \cdot t_{DL}$$

by inserting the following values:

max_T_SDR: Maximum response time of slaves in bit times.

L_FOC: Total length of the fibre-optic cable used in the ring in km.

If bus segments start from the ring couplers, which have been extended beyond the maximum electrical cable lengths using FOC couplers or repeaters, the two longest bus segments should be added to the FOC length within the ring.

t_FOC: Constant which considers the bit times per km of fibre-optic cable (see table)

n_DL: Number of DL-PBR modules used in the ring.

t_DL: Constant which considers the delay time of a DL-PBR module in bit times (see table).

Data rate [kbit/s]	t_FOC [bit times/km]	t_DL [bit times]
187.5	3.33	3
93.75	1.66	3
19.2	0.33	2
9.6	0.17	2

Attention: When the OPBM04 is used in connection with BiDi optics, the FOC connections between two OPBM04 modules each have to be crossed over, i.e. optical port 1 of device 1 has to be connected to optical port 2 of device 2 and optical port 2 of device 1 to optical port 1 of device 2.

Maintenance / Repairs

The OPBM04 optical multiplexer Profibus/RS485 is maintenance-free and does not contain any parts requiring maintenance. Optical interfaces not in use should always be provided with the associated blind plugs to avoid the ingress of dirt.

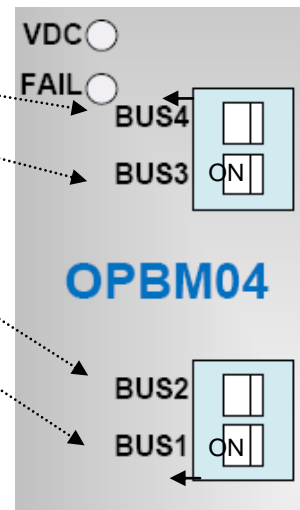
Commissioning and settings

Prior to the commissioning, the fastening of the module, the installation and the related cables and connection shall be checked.

For Profibus/RS485 connections which terminate the connecting cable the associated terminating resistors in the OPBM04 need to be activated

by switching on the DIP switches in the front panel. For this purpose,

slide the corresponding switches Bus 1 Bus 2 Bus 3 and Bus 4 into "ON" position.



Disposal

The disposal of the packaging material and of used parts must be realised in compliance with the regulations of the country in which the device is installed.

Warnings & Safety Advice

<p>This equipment item is a component of explosion-proof design destined for operation inside an explosive atmosphere. It belongs to equipment group I M1 and is suited for use underground.</p> <p>Especially the following warnings and safety advice shall be observed:</p>
<p>The interconnection with other electrical equipment must be certified separately.</p>
<p>Connection and installation of the component have to be carried out by instructed qualified personnel in due consideration of the specified type of protection and in accordance with the applicable regulations for installation.</p>
<p>This component may only be connected and operated with the specified voltage.</p>
<p>For the operation of this component in industrial facilities the accident prevention regulations of the employer's liability insurance association for electrical installations and equipment have to be observed.</p>
<p>Make sure to avoid any damage to the housing. Components with damaged housing must not be operated and have to be put out of service immediately.</p>
<p>Attachment and installation of further parts is prohibited.</p>
<p>The equipment item must only be operated under the indicated ambient conditions. Harsh ambient conditions can result in damage to the device and therefore lead to a possible risk for the life of the user. Such harsh ambient conditions can be:</p> <ul style="list-style-type: none"> • excessive air humidity (> 75% rel., condensing) • moisture, dusts (pay attention to degree of protection). • combustible gases, vapours, solvents which the type of protection does not cover. • excessively high ambient temperatures (>+ 55°C) • excessively low ambient temperatures (<- 20°C)
<p>The ambient temperature range specified for the component must neither be exceeded nor fallen short of during operation.</p>
<p>Make sure to replace defective parts by corresponding original spare parts only.</p>
<p>Repairs must only be carried out by the manufacturer or a person committed by the manufacturer for this work in connection with a new routine test for this component.</p>
<p>In case of transport and storage as well as when not in use the devices and components have to be protected against damage and ingress of dirt.</p>
<p>Non-observance of the above mentioned points results in loss of the explosion protection. In this case the device will constitute a danger for the life of the operator and can cause an explosive atmosphere to ignite.</p>

<p>FHF Bergbautechnik GmbH & Co. KG Eintrachtstr. 95 42551 Velbert</p>	 <p>FHF Bergbautechnik GmbH & Co. KG</p>	<p>Phone: +49 (02051) 270 – 0 Fax: +49 (02051) 270-366 Email: info@fhf-bt.de URL : www.fhf-bt.de</p>
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EG-KONFORMITÄTSERKLÄRUNG

EC DECLARATION OF CONFORMITY

Wir erklären in alleiniger Verantwortung, dass das Produkt auf das sich diese Erklärung bezieht mit der/den folgenden Norm(en) oder normativen Dokumenten übereinstimmt:

Herewith we declare bearing sole responsibility that the product referred in this declaration is in conformity with the following standards or normative documents and regulations of the directive:

Bezeichnung Erzeugnis / Komponente Name of product or component	Optischer Profibus/RS458 Multiplexer Optical Profibus / RS458 Multiplexer
Geräte- oder Typenbezeichnung Equipment type or mark of equipment	OPBM04
Bestimmung der Richtlinie Provisions of the directive	Nr. und Ausgabedatum der Norm(en) No. and date of issue of the standard(s)
94/9/EG: Geräte und Schutzsysteme zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen 94/9/EC: Equipment and protective systems intended for use in potentially explosive atmospheres	EN 60079-0:2006 General requirements EN 60079-11:2007 Intrinsic safety „i“ EN 50303:2000 Equipment Group I Category MI EN60079-28:2007 Optical radiation
EG-Baumusterprüfbescheinigung EC-Type-Examination Certificate	BVS 10 ATEX E 051 U
Benannte Stelle für die Bescheinigung Notified body of the certificate <i>Kennnummer / Inspection number</i>	DEKRA EXAM GmbH 0158
Hersteller / Anschrift Manufacturer / Factory address	FHF Bergbautechnik GmbH & Co. KG Eintrachtstr. 95 D – 42551 Velbert

Geschäftsführer:
Managing director:

Dr. Opitz, Hans-Peter

.....
(name, prename)

Velbert

.....
(Ort / place)

14.10.11

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(Datum / date)



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(Unterschrift / signature)