A system from the
MFW product family

THE SOLUTION

OPERATING INSTRUCTIONS

Modular optical fibre telecontrol system

Point-to-point connection

29.11.2006

MFW-LWL-BA-UK-001

INFO www.ees-online.de

Table of contents

1 Applicability

The description applies to the following MFW modules:

Item number	Type
97BLAGAN0BB0	MF-L1S00-G8DEX-DIA-0-BB-0
97BLAGBN0BB0	MF-L1S00-G8DAL-DIA-0-BB-0
97BLAGCN0BX0	MF-L1S00-G8DAR-DIA-0-BX-0
97HLAGAN0BB0	UF-L1S00-G8DEX-DIA-0-BB-0
97HLAGBN0BB0	UF-L1S00-G8DAL-DIA-0-BB-0
97HLAGCN0BX0	UF-L1S00-G8DAR-DIA-0-BX-0
97BLBGAN0BB0	MF-L1M10-G8DEX-DIA-0-BB-0
97BLBGBN0BB0	MF-L1M10-G8DAL-DIA-0-BB-0
97BLBGCN0BX0	MF-L1M10-G8DAR-DIA-0-BX-0
97HLBGAN0BB0	UF-L1M10-G8DEX-DIA-0-BB-0
97HLBGBN0BB0	UF-L1M10-G8DAL-DIA-0-BB-0
97HLBGCN0BX0	UF-L1M10-G8DAR-DIA-0-BX-0
97BLCGAN0BB0	MF-L1M20-G8DEX-DIA-0-BB-0
97BLCGBN0BB0	MF-L1M20-G8DAL-DIA-0-BB-0
97BLCGCN0BX0	MF-L1M20-G8DAR-DIA-0-BX-0
97HLCGAN0BB0	UF-L1M20-G8DEX-DIA-0-BB-0
97HLCGBN0BB0	UF-L1M20-G8DAL-DIA-0-BB-0
97HLCGCN0BX0	UF-L1M20-G8DAR-DIA-0-BX-0

2 General notes

2.1 Symbols used

The following symbols are used in this document:

Safety instruction
This symbol marks warnings, prohibitions and directions relating to hazards. It is essential that they are observed and obeyed.

Additional note
This symbol indicates additional information.

Important section
This symbol indicates particularly important information.

Cross-reference
This symbol refers to diagrams and to other locations within the document.

2.2 Terminology

MFW
The point-to-point connection version of the MFW Modular Telecontrol Network consists of a central unit and a substation. Each station requires at least one basic module. Up to 15 expansion modules can be connected to this.

Basic module
The basic modules represent the minimum core of a telecontrol station. They contain at least the following function groups:

- internal modem (in this case a fibre-optic modem)
- 8 binary inputs or outputs with status LED, or an additional serial interface for protocol coupling
- two CAN bus interfaces for connecting the expansion modules
- watchdog LED and fault signalling contact

The basic modules are available in two versions – master module and substation module.

Master module
Only one master module, whose type name contains „MF-…“, needs to be present in the system, and is usually used in the central station. It co-ordinates the flow of data.

Substation module
The substation module, whose type name contains „UF-…“, is used in the substations.

Expansion module
Each basic module can be fitted with up to a maximum of 15 expansion modules in order to increase the I/O scope. These are connected via the CAN bus interface.

I/O module
The majority of basic modules contain 8 inputs or outputs. These are referred to as I/O modules. In the same way, the expansion modules contain an I/O module consisting of 8 binary inputs, 8 binary outputs, 4 analog inputs or 4 analog outputs.

Module number
Each I/O module is given a module number. The data is exchanged between modules with the same module number. The physical arrangement of the modules within the system (the station address) is of no significance at all here. The input module with number 5, for instance, transmits its data to all the output modules whose number is 5.

2.3 Safety instructions

These operating instructions must be carefully read, understood and followed!

Risk of interference with electronic devices! When operating the telecontrol system close to devices that are subject to interference, the special regulations for these areas must be observed!

Risk of ignition from electromagnetic fields! The MFW modules must not be operated in the neighbourhood of inflammable gases or liquids (fuel depots, petrol stations, chemical works, gas containers etc.)!

Risk of damage!
The MFW modules must not be opened or subjected to improper modification!

2.4 Correct and proper usage

The telecontrol system is intended exclusively for the applications described in these operating instructions.

Any other usage can be hazardous and is forbidden. The manufacturer cannot be held liable for the consequences of improper use of the MFW modules or for any application that does not accord with the contents of these operating instructions.

3 Device description

The modular telecontrol network (MFW) was designed specially for the integration of widely spread outstations. The MFW can be operated as a fully independent, cost-effective telecontrol system or as an extension to existing telecontrol interface modules. Almost all types of cable (telephone line, three-phase current cable, cable screen, electrically isolated cable, optical fibres etc.) and various radio ranges are suitable as transmission media. These operating instructions describe only a small part of it: the point-to-point transmission on optical fibres.

In its minimum configuration, the telecontrol system consists of a central station and a substation. In each station at least one basic module is needed. This includes the following function groups, display and setting elements:

- internal fibre optic modem
- RS232 diagnostics interface
- 8 binary inputs or outputs with status LED, or an additional serial interface for protocol coupling
- two CAN bus interfaces for connecting the expansion modules
- watchdog LED and fault signalling contact
- DIP switch for setting of module number etc.

Each basic module can be fitted with up to a maximum of 15 expansion modules in order to increase the I/O scope. These are connected via the CAN bus interface. Further information about the expansion modules can be found in the respective instruction manual.

The data exchange is event- and time-controlled. Measuring and set values, messages, commands, momentary and counting pulses are transmitted. With digital I/O modules, inputs/outputs 1-4 are switchable between static or counting/momentary pulse. Analog signals can be transmitted both as voltage values 0-10V or as current values 0-20mA.

In the event of a fault, the system detects the faulty communication and reports it via LED and relay contact both in the central station and in the respective substation. In addition, a binary contact can be used to signal availability of all connected stations at any point of the telecontrol system, if appropriate I/O modules are used. If a serial interface is used, this information can also be evaluated via this interface. After the cause of the fault has been rectified, normal operation is resumed automatically.

The use of optical fibres as transmission media ensures a robust fault-free transmission over long distances. For each direction of transmission an individual optical fibre is used. There are three types available for the connection of the different fibre optic types:

1. Multimode fibre 50/125µm or 62.5/125µm core/cladding diameter.
   Wavelength1300 nm
2. Monomode fibre 9/125µm core/cladding diameter, wave length 1310 nm
3. Multimode fibre 50/125µm or 62.5/125µm core/cladding diameter.
   Wave length 820nm

The distance which can be bridged depends on the glass fibre type used, on the plugs and on the splice losses and can amount to up to 22km. For the fibre optic connection to the basic module the ST type plug connection is used.

4 Assembly and installation

1. Unpack all the telecontrol system's modules, and check them for transport damage. Report any transport damage immediately to the responsible carrier

Please check that the delivery is complete. The delivery can include master and substation modules, expansion modules and other accessories.

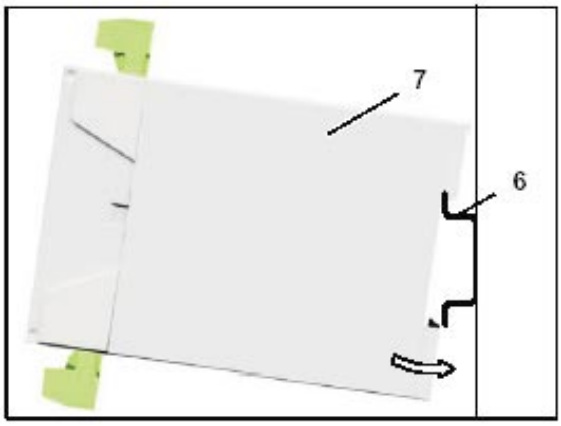
2. Select mounting locations for the individual stations.

3. Module configuration (--> section covering „Configuring the telecontrol system")

The following DIP switch settings must be made when starting the system for the first time:

- Module function
- Module numbers for all modules with I/O
- Current or voltage input at analog input modules
- Counting or pulse I/O at digital modules

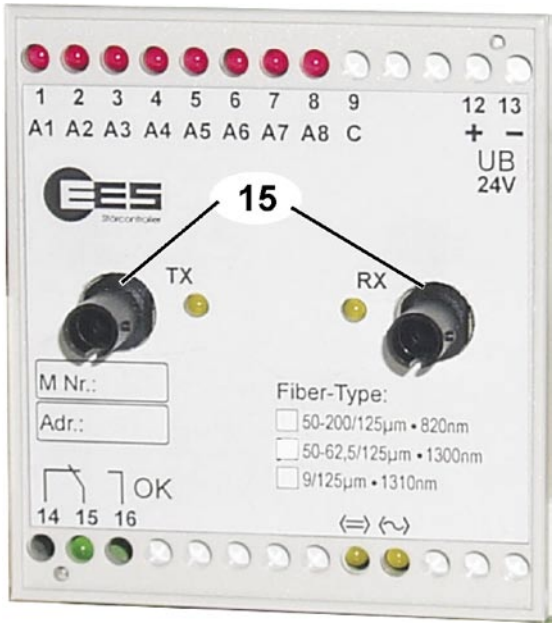
4. Engage the basic module and any expansion modules [7] that may be required on the mounting rail [6].



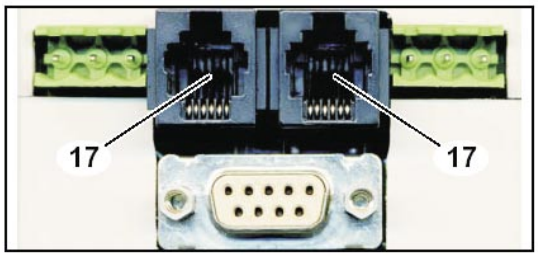
5. Connect the input and output leads.

The length of the input and output leads should not exceed a maximum of 3 m.

6. Connect the transmitting and receiving optical fibres to the appropriate sockets [15].

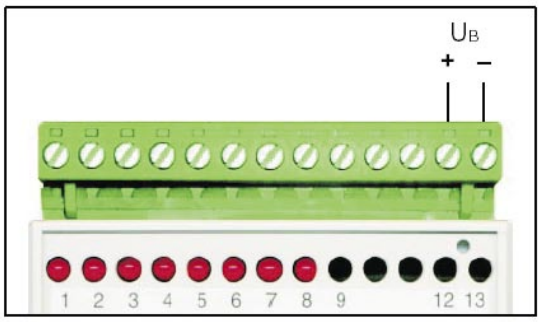


7. If any other optional input/output modules are present, connect them using the supplied cable to the expansion sockets [17] (COM1, COM2).



Assembly and installation are carried out in accordance with the associated instructions.

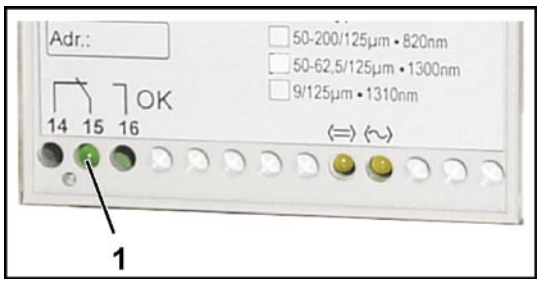
8. Connect the power supply to the basic module..



The length of the power supply lead should not exceed a maximum of 10 m.

9. Switch on the power supply.

✓ Control lamp [1] lights up.
The substation is ready for operation.

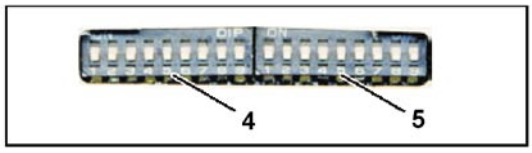


5. Configuring the telecontrol system

5.1 General principles

Data within the telecontrol system is exchanged on the basis of module numbers. A module number is assigned to every basic or expansion module that contains an I/O module. The data is exchanged between modules with the same module number. The physical arrangement of the modules within the system (the station address) is of no significance at all here. The input module with number 5, for instance, transmits its data to all the output modules for which the module number has also been set to 5. More than one output module can have the same module number. An input module number, however, can only be used once within one system.

All the important settings can be made with the aid of DIP switches. These include, for instance, the module function, module number (0 … 254), selection between static and counter values in the case of digital I/O or between current and voltage in the case of analog signals and so forth. DIP switches A and B [4, 5] are located on the underneath of the basic module.



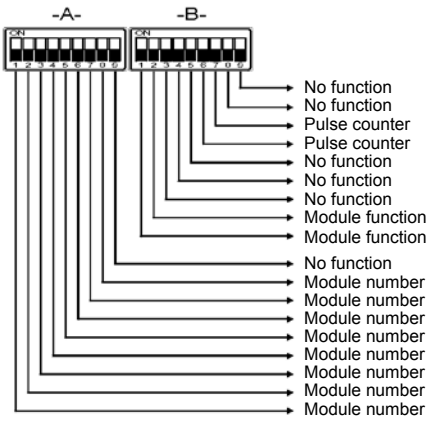
Module numbers 251 ..254 are reserved for the output of station errors.

5.2 **Basic module**

Data within the telecontrol system is exchanged on the basis of module numbers. A module number is assigned to every basic or expansion module that contains an I/O module. The data is exchanged between modules with the same module number.
All the important settings can be made with the aid of DIP switches. These include, for instance, the module number (0 … 254), selection between static and counter values in the case of digital I/O or between current and voltage in the case of analog signals and so forth. DIP switches A and B [4, 5] are located on the underneath of the basic module. The DIP switches on the master and the substation have the same assignments.

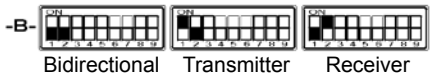
Meaning	Values	DIP switches
Module function	- bidirectional operation - unidirectional (transmitter) - unidirectional (receiver) - test mode	B1 – B2
Module number of the I/O module	0 – 254	A1 –A8
Number of pulse counters	0 – 4	B6 – B7

Programming switch for the master module:



Addressing: (examples for module numbers)

Function in the system:



Number of pulse counters:

5.3 **Expansion modules**

Each basic module can be fitted with up to a maximum of 15 expansion modules in order to increase the I/O scope. The following modules are available for this purpose:

EM-G8DEX-0-BB-0 8 digital inputs
EM-G8DAR-0-BX-0 8 relay outputs
EM-G8DAL-0-BB-0 8 transistor outputs
EM-G4AE0-0-BX-0 4 analog inputs (0 ..10V or 0 ..20mA)
EM-G4AA0-0-BX-0 4 analog outputs (0 ..10V or 0 ..20mA)

A precise description of the way the modules operate can be found in the operating instructions for the MFW expansion module. Only the necessary DIP switch settings will be listed below. The assignment of the DIP switches may be read from the label on the side of the module or found in the expansion module‘s operating instructions.

5.4.1 **Digital input**

Meaning	Values
Module number of the I/O module	0 – 250
Type of I/Os 1 - 4	static or pulse
Maximum count rate	1Hz /10Hz

5.4.2 **Digital output**

Meaning	Values
Module number of the I/O module	0 – 254
Type of I/Os 1 -4	static or pulse
Maximum count rate	1Hz /12Hz

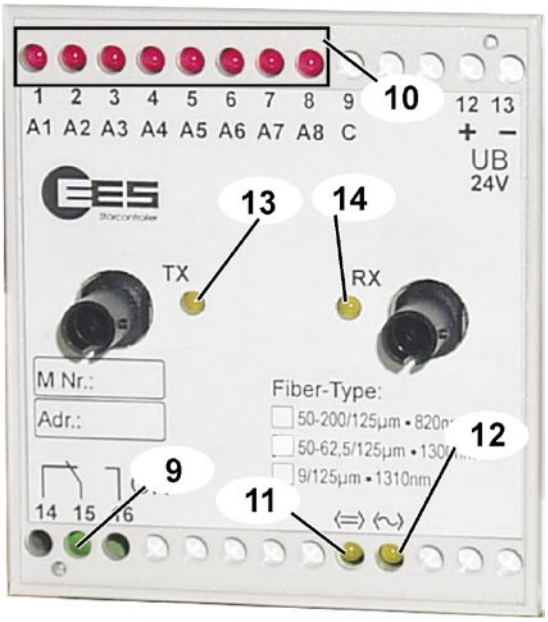
5.4.3 **Analog input**

Meaning	Values
Module number of the I/O module	0 – 250
Current or voltage input may be set for each channel	Current / voltage

5.4.4 **Analog output**

Meaning	Values
Module number of the I/O module	0 – 250

6 **Indicator lights**



9 Indicator light *OK*

10 Indicator lights
Digital inputs or outputs light up if a signal is present.

11 The *External module* indicator light lights up if an external module is connected.

12 No function

13 TX transmit data over optical fibre

14 RX receive data over optical fibre

7 Diagnostic functions

A variety of diagnostic information is available to monitor and assess the data link. These include, for instance, station errors indicated via the LED matrix display or by a relay contact, or more detailed information via the diagnostic interface.

The *OK* indicator light [9] provides information about the current error status:

- Permanent light = no error
- Flashing = error
- Off = no power supply

The sequence of flashes is composed of:

- No. of long flashes → 1st error code digit
- No. of short flashes → 2nd error code digit
- Pause

For example: — — ----- (= error code 24)

When more than one error occurs at the same time, the one with the highest priority is always the one that is indicated.

7.1 Error codes

No	Error	Comment
12	CAN bus error	The link between the basic module and the expansion module is faulty.
13	Error in partner station	The partner station is reporting an error.
16	Bad connection to partner station	(poor reception, or none at all, at the partner station)
17	Bad connection from the partner station	(poor reception, or none at all, at this station)
61	Serial interface error	The error only occurs on basic modules with a serial interface. It occurs if this communication is faulty.

7.2 Diagnostic interface

The basic modules have an RS 232 interface than that can be used as a diagnostic interface.

The diagnostic interface can be used to obtain additional information about the condition of the system with the aid of a terminal. The terminal must be set as follows for this purpose:

-9600 baud
-8 bits
-1 start bit
-1 stop bit
-no parity
-no hardware or software handshake

The following sections list the commands that can be used to ask for information. Upper and lower-case are ignored in the letters composing the command. The commands have to be completed with <ENTER>.

7.2.1 **Master module diagnostic parameters**

Command/ syntax	Function
VQ<x>	Quality of connection The ratio of responses to inquiry telegrams for this substation is returned, expressed as the figure per thousand (0...999). No x or x=1 - Switch on output of the connection quality (continuous output) All other values of x - Switch off output The connection quality output has the following format: E = <V1>%, G = <V2>%<cr> V1 - connection quality (reception at this station) V2 - connection quality (reception at the partner station) For example: E = 100%, G = 100%
F<No.>	F without <No> - output of the current error (error codes) F<No.> - Output of the error text belonging to the error number <No.> For example: F<ENTER> → „Error: 12,13," F12<ENTER> → „Error: CAN bus error" F13<ENTER> → „Error: Error in partner station"
N	Output of the serial number
U1	Query of the current substation error The function returns the error code of the substation's current error. Only the most significant error is ever reported.
T...	Reading parameters <52> Serial number of the module <53> Version number of the software
Z<n>	Specifies the pulse width of the output pulse for all outputs that are set to generate pulse outputs. n =1...256 pulse width = n x 40 ms Standard setting n =1

7.2.2 **Substation module diagnostic parameters**

Command/ syntax	Function
VQ<x>	Quality of connection The ratio of responses to inquiry telegrams for this substation is returned, expressed as the figure per thousand (0...999). No x or x=1 - Switch on output of the connection quality (continuous output) All other values of x - Switch off output The connection quality output has the following format: E = <V1>%, G = <V2>%<cr> V1 - connection quality (reception at this station) V2 - connection quality (reception at the partner station) For example: E = 100%, G = 100%
F<No.>	F without <No> - output of the current error (error codes) F<No.> - Output of the error text belonging to the error number <No.> For example: F<ENTER> → „Error: 12,13," F12<ENTER> → „Error: CAN bus error" F13<ENTER> → „Error: Error in partner station"
M	Output of the module list of the basic module A line is used for every possible module. M<ADR>,<status>,<serial no.>,<mnr>,<error> <Adr > 0...15 (internal address) <Status> 0=free, 1 = occupied <Serial number> Serial number of module hardware <mno> Set module number <mtyp> module type AE,AA,DE,DA <error> „error" or „OK"
T...	Reading parameters <52> Serial number of the module <53> Version number of the software
Z<n>	Specifies the pulse width of the output pulse for all outputs that are set to generate pulse outputs. n =1...256 pulse width = n x 40 ms Standard setting n =1

8 Transmission ranges

The transmission range of the optical fibre transmission system is determined by the transmitter power, the sensitivity of the receiver, and losses on the transmission path. The difference between the transmitted power and the receiver‘s sensitivity is referred to as the budget. The budget corresponds to the maximum permitted losses along the transmission path for which data transmission is possible with no reserves.

The maximum possible range can be calculated as follows:

Range(km) = (budget(dB) - reserve(dB))/optical fibre attenuation (dB/km)

The budget can never be fully exploited when laying out a transmission path. Some reserve must be kept in hand so that, for instance, additional splices can be made if repairs are necessary.

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Optical fibre type Core/jacket diameter	Wavelength	Budget min./typ.	Typical optical fibre attenuation	Connector/ splice reserve	Transmission range min./typ.
Monomode 9/125µm	1310nm	12db/18db	0,4db/km	6db	15km/30km
Multimode 50/125µm	1300nm	11db/15db	0,5db/km	4db	14km/22km
Multimode 62.5/125µm	1300nm	15db/18db	0,9db/km	4db	12km/15km
Multimode 50/125µm	850nm	11db/15db	2,4db/km	4db	3km/5km
Multimode 62.5/125µm	850nm	16db/20db	3,0db/km	4db	3km/5km

9 Technical data

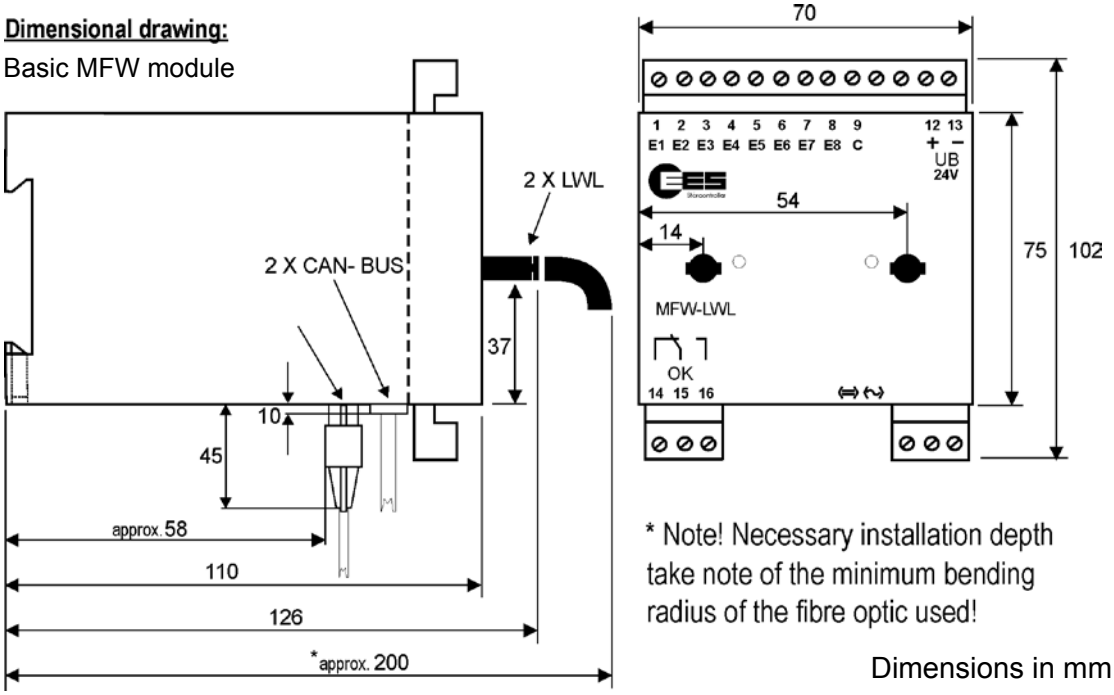
Rated operating voltage	24 V DC
Operating voltage range	20 ... 32 V DC
Air humidity	maximum 95%, non-condensing
Operating and ambient temperature	-20°C ... +60°C
Connection terminals	Nominal cross section 2.5 mm^2
Housing / protection class	Plastic / IP 40
Version for monomode optic fibre @1310 nm	
Budget minimal/typical with 9/125 µm fibre optic	12 db/18 db
Plug-in optical fibre connection	2 ST sockets
Version for monomode optic fibre @1300 nm	
Budget minimal/typical with 50/125 µm fibre optic	11 db/15 db
Budget minimal/typical with 62,5/125 µm fibre optic	15 db/18 db
Plug-in optical fibre connection	2 ST sockets
Version for monomode optic fibre @820 nm	
Budget minimal/typical with 50/125 µm fibre optic	11 db/15 db
Budget minimal/typical with 62.5/125 µm fibre optic	16 db/20 db
Plug-in optical fibre connection	2 ST sockets
Digital input module	
Power consumption	approx. 2.5 W
Signal voltage	approx. 16 ... 48 V AC/DC*
Input resistance	approx. 10 kOhm
max. count rate	10 Hz
min. pulse width / pause	50 ms
Electrical isolation between signal and supply voltage	4 kV_{eff}
Digital output module	
Power consumption	
with relay outputs	approx. 3.5 W
With transistor outputs	max. 2.5 W logic + load current
Contact loading of the relay outputs**	
minimum	1,2 V /1 mA
maximum	250 V AC / 400 mA 250 V AC / 2 A (pure ohmic load) 30 V DC /2 A 110 V DC /0,2 A 220 V DC /0,1 A
Total 230V AC current (purely ohmic load)	maximum 8 A
Load capacity with transistor outputs	maximum 50 mA per output
max. count rate	12 Hz
min. pulse width / pause	40 ms
Electrical isolation between output and supply voltage	4 kV_{eff} (not at transistor outputs!)

* Other figures on request

** We would be happy to supply you with more precise specifications on request.

Dimensional drawing:

Basic MFW module

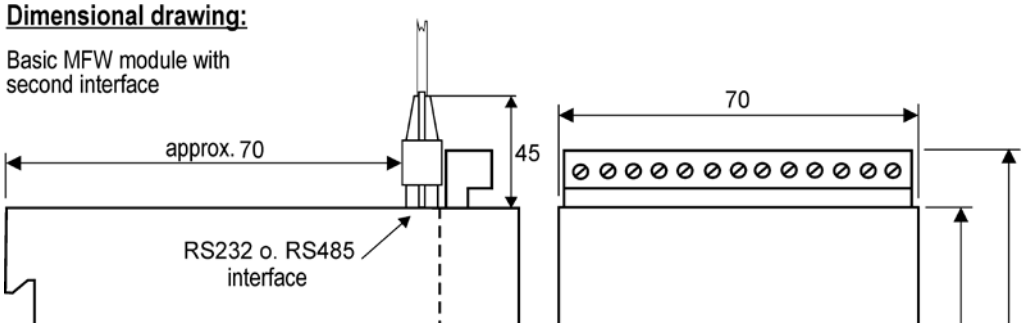


* Note! Necessary installation depth take note of the minimum bending radius of the fibre optic used!

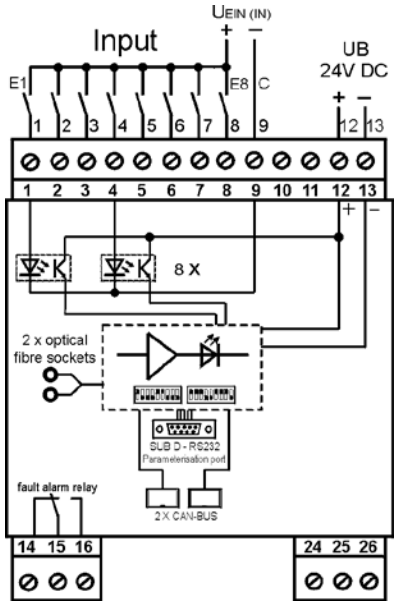
Dimensions in mm

Dimensional drawing:

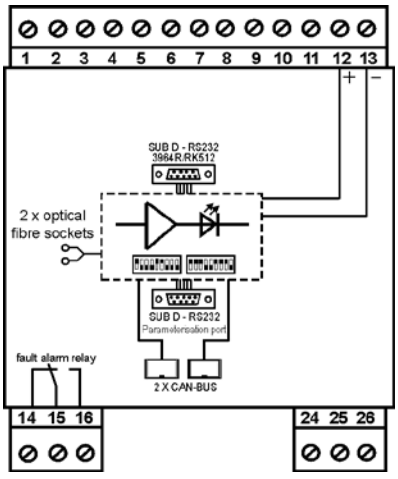
Basic MFW module with second interface



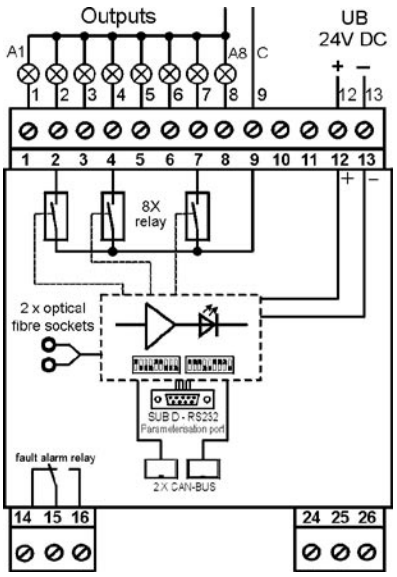
Terminal assignments



Basic module with 8 digital inputs

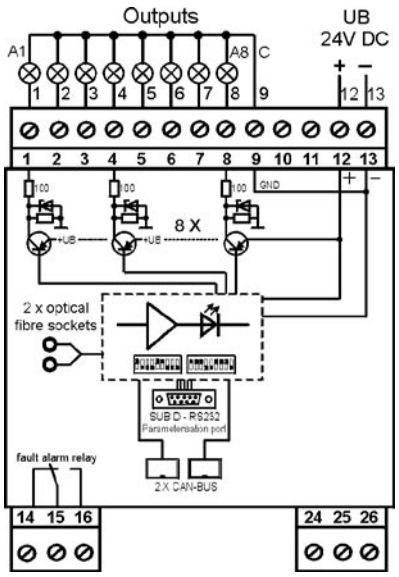


Basic module with additional serial interface



Basic module with 8 output relays

Note:
positive switching PNP transistors



Basic module with 8 transistor outputs

The right to make technical changes is reserved

10 Accessories

Only accessories approved by the manufacturer (input/output modules etc.) may be connected to the MFW module.

Additional modules for digital and analog input and output are available for the basic MFW modules.

Further accessories and more detailed information may be found in the appropriate product sections in the catalogue.

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