Digital Mass Flow Controller
Type MF1

– Instruction Manual –

MKS Instruments
Deutschland GmbH

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Mass Flow Controller Safety Information

Symbols Used in This Instruction Manual

Definitions of WARNING, CAUTION, and NOTE messages used throughout the manual.

Warning 

The WARNING sign denotes a hazard to personnel. It calls attention to a procedure, practice, condition, or the like, which, if not correctly performed or adhered to, could result in injury to personnel.

Caution 

The CAUTION sign denotes a hazard to equipment. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of all or part of the product.

Note 

The NOTE sign denotes important information. It calls attention to a procedure, practice, condition, or the like, which is essential to highlight.

Safety Procedures and Precautions

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of intended use of the instrument and may impair the protection provided by the equipment. MKS Instruments, Inc. assumes no liability for the customer's failure to comply with these requirements.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to an MKS Calibration and Service Center for service and repair to ensure that all safety features are maintained.

SERVICE BY QUALIFIED PERSONNEL ONLY

Operating personnel must not attempt component replacement and internal adjustments. Any service must be made by qualified service personnel only.

USE CAUTION WHEN OPERATING WITH HAZARDOUS MATERIALS

If hazardous materials are used, observe the proper safety precautions, completely purge the instrument when necessary, and ensure that the material used is compatible with the wetted materials in this product, including any sealing materials.

PURGE THE INSTRUMENT

After installing the unit, or before removing it from a system, purge the unit completely with a clean, dry gas to eliminate all traces of the previously used flow material.

USE PROPER PROCEDURES WHEN PURGING

This instrument must be purged under a ventilation hood, and gloves must be worn for protection.

DO NOT OPERATE IN AN EXPLOSIVE ENVIRONMENT

To avoid explosion, do not operate this product in an explosive environment unless it has been specifically certified for such operation.

USE PROPER FITTINGS AND TIGHTENING PROCEDURES

All instrument fittings must be consistent with instrument specifications, and compatible with the intended use of the instrument. Assemble and tighten fittings according to manufacturer's directions.

CHECK FOR LEAK-TIGHT FITTINGS

Carefully check all vacuum component connections to ensure leak-tight installation.

OPERATE AT SAFE INLET PRESSURES

Never operate at pressures higher than the rated maximum pressure (refer to the product specifications for the maximum allowable pressure).

INSTALL A SUITABLE BURST DISC

When operating from a pressurized gas source, install a suitable burst disc in the vacuum system to prevent system explosion should the system pressure rise.

KEEP THE UNIT FREE OF CONTAMINANTS

Do not allow contaminants to enter the unit before or during use. Contamination such as dust, dirt, lint, glass chips, and metal chips may permanently damage the unit or contaminate the process.

ALLOW THE UNIT TO WARM UP

If the unit is used to control dangerous gases, they should not be applied before the unit has completely warmed up. Use a positive shutoff valve to ensure that no erroneous flow can occur during warm up.

Chapter 1: General Information

Introduction

MF1 is a state of the art high performance digital MFC with various options:

- Controller or meter version
- Metal or MEMS sensor versions
- Ranges from 10 sccm to 20 slm with various gases
- various fittings available
- PROFIBUS, Analog, RS 485, EtherCAT, ProfiNet or USB Process Interface

Power Supply and Readout Units

The MF1 can be ordered as an analog version and thus can interface to complementary MKS equipment which are available as single channel, dual channel, 4- and 8-channel units to display the flow signal and to provide the power and set point commands. Refer to the corresponding manuals for requirements and instructions.

Instruction Manual

Contents

This manual provides instructions on setup, installation, operation and service of:

- Mass flow controller MF1 analog operation
- Mass flow controller MF1 Profibus operation
- Mass flow controller MF1 RS485 operation
- Mass flow controller MF1 USB operation
- Mass flow controller MF1 EtherCAT operation
- Mass flow controller MF1 ProfiNet operation

Conventions

If not explicitly expressed differently at the respective place in this handbook all data are referenced to:

a) Temperature in °C
b) Gas type is nitrogen N2
c) Pressure in mbar or bar with index (a) relates to absolute pressure and whereas index (g) stands for gauge pressure, related to atmospheric and index (d) indicates differential pressure.
d) Flow rates are given in sccm[**] or slm[***] related to nitrogen or dry air.

[**] 1 sccm = 1 standard cm^3 / min ; Standard conditions: 1013.25 mbar and 0 °C

[***] 1 slm = 1 standard liter / min = 1000 sccm

Chapter 2: Shipment

General

Unpacking

MKS has carefully packed each unit so that it will reach you in perfect operating order. Upon receiving the unit, however, you should check for defects, cracks, broken connectors, damaged cables etc., to be certain that damage has not occurred during shipment.

Note 

Do *not* discard any packing materials until you have completed your inspection and are sure the unit arrived safely.

If you find any damage, please notify your carrier and MKS immediately. If it is necessary to return the unit to MKS, obtain an ERA Number (Equipment Return Authorization Number) from the MKS Service Center before shipping. Please refer to the inside of the back cover of this manual for a list of MKS Calibration and Service Centers.

Unpacking Checklist

- Mass flow controller
- Mating connectors
- GSD file (CD) (for Profibus only)
- Manual (this book)
- Calibration sheet

Optional Accessories:

Control units, power supplies, readout units

Cable

Profibus Support Kit: 1179-PB-SUPPORT for units with profibus only

Label

The label shows the following information:	See figure 1 as an example:
Model code	MF1
Sealing	FKM
Range	500 sccm
Gas type	SiH4 (the range is related to this gas)
Serial number	454145G20
CE mark	CE
Manufacturer	MKS Instruments Deutschland GmbH

Figure 1 Model Code Label

Across the housing and the meter/controller body there is a warranty void sticker to avoid access to the inside by unauthorized people. Broken or removed label means lost of any warranty.

Clean Room Packaging

It is possible to get the flow controller delivered in clean room packaging (as an option). When unpacking, follow these steps:

1. Remove the outer bag in an ante room (garmenting room) or transfer box.
   Do not allow this outer bag to enter the clean room.
2. Wipe down the exterior of the inner bag with a clean room wipe.
   This step reduces the contamination introduced into the clean room.
3. Remove the inner bag in the clean room.

Chapter 3: Installation and Start Up

General Requirements

Environmental

Follow the guidelines below when installing and using your mass flow controller.

1. Maintain the normal operating temperature between 0 – 40°C (32° to 104°F).
2. Observe the pressure limits
   - Maximum gas inlet pressure is 10 bar (g).
   - Operational differential pressure is:

     For F.S. of 10 to 5000 sccm 0,7 bar (d) to 2.75 bar (d)

     For F.S. of 10000 to 20000 sccm 1 bar (d) to 2.75 bar (d)

   - The standard orifice is sized for control over this range with the outlet at atmospheric pressure.
3. Two kinds of power supply are possible (applies to all units):

   ± 15 V

   or

   24 V (20 to 31.5 V)

   Current: < 300 mA @ 24 VDC for Profibus, USB, RS485 or analog interface
4. Allow minimum 15 minutes for warm-up time for analog units as well as for units with Profibus, RS 485 or USB interface.
5. Use high purity gas to purge the instrument.
6. The use of a filter upstream of the mass flow controller is recommended, if enough pressure is available.

Refer also to *Appendix A, Product Specifications* for other possible precautions and restrictions.

Location and Orientation

1. Set the controller into position where it will be connected to a gas supply.

   Placement of flow components in an orientation other than that in which they were calibrated (typically horizontal) may cause a small zero shift. The zero offset can be removed according to the instructions for zeroing.

2. Install the flow controller in the gas stream such that the flow will be in the direction of the arrow on the side of the controller.

   Take into consideration the specified leak through the closed control valve in case of a mass flow controller. The specified value refers to new and unused units, but may change during operation by age, cycles, temperature and gas. To achieve best possible leak tightness we strongly recommend the use of positive shut off valves.

   The normal position is horizontal, the process interface connector pointing upwards or vertical with flow direction either upwards or downwards.

   It is possible to mount the units the way that the connector points downwards but control performance and valve leak can be affected. This applies especially to units with higher flow ranges. Therefore the ‘ceiling mount attitude’ should be avoided.

3. Allow adequate clearance for the tubing. Take into account when designing the plumbing that a unit may be removed later, e.g. for service or maintenance.

   To de-install units with metal ferrule compression fittings (for example Swagelok) the tubing must be moved away some millimeters in axial direction whereas VCR fittings allow the instrument to be removed sidewards also out from complexive and stiff plumbing systems.

4. Allow adequate clearance for the cable connector.

5. Position the unit to provide access to the zero button and rotary switches for address setting. Make sure that the status LED is visible.

6. The device dissipates considerable power, related to it’s small volume. Make sure that the maximum specified ambient temperature close to the device is not exceeded, by providing adequate cooling. The main temperature is radiated on the both sides of the device.

Leak Integrity

We recommend to check leak tightness of all ports and connections of the plumbing with a helium leak detector.

Pressure Drop Test

If a leak check at high pressure is intended then check for the highest allowable pressure for all parts involved. Example: If a pressure based leak check at 5 bar (g) is done you will damage a pressure transducer in the line if it is limited to 3.5 bar (g). In this case the pressure transducer (or whatever component is affected) must be removed or protected by a suitable valve.

Dimensions

The overall outline dimensions (length, width, height) are identical for the analog, Profibus, RS 485 and USB Units.

(All dimensions are listed in millimeters. Conversion: 1 inch = 25.4 mm)

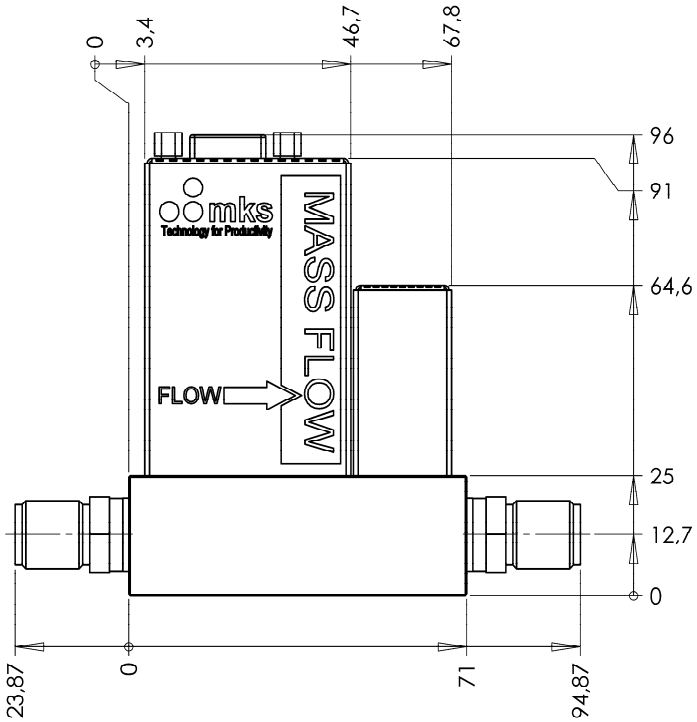


Figure 2 Side View - Dimensions (for 4 VCR, Sub D Connector and "single-part-body"; flow from left to right)

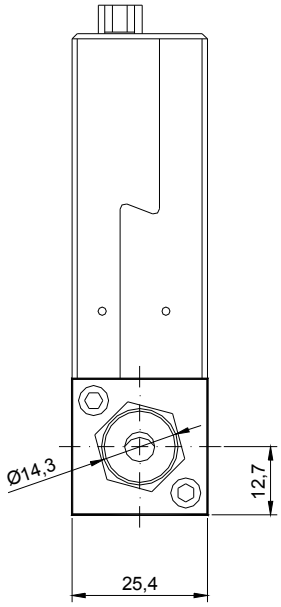


Figure 3 Front View – Dimensions (4 VCR)

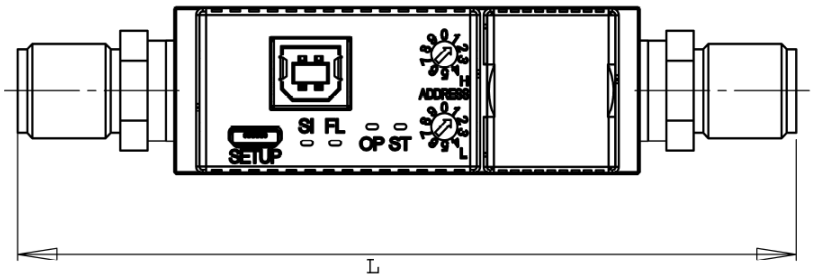


Figure 4 Top View – Dimensions (flow from left to right)

Order Code	Fittings (compatible)	L in mm
MF1 _ ___ ___ R _ _ 0	4 VCR male	118.74 ± 1
MF1 _ ___ ___ S _ _ 0	1/4 " Swagelok*	107.6 ± 1
MF1 _ ___ ___ G _ _ 0	4 VCO male	110.6 ± 1
MF1 _ ___ ___ D _ _ 0	DN 16 KF	118.73 ± 1
MF1 _ ___ ___ M _ _ 0	6 mm Swagelok*	107.6 ± 1
MF1 _ ___ ___ P _ _ 0	1/8 " Swagelok*	107.6 ± 1
	**) without nuts and ferrules*	

Table 1 Total length for different fittings

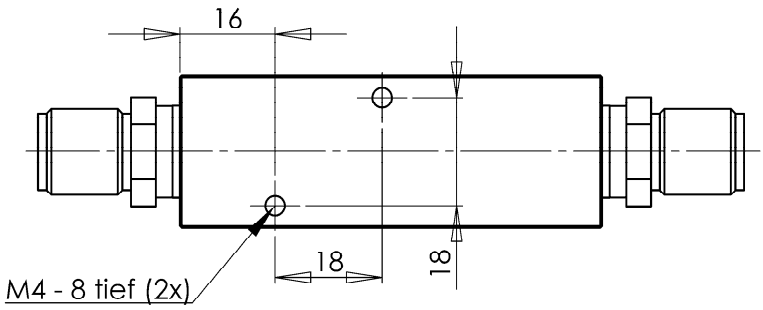


Figure 5 Bottom View – Dimensions (flow from left to right)

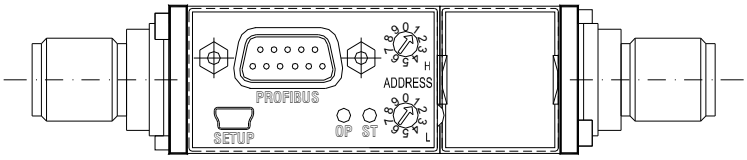


Figure 6 Connector and Control Elements for Profibus unit (flow from left to right)

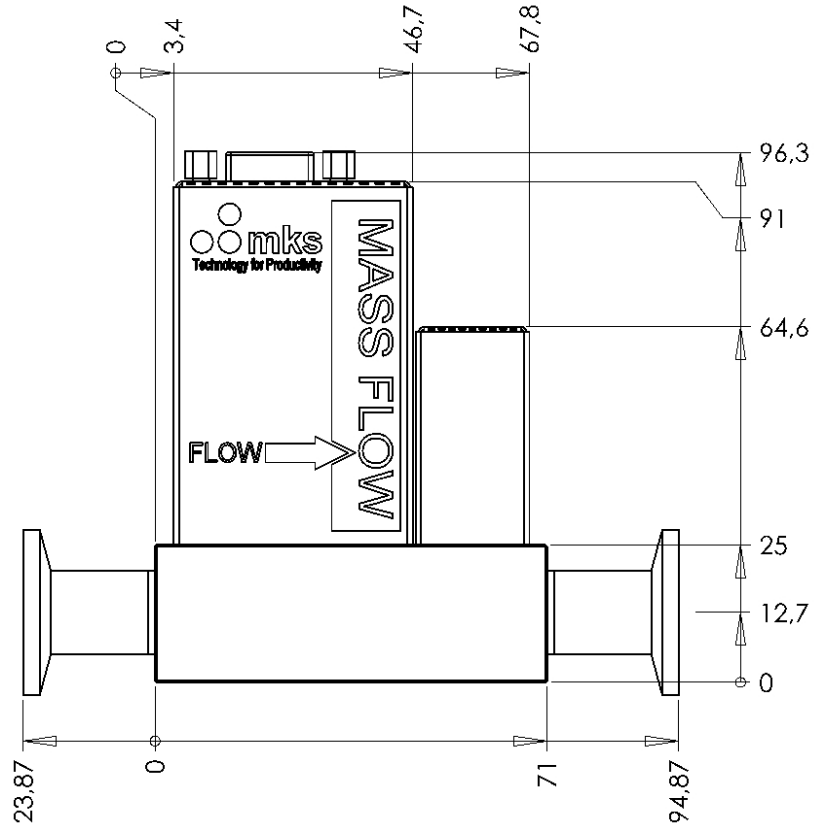


Figure 7 Side view - Dimensions (DN 16 KF, Sub D connector and "single-part-body"; flow from left to right)

Electrical Connections and Cables

The units comply with the European standards and thus they are labeled with the CE-mark. To fulfill the above listed guidelines it is mandatory to use the appropriate interconnection cables.

Note

EMC Directive Requirements according to 2004/108/EC:

The instrument complies to EN 61326-2-2 with the requirements for industrial applications. Braided shielded cables must be used.

We recommend to use the cables offered by MKS Instruments.

Cables which are in compliance with the CE guidelines are marked with an „E“ or „S“ (example: CB259E-... or CB259S-...).

The PROFIBUS cable must be qualified.

Cables

See for detailed information the section of the Process Interfaces.

Power Supply / Readout Units of other Manufacturers

Should you use power supplies / readout units of manufacturers other than MKS then make sure that these units fulfill the electrical specifications for use with the mass flow controllers/meters as described herein. Refer to *Appendix A, Product Specifications*.

Non MKS Cables

Requirements

Should you choose to manufacture your own cables, follow the guidelines listed below:

1. The cable must have a braided shield, covering all wires. Neither aluminum foil nor spiral shielding will be as effective: using either may nullify regulatory compliance.
2. The connectors must have a metal case which has direct contact to the cable's shield on the whole circumference of the cable.
3. With very few exceptions, the connector(s) must make good contact (typical 0,01Ω or less) to the device's case (ground). The case also must be properly grounded.
4. When selecting the cable, consider:
   a) The voltage ratings.
   b) The cumulative I^2R heating of all the conductors (keep them safely cool).
   c) The voltage drop of the conductors, so that adequate power or signal voltage gets to the device.
   d) The capacitance and inductance of cables which are handling fast signals
   e) If there are specific requirements when supply units etc. of other manufacturers are used

Finishing the Installation

1. Check all fittings and flanges for leaks.
   Do not proceed with the next step until you have not made sure that there are no leaks.
2. Connect the interface cable(s) to the mass flow controller.
   Connect the other end of the cable to the power supply/control electronics.
   Check all electrical connections.

This ends the mass flow controller's installation.

Start Up the Mass Flow Controller/Meter

1. After you have successfully checked all mechanical and electrical connections and when you are certain that there is no gas leakage, then power can be applied to the mass flow controller or to the flow meter, respectively.

   The first start up should be done preferably using a non-critical gas. This could be for example nitrogen or dry air (if there are no reactive residuals in the plumbing system) or any inert gas.

2. Switch on the power supply.

   When power is first applied, the analog output signal will remain zero until the booting process is finished (analog version)

   The unit performs automatically a reset, indicated by green blinking of the status LED ST. Finally the LED changes to green light which indicates that the unit is ready for use.

   You can monitor the flow output signal as the instrument stabilizes and the output approaches zero. Approximately 15 minutes after power up the signal should be stable within some millivolts close to zero.

Note 

Do not use dangerous gases for the first start up. Use a non-critical gas, for example the gas which serves for purging.

Note 

If the instrument is being used to control dangerous gases, be sure that the system is fully warmed up before applying gases to the system. You may choose to install a positive shutoff valve to prevent inadvertent gas flow during the warm-up period.

Once the instrument is completely warmed up, you can proceed to zero the unit as required.

Zero Adjust

1. If no gas is flowing and the mass flow controller has stabilized (ref. to *Appendix A, Specifications, Warm Up)* the flow output signal can be zeroed. This can be done in two different ways:

   a) using the push button AUTOZERO, located at the gas inlet side of the unit. Use this means only when gas flow is completely stopped. Check that the flow signal has been set to zero!

   b) Operation of these functions is also possible via one of the digital interfaces.

2. When using a control unit by MKS then you should use the zeroing means there. If the control unit does not provide enough compensation range then the ZERO button at the mass flow unit must be used.

Note

Zeroing should be done only on units that are installed in final position.

It is recommended to completely stop the gas flow prior to any zero adjustment.

If a pressure difference exists at the mass flow control unit then a small flow might occur even if the integrated control valve is closed. This is more likely with special units for low inlet pressures.
Do not adjust the flow signal then to zero because it is a real flow but use a positive shutoff valve to definitely stop the flow.

The integrated control valve may not completely shut off the gas flow.

3. Periodically check the zero adjustment of the unit, e.g. on maintenance intervals. The zero adjustment is mainly affected by thermal effects and especially by contamination.

Beside the need for achieving measurements of highest accuracy the zero signal is a very important indication for diagnosing the condition of flow sensor and control valve.

Zero Button

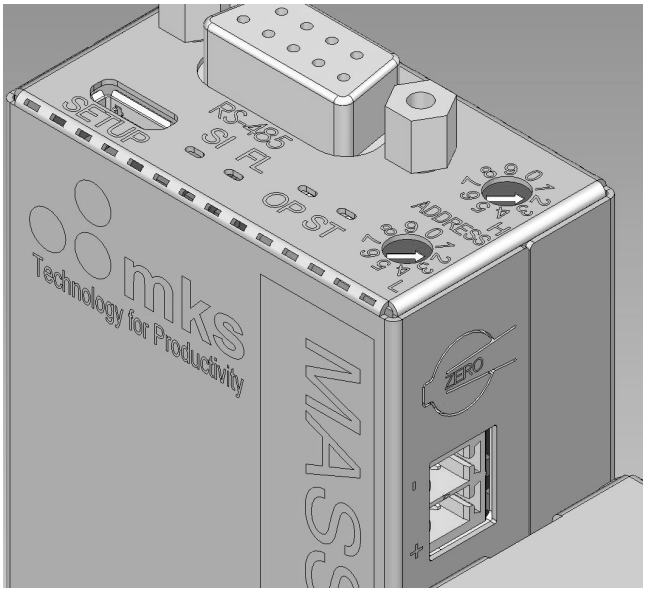


Figure 8 Zero Button

Zero Button

As long as the Zero Button is pushed, the SI LED will blink each second:

- 1-2 sec = ZERO function is triggered if the actual flow is smaller than 5% of full scale and the control valve is closed
- 5 sec = reset of device (reset is equal to a power cycle)
- 7 sec = switch USB mode from MSD to CDC or vice versa (for details see chapter *Chapter 4: USB Setup Interface* page 27)

Chapter 4: USB Setup Interface

General

- The USB Setup Interface, which is included for all process interface versions, is dedicated for setup purposes only
- Process Interface is the interface to the tool host computer or controller. This interface is either a PROFIBUS-DP, RS 485, ModBus, USB, EtherCAT or an analog voltage interface.
- User Interface: AUTOZERO button, rotary switches for address setup and LED's for status display. The LED's provide information depending on the interface type.

The purpose of the Setup interface is to do setup and diagnostics. It does not guaranty a response in a controlled time frame. The USB operates either as MSD (mass storage device) or as CDC (communication device class). The USB Setup Interface serves for configuration and communication in non-industrial applications, e.g. use in a laboratory.

Installation

Electrical connection:

The USB Setup Interface is a micro-B connector labeled "SETUP" (see *Figure 9*).

The power Interface supplies the device with nominal 24V, which can vary from 20V to 31.5V. See "Chapter 5 Process interfaces" for details.

Cable:

Any standard USB cable not longer than 3 m should support the communication with a PC.

Operation

Address

Configuration

The MF1 can appear on a PC as a mass storage device as well as a serial interface. The mode of operation can be changed either via a command in the respective other mode or by pressing the zero button for 7 seconds (7 x blink-acknowledgement by SI-LED). The chosen mode will be taken with the next startup.

- Switching from CDC to MSD is done directly and the message "connection closed" is sent to the terminal.
- Switching from MSD to CDC is done after the drive is removed from the Windows PC.
- For the CDC mode “usbser.sys” has to be installed on the Windows PC. It is included on the Windows installation CD. For the installation of the MF1 the file 'mkscdc.inf' is required, which is included on the CD delivered with the MFC.

MSD-Mode

Using the MF1 as a MSD can be done the following way:

- when starting the device the data from a SETUP.INI-file will be taken into the MF1-objects. Do not forget to open the link to Windows prior to re-start the MF1.
- a FACTORY.INI will be executed firstly. The FACTORY.INI can even overwrite protected parameter. To do so, however, it must hand over the password. After overwriting the FACTORY.INI will be erased.

Protocoll

General Description

INI-files format:

- $ ObjectName Instance [ParameterName Value] # Comment
- ! ParameterName Value # Comment

Once the INI-files have been processed a REPORT.HTM file will be generated, which represents clearly status and all objects with their parameters.

The serial interface operation is performed as follows:

- for accessing the parameter of an object, select first the Object and the Instance:
  $ ObjectName Instance [ParameterName [Value]] <CR>
- for setting additional parameter of the same object you could add (value has to fit to the type)[1]:
  ! ParameterName Value <CR>
- for reading the parameter the query start with an ?:
  ? ParameterName <CR>

[1] Parameter is referring to the last send ObjectName; It is recommended to send also the ObjectName, when ParameterName is send.

- the response for setting or the actual value will be returned:
  > Value <CR>

- in case off error, e.g. wrong type or not existing name a code is returned:
  ! Code <CR>
- Command:
  * CommandName <CR>

Note *It is possible to power the MFC electronic only via the USB interface, which enables the check or the update of the settings, but not the operation of the MFC.*

Default settings

Objects

Object Model

All parameters of the device reside in objects.

Object Reference

Object Definitions are documented in the Object Reference. Actual Values of the parameters are available in REPORT.HTM on the MSD drive.

Object Parameters Description

Object Parameters for all Objects [*; ObjId=*]		
Name	**Par. Type**	**Description**
ObjId	Inst	ID of Object
ObjName	Inst	Short Name of Object
Length	Inst	Byte size of Object
NrOfInstances	Inst	Numbers of Instances
ActInst	Inst	choose the actual Instance (e.g. used for Profibus)

Standard Input 1179 Object [SmallRecv; ObjId=20]		
Name	**Par. Type**	**Description**
ValveOverride	Inst	see Valve - ValveOverride
Autozero	Inst	see Meter - AutoZero
ReportDiag	Inst	changing generate a 6 byte Profibus Diagnostic
WinkStatus	Inst	0 to 1 transition sets the blue LED to blinking for 5 sec
EnableTotalizer	Inst	see Meter - EnableTotalizer
ResetTotalizer	Inst	see Meter - ResetTotalizer
ResetStatus	Inst	0 to 1 transition resets error status bits

Standard Input 1179 Object [SmallRecv; ObjId=20]		
SelectGasTable	Inst	see SigProc - SelectGasTable
EnGasCorrection	Inst	see Meter - EnGCF
FlowSetpoint	Inst	in [FLOW_UNIT] in 10E-4 steps
SetDefault	Func	Reset object to default values
Autozero	Func	see Meter - AutoZero
ResetAutozero	Func	see Meter - ResetAutoZero
Wink	Func	see Meter - Wink
ResetTotalizer	Func	see Meter - ResetTotalizer

Standard Output 1179 Object [SmallSend; ObjId=21]		
Name	**Par. Type**	**Description**
HighLimitAlarm	Inst	see SigProc - TripPointHighAlarm
LowLimitAlarm	Inst	see SigProc - TripPointLowAlarm
SystemError	Inst	any severe error condition
High2LimitAlarm	Inst	see SigProc - TripPointHigh2Alarm
Low2LimitAlarm	Inst	see SigProc - TripPointLow2Alarm
ValveClosed	Inst	(THERMAL_MASS_FOW_RATE < 1%) && (VALVE_OVERWRITE == FLOW_OFF)
Purge	Inst	THERMAL_MASS_FLOW_RATE > 110%
OverTemperature	Inst	INTERNAL_TEMP > MAX_TEMP
ValveDriveAlarm	Inst	VALVE_DRIVE_LEVEL > MAX_VTP
CalibrationRecommended	Inst	TIME_TO_CAL count down expired
Uncalibrated	Inst	if a disabled or no table is used
ControllerError	Inst	abs (set - flow) greater for a longer time period
MemoryFailure	Inst	E2PROM checksum error
UnexpectedCondition	Inst	any process error condition
ThermalMassFlowRate	Inst	in [FLOW_UNIT] in 10E-4 steps;
InternalTemperature	Inst	temperature in [°C] (in 10E-4) steps; see System - InternalTemp
ValveDriveLevel	Inst	0..100% (in 10E-4 steps´) 0% = valve is closed 100% = valve is in purge position (full open) see Valve - ValvePosition
SetDefault	Func	Reset object to default values

Full Output 1179 Object [FullSend; ObjId=22]		
Name	**Par. Type**	**Description**
HighLimitAlarm	Inst	see SigProc - TripPointHighAlarm
LowLimitAlarm	Inst	see SigProc - TripPointLowAlarm
SystemError	Inst	see SmallSend - SystemError
High2LimitAlarm	Inst	see SigProc - TripPointHigh2Alarm
Low2LimitAlarm	Inst	see SigProc - TripPointLow2Alarm
ValveClosed	Inst	see SmallSend - ValveClosed

Full Output 1179 Object [FullSend; ObjId=22]		
Purge	Inst	see SmallSend - Purge
OverTemperature	Inst	see SmallSend - OverTemperature
ValveDriveAlarm	Inst	see SmallSend - ValveDriveAlarm
CalibrationRecommended	Inst	see SmallSend - CalibrationRecommended
Uncalibrated	Inst	see SmallSend - Uncalibrated
ControllerError	Inst	see SmallSend - ControllerError
MemoryFailure	Inst	see SmallSend - MemoryFailure
UnexpectedCondition	Inst	see SmallSend - UnexpectedCondition
ThermalMassFlowRate	Inst	see SmallSend - ThermalMassFlowRate
InternalTemperature	Inst	see SmallSend - InternalTemperature
ValveDriveLevel	Inst	see SmallSend - ValveDriveLevel
FlowTotalized	Inst	totalized flow in FlowUnit (in 10E-1 steps) i.e. min. 298 days for a 500 range
SetDefault	Func	Reset object to default values

Standard Setup 1179 Object [SmallSetup; ObjId=23]		
Name	**Par. Type**	**Description**
BaseUnit	Inst	Display in base unit; (base unit =>FlowUnit of CalTable Object)
OperationMode	Inst	see Analog - OperationMode
ZeroGain	Inst	5% .. 200% full scale (in 1¤-4 steps); see Meter - ZeroGain
ZeroOffset	Inst	-5% .. +5% full scale (in 1¤-4 steps); see Meter - ZeroOffset
TripPointHigh	Inst	-10% .. + 120% full scale (in 1¤-4 steps); see SigProc - TripPointHigh
TripPointLow	Inst	-10% .. + 120% full scale (in 1¤-4 steps); see SigProc - TripPointLow
GasCorrection	Inst	(in 1E-4 steps) see Meter - GCF
DefaultTable	Inst	see SigProc - DefaultTable
TripPointHigh2	Inst	-10% .. + 120% full scale (in 1¤-4 steps); see SigProc - TripPointHigh2
TripPointLow2	Inst	-10% .. + 120% full scale (in 1¤-4 steps); see SigProc - TripPointHigh2
FilterSettling	Inst	0.0 .. 1000.0 in [sec] (in 1E-4 steps); see SigProc - FilterSettling
SoftStartRate	Inst	0.0 .. 3600.0 in [sec] (in 1E-4 steps); see Controller - FilterSettling
TimeToCal	Inst	see System - TimeToCal
CalDate	Inst	see Identity - CalDate
UserTag	Inst	see Identity - UserTag
SetDefault	Func	Reset object to default values

Standard Diagnostic Object [SmallDiag; ObjId=24]		
Name	**Par. Type**	**Description**
CommonExceptionDetailAlarm	Inst	see Status - CommonExceptionDetailAlarm
DeviceExceptionDetailAlarm	Inst	see Status - DeviceExceptionDetailAlarm
ManufacturerExceptionDetailAlarm	Inst	see Status - ManufacturerExceptionDetailAlarm
CommonExceptionDetailWarn	Inst	see Status - CommonExceptionDetailWarn

Standard Diagnostic Object [SmallDiag; ObjId=24]		
DeviceExceptionDetailWarn	Inst	see Status - DeviceExceptionDetailWarn
ManufacturerExceptionDetailWarn	Inst	see Status - ManufacturerExceptionDetailWarn
ProductCode	Inst	see Identity - ProductCode
SoftwareRevision	Inst	see Identity - SoftwareRevision
HardwareRevision	Inst	see Identity - HardwareRevision
FullScale	Inst	calculated fullscale for 1179 Objects
RunHours	Inst	see System - RunHours
InternalTemp	Inst	temperature in [°C] (in 10E-4) steps; see System - InternalTemp
ValvePosition	Inst	0..100% (in 10E-4 steps´) 0% = valve is closed 100% = valve is in purge position (full open) see Valve - ValvePosition
TimeToCal	Inst	see System - TimeToCal
SetDefault	Func	Reset object to default values

Identity Object [Identity; ObjId=25]		
Name	**Par. Type**	**Description**
DeviceType	Inst	MFC,MFM
ProductCode	Inst	MF1
Manufacturer	Inst	MKS Instruments
Model	Inst	MF1..
SerialNumber	Inst	G123456G20
SoftwareRevision	Inst	TBD
HardwareRevision	Inst	TBD
InterfaceType	Inst	[ANALOG, PB, DNET, RS485, ...]
SensorType	Inst	[MEMS, AMETAL]
SpecialNr	Inst	Device Special Number
CalDate	Inst	Date of calibration
UserTag	Inst	any 32 character string
SvnNr	Inst	actual SVN software project number
SibSNr	Inst	SIB Serial Number
DibSNr	Inst	DIB Serial Number
DibFwVersion	Inst	DIB Firmware Version
CdcName	Inst	Cdc Name (default: device serial) Can used to assign a device part on the USB bus.
CdcRevision	Inst	CDC Revision for InstrumentBrowser
SetDefault	Func	Reset object to default values

Password Object [Password; ObjId=26]		
Name	**Par. Type**	**Description**
SetPasswordDevice	Inst	Set new Device Password
UnlockDevice	Inst	Unlock device for user defined setup; (CalTable...)

Password Object [Password; ObjId=26]		
UnlockFactory	Inst	Unlock device for factory setup
UnlockDeviceStatus	Inst	[0=locked; 1=unlocked]
UnlockFactoryStatus	Inst	[0=locked; 1=unlocked]
SetDefault	Func	Reset object to default values

Meter Object [Meter; ObjId=27]		
Name	**Par. Type**	**Description**
FlowValueF	Inst	actual flow value as float in FlowUnit
FlowValueI	Inst	actual flow value as int (in 10E-4 steps) in FlowUnit
FlowUnit	Inst	recalculate FlowUnit of CalTable to User defined FlowUnit [SCCM, SLM, SCCH, SLH, SCMM, SCMH, SCFM, SCFH, %, ‰, PPM, PPC, PPT, PPQ, V, DEFAULT]
FullScale	Inst	full scale is calculated from Parameter CalConv=>FullScale and Meter=>FlowUnit.
GCF	Inst	global GCF; default = 1.0
EnGCF	Inst	enable global GCF [0 = disabled, 1 = enabled]
ZeroGain	Inst	for autozero ZeroGain
ZeroOffset	Inst	for autozero, -5% .. +5% of full scale
EnAutoZero	Inst	enable Autozero ZeroOffset and ZeroGain [0,1]; default = 1
AutoZero	Inst	0 to 1 transition activates zeroing if (VALVE_OVERRIDE==FLOW_OFF && FLOW_SETPOINT < 5%FS)
UserSpan	Inst	set global user span
UserZero	Inst	set global user zero
Overflow	Inst	TBD
Underflow	Inst	TBD
TotalFlow	Inst	Totalized Flow of Meter Object in FlowUnit (in 10E-1 steps) i.e. min. 298 days for a 500 range
EnableTotalizer	Inst	enable the totalizer function
ResetTotalizer	Inst	0 to 1 transition resets totalizer to zero
SetDefault	Func	Reset object to default values
Autozero	Func	if read or write, execute Autozero if (VALVE_OVERRIDE==FLOW_OFF && FLOW_SETPOINT < 5%FS)
ResetAutozero	Func	if read or write, clear Autozero
Wink	Func	if read or write, execute WinkStatus
ResetTotalizer	Func	if read or write, reset the TotalFlow value to 0

Controller Object [Controller; ObjId=28]		
Name	**Par. Type**	**Description**
SetpointF	Inst	setpoint as float
SetpointI	Inst	setpoint as int (in 10E-1 steps)
FlowUnit	Inst	see Meter - FlowUnit
FullScale	Inst	see Meter - FullScale
Config	Inst	[controller, meter, direct]

Controller Object [Controller; ObjId=28]		
		controller => Valve controls the flow meter => Valve full open direct => Valve is controlled with the setpoint from 0% to 100%
SoftStartRate	Inst	0.0 .. 3600.0 in [sec]
SlewRate	Inst	0.0 .. 3600.0 in [sec]
SpHystLow	Inst	Setpoint off in [%]
SpHystHigh	Inst	Setpoint on in [%]
SetDefault	Func	Reset object to default values

Sensor Object [Sensor; ObjId=29]		
Name	**Par. Type**	**Description**
FlowValue	Inst	Actual flow in % uncalibrated
FullScaleN2	Inst	Maximum flow of MF1 in sccm of N2
SetDefault	Func	Reset object to default values

Actuator (Valve) Object [Valve; ObjId=30]		
Name	**Par. Type**	**Description**
ValvePosition	Inst	0..100% 0% = valve is closed 100% = valve is in purge position (full open)
ValveOverride	Inst	[normal, Valve Close, Valve Purge]
ValveType	Inst	[Meter, Controller Normally Close]
SetDefault	Func	Reset object to default values

Signal Processing Object [SigProc; ObjId=31]		
Name	**Par. Type**	**Description**
TripPointHighAlarm	Inst	(flow > HIGH_LIMIT), Hysteresis = 0.5%)
TripPointLowAlarm	Inst	(flow < LOW_LIMIT), Hysteresis = 0.5%
TripPointHigh2Alarm	Inst	(flow > HIGH2_LIMIT), Hysteresis = 0.5%)
TripPointLow2Alarm	Inst	(flow < LOW2_LIMIT), Hysteresis = 0.5%
TripPointHigh	Inst	-10% .. + 120% full scale
TripPointLow	Inst	-10% .. + 120% full scale
TripPointHigh2	Inst	-10% .. + 120% full scale
TripPointLow2	Inst	-10% .. + 120% full scale
FilterSettling	Inst	0.0 .. 1000.0 in [sec]
DefaultTable	Inst	0 .. 14 is the default table, 15 function (y=x) is the gas table
SelectGasTable	Inst	0..14; 15 = default gas table is used
SetDefault	Func	Reset object to default values

Gas Calibration Object [CalTable; ObjId=32]		
Name	**Par. Type**	**Description**
Instance	Inst	Show the Instance of the Object
GasName	Inst	e.g N2
GasNumber	Inst	Gas Semi Number
ZeroTempCoef	Inst	Zero Drift Compensation Factor
SpanTempCoef	Inst	Span Drift Compensation Factor
CalTemp	Inst	Internal Temperature while Calibration
SensorOffset	Inst	Sensor Offset correction
SensorSpan	Inst	Sensor Span correction
FullScaleCal	Inst	Fullscale for calibration table
FlowUnit	Inst	Calibration FlowUnit [SCCM, SLM, SCCH, SLH, SCMM, SCMH, SCFM, SCFH, USER_MIN, USER_HOUR] USER_MIN => user defined UNIT counted in minutes if not exists jet. USER_HOUR => user defined UNIT counted in hours if not exists jet.
GasTableLength	Inst	2..21 = table with 2..21 points 0 or 1 = disable table
SensorValue0	Inst	sensor Value
FlowValue0	Inst	flow Value
SensorValue1	Inst	...
FlowValue1	Inst	...
SensorValue ...	Inst	...
FlowValue ...	Inst	...
Pointer	Inst	TBD
SetDefault	Func	Reset object to default values
StoreSensorValue	Func	TBD

Controller Calibration Object [ControllerTable; ObjId=33]		
Name	**Par. Type**	**Description**
Instance	Inst	Show the Instance of the Object
ControllerP	Inst	Valve Controller proportional value
ControllerI	Inst	Valve Controller integral value
ControllerD	Inst	Valve Controller derivativ value
SetDefault	Func	Reset object to default values

Acceleration Setup Object [AccelSetup; ObjId=34]		
Name	**Par. Type**	**Description**
Instance	Inst	Show the Instance of the Object
SetpointFilter	Inst	Setpoint Filter
StartAddGain	Inst	Start additional Gain

Acceleration Setup Object [AccelSetup; ObjId=34]		
StartMinFlow	Inst	Start min. Flow
TempCoefOffset	Inst	reserved
TempCoefGain	Inst	reserved
SpeedupGain	Inst	Speedup Gain
SpeedupTau	Inst	Speedup Tau
SpeedupGainFlowInc	Inst	Speedup Gain Flow Increment
SpeedupGainTempInc	Inst	Speedup Gain Temp Increment
SpeedupTauTempInc	Inst	Speedup Tau Temp Increment
TempValveOffset	Inst	Add Valve Offset addicted to Temperature (TempValveOffset * Calibration TempDif)
FltType	Inst	[no Filter, Filter1, Filter2]
Flt1StabFac	Inst	Stabilization Factor for Filter 1
Flt1ReactFac	Inst	Reactivation Factor for Filter 1
Flt2Boarder	Inst	Filter Boarder for Filter 2
Digits	Inst	define the resolution
AddValveOffset	Inst	Add Valve Offset
SetDefault	Func	Reset object to default values

Gas Conversion Object [GasConv; ObjId=35]		
Name	**Par. Type**	**Description**
Instance	Inst	Show the Instance of the Object
ID	Inst	Name of the conversion e.g. gas name
CalTableInstance	Inst	Reference to the CalTable which linearizes the flow signal
ControllerSetupInstance	Inst	Reference to the ControllerSetup which define the PID settings
AccelSetupInstance	Inst	Reference to the AccelSetup which define the speedup settings
GasCorrectionFactor	Inst	Factor for translating the linearized gas type to the wanted
FullScale	Inst	FullScale derived from physical by the GCF and Meter - FlowUnit
MinDisplay	Inst	define zero for relative outputs [in Meter - FlowUnit] e.g. %, ‰, V
MaxDisplay	Inst	define FullScale for relative outputs [in Meter - FlowUnit] e.g. %, ‰, V
SetDefault	Func	Reset object to default values

Device Status Object [Status; ObjId=36]		
Name	**Par. Type**	**Description**
ExceptionByte	Inst	reserved
CommonExceptionDetailAlarm	Inst	bit0 = reserved bit1 = TripPointHigh2Alarm bit2 = TripPointLow2Alarm bit3 - bit7 = reserved
DeviceExceptionDetailAlarm	Inst	bit0 = an USB error occurred
ManufacturerExceptionDetailAlarm	Inst	reserved
CommonExceptionDetailWarn	Inst	bit0 = CalibrationRecommended bit1 = TripPointHighAlarm

Device Status Object [Status; ObjId=36]		
		bit2 = TripPointLowAlarm bit3 = ControllerError bit4 - bit7 = reserved
DeviceExceptionDetailWarn	Inst	reserved
ManufacturerExceptionDetailWarn	Inst	bit0 = an power fail occurred bit1 = an setpoint overflow occurred bit2 = an flow value overflow occurred bit3 - bit7 = reserved
AlarmEnable	Inst	[disable, enable] Enable diagnostics if an error alarm status has changed
WarningEnable	Inst	disable, enable] Enable diagnostics if an warning alarm status has changed
EepromChecksumFailCnt	Inst	Counter for Eeprom checksum fail errors
FlashChecksumFailCnt	Inst	Counter for flash checksum fail errors
StartUpCnt	Inst	Counts the startups
LowVoltageCnt	Inst	Counter for low voltage errors
WpdCnt	Inst	Counter for set device password
WpfCnt	Inst	Counter for set factory password
WdSibCnt	Inst	Counter for SIB watchdogs
SibDibComExcepCnt	Inst	Counter for SIB<=>DIB communication lost
WdDibCnt	Inst	Counter for DIB watchdogs
SetDefault	Func	Reset object to default values

Analog Interface Object [Analog; ObjId=37]		
Name	**Par. Type**	**Description**
OperationMode	Inst	[Analog, Digital] sets the inputs to analog or digital mode
FullscaleVoltage	Inst	output Voltage if GasConf - MaxDisplay is reached
ZeroscaleVoltage	Inst	output Voltage if GasConf - MinDisplay is reached
SetDefault	Func	Reset object to default values

Fieldbus Interface Object [Fieldbus; ObjId=38]		
Name	**Par. Type**	**Description**
Address	Inst	configured address
SoftwareAddress	Inst	if software address is < 126 this address is used for fieldbus
MaxBaudrate	Inst	Shows the maximum Profibus baud rate
CyclTlgInputObjectId	Inst	Id of last used cyclic input telegram
CyclTlgOutputObjectId	Inst	Id of last used cyclic output telegram
Config	Inst	reserved
SetDefault	Func	Reset object to default values
RestartFieldBus	Func	restart RestartFieldBus

Com Interface Object [ComIfc; ObjId=39]		
Name	**Par. Type**	**Description**
Address	Inst	Defines the device address by the rotary switches.
SoftwareAddress	Inst	f the software address is < 100 the rotary switches address is ignored and the software configurable address is used.
Baudrate	Inst	Defines the baud rate for the communication.
Parity	Inst	Define the parity setup. 0 => none 1 => even 2 => odd
DataBits	Inst	Define the data bits. Possible values are 7 or 8.
StopBits	Inst	Define the stop bits. 0 => 1,5 Stop Bits 1 => 1 Stop Bit 2 => 2 Stop Bits
Config	Inst	reserved
FailsaveTimeout	Inst	Timeout definition.
SetDefault	Func	Reset object to default values
RestartComIfc	Func	restart ComInterface

Network Interface Object [NetIfc; ObjId=40]		
Name	**Par. Type**	**Description**
IpAddress	Inst	reserved
SubnetMask	Inst	reserved
Gateway	Inst	reserved
Dhcp	Inst	reserved
Dns1	Inst	reserved
Dns2	Inst	reserved
HostName	Inst	reserved
DomainName	Inst	reserved
SmtpServer	Inst	reserved
SmtpUser	Inst	reserved
SmtpPswd	Inst	reserved
Config	Inst	reserved
SetDefault	Func	reserved
RestartNetIfc	Func	reserved

Hardware Object [Hardware; ObjId=41]		
Name	**Par. Type**	**Description**
ChnId	Inst	Name of Hardware Channel
M	Inst	Calibration M value
B	Inst	Calibration B value

Hardware Object [Hardware; ObjId=41]		
Value	Inst	actual raw value
SetDefault	Func	Reset object to default values

System Object [System; ObjId=42]		
Name	**Par. Type**	**Description**
FirstError	Inst	reserved
LastError	Inst	reserved
RunHours	Inst	run time in hours
TimeToCal	Inst	Time to cal counter
InternalTemp	Inst	temperature in [°C]
SensorTemp	Inst	Sensor temperature
TempCompMode	Inst	[LM35 on Sensor, Internal Sensor Temp] => Sensor Temp
UsbMode	Inst	[msd, cdc]
MemoryMode	Inst	[Littleendian, Bigendian] lsb/msb first for process communication (e.g. Profibus)
SibHwTestStat	Inst	SIB factory test status
SetDefault	Func	Reset object to default values
SetDefaultAll	Func	Reset all object to default values

Alias Constants Object [AliasConstants; ObjId=43]		
Name	**Par. Type**	**Description**
NullByte	Inst	empty dummy byte for Alias Objects
NullBit	Inst	empty dummy bit for Alias Objects
NullNibble	Inst	empty dummy bit for Alias Objects
SetDefault	Func	Reset object to default values

Alias Objects Object [AliasObjects; ObjId=44]		
Name	**Par. Type**	**Description**
AliasObjectId	Inst	TBD
AliasObjectName	Inst	TBD
AliasObjectUsage	Inst	TBD
SetDefault	Func	TBD
DisableAliases	Func	TBD
AssembleAliases	Func	Reset object to default values

Alias Params Object [AliasParams; ObjId=45]		
Name	**Par. Type**	**Description**
AliasObjectInstance	Inst	TBD
SourceObjectId	Inst	TBD
SourceAttributeId	Inst	TBD

Object Parameter Reference

Standard Input 1179 Object [SmallRecv]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
20	148	0	0	ObjId	R	uint8	20	-	-	-
20	148	0	1	ObjName	R	char[12]	SmallRecv	-	-	-
20	148	0	2	Length	R	uint16	6	-	-	-
20	148	0	3	NrOfInstances	R	uint8	1	-	-	-
20	148	0	4	ActInst	RW	uint8	1	1	1	-
20	20	1..n	0	ValveOverride	RW	uint:2	1	0	2	NSTNV
20	20	1..n	1	Autozero	W	uint:1	0	0	1	NSTNV
20	20	1..n	2	ReportDiag	W	uint:3	0	0	3	NSTNV
20	20	1..n	3	WinkStatus	W	uint:1	0	0	1	NSTNV
20	20	1..n	4	EnableTotalizer	RW	uint:1	0	0	1	NSTNV
20	20	1..n	5	ResetTotalizer	W	uint:1	0	0	1	NSTNV
20	20	1..n	6	ResetStatus	W	uint:1	0	0	1	NSTNV
20	20	1..n	7	SelectGasTable	RW	uint:4	15	0	15	NSTNV
20	20	1..n	8	EnGasCorrection	RW	uint:1	0	0	1	NSTNV
20	20	1..n	9	FlowSetpoint	RW	long	0	-2147483647	2147483647	NSTNV
20	20	-	100	SetDefault	W	cmd	-	-	-	-
20	20	-	101	Autozero	W	cmd	-	-	-	-
20	20	-	102	ResetAutozero	W	cmd	-	-	-	-
20	20	-	103	Wink	W	cmd	-	-	-	-
20	20	-	104	ResetTotalizer	W	cmd	-	-	-	-

Standard Output 1179 Object [SmallSend]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**

Standard Output 1179 Object [SmallSend]										
21	149	0	0	ObjId	R	uint8	21	-	-	-
21	149	0	1	ObjName	R	char[12]	SmallSend	-	-	-
21	149	0	2	Length	R	uint16	14	-	-	-
21	149	0	3	NrOfInstances	R	uint8	1	-	-	-
21	149	0	4	ActInst	RW	uint8	1	1	1	-
21	21	1..n	0	HighLimitAlarm	R	uint:1	0	0	1	NSTNV
21	21	1..n	1	LowLimitAlarm	R	uint:1	0	0	1	NSTNV
21	21	1..n	2	SystemError	R	uint:1	0	0	1	NSTNV
21	21	1..n	3	High2LimitAlarm	R	uint:1	0	0	1	NSTNV
21	21	1..n	4	Low2LimitAlarm	R	uint:1	0	0	1	NSTNV
21	21	1..n	5	ValveClosed	R	uint:1	0	0	1	NSTNV
21	21	1..n	6	Purge	R	uint:1	0	0	1	NSTNV
21	21	1..n	7	OverTemperature	R	uint:1	0	0	1	NSTNV
21	21	1..n	8	ValveDriveAlarm	R	uint:1	0	0	1	NSTNV
21	21	1..n	9	CalibrationRecommended	R	uint:1	0	0	1	NSTNV
21	21	1..n	10	Uncalibrated	R	uint:1	0	0	1	NSTNV
21	21	1..n	11	ControllerError	R	uint:1	0	0	1	NSTNV
21	21	1..n	12	MemoryFailure	R	uint:1	0	0	1	NSTNV
21	21	1..n	13	UnexpectedCondition	R	uint:1	0	0	1	NSTNV
21	21	1..n	14	ThermalMassFlowRate	R	long	0	-2147483647	2147483647	NSTNV
21	21	1..n	15	InternalTemperature	R	long	0	-2147483647	2147483647	NSTNV
21	21	1..n	16	ValveDriveLevel	R	long	0	-2147483647	2147483647	NSTNV
21	21	-	100	SetDefault	WPF	cmd	-	-	-	-

Full Output 1179 Object [FullSend]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
22	150	0	0	ObjId	R	uint8	22	-	-	-
22	150	0	1	ObjName	R	char[12]	FullSend	-	-	-
22	150	0	2	Length	R	uint16	18	-	-	-
22	150	0	3	NrOfInstances	R	uint8	1	-	-	-
22	150	0	4	ActInst	RW	uint8	1	1	1	-

Full Output 1179 Object [FullSend]										
22	22	1..n	0	HighLimitAlarm	R	uint:1	0	0	1	NSTNV
22	22	1..n	1	LowLimitAlarm	R	uint:1	0	0	1	NSTNV
22	22	1..n	2	SystemError	R	uint:1	0	0	1	NSTNV
22	22	1..n	3	High2LimitAlarm	R	uint:1	0	0	1	NSTNV
22	22	1..n	4	Low2LimitAlarm	R	uint:1	0	0	1	NSTNV
22	22	1..n	5	ValveClosed	R	uint:1	0	0	1	NSTNV
22	22	1..n	6	Purge	R	uint:1	0	0	1	NSTNV
22	22	1..n	7	OverTemperature	R	uint:1	0	0	1	NSTNV
22	22	1..n	8	ValveDriveAlarm	R	uint:1	0	0	1	NSTNV
22	22	1..n	9	CalibrationRecommended	R	uint:1	0	0	1	NSTNV
22	22	1..n	10	Uncalibrated	R	uint:1	0	0	1	NSTNV
22	22	1..n	11	ControllerError	R	uint:1	0	0	1	NSTNV
22	22	1..n	12	MemoryFailure	R	uint:1	0	0	1	NSTNV
22	22	1..n	13	UnexpectedCondition	R	uint:1	0	0	1	NSTNV
22	22	1..n	14	ThermalMassFlowRate	R	long	0	-2147483647	2147483647	NSTNV
22	22	1..n	15	InternalTemperature	R	long	0	-2147483647	2147483647	NSTNV
22	22	1..n	16	ValveDriveLevel	R	long	0	-2147483647	2147483647	NSTNV
22	22	1..n	17	FlowTotalized	R	long	0	-2147483647	2147483647	NSTNV
22	22	-	100	SetDefault	WPF	cmd	-	-	-	-

Standard Setup 1179 Object [SmallSetup]									
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
23	151	0	0	ObjId	R	uint8	23	-	-	-
23	151	0	1	ObjName	R	char[12]	SmallSetup	-	-	-
23	151	0	2	Length	R	uint16	80	-	-	-
23	151	0	3	NrOfInstances	R	uint8	1	-	-	-
23	151	0	4	ActInst	RW	uint8	1	1	1	-
23	23	1..n	0	BaseUnit	RW	uint:1	0	0	1	STNV
23	23	1..n	1	OperationMode	RW	uint:1	0	0	1	STNV
23	23	1..n	2	ZeroGain	RW	long	1000000	50000	2000000	STNV
23	23	1..n	3	ZeroOffset	RW	long	0	-50000	50000	STNV
23	23	1..n	4	TripPointHigh	RW	long	0	-100000	1200000	STNV
23	23	1..n	5	TripPointLow	RW	long	0	-100000	1200000	STNV
23	23	1..n	6	GasCorrection	RW	long	10000	100	100000	STNV
23	23	1..n	7	DefaultTable	RW	uint8	0	0	15	STNV
23	23	1..n	8	TripPointHigh2	RW	long	0	-100000	1200000	STNV
23	23	1..n	9	TripPointLow2	RW	long	0	-100000	1200000	STNV
23	23	1..n	10	FilterSettling	RW	long	0	0	10000000	STNV
23	23	1..n	11	SoftStartRate	RW	long	0	0	36000000	STNV
23	23	1..n	12	TimeToCal	RW	uint16	0	0	65535	NSTNV

Standard Setup 1179 Object [SmallSetup]										
23	23	1..n	13	CalDate	RW	char[7]	10108	-	-	STNV
23	23	1..n	14	UserTag	RW	char[32]		-	-	STNV
23	23	-	100	SetDefault	WPF	cmd	-	-	-	-

Standard Diagnostic Object [SmallDiag]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
24	152	0	0	ObjId	R	uint8	24	-	-	-
24	152	0	1	ObjName	R	char[12]	SmallDiag	-	-	-
24	152	0	2	Length	R	uint16	48	-	-	-
24	152	0	3	NrOfInstances	R	uint8	1	-	-	-
24	152	0	4	ActInst	RW	uint8	1	1	1	-
24	24	1..n	0	CommonExceptionDetailAlarm	R	uint8	0	0	255	NSTNV
24	24	1..n	1	DeviceExceptionDetailAlarm	R	uint8	0	0	255	NSTNV
24	24	1..n	2	ManufacturerExceptionDetailAlarm	R	uint8	0	0	255	NSTNV
24	24	1..n	3	CommonExceptionDetailWarn	R	uint8	0	0	255	NSTNV
24	24	1..n	4	DeviceExceptionDetailWarn	R	uint8	0	0	255	NSTNV
24	24	1..n	5	ManufacturerExceptionDetailWarn	R	uint8	0	0	255	NSTNV
24	24	1..n	6	ProductCode	R	char[8]	MF1	-	-	NSTNV
24	24	1..n	7	SoftwareRevision	R	char[8]	01.01.00	-	-	NSTNV
24	24	1..n	8	HardwareRevision	R	char[8]	01.01.00	-	-	NSTNV
24	24	1..n	9	FullScale	R	long	1	-2147483647	2147483647	NSTNV
24	24	1..n	10	RunHours	R	long	0	0	2000000000	NSTNV
24	24	1..n	11	InternalTemp	R	float	0	0	120	NSTNV
24	24	1..n	12	ValvePosition	R	float	0	0	110	NSTNV
24	24	1..n	13	TimeToCal	R	uint16	0	0	65535	NSTNV
24	24	-	100	SetDefault	WPF	cmd	-	-	-	-

Identity Object [Identity]									
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
25	153	0	0	ObjId	R	uint8	25	-	-	-

Identity Object [Identity]										
25	153	0	1	ObjName	R	char[12]	Identity	-	-	-
25	153	0	2	Length	R	uint16	257	-	-	-
25	153	0	3	NrOfInstances	R	uint8	1	-	-	-
25	153	0	4	ActInst	RW	uint8	1	1	1	-
25	25	1..n	0	DeviceType	R	char[8]	MFC	-	-	STNV
25	25	1..n	1	ProductCode	RWPF	char[8]	MF1	-	-	STNV
25	25	1..n	2	Manufacturer	R	char[16]	MKSI	-	-	STNV
25	25	1..n	3	Model	RWPF	char[32]	MF1	-	-	STNV
25	25	1..n	4	SerialNumber	RWPF	char[16]	123456	-	-	STNV
25	25	1..n	5	SoftwareRevision	R	char[8]	01.01.00	-	-	STNV
25	25	1..n	6	HardwareRevision	RWPF	char[8]	01.01.00	-	-	STNV
25	25	1..n	7	InterfaceType	R	char[21]		-	-	STNV
25	25	1..n	8	SensorType	RWPF	char[21]		-	-	STNV
25	25	1..n	9	SpecialNr	RWPF	uint16	0	0	65535	STNV
25	25	1..n	10	CalDate	RW	char[7]	10109	-	-	STNV
25	25	1..n	11	UserTag	RW	char[32]	user	-	-	STNV
25	25	1..n	12	SvnNr	R	long	0	0	2147483647	STNV
25	25	1..n	13	SibSNr	R	char[16]	X	-	-	STNV
25	25	1..n	14	DibSNr	R	char[16]	X	-	-	STNV
25	25	1..n	15	DibFwVersion	R	char[21]	X	-	-	STNV
25	25	1..n	16	CdcName	R	char[13]	MF1	-	-	STNV
25	25	1..n	17	CdcRevision	R	char[8]	01.01.00	-	-	STNV
25	25	-	100	SetDefault	WPF	cmd	-	-	-	-

Password Object [Password]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
26	154	0	0	ObjId	R	uint8	26	-	-	-
26	154	0	1	ObjName	R	char[12]	Password	-	-	-
26	154	0	2	Length	R	uint16	53	-	-	-
26	154	0	3	NrOfInstances	R	uint8	1	-	-	-
26	154	0	4	ActInst	RW	uint8	1	1	1	-
26	26	1..n	0	SetPasswordDevice	WPD	char[17]	-	-	-	STNV
26	26	1..n	1	UnlockDevice	W	char[17]	-	-	-	NSTNV
26	26	1..n	2	UnlockFactory	W	char[17	-	-	-	NSTNV

Password Object [Password]										
						]				
26	26	1..n	3	UnlockDeviceStatus	R	uint8	0	0	1	NSTNV
26	26	1..n	4	UnlockFactoryStatus	R	uint8	0	0	1	NSTNV
26	26	-	100	SetDefault	WPF	cmd	-	-	-	-

Meter Object [Meter]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
27	155	0	0	ObjId	R	uint8	27	-	-	-
27	155	0	1	ObjName	R	char[12]	Meter	-	-	-
27	155	0	2	Length	R	uint16	48	-	-	-
27	155	0	3	NrOfInstances	R	uint8	1	-	-	-
27	155	0	4	ActInst	RW	uint8	1	1	1	-
27	27	1..n	0	FlowValueF	R	float	0	-1,00E+038	1,00E+038	NSTNV
27	27	1..n	1	FlowValueI	R	long	0	-2147483647	2147483647	NSTNV
27	27	1..n	2	FlowUnit	RWPD	uint8	0	0	15	STNV
27	27	1..n	3	FullScale	R	float	1	-1,00E+038	1,00E+038	NSTNV
27	27	1..n	4	GCF	RW	float	1	0.01	10	STNV
27	27	1..n	5	EnGCF	RW	uint:1	0	0	1	NSTNV
27	27	1..n	6	ZeroGain	RW	float	100	5	200	STNV
27	27	1..n	7	ZeroOffset	RW	float	0	-5	5	STNV
27	27	1..n	8	EnAutoZero	RW	uint:1	1	0	1	STNV
27	27	1..n	9	AutoZero	RW	uint:1	0	0	1	NSTNV
27	27	1..n	10	UserSpan	RW	float	100	1	10000	STNV
27	27	1..n	11	UserZero	RW	float	0	-10	10	STNV
27	27	1..n	12	Overflow	R	float	0	-1,00E+038	1,00E+038	NSTNV
27	27	1..n	13	Underflow	R	float	0	-1,00E+038	1,00E+038	NSTNV
27	27	1..n	14	TotalFlow	R	long	0	-2147483647	2147483647	NSTNV
27	27	1..n	15	EnableTotalizer	RW	uint:1	0	0	1	NSTNV
27	27	1..n	16	ResetTotalizer	RW	uint:1	0	0	1	NSTNV
27	27	-	100	SetDefault	W	cmd	-	-	-	-
27	27	-	101	Autozero	W	cmd	-	-	-	-
27	27	-	102	ResetAutozero	W	cmd	-	-	-	-
27	27	-	103	Wink	W	cmd	-	-	-	-
27	27	-	104	ResetTotalizer	W	cmd	-	-	-	-

Controller Object [Controller]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
28	156	0	0	ObjId	R	uint8	28	-	-	-
28	156	0	1	ObjName	R	char[12]	Controller	-	-	-
28	156	0	2	Length	R	uint16	30	-	-	-

Controller Object [Controller]										
28	156	0	3	NrOfInstances	R	uint8	1	-	-	-
28	156	0	4	ActInst	RW	uint8	1	1	1	-
28	28	1..n	0	SetpointF	RW	float	0	-1,00E+038	1,00E+038	NSTNV
28	28	1..n	1	SetpointI	RW	long	0	-2147483647	2147483647	NSTNV
28	28	1..n	2	FlowUnit	R	uint8	0	0	15	NSTNV
28	28	1..n	3	FullScale	R	float	1	-1,00E+038	1,00E+038	NSTNV
28	28	1..n	4	Config	RW	uint8	0	0	2	STNV
28	28	1..n	5	SoftStartRate	RW	float	0	0	3600	STNV
28	28	1..n	6	SlewRate	RW	float	0	0	3600	STNV
28	28	1..n	7	SpHystLow	RWPD	float	1	0	5	STNV
28	28	1..n	8	SpHystHigh	RWPD	float	2	0	5	STNV
28	28	-	100	SetDefault	WPF	cmd	-	-	-	-

Sensor Object [Sensor]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
29	157	0	0	ObjId	R	uint8	29	-	-	-
29	157	0	1	ObjName	R	char[12]	Sensor	-	-	-
29	157	0	2	Length	R	uint16	8	-	-	-
29	157	0	3	NrOfInstances	R	uint8	1	-	-	-
29	157	0	4	ActInst	RW	uint8	1	1	1	-
29	29	1..n	0	FlowValue	RW	float	0	-1,00E+006	1,00E+006	NSTNV
29	29	1..n	1	FullScaleN2	RWPF	float	1	0.1	1,00E+009	STNV
29	29	-	100	SetDefault	WPF	cmd	-	-	-	-

Actuator (Valve) Object [Valve]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
30	158	0	0	ObjId	R	uint8	30	-	-	-
30	158	0	1	ObjName	R	char[12]	Valve	-	-	-
30	158	0	2	Length	R	uint16	6	-	-	-
30	158	0	3	NrOfInstances	R	uint8	1	-	-	-
30	158	0	4	ActInst	RW	uint8	1	1	1	-
30	30	1..n	0	ValvePosition	R	float	0	-1	100	NSTNV
30	30	1..n	1	ValveOverride	RW	uint8	0	0	2	NSTNV
30	30	1..n	2	ValveType	RWPF	uint8	1	0	1	STNV
30	30	-	100	SetDefault	WPF	cmd	-	-	-	-

Signal Processing Object [SigProc]

Signal Processing Object [SigProc]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
31	159	0	0	ObjId	R	uint8	31	-	-	-
31	159	0	1	ObjName	R	char[12]	SigProc	-	-	-
31	159	0	2	Length	R	uint16	24	-	-	-
31	159	0	3	NrOfInstances	R	uint8	1	-	-	-
31	159	0	4	ActInst	RW	uint8	1	1	1	-
31	31	1..n	0	TripPointHighAlarm	R	uint:1	0	0	1	NSTNV
31	31	1..n	1	TripPointLowAlarm	R	uint:1	0	0	1	NSTNV
31	31	1..n	2	TripPointHigh2Alarm	R	uint:1	0	0	1	NSTNV
31	31	1..n	3	TripPointLow2Alarm	R	uint:1	0	0	1	NSTNV
31	31	1..n	4	TripPointHigh	RW	float	0	0	110	STNV
31	31	1..n	5	TripPointLow	RW	float	0	0	110	STNV
31	31	1..n	6	TripPointHigh2	RW	float	0	0	110	STNV
31	31	1..n	7	TripPointLow2	RW	float	0	0	110	STNV
31	31	1..n	8	FilterSettling	RW	float	0	0	1,00E+007	STNV
31	31	1..n	9	DefaultTable	RW	uint8	0	0	15	STNV
31	31	1..n	10	SelectGasTable	RW	uint8	15	0	15	NSTNV
31	31	-	100	SetDefault	WPF	cmd	-	-	-	-

Gas Calibration Object [CalTable]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
32	160	0	0	ObjId	R	uint8	32	-	-	-
32	160	0	1	ObjName	R	char[12]	CalTable	-	-	-
32	160	0	2	Length	R	uint16	206	-	-	-
32	160	0	3	NrOfInstances	R	uint8	16	-	-	-
32	160	0	4	ActInst	RW	uint8	1	1	16	-
32	32	1..n	0	Instance	R	uint8	1	1	16	STNV
32	32	1..n	1	GasName	RWPD	char[8]	N2	-	-	STNV
32	32	1..n	2	GasNumber	RWPD	uint16	13	0	65535	STNV
32	32	1..n	3	ZeroTempCoef	RWPD	float	0	-1	1	STNV
32	32	1..n	4	SpanTempCoef	RWPD	float	0	-2	2	STNV
32	32	1..n	5	CalTemp	RWPD	float	30	0	100	STNV
32	32	1..n	6	SensorOffset	RWPD	float	0	-10	10	STNV
32	32	1..n	7	SensorSpan	RWPD	float	100	0	400	STNV
32	32	1..n	8	FullScaleCal	RWPD	float	100	-1,00E+038	1,00E+038	STNV
32	32	1..n	9	FlowUnit	RWPD	uint8	0	0	9	STNV
32	32	1..n	10	GasTableLength	RWPD	uint8	0	0	20	STNV
32	32	1..n	11	SensorValue0	RWPD	float	0	-1,00E+038	1,00E+038	STNV
32	32	1..n	12	FlowValue0	RWPD	float	0	-1,00E+038	1,00E+038	STNV

Gas Calibration Object [CalTable]										
32	32	1..n	13	SensorValue1	RWPD	float	0	-1,00E+038	1,00E+038	STNV
32	32	1..n	14	FlowValue1	RWPD	float	0	-1,00E+038	1,00E+038	STNV
32	32	1..n	15	SensorValue ...	RWPD	float	0	-1,00E+038	1,00E+038	STNV
32	32	1..n	16	FlowValue ...	RWPD	float	0	-1,00E+038	1,00E+038	STNV
32	32	1..n	53	Pointer	RWPD	uint8	1	1	20	STNV
32	32	-	100	SetDefault	WPF	cmd	-	-	-	-
32	32	-	101	StoreSensorValue	W	cmd	-	-	-	-

Controller Calibration Object [ControllerTable]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
33	161	0	0	ObjId	R	uint8	33	-	-	-
33	161	0	1	ObjName	R	char[12]	ControllerT	-	-	-
33	161	0	2	Length	R	uint16	13	-	-	-
33	161	0	3	NrOfInstances	R	uint8	16	-	-	-
33	161	0	4	ActInst	RW	uint8	1	1	16	-
33	33	1..n	0	Instance	R	uint8	1	1	16	STNV
33	33	1..n	1	ControllerP	RWPD	float	1	0	100000	STNV
33	33	1..n	2	ControllerI	RWPD	float	0	0	100000	STNV
33	33	1..n	3	ControllerD	RWPD	float	0	0	100000	STNV
33	33	-	100	SetDefault	WPF	cmd	-	-	-	-

Acceleration Setup Object [AccelSetup]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
34	162	0	0	ObjId	R	uint8	34	-	-	-
34	162	0	1	ObjName	R	char[12]	AccelSetup	-	-	-
34	162	0	2	Length	R	uint16	66	-	-	-
34	162	0	3	NrOfInstances	R	uint8	16	-	-	-
34	162	0	4	ActInst	RW	uint8	1	1	16	-
34	34	1..n	0	Instance	R	uint8	1	1	16	STNV
34	34	1..n	1	SetpointFilter	RWPD	float	0	0	1000	STNV
34	34	1..n	2	StartAddGain	RWPD	float	0	1	1000	STNV
34	34	1..n	3	StartMinFlow	RWPD	float	0	0	1000	STNV
34	34	1..n	4	TempCoefOffset	RWPD	float	0	0	1000	STNV
34	34	1..n	5	TempCoefGain	RWPD	float	0	0	1000	STNV
34	34	1..n	6	SpeedupGain	RWPD	float	0	0	100000	STNV
34	34	1..n	7	SpeedupTau	RWPD	float	0	0	100000	STNV
34	34	1..n	8	SpeedupGainFlowInc	RWPD	float	-0.27	-1000	1000	STNV

Acceleration Setup Object [AccelSetup]										
34	34	1..n	9	SpeedupGainTempInc	RWPD	float	0	-1000	1000	STNV
34	34	1..n	10	SpeedupTauTempInc	RWPD	float	0	-1000	1000	STNV
34	34	1..n	11	TempValveOffset	RWPD	float	0	-1000	1000	STNV
34	34	1..n	12	FltType	RWPD	long	0	0	2	STNV
34	34	1..n	13	Flt1StabFac	RWPD	float	0	0	1000	STNV
34	34	1..n	14	Flt1ReactFac	RWPD	float	1	0	1	STNV
34	34	1..n	15	Flt2Boarder	RWPD	float	0	0	1000	STNV
34	34	1..n	16	Digits	RWPD	uint8	5	2	6	STNV
34	34	1..n	17	AddValveOffset	RWPD	float	0	0	131072	STNV
34	34	-	100	SetDefault	WPF	cmd	-	-	-	-

Gas Conversion Object [GasConv]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
35	163	0	0	ObjId	R	uint8	35	-	-	-
35	163	0	1	ObjName	R	char[12]	GasConv	-	-	-
35	163	0	2	Length	R	uint16	28	-	-	-
35	163	0	3	NrOfInstances	R	uint8	16	-	-	-
35	163	0	4	ActInst	RW	uint8	1	1	16	-
35	35	1..n	0	Instance	R	uint8	1	1	16	STNV
35	35	1..n	1	ID	RW	char[8]	N2	-	-	STNV
35	35	1..n	2	CalTableInstance	RW	uint8	1	1	16	STNV
35	35	1..n	3	ControllerSetupInstance	RW	uint8	1	1	16	STNV
35	35	1..n	4	AccelSetupInstance	RW	uint8	1	1	16	STNV
35	35	1..n	5	GasCorrectionFactor	RW	float	1	0.1	20	STNV
35	35	1..n	6	FullScale	R	float	100	-1,00E+038	1,00E+038	STNV
35	35	1..n	7	MinDisplay	RWPD	float	0	-1,00E+038	1,00E+038	STNV
35	35	1..n	8	MaxDisplay	RWPD	float	100	-1,00E+038	1,00E+038	STNV
35	35	-	100	SetDefault	WPD	cmd	-	-	-	-

Device Status Object [Status]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
36	164	0	0	ObjId	R	uint8	36	-	-	-
36	164	0	1	ObjName	R	char[12]	Status	-	-	-
36	164	0	2	Length	R	uint16	27	-	-	-
36	164	0	3	NrOfInstances	R	uint8	1	-	-	-
36	164	0	4	ActInst	RW	uint8	1	1	1	-
36	36	1..n	0	ExceptionByte	R	uint8	0	0	255	STNV
36	36	1..n	1	CommonExceptionDetailAlarm	R	uint8	0	0	255	NSTNV

Device Status Object [Status]										
36	36	1..n	2	DeviceExceptionDetailAlarm	R	uint8	0	0	255	NSTNV
36	36	1..n	3	ManufacturerExceptionDetailAlarm	R	uint8	0	0	255	NSTNV
36	36	1..n	4	CommonExceptionDetailWarn	R	uint8	0	0	255	NSTNV
36	36	1..n	5	DeviceExceptionDetailWarn	R	uint8	0	0	255	NSTNV
36	36	1..n	6	ManufacturerExceptionDetailWarn	R	uint8	0	0	255	NSTNV
36	36	1..n	7	AlarmEnable	RW	uint8	0	0	1	STNV
36	36	1..n	8	WarningEnable	RW	uint8	0	0	1	STNV
36	36	1..n	9	EepromChecksumFailCnt	R	uint16	0	0	65535	STNV
36	36	1..n	10	FlashChecksumFailCnt	R	uint16	0	0	65535	STNV
36	36	1..n	11	StartUpCnt	R	uint16	0	0	65535	STNV
36	36	1..n	12	LowVoltageCnt	R	uint16	0	0	65535	STNV
36	36	1..n	13	WpdCnt	R	uint16	0	0	65535	STNV
36	36	1..n	14	WpfCnt	R	uint16	0	0	65535	STNV
36	36	1..n	15	WdSibCnt	R	uint16	0	0	65535	STNV
36	36	1..n	16	SibDibComExcepCnt	R	uint16	0	0	65535	STNV
36	36	1..n	17	WdDibCnt	R	uint16	0	0	65535	STNV
36	36	-	100	SetDefault	WPF	cmd	-	-	-	-

Analog Interface Object [Analog]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
37	165	0	0	ObjId	R	uint8	37	-	-	-
37	165	0	1	ObjName	R	char[12]	Analog	-	-	-
37	165	0	2	Length	R	uint16	10	-	-	-
37	165	0	3	NrOfInstances	R	uint8	1	-	-	-
37	165	0	4	ActInst	RW	uint8	1	1	1	-
37	37	1..n	0	OperationMode	RW	uint:1	0	0	1	STNV
37	37	1..n	1	FullscaleVoltage	RW	float	5	5	10	STNV
37	37	1..n	2	ZeroscaleVoltage	RW	float	0	0	2	STNV
37	37	-	100	SetDefault	WPF	cmd	-	-	-	-

Fieldbus Interface Object [Fieldbus]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
38	166	0	0	ObjId	R	uint8	38	-	-	-
38	166	0	1	ObjName	R	char[12]	Fieldbus	-	-	-
38	166	0	2	Length	R	uint16	12	-	-	-
38	166	0	3	NrOfInstances	R	uint8	1	-	-	-
38	166	0	4	ActInst	RW	uint8	1	1	1	-
38	38	1..n	0	Address	R	uint8	1	0	127	STNV
38	38	1..n	1	SoftwareAddress	RW	uint8	126	0	127	STNV

Fieldbus Interface Object [Fieldbus]									
38	38	1..n	2	MaxBaudrate	R	long	12000000	9600	12000000	STNV
38	38	1..n	3	CyclTlgInputObjectId	RW	uint8	20	0	45	STNV
38	38	1..n	4	CyclTlgOutputObjectId	RW	uint8	21	0	45	STNV
38	38	1..n	5	Config	R	long	0	0	0	STNV
38	38	-	100	SetDefault	W	cmd	-	-	-	-
38	38	-	101	RestartFieldBus	W	cmd	-	-	-	-

Com Interface Object [ComIfc]									
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
39	167	0	0	ObjId	R	uint8	39	-	-	-
39	167	0	1	ObjName	R	char[12]	ComIfc	-	-	-
39	167	0	2	Length	R	uint16	17	-	-	-
39	167	0	3	NrOfInstances	R	uint8	1	-	-	-
39	167	0	4	ActInst	RW	uint8	1	1	1	-
39	39	1..n	0	Address	R	uint8	0	0	125	STNV
39	39	1..n	1	SoftwareAddress	RW	uint8	126	0	127	STNV
39	39	1..n	2	Baudrate	RW	long	115200	110	3000000	STNV
39	39	1..n	3	Parity	RW	uint8	0	0	2	STNV
39	39	1..n	4	DataBits	RW	uint8	8	7	8	STNV
39	39	1..n	5	StopBits	RW	uint8	1	1	3	STNV
39	39	1..n	7	Config	R	long	0	0	0	STNV
39	39	1..n	6	FailsaveTimeout	RW	long	0	0	60000	STNV
39	39	-	100	SetDefault	W	cmd	-	-	-	-
39	39	-	101	RestartComIfc	W	cmd	-	-	-	-

Network Interface Object [NetIfc]									
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
40	168	0	0	ObjId	R	uint8	40	-	-	-
40	168	0	1	ObjName	R	char[12]	NetIfc	-	-	-
40	168	0	2	Length	R	uint16	334	-	-	-
40	168	0	3	NrOfInstances	R	uint8	1	-	-	-
40	168	0	4	ActInst	RW	uint8	1	1	1	-
40	40	1..n	0	IpAddress	RW	IpAdr	0	0	4294967295	STNV
40	40	1..n	1	SubnetMask	RW	IpAdr	0	0	4294967295	STNV
40	40	1..n	2	Gateway	RW	IpAdr	0	0	4294967295	STNV
40	40	1..n	3	Dhcp	RW	uint8	0	0	1	STNV
40	40	1..n	4	Dns1	RW	IpAdr	0	0	4294967295	STNV
40	40	1..n	5	Dns2	RW	IpAdr	0	0	4294967295	STNV
40	40	1..n	6	HostName	RW	char[65]		-	-	STNV

Network Interface Object [NetIfc]										
40	40	1..n	7	DomainName	RW	char[49]		-	-	STNV
40	40	1..n	8	SmtpServer	RW	char[65]		-	-	STNV
40	40	1..n	9	SmtpUser	RW	char[65]		-	-	STNV
40	40	1..n	10	SmtpPswd	RW	char[65]		-	-	STNV
40	40	1..n	11	Config	R	long	0	0	0	STNV
40	40	-	100	SetDefault	W	cmd	-	-	-	-
40	40	-	101	RestartNetIfc	W	cmd	-	-	-	-

Hardware Object [Hardware]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
41	169	0	0	ObjId	R	uint8	41	-	-	-
41	169	0	1	ObjName	R	char[12]	Hardware	-	-	-
41	169	0	2	Length	R	uint16	23	-	-	-
41	169	0	3	NrOfInstances	R	uint8	10	-	-	-
41	169	0	4	ActInst	RW	uint8	1	1	10	-
41	41	1..n	0	ChnId	R	char[11]		-	-	NSTNV
41	41	1..n	1	M	RWPD	float	7.15e-08	-1	131070	STNV
41	41	1..n	2	B	RWPD	float	0	-2.14748e+09	2.14748e+09	STNV
41	41	1..n	3	Value	R	long	0	-2147483647	2147483647	NSTNV
41	41	-	100	SetDefault	WPF	cmd	-	-	-	-

System Object [System]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
42	170	0	0	ObjId	R	uint8	42	-	-	-
42	170	0	1	ObjName	R	char[12]	System	-	-	-
42	170	0	2	Length	R	uint16	39	-	-	-
42	170	0	3	NrOfInstances	R	uint8	1	-	-	-
42	170	0	4	ActInst	RW	uint8	1	1	1	-
42	42	1..n	0	FirstError	R	uint8	0	0	255	STNV
42	42	1..n	1	LastError	R	uint8	0	0	255	STNV
42	42	1..n	2	RunHours	R	long	0	0	2000000000	STNV
42	42	1..n	3	TimeToCal	RW	uint16	0	0	65535	STNV
42	42	1..n	4	InternalTemp	R	float	0	0	100	NSTNV
42	42	1..n	5	SensorTemp	R	float	0	0	100	NSTNV
42	42	1..n	6	TempCompMode	RWPF	uint8	0	0	1	STNV

System Object [System]										
42	42	1..n	7	UsbMode	RW	uint8	0	0	1	STNV
42	42	1..n	8	MemoryMode	RW	uint8	1	0	1	STNV
42	42	1..n	9	SibHwTestStat	R	char[20]	notDone	-	-	STNV
42	42	-	100	SetDefault	WPD	cmd	-	-	-	-
42	42	-	101	SetDefaultAll	WPD	cmd	-	-	-	-

Alias Constants Object [AliasConstants]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
43	171	0	0	ObjId	R	uint8	43	-	-	-
43	171	0	1	ObjName	R	char[12]	AliasConsta	-	-	-
43	171	0	2	Length	R	uint16	2	-	-	-
43	171	0	3	NrOfInstances	R	uint8	1	-	-	-
43	171	0	4	ActInst	RW	uint8	1	1	1	-
43	43	1..n	0	NullByte	R	uint8	0	0	255	STNV
43	43	1..n	1	NullBit	R	uint:1	0	0	1	STNV
43	43	1..n	2	NullNibble	R	uint:4	0	0	15	STNV
43	43	-	100	SetDefault	WPF	cmd	-	-	-	-

Alias Objects Object [AliasObjects]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
44	172	0	0	ObjId	R	uint8	44	-	-	-
44	172	0	1	ObjName	R	char[12]	AliasObject	-	-	-
44	172	0	2	Length	R	uint16	14	-	-	-
44	172	0	3	NrOfInstances	R	uint8	8	-	-	-
44	172	0	4	ActInst	RW	uint8	1	1	8	-
44	172	0	5	AliasObjectsDisabled	R	uint:1	1	-	-	-
44	172	0	6	AliasObjectsAssembled	R	uint:1	0	-	-	-
44	172	0	7	AliasObjectsConsistent	R	uint:1	0	-	-	-
44	172	0	8	AssembleErrorMsg	R	char[64]	OK	-	-	-
44	44	1..n	0	AliasObjectId	RW	uint8	0	0	19	STNV
44	44	1..n	1	AliasObjectName	RW	char[12]		-	-	STNV
44	44	1..n	2	AliasObjectUsage	RW	uint8	0	0	2	STNV
44	44	-	100	SetDefault	WPD	cmd	-	-	-	-
44	44	-	101	DisableAliases	WPD	cmd	-	-	-	-
44	44	-	102	AssembleAliases	WPD	cmd	-	-	-	-

Alias Params Object [AliasParams]										
Obj.	**Slot**	**Inst.**	**Param.**	**Name**	**Access**	**Type**	**Default**	**Min.**	**Max.**	**Store**
45	173	0	0	ObjId	R	uint8	45	-	-	-
45	173	0	1	ObjName	R	char[12]	AliasParams	-	-	-
45	173	0	2	Length	R	uint16	3	-	-	-
45	173	0	3	NrOfInstances	R	uint8	254	-	-	-
45	173	0	4	ActInst	RW	uint8	1	1	254	-
45	45	1..n	0	AliasObjectInstance	RW	uint8	1	1	8	STNV
45	45	1..n	1	SourceObjectId	RW	uint8	0	0	45	STNV
45	45	1..n	2	SourceAttributeId	RW	uint8	0	0	254	STNV

Chapter 5 Process Interfaces

Functions

Beside the normal flow control mode the units are equipped with digital interfaces, which provide a number of helpful functions and useful information.

Report Functions

Calibration Date, Type, Model, Manufacturer, Serial No., Firmware/Hardware Revision, Product Code, Date of Factory Calibration, Full Scale Range, Flow Unit, Standard Temperature Standard Pressure, Valve Type, Valve Power Off Mode.

Valve Override

With the override signal the control valve can be driven completely open or closed.

Set the parameter VALVE_OVERRIDE to NORMAL to allow the mass flow controller establishing a flow in accordance to the setpoint command FLOW_SETPOINT.

Set the parameter VALVE_OVERRIDE to FLOW_OFF to completely close the control valve.

Set the parameter VALVE_OVERRIDE to PURGE to completely open the control valve. This command may be used to purge or vent the instrument or the system.

Auto Zero

If VALVE_OVERRIDE is equal to FLOW_OFF and THERMAL_MASS_FLOW_RATE is smaller than 5 % of full scale, the flag AUTOZERO (0 to 1 transition) will take the actual sensor signal as zero and will subtract this value from all future measurements (refer also to *USER_ZERO*).

Note: Zero adjust can be performed also using the AUTOZERO button (See also page 24).

Alarm Limits

LOW_TRIP_POINT and HIGH_TRIP_POINT define the limits for LOW_LIMIT_ALARM and HIGH_LIMIT_ALARM flags. Consider that there is a 0.5% hysteresis for each limit switch. The hysteresis of 0.5% is divided in a slope 0.25% above and another slope 0.25% below the defined limit.

Temperature Measurement

The internal temperature of the device is measured in °Celsius and given as INTERNAL_TEMP.

Valve Drive Level

The position of the valve is given in VALVE_DRIVE_LEVEL. 0% means that the valve is closed and 100% means that the valve is fully opened (e.g. at the PURGE command).
A typical value under normal operating conditions is 40…60 % with new units. The value depends on many parameters, e.g. pressure conditions, temperature, contamination, age etc., and may change also during operation even at the same flow rate.

User Span / Gas Correction

For tuning the flow controller's accuracy the USER_SPAN parameter should be used and for application of a specific gas the nominal full scale (e.g. N2) may be multiplied by the GCF of the gas and the parameter FULL_SCALE_RNG may be set with the result. Another option is to set the parameter GAS_CORRECTION to the GCF of the gas (full functionality only).

User Zero

The parameter USER_ZERO may be set to the flow sensors offset. (See also *AUTO ZERO*)

Filter

The filter is a single-pole low pass filter. The parameter that the user can adjust is the settling time of the filter (FILTER_SETTLING). E.g. if a step input (magnitude 100) is applied to the filter with a settling time of 100 second, the response out of the filter will be within 2% of the final value (98%) in 100 second. The default value is 0 seconds (no filtering). This filter only influence the output signal and has no effect on the control circuit.

Gas Tables

Gas tables may be switched off by setting the default table to 15 (i.e. no table is used) and by selecting the default table. Or by programming a 0 for POINT_NUM (ref. to *Calibration Table* at the end of this chapter; function (y=x)) and selecting it. Or by selecting a table with no (zero) points.

A backup of the Gas Tables is generated on Factory Setup. This backup is used for reset the tables.

Soft Start Rate

A change in the set point is performed in a slope, which is defined by SOFT_START_RATE.

Each controller is factory set to its optimum performance.

PROFIBUS Process Interface

Installation

Pinout

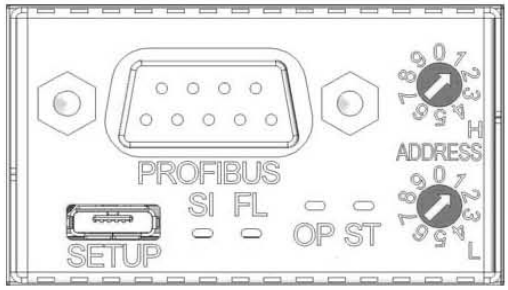


Figure 9 Profibus Connector

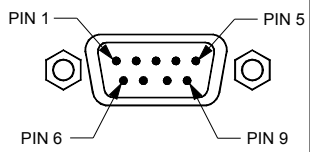
PROFIBUS Interface		
Item	**Detail**	**Description**
SETUP	-	Mini USB connector, present for every interface variant. Operates as MSD or CDC.
PROFIBUS		Standard D-Sub PROFIBUS connector
	Pin-1	nc
	Pin-2	nc
	Pin-3	RXD/TXD - P
	Pin-4	CNTR - P
	Pin-5	DGND
	Pin-6	VP
	Pin-7	Nc
	Pin-8	RXD/TXD – N
	Pin-9	nc

Table 2 Profibus Interface

Power supply

The MF1 has to be powered via the Phönix MC-Series connector below the Zero switch. Therefore a mating connector is included in the delivery. For the correct power supply specification see the technical specification in Appendix A.

Cable

It is recommended to use cables, which fulfil the EN 50170 type A:

Wave impedance [Ω]	135 … 165 at 3 ..20 MHz
Loop resistance [Ω/ km]	< 100
Core diameter	> 0,64
Nom. Capacitance Conductor to Shield [pF/m]	< 30

Table 3 Cable specification (EN 50170)

The maximum fieldbus cable length per segment is dependent of the baud rate.

Baud rate	**Maximum length of segment**
9,6; 19,2; 93,75 kBaud	1200 m
187,5 kBaud	1000 m
500 kBaud	400 m
1500 kBaud	200 m
3000 – 12000 kBaud	100 m

Table 4 Maximum segment length as a function of the baud rate

It is recommended to use a termination resistor, which are typically included in the fieldbus connectors. The termination resistors provide low impedance that reduces the sensitivity to electrical noise and prevents data reflection that can cause data communication corruption.

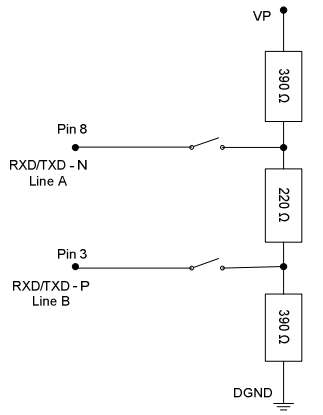


Figure 10 Termination resistor

Operation

Address

If the software address setting is 126, the address is set via the rotary switches (up to address 99). Otherwise the rotary switch setting is irrelevant and the software address setting is used.

Configuration (GSD)

For the configuration of the MFC with a PC a GSD file is required. You will find the file on the CD, which is part of the delivery. There are two GSD files. For the use with Profibus DPV 0 (order code MF1_ _ _ _ _ _ _ _ 4 _ _) select “MKS_1179.gsd and for the Profibus DPV1 (order code MF1_ _ _ _ _ _ _ _ _ P _ _) select MKS_0C0B.gsd. The DPV 0 is compatible to the 1179B Profibus.

The Profibus DPV1 supports the acyclic communication.

Feedback and Diagnostics

Error codes

Error codes are defined by the Profibus specification.

LED Functions

LED Signals		
ST	Off	No power or not initialized
	Green	Initialized
	Flashing green	Initialized, diagnostic events present
	Red	Exception error
OP	Off	No power, not initialized
	Green	Online, data exchange
	Flashing green	Online, clear
	Flashing red (1 flash)	Parametrization error
	Flashing red (2 flashes)	PROFIBUS Configuration error
SI	Green	Sensor OK
	Flashing red	Power too low
	Blue	Pure USB operation
	Flashing red & green	Self Test or Boot
	Flashing blue	Shows Seconds forAUTOZERP button
FL	Off	No flow
	Flashing blue	Flow Indicator: Flashes proportional to actual flow
	Blue on	100% Flow

Protocol (PROFIBUS cyclic telegrams)

Data Interface

The MF1 with PROFIBUS have a small data interface with a basic function set and a full data interface with the full function set of the device. The selection between small and full functionality is made at setup time with the type of configuration data, which is loaded down, to the device.

- Small / Full Parameter selects the internal function set and is declared by the GSD file parameters:

  User_Prm_Data_Len *and* ***User_Prm_Data***. The content of these parameters is either the small setup or full setup structure.

- Small / Full Receive Data, is selected by the MODULE definition in the GSD file. E.g.:

  Module = "SMALL_MFC" 0x91, 0xD5, 0xA1, 0xE1 or
  Module = "FULL_MFC" 0x91, 0xD7, 0xA1, 0xE1

The data interfaces are documented as data structures with consecutive fields. There is a table entry for each field, with name, address (add), type information and a comment for explanation. The address field (Add.) defines the byte and bit address **(ByteOffset:BitOffset).** For the memory layout the **Motorola Format** is used. The following types are used:

- uint:X an unsigned integer with X bits length.
- long signed long integer (4 bytes)
- uint16 unsigned integer (2 bytes, word)
- uint8 unsigned integer (byte)
- char[X] character array of length X

Send Data

Send data			
Name	**Add.**	**Type**	**Comment**
VALVE_OVERRIDE	1:0	uint:2	NORMAL, FLOW_OFF, PURGE
AUTOZERO	1:2	uint:1	0 to 1 transition activates zeroing if (VALVE_OVERRIDE==FLOW_OFF && FLOW_SETPOINT < 5%FS)
REPORT_DIAG	1:3	uint:3	transition to a new value, triggers the device to send a new actual diagnosis: 0 = no diagnosis 1 = diagnosis of small functionality 2 = diagnosis of full functionality 3 = report selected gas table 4..7 = reserved
WINK_STATUS	1:6	uint:1	0 to 1 transition sets the LED to blink red/green for 3 seconds
ENABLE_TOTALIZER	1:7	uint:1	0 = disabled, 1 = enabled
RESET_TOTALIZER	0:0	uint:1	0 to 1 transition resets totalizer to zero
RESET_STATUS	0:1	uint:1	0 to 1 transition resets error status bits
SELECT_GAS_TABLE	0:2	uint:4	0..14; 15 = default gas table is used

EN_GAS_CORRECTION	0:6	uint:1	0 = disabled, 1 = enabled
Reserved	0:7	uint:1	
FLOW_SETPOINT	2:0	long	in [FLOW_UNIT] in 10E-4 steps valve switched off if setpoint < 1% valve switched on if setpoint > 2%

Small Receive Data

Small receive data			
Name	**Add.**	**Type**	**Comment**
HIGH_LIMIT_ALARM	1:0	uint:1	(flow > HIGH_LIMIT), Hysteresis = 0.5%
LOW_LIMIT_ALARM	1:1	uint:1	(flow < LOW_LIMIT) , Hysteresis = 0.5%
SYSTEM_ERROR	1:2	uint:1	any severe error condition
Reserved	1:3	uint:5	
Reserved	0:0	uint:8	
THERMAL_MASS_FLOW _RATE	2:0	long	in [FLOW_UNIT] in 10E-4 steps
INTERNAL_TEMP	6:0	long	temperature in °C
VALVE_DRIVE_LEVEL	10:0	long	0 .. 100% (in 10E-4 steps) 0% = valve is closed 100% = valve is in purge position (full open)

Full Receive Data

Full receive data			
Name	**Add.**	**Type**	**Comment**
HIGH_LIMIT_ALARM	1:0	uint:1	(flow > HIGH_LIMIT), Hysteresis = 0.5% *
LOW_LIMIT_ALARM	1:1	uint:1	(flow < LOW_LIMIT) , Hysteresis = 0.5% *
SYSTEM_ERROR	1:2	uint:1	any severe system error condition
HIGH2_LIMIT_ALARM	1:3	uint:1	(flow > HIGH2_LIMIT), Hysteresis = 0.25%
LOW2_LIMIT_ALARM	1:4	uint:1	(flow < LOW2_LIMIT), Hysteresis = 0.25%
VALVE_CLOSED	1:5	uint:1	(THERMAL_MASS_FLOW_RATE < 1%) && (VALVE_OVERRIDE == FLOW_OFF)
PURGE	1:6	uint:1	THERMAL_MASS_FLOW_RATE > 110%
OVER_TEMPERATURE	1:7	uint:1	INTERNAL_TEMP > MAX_TEMP
VALVE_DRIVE_ALARM	0:0	uint:1	VALVE_DRIVE_LEVEL > MAX_VTP
CALIBRATION_ RECOMMENED	0:1	uint:1	TIME_TO_CAL count down expired
UNCALIBRATED	0:2	uint:1	if a disabled or no table is used
CONTROLLER_ERROR	0:3	uint:1	abs (setp - flow) greater for a longer time period
MEMORY_FAILURE	0:4	uint:1	E2PROM checksum error
UNEXPECTED_ CONDITION	0:5	uint:1	any process error condition
Reserved	0:6	uint:2	
THERMAL_MASS_FLOW _RATE	2:0	long	in [FLOW_UNIT] in 10E-4 steps
INTERNAL_TEMP	6:0	long	temperature in ° C
VALVE_DRIVE_LEVEL	10:0	long	0 .. 100% (in 10E-4 steps) 0% = valve is closed 100% = valve is in purge position (full open)
FLOW_TOTALIZED	14:0	long	in sl / sm3 (in 10E-4 steps) i.e. min. 298 days for a 500 range.

*) Hysteresis is +/- 0.25% (i.e. 0.5% in total) based on current limit

Small Setup

Small setup			
Name	**Add.**	**Type**	**Comment**
STRUCT_ID	0:0	uint8	0x10 (SMALL_SETUP)
INITIAL_SETUP	2:0	uint:1	THIS, ROM
BASE_UNIT	2:1	uint:1	Display in base unit
OPERATION_MODE	2:2	uint:1	0=ANALOG, 1=PROFIBUS
Reserved	2:3	uint:5	
Reserved	1:0	uint:8	
USER_SPAN	3:0	long	5% .. 200% in [%] (in 1E-4 steps)
USER_ZERO	7:0	long	-5% .. +5% of full scale (in 1E-4 steps)
HIGH_TRIP_POINT	11:0	long	-10% .. +120% of full scale (in 1E-4 steps)
LOW_TRIP_POINT	15:0	long	-10% .. +120% of full scale (in 1E-4 steps)

Full Setup

Full setup			
Name	**Add.**	**Type**	**Comment**
STRUCT_ID	0:0	uint8	0x11 (FULL_SETUP)
INITIAL_SETUP	2:0	uint:1	THIS, ROM
BASE_UNIT	2:1	uint:1	display in base unit
OPERATION_MODE	2:2	uint:1	0=ANALOG, 1=PROFIBUS
SET_USER_SPAN	2:3	uint:1	1=USER_SPAN will be updated
SET_USER_ZERO	2:4	uint:1	1=USER_ZERO will be updated
SET_HIGH_TRIP_POINT	2:5	uint:1	1=HIGH_TRIP_POINT will be updated
SET_LOW_TRIP_POINT	2:6	uint:1	1=LOW_TRIP_POINT will be updated
SET_GAS_CORRECTION	1:7	uint:1	1=GAS_CORRECTION will be updated
SET_DEFAULT_TABLE	1:0	uint:1	1=DEFAULT_TABLE will be updated
SET_HIGH2_TRIP_POINT	1:1	uint:1	1=HIGH2_TRIP_POINT will be updated
SET_LOW2_TRIP_POINT	1:2	uint:1	1=LOW2_TRIP_POINT will be updated
SET_FILTER_SETTLING	1:3	uint:1	1=FILTER_SETTLING will be updated
SET_SOFT_START_RATE	1:4	uint:1	1=SOFT_START_RATE will be updated
SET_TIME_TO_CAL	1:5	uint:1	1=TIME_TO_CAL will be updated
SET_CAL_DATE	1:6	uint:1	1=CAL_DATE will be updated
SET_USER_TAG	1:7	uint:1	1=USER_TAG will be updated
USER_SPAN	3:0	long	5% .. 200% in [%] (in 1E-4 steps)
USER_ZERO	7:0	long	-5% .. +5% full scale (1E-4 steps)
HIGH_TRIP_POINT	11:0	long	-10% .. +120% full scale (1E-4 steps)
LOW_TRIP_POINT	15:0	long	-10% .. +120% full scale (1E-4 steps)
GAS_CORRECTION	19:0	long	0.05 .. 2.00 (in 1E-4 steps)
DEFAULT_TABLE	23:0	uint8:4	0 .. 14 is the default table, 15 function (y=x) is the gas table
Reserved	23:4	uint8:4	
HIGH2_TRIP_POINT	24:0	long	-10% .. +120% full scale (1E-4 steps)

LOW2_TRIP_POINT	28:0	long	-10% .. +120% full scale (1E-4 steps)
FILTER_SETTLING	32:0	long	0.0 .. 1000.0 in [sec] (in 1E-4 steps)
SOFT_START_RATE	36:0	long	0.0 .. 3600.0 in [sec] (in 1E-4 steps)
TIME_TO_CAL	40:0	uint16	if SET_TIME_TO_CAL is 1 it will last TIME_TO_CAL hours until CALIBRATION_RECOMMENDED flag becomes active.
CAL_DATE	42:0	char[6]	MM/DD/YY
USER_TAG	48:0	chr[32]	any 32 character string

Small Diagnostics (for DPV0 only)

small diagnostics			
Name	**Add.**	**Type**	**Comment**
STRUCT_ID	0:0	uint8	0x20 (SMALL_DIAG)
Exception Status			
ALARM_DEVICE_ COMMON	1:0	uint:1	specific to network (e.g. power fail)
ALARM_DEVICE_ SPECIFIC	1:1	uint:1	specific to flow device (e.g. r/w EPROM)
ALARM_MKS_SPECIFIC	1:2	uint:1	specific to MKS
ALARM_TABLE_ERROR	1:3	uint:1	Reports cal. Table errors
Reserved	1:4	uint:4	
Identification:			
PRODUCT_CODE	2:0	uint16	1179
REVISION_CODE	4:0	uint8	0x01
VERSION_CODE	5:0	uint16	0x0100
Specification:			
FULL_SCALE_RNG	7:0	long	full scale range in [FLOW_UNIT] (in 1E-4 steps)
FLOW_UNIT	11:0	uint8	SCCM, SLM (SCCM is base unit)
Status:			
INTERNAL_TEMP	12:0	long	temperature in °C
VALVE_DRIVE_LEVEL	16:0	long	0 .. 100% (in 10E-4 steps)
RUN_HOURS	20:0	uint16	hours

Full Diagnostics (for DPV0 only)

Full diagnostics			
Name	**Add.**	**Type**	**Comment**
STRUCT_ID	0:0	uint8	0x21 (SMALL_DIAG)
ALARM_DEVICE_ COMMON	1:0	uint:1	specific to network (e.g. power fail)
ALARM_DEVICE_ SPECIFIC	1:1	uint:1	specific to flow device (e.g. r/w EPROM)
ALARM_MKS_SPECIFIC	1:2	uint:1	specific to MKS (LinTab error)
ALARM_TABLE_ERROR	1:3	uint:1	Reports cal. Table errors
Reserved	1:4	uint:4	
PRODUCT_CODE	2:0	uint16	1179
REVISION_CODE	4:0	uint8	0x01
VERSION_CODE	5:0	uint16	0x0100
FULL_SCALE_RNG	7:0	long	full scale range in [FLOW_UNIT] (in 1E-4 steps)
FLOW_UNIT	11:0	uint8	SCCM, SLM
INTERNAL_TEMP	12:0	long	temperature in °C
VALVE_DRIVE_LEVEL	16:0	long	0 .. 100% (in 10E-4 steps)
RUN_HOURS	20:0	uint16	hours
MANUFACTURER	22:0	char[20]	MKS INSTRUMENTS
MODEL_DESIGNATION	42:0	char[20]	MF1C01313CM1BV0
SERIAL_NUMBER	62:0	char[20]	999999 G
DEVICE_TYPE	82:0	char[6]	MFC, MFM
MODEL_TYPE	88:0	char[6]	MF1
FIRMWARE_REVISION	94:0	char[6]	1.01
HARDWARE_REVISION	100:0	char[6]	A
FACTORY_CAL_DATE	106:0	char[6]	MM/DD/YY
VENDOR_CODE	112:0	uint16	0
STANDARD_TEMP	114:0	long	273.0 K (0 °C)
STANDARD_PRESSURE	118:0	long	101.3kPa (in 10E-4 steps)
VALVE_TYPE	122:0	uint8	0=SOLENOID, 1=VOICE_COIL, 2=PIEZO_ELECTRIC
VALVE_POWER_OFF_ MODE	123:0	uint8	0=CLOSED, 1=OPEN, 2=LAST_POS
GAS_TABLE_NUM	124:0	uint8	Number of gas tables programmed. i.e. values != 0 in GAS_CODE_OF_TABLE_I
GAS_CODE_OF_ TABLE_I	125:0	uint8[15]	gas code of gas tables 0=no table (y=x)
POINT_NUM_OF_ TABLE_I	140:0	uint8[15]	Point number of gas tables
TABLE_FLAGS	155:0	uint:1[15]	0=FACTORY; 1=USER; 1 means that the user has overwritten the gas table once. All these flags will be reset at factory setup.
ACTIVE_GAS_NAME	157:0	char[16]	e.g. N2, is name of DEFAULT_TABLE if there was no cyclic comm. In the past.
CAL_DATE	173:0	char[6]	MM/DD/YY
USER_TAG	179:0	char[32]	any 32 character string
REM_TIME_TO_CAL	211:0	uint16	Remaining TIME_TO_CAL
FLOW_TOTALIZED	213:0	long	in sl/sm3 (in 10E-4 steps) i.e. min. 298 days for a 500 range. No base unit feature.

Calibration Table (for DPV0 only)

Calibration table			
Name	**Add.**	**Type**	**Comment**
STRUCT_ID	0:0	uint8	0x12 or 0x22 for diagnosis
GAS_TABLE_IDX	1:0	uint8	0..14
GAS_CODE	2:0	uint8	0..254 255 resets to factory setup
POINT_NUM	3:0	uint8	2..15 = table with 2 .. 15 points 0 = disables table 1 = enables table
GAS_NAME	4:0	char[16]	e.g. N2
SENSOR_VALS	20:0	long[15]	in [FLOW_UNIT] in 10E-4 steps
FLOW_VALS	80:0	long[15]	in [FLOW_UNIT] in 10E-4 steps

If a table is loaded, which is not strict monotonous, the table will be disabled (POINT_NUM = 0). If a table, with a not valid index, is loaded, no tables will be affected. In both case the error flag for the table will be set.

The calibration tables convert the measured value (SENSOR_VALS) to the true physical value (FLOW_VALS). If the actual measured value is between two SENSOR_VALS, the flow will be calculated by linear interpolation. If the measured value is outside of the table definitions, the first (last) straight line will be continued.

The GAS_CODE may be any definition for gases. It is not evaluated. The GAS_NAME may be any 16 character string. It is also not evaluated.

The calibration tables stored from the factory may be recalled by an GAS_CODE of 255. In this case the TABLE_FLAG in the full diagnostic is reset.

Diagnosis (for DPV1 only)

Diagnosis			
Name	**Add.**	**Type**	**Comment**
CommonExceptionDetailAlarm	0:0	uint8	see Status - CommonExceptionDetailAlarm
DeviceExceptionDetailAlarm	1:0	uint8	see Status - DeviceExceptionDetailAlarm
ManufacturerExceptionDetailAlarm	2:0	uint8	see Status - ManufacturerExceptionDetailAlarm
CommonExceptionDetailWarn	3:0	uint8	see Status - CommonExceptionDetailWarn
DeviceExceptionDetailWarn	4:0	uint8	see Status - DeviceExceptionDetailWarn
ManufacturerExceptionDetailWarn	5:0	uint8	see Status - ManufacturerExceptionDetailWarn

Analog Process Interface

Functions

Valve Override

The valve override feature enables the control valve to be fully opened (purged) or closed independent of the set point command signal:

To close the valve, apply a TTL low to pin 1 or connect pin 1 to pin 7 (SIG_GND).

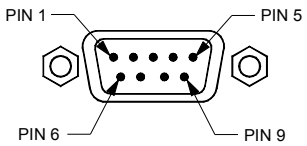
To open the valve, apply a +5 V signal to pin 1. This command may be used to purge or vent the instrument or the system.

Scaling the Signal

The scaling of the MF1 analog output signal could be changed via the USB Setup interface. The scaling range is 0 to 2 V for the zero signal (0%) and 5 to 10 V for the F.S. signal (100%), which means an output signal 2 to 7 V or 0 to 10 V could be setup. Default setting is 0 to 5 V. The voltage is proportional to the flow. The setpoint input is always scaled as the output signal. The resolution of the voltage signal is 0.4 mV independent of the used scaling. For changing the scaling see Chapter 4.

Installation

Pinout

Analog Interface		
Item	**Detail**	**Description**
SETUP	-	Mini USB connector, present for every interface variant. Operates as MSD or CDC.
ANALOG		Standard D-Sub connector
	Pin-1: VALVE_OVERRIDE	Apply PWR_GND for close, apply +5V for open
	Pin-2: FLOW	Default Range 0..5V, reference to SIG_GND
	Pin-3: [POWER+]	+15V dual supply or 24V single supply (Surge protected)
	Pin-4: [POWER_GND]	Power ground for dual supply, signal ground for single supply
	Pin-5: [POWER -]	-15V or power ground for single supply; connected to “–“ of the Phönix connector.
	Pin-6: SETPOINT	Set point input; default 0 – 5 V; reference to SIG_GND

Analog Interface		
	Pin-7: SIG_GND	Signal ground
	Pin-8: [reserved]	reserved
	Pin-9: [reserved]	reserved

Table 5 Analog Interface

Power supply

The MF1 could be powered via the Phönix MC-Series connector below the Zero switch or via the Sub D connector. Therefore a mating connector is included in the delivery. For the correct power supply specification see the technical specification in Appendix A. The Pin 5 of the 9 Pin Sub D connector is connected with the Phönix connector Pin "-". If the Phönix connector is used for power supply the Pin 5 of the Sub D connector must not be connected and vice versa.

Cables and Controllers by MKS

MKS Controller	Number of provided Channels	MKS Cable
PR4000B	1 or 2	CBE147-12-3M
247D	4	CBE147-12-3M
647C	4 or 8	CBE147-12-3M

Table 6 MKS Controller and cables for analog MF1 units

Operation

Configuration

The analog version of the MF1 could be configured via the USB Setup Interface. See for details Chapter 4.

Feedback and Diagnostic

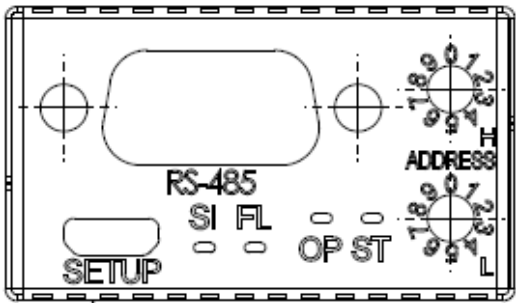
LED Functions

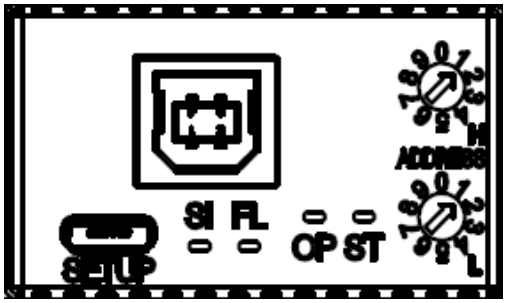
LED Signals		
ST	Off	No power or not initialized
	Green	Initialized
	Flashing green	Initialized, diagnostic events present
	Red	Exception error
FL	Off	No flow
	Flashing blue	Flow Indicator: Flashes proportional to actual flow
	Blue on	100% Flow

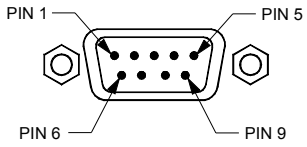
RS485 and USB Interfaces

Installation

Pinout





RS485 and USB Interface		
Item	**Detail**	**Description**
SETUP	-	Mini USB connector, present for every interface variant. Operates as MSD or CDC.
USB	-	USB Connector B
RS 485		Sub D 9-poles, socket
	Pin-1	
	Pin-2	
	Pin-3	A
	Pin-4	RTS
	Pin-5	GND
	Pin-6	
	Pin-7	
	Pin-8	B
	Pin-9	

Power supply

The MF1 has to be powered via the Phönix MC-Series connector below the Zero switch. Therefore a mating connector is included in the delivery. For the correct power supply specification see the technical specification in Appendix A.

Cable for RS485

RS485 is a balanced communication system, because signal on one wire is ideally the exact opposite of the signal on the second wire. The maximum length of cable span depends on environment, cable quality and communication speed, but relative long cable spans up to 1,200m (4,000 ft.) is possible. There are 2 wires, other than ground, that are used to transmit the digital RS485 signal. To comply with EN61326-1 immunity requirements, use a braided, shielded cable. Connect the braid to the metal hoods at both ends of the cable with the end for power supply connected to earth ground.

Cable for USB

The MF1 with USB process interface supports the full speed USB 2.0 connections. Therefore the maximum cable length is limited to 5 meters. Standard USB 2.0 cable must be used.

Operation

Address

Defines the device address by the rotary switches. Rotary switch address setting is used as Interface address/ID, if software address setting is 126. Otherwise the software address setting is used as Interface address/ID and the rotary switch setting is irrelevant.

Configuration

All Parameters for the communication are defined at the 'Com Interface Object' [ComIfc].

The delivery settings are:

Default settings	
Parameter	RS485/USB
Software Address	248
Baud Rate	115200
Parity	0 => none
Data Bits	8
Stop Bits	1
Failsave Timeout	0 (not used)
Config	0 => Human Readable Protocol

Baud rate

Supported Baud Rate

Expected Baud Rate	Actual Baud Rate	CD (Clock Divider)	Error [%]	Comment
50	50	60069	0	
110	110	27304	0	
300	300,01	10011	0	
600	599,97	5006	-0,01	
1200	1199,93	2503	-0,01	
2400	2400,82	1251	0,03	
4800	4797,81	626	-0,05	
9600	9595,62	313	-0,05	
14400	14370,47	209	-0,21	
19200	19252,75	156	0,27	
28800	28879,12	104	0,27	
38400	38505,49	78	0,27	
56000	55619,05	54	-0,68	
57600	57758,24	52	0,27	
115200	115516,48	26	0,27	
230400	231032,97	13	0,27	
256000	250285,71	12	-2,28	
500000	500571,43	6	0,11	
1000000	1001142,85	3	0,11	
1500000	1501714,28	2	0,11	
3000000	3003428,56	1	0,11	

It is possible to use other baud rates, but it is not recommended to work with an error higher than 5%.

Parity

Define the parity setup.

0 => none

1 => even

2 => odd

DataBits

Define the data bits. Possible values are 7 or 8.

StopBits

Define the stop bits.

0 => 1,5 Stop Bits

1 => 1 Stop Bit

2 => 2 Stop Bits

Failsafe Timeout

The timeout value is defined in milliseconds.
If the value is > 0 the timeout function is active.
If the time for the next command is bigger than the timeout time a Timeout Error occurred.
If a Timeout Error occurred, the operation LED switch to red and the valve is shutdown.
To activate the valve controller you have to set the Valve Override to Normal status and send a setpoint.
To clear the red timeout LED you have to read the Communication Status.
At delivery the timeout function is deactivated by a value of 0.
A new timeout value is stored in the non-volatile memory of the device.

Feedback and Diagnostics

Error Codes

For every command that is send to the MF1 the device send a return message.

If a command is not existing, it cannot be executed, the value is out of range or missed or a framing error occurred the MF1 will send an error message back.

Error Telegram (E)

receive:

E	Cmd	CNE	SVR	RVR	VaM	FEr	VaE
Cmd	Error Messages 0 => not occurred 1 => occurred						
	Cmd	Transmitted command					
	CNE	Command not existed					
	SVR	Send value is out of range					
	RVR	Receive value is out of range					
	VaN	Value is needed					
	FEr	Protocol frame error					
	VaE	Value Syntax Error					

LED Functions

LED Functions		
Item	**Detail**	**Description**
ST	Off	No power or not initialized
	Green	Initialized
	Red	Communication Error
OP	Off	No power, not initialized
	Green	Initialized
	Flashing green	Data exchange
	Red	Timeout error
	Flashing red	Timeout error, data exchange
SI	Green	Sensor OK
	Flashing red	Power too low
	Blue	Pure USB operation
	Flashing red & green	Self Test or Boot

	Flashing blue	Shows Seconds for AUTOZERO button
FL	Off	No flow
	Flashing blue	Flow Indicator: Flashes proportional to actual flow
	Blue on	100% Flow

Protocol ("Human Readable Protocol")

The Human Readable Protocol (ASCII) is small and easy to use by manual operation via a terminal. It could be easily implemented at a host with a common (UART) serial interfaces.

Send telegram

Byte1	2	3	4	5	6	7	8	9	10	11	12/5
@	0	1	C	1	.	0	0	0	0	0	CR
Adr			Cmd	Val (optional)							End

Ard: Device address

Cmd: Command (see command list)

Val: Optional numeric value for the executed command. For fixed protocol length fill this value with zero.

End: Protocol end character CR (hex: 0x13)

Receive telegram

Byte1	2	3	4	5	6	7	8	9	10	11	12
@	-	-	F	1	.	0	0	0	0	0	CR
Str	Err	Vlv	Cmd	Val							End

Str: Start Character, always @

Err: Error Sign
'-' = No error
'E' = an MF1 error Occurred
'U' = an Communication error occurred
'B' = an MF1 and Communication error occurred

Val: Valve Override Mode
'N' = Normal
'C' = Close
'P' = Purge

Cmd: Received value Format

End: Protocol end character CR (hex: 0x13)

Command Reference List

This next table shows the commands with the dedicated return cmd values.

The communication is process optimized. For every command where an acknowledge is not necessary the MF1 returns the actual flow value (F) as acknowledge. Only if the command cannot be executed or an error occurred the MF1 sends an error message (E). So in normal mode it is guaranteed that the application receives the actual flow in every cyclic step.

Cmd	Description	Return Cmd
F	Get Actual **F**low	F
T	Get **T**emperature	T
V	Get **V**alve Drive Level	V
S	Set Flow **S**etpoint, Get Actual Flow	F
s	Get Flow **S**etpoint	s
N	Set Valve Override **N**ormal	F
C	Set Valve Override **C**lose	F
P	Set Valve Override **P**urge	F
A	Set **A**utozero	F
W	Set **W**inkStatus	F
G	Select **G**as Table Index	F
g	Get **G**as Table Index	g
D	Get **D**evice Status	D
M	Get **M**F1 Error Status	M
U/u	Get Comm**u**nication Status	U
E	**E**rror Telegram	E

Command list description

Get Actual Flow (F)

send:

F							
Cmd	not required						

receive:

F	1	.	0	0	0	0	0
Cmd	Actual Flow [calibrated flow unit e.g. sccm]						

Get Temperature (T)

send:

T							
Cmd	not required						

receive:

T	1	.	0	0	0	0	0
Cmd	Internal Temperature [°C]						

Get Valve Drive Level (V)

send:

V							
Cmd	not required						

receive:

V	1	.	0	0	0	0	0
Cmd	Valve Drive Level [%]						

Set Flow Setpoint, Get Actual Flow (S)

send:

S	1	.	0	0	0	0	0
Cmd	Setpoint [calibrated flow unit e.g. sccm]						

receive:

F	1	.	0	0	0	0	0
Cmd	Actual Flow [calibrated flow unit e.g. sccm]						

Get Flow Setpoint (s)

send:

s							
Cmd	not required						

receive:

s	1	.	0	0	0	0	0
Cmd	Get the actual setpoint						

Set Valve Override Normal (N)

send:

N							
Cmd	not required						

receive:

F	1	.	0	0	0	0	0
Cmd	Actual Flow [calibrated flow unit e.g. sccm]						

Set Valve Override Close (C)

send:

C							
Cmd	not required						

receive:

F	1	.	0	0	0	0	0
Cmd	Actual Flow [calibrated flow unit e.g. sccm]						

Set Valve Override Purge (P)

send:

P							
Cmd	not required						

receive:

F	1	.	0	0	0	0	0
Cmd	Actual Flow [calibrated flow unit e.g. sccm]						

Set Autozero (A)

send:

A							
Cmd	not required						

receive:

F	1	.	0	0	0	0	0
Cmd	Actual Flow [calibrated flow unit e.g. sccm]						

Set WinkStatus (W)

send:

W							
Cmd	not required						

receive:

F	1	.	0	0	0	0	0
Cmd	Actual Flow [calibrated flow unit e.g. sccm]						

Select Gas Table Index (G)

send:

G	0	0	0	0	0	0	1
Cmd	Gas Table Index 0..14						

receive:

F	1	.	0	0	0	0	0
Cmd	Actual Flow [calibrated flow unit e.g. sccm]						

Get Gas Table Index (g)

send:

g							
Cmd	not required						

receive:

g	0	0	0	0	0	0	1
Cmd	Return the actual Gas Table Index						

Get Device Status (D)

send:

D							
Cmd	not required						

receive:

D	HL1	LL1	HL2	LL2	VCL	PUG	CAL
Cmd	Status Messages 0 => not occurred 1 => occurred						

HL1	High Limit Alarm 1
LL1	Low Limit Alarm 1
HL2	High Limit Alarm 2
LL2	Low Limit Alarm 2
VCL	Valve Closed
PUG	Purge
CAL	Calibration is Recomended

Get MF1 Error Status (M)

send:

M							
Cmd	not required						

receive:

M	SYE	OVT	VDA	UNC	COE	MEF	UEC
Cmd	Error Messages 0 => not occurred 1 => occurred						

SYE	System Error
OVT	Over Temperature
VDA	Valve Drive Alarm
UNC	Uncalibrated
COE	Controller Error
MEF	Memory Failure
UEC	Unexpected Condition

Get Communication Status (U or u)

send:

U or u							
Cmd	not required						

receive:

U or u	res	res	res	res	res	ERR	TOO
Cmd	Error Messages 0 => not occurred 1 => occurred						
	res		reserved				
	ERR		An Error Telegram Occurred				
	TOO		Timeout Occurred				

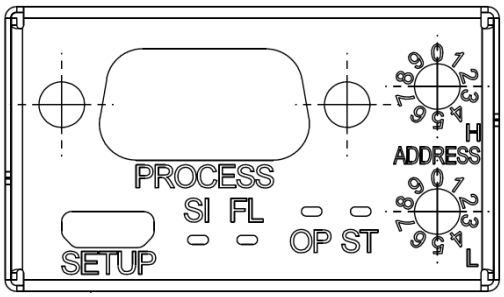
After reading the Communication Status with 'U' the status is reset.

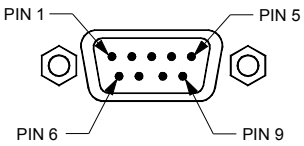
For leaving the communication without a timeout error, send the 'U' cmd.

Modbus Interface

Installation

Pinout



2W-Modbus Pinout			
Pin	IDv Signal	EIA/TIA 485 Name	Description
		Sub D 9-poles, socket	
3	PMC	--	Port Mode Control Open → 2W-Mode Low level (connected with Common) → 4W-Mode
5	D1	B/B'	Transceiver terminal 1, V1 Voltage (V1 > V0 for binary 1[OFF] state)
9	D0	A/A'	Transceiver terminal 0, V0 Voltage (V0 > V1 for binary 0 [ON] state)
2	VP	--	DC Power Supply Positive 20 to 31.5 V
1	Common	C/C'	Signal and Power Supply Common

4W-Modbus Pinout			
Pin	IDv Signal	EIA/TIA 485 Name	Description
8	RXD0	A'	Receiver terminal 0, Va' Voltage (Va' > Vb' for binary 0 [ON] state)
			Receiver terminal 1, Vb' Voltage (Vb' > Va' for binary 1 [OFF] state)
3	PMC	--	Port Mode Control Open → 2W-Mode Low level (connected with Common) → 4W-Mode
5	TXD1	B	Generator terminal 1, Vb Voltage (Vb > Va for binary 1 [OFF] state)
9	TXD0	A	Generator terminal 0, Va Voltage (Va > Vb for binary 0 [ON] state)
2	VP	--	DC Power Supply Positive 20 to 31.5 V
1	Common	C/C'	Signal and Power Supply Common

Port mode control: PMC circuit (TTL compatible). The port mode is controlled by this external circuit. In the first case while an open circuit PMC will ask for the 2W-MODBUS mode, a Low level on PMC will switch the port into 4W-MODBUS Mode.

Power

The MF1 could be powered via the Phönix MC-Series connector below the Zero switch or via the Sub D connector. Therefore a mating connector is included in the delivery. For the correct power supply specification see the technical specification in Appendix A. The Pin 1 of the 9 Pin Sub D connector is connected with the Phönix connector Pin "-". If the Phönix connector is used for power supply the Pin 1 of the Sub D connector must not be connected and vice versa.

Cable

A MODBUS over Serial Line Cable must be shielded. At one end of each cable its shield must be connected to protective ground. If a connector is used at this end, the shell of the connector is connected to the shield of the cable.

An RS485-MODBUS must use a balanced pair (for D0-D1) and a third wire (for the Common). In addition to that a second balanced pair must be used in a 4W-MODBUS system (for RXD0-RXD1).

For RS485-MODBUS, Wire Gauge must be chosen sufficiently wide to permit the maximum length (1000 m). AWG 24 is always sufficient for the MODBUS Data.

Category 5 cables may operate for RS485-MODBUS, to a maximum length of 600 m.

For the balanced pairs used in an RS485-system, a characteristic impedance with a value higher than 100 Ohms may be preferred, especially for 19200 and higher baud rates.

Operation

Address

MODBUS compatible addressing description

The first 255 bytes of cyclic input and cyclic output data are available over the MODBUS addressing. If the software address is < 248 in ASCII Modbus mode or < 99 in RTU Modbus mode, the rotary switches are ignored and the software configurable address is used.

Note: The Address “Zero” is not supported and would cause a red ST LED.

Configuration

All Parameters for the communication are defined at the 'Com Interface Object' [ComIfc].

The delivery settings are:

Default settings	
Parameter	Modbus
Software Address	248
Baud Rate	9600
Parity	1 => even
Data Bits	8
Stop Bits	1
Failsave Timeout	0 (not used)
Config	1 => MODBUS compatible RTU protocol

Configure the protocol.

0 → Human Readable Protocol, see RS485/USB Protocol

1 → MODBUS compatible RTU protocol

2 → MODBUS compatible ASCII protocol

Parity

Define the parity setup.

0 => none

1 => even

2 => odd

DataBits

Define the data bits. Possible values are for:

ASCII 7 or 8.

RTU 8.

StopBits

Define the stop bits.

0 => 1,5 Stop Bits

1 => 1 Stop Bit

2 => 2 Stop Bits

Failsafe Timeout

This configures the timeout between characters at ASCII mode, at RTU mode this parameter is not used. The timeout value is defined in milliseconds. If the value is > 0 the timeout function is active.
If the time for the next command is bigger than the timeout time a Timeout Error occurred.
If a Timeout Error occurred, the operation LED switch to red and the valve is shutdown.
To activate the valve controller you have to set the Valve Override to Normal status and send a setpoint.
To clear the red timeout LED you have to read the Communication Status.
At delivery the timeout function is deactivated by a value of 0.
A new timeout value is stored in the non-volatile memory of the device.

Baud rate

Supported Baud Rate				
Expected Baud Rate	**Actual Baud Rate**	**CD (Clock Divider)**	**Error [%]**	**Comment**
50	50	60069	0	
110	110	27304	0	
300	300,01	10011	0	
600	599,97	5006	-0,01	
1200	1199,93	2503	-0,01	
2400	2400,82	1251	0,03	
4800	4797,81	626	-0,05	
9600	9595,62	313	-0,05	
14400	14370,47	209	-0,21	
19200	19252,75	156	0,27	
28800	28879,12	104	0,27	
38400	38505,49	78	0,27	
56000	55619,05	54	-0,68	
57600	57758,24	52	0,27	
115200	115516,48	26	0,27	

It is possible to use other baud rates, but it is not recommended to work with an error higher than 5%. The MODBUS specification advises an error smaller than 1%.

$$CD \approx \frac{48054857}{BaudRate * 16}$$

For the calculation of the error use this formula:

Rounding the CD to an integer and calculate now the error.

$$Error = 100 * \left(1 - \frac{ExpectedBaudRate * CD * 16}{48054857}\right)$$

Feedback and Diagnostics

Error Codes

Standard Modbus Error codes are used.

LED Functions

LED Functions		
Item	**Detail**	**Description**
ST	Off	No power or not initialized
	Green	Initialized
	Red	Communication Error
OP	Off	No power, not initialized
	Green	Initialized
	Flashing green	Data exchange
	Red	Timeout error
	Flashing red	Timeout error, data exchange
SI	Green	Sensor OK
	Flashing red	Power too low
	Blue	Pure USB operation
	Flashing red & green	Self Test or Boot
	Flashing blue	Shows Seconds for AUTOZERO button
FL	Off	No flow
	Flashing blue	Flow Indicator: Flashes proportional to actual flow
	Blue on	100% Flow

Protocol (Modbus compatible)

Holding Registers

The address of the Holding Register starts at 1.

The Holding Registers are read- and writable.

The Holding Register represent the selected input object (default: Standard Input 1179 Object) byte by byte.

One Holding Register is an 16 bit Value and represent two bytes of the selected input object

Example with the "Standard Input 1179 Object"		
MODBUS Holding Register Address	Bit	Parameter
1	1..2	ValveOverride
1	3	Autozero
1	4...6	ReportDiag (not used at Modbus)
1	7	WinkStatus
1	8	EnableTotalizer
1	9	ResetTotalizer
1	10	ResetStatus
1	11..14	SelectGasTable
1	15	EnGasCorrection
1	16	Not used
2	1...16	FlowSetpoint LSB (Byte 1 + 2)
3	1...16	FlowSetpoint MSB (Byte 3 + 4)

Coils

The address of the Coils starts at 1.

The Coils are read- and writable.

The Coils represent the selected input object (default: Standard Input 1179 Object) bit by bit.

One Coil is an 1 bit Value and represent one bit of the selected input object

Example with the “Standard Input 1179 Object”	
MODBUS Coil Address	Parameter
1..2	ValveOverride
3	Autozero
4...6	ReportDiag (not used at Modbus)
7	WinkStatus
8	EnableTotalizer
9	ResetTotalizer
10	ResetStatus
11..14	SelectGasTable
15	EnGasCorrection
16	Not used
17...32	FlowSetpoint LSB (Byte 1 + 2)
33...64	FlowSetpoint MSB (Byte 3 + 4)

Input Registers

The address of the Input Register starts at 1.

The Input Registers are readable and not writable.

The Input Register represent the selected output object (default: Standard Output 1179 Object) byte by byte.

One Input Register is an 16 bit Value and represent two bytes of the selected output object

Example with the “Standard Output 1179 Object”		
MODBUS Input Register Address	Bit	Parameter
1	1	HighLimitAlarm
1	2	LowLimitAlarm
1	3	SystemError
1	4	High2LimitAlarm
1	5	Low2LimitAlarm
1	6	ValveClose
1	7	Purge
1	8	OverTemperature
1	9	ValveDriveAlarm
1	10	CalibrationRecommended
1	11	Uncalibrated
1	12	ControllerError
1	13	MemoryFailure
1	14	UnexpectedCondition
1	15 .. 16	Not used
2	1...16	ThermalMassFlowRate LSB (Byte 1 + 2)
3	1...16	ThermalMassFlowRate MSB (Byte 3 + 4)
4	1...16	InternalTemperature LSB (Byte 1 + 2)
5	1...16	InternalTemperature MSB (Byte 3 + 4)
6	1...16	ValveDriveLevel LSB (Byte 1 + 2)
7	1...16	ValveDriveLevel MSB (Byte 3 + 4)

Discrete Inputs

The address of the Discrete Inputs starts at 1.

The Discrete Inputs are readable and not writable.

The Discrete Inputs represent the selected output object (default: Standard Output 1179 Object) bit by bit.

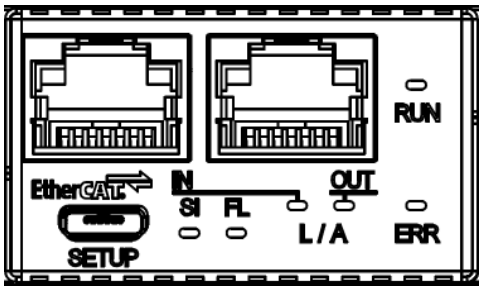
One Input Register is an 1 bit Value and represent 1 bit of the selected output object

Example with the "Standard Output 1179 Object"	
MODBUS Discrete Input Address	Parameter
1	HighLimitAlarm
2	LowLimitAlarm
3	SystemError
4	High2LimitAlarm
5	Low2LimitAlarm
6	ValveClose
7	Purge
8	OverTemperature
9	ValveDriveAlarm
10	CalibrationRecommended
11	Uncalibrated
12	ControllerError
13	MemoryFailure
14	UnexpectedCondition
15 .. 16	Not used
17...32	ThermalMassFlowRate LSB (Byte 1 + 2)
33...64	ThermalMassFlowRate MSB (Byte 3 + 4)
65...80	InternalTemperature LSB (Byte 1 + 2)
81...96	InternalTemperature MSB (Byte 3 + 4)
97...112	ValveDriveLevel LSB (Byte 1 + 2)
113...128	ValveDriveLevel MSB (Byte 3 + 4)

EtherCAT

Installation

Pinout



EtherCAT Pinout		
Pin	Signal	Description
		2 x RJ45
1	Tx+	
2	Tx-	
3	Rx+	
4	-	Normally left unused; to ensure signal integrity, these pins are tied together and terminated to PE via a filter circuit in the interface.
5	-	
6	Rx-	
7	-	Normally left unused; to ensure signal integrity, these pins are tied together and terminated to PE via a filter circuit in the interface.
8	-	

Power supply

The MF1 has to be powered via the Phönix MC-Series connector below the Zero switch. Therefore a mating connector is included in the delivery. For the correct power supply specification see the technical specification in Appendix A.

Cable

According to IEC 61784-5.

Example for cable type based on the template given in IEC 61918:2010	
Characteristic	CP 12/1, CP12/2 (EtherCAT) Type B cable
Nominal impedance of cable (tolerance)	100 Ω ± 15 Ω (IEC 61156-5)
Balanced or unbalanced	Balanced
DCR of conductors	≤ 115 Ω/km
Number of conductors	4

Shielding	S/FTP, S/FTQ, S/STP
Transfer Impedance	< 50 mΩ/m at 10 MHz
Installation Type	Flexible, occasional movement or vibration
Outer cable diameter	5,5 mm – 8 mm
Wire cross section	AWG 22/7
Wire diameter	1,5 mm ± 0,1 mm
Delay scew	≤ 20 ns/100 m

We recommend due to the space requirements the following connector:

Manufacturer	Type	Order Code
Weidenmüller	IE-PS-RJ45-FH-BK	1963600000

Operation

Address

The addresses are defined by the master.

Feedback and Diagnostics

Error Code

Standard EtherCAT Error codes are used.

LED functions

EtherCAT Interface		
Item	Detail	Description
RUN LED	This LED reflects the status of the CoE (CANopen over EtherCAT) communication.	
	OFF	CoE device in 'INIT'-state (or no power)
	Green	CoE device in 'OPERATIONAL'-state
	Green, blinking	CoE device in 'PRE-OPERATIONAL'-state
	Green, single flash	CoE device in 'SAFE-OPERATIONAL'-state
	Red(1)	Fatal Event (If RUN and ERR turns red, this indicates a fatal event, forcing the bus interface to a physically passive state.)
ERR LED	This LED indicates EtherCAT communication errors etc.	
	Off	No error (or no power)
	Red, blinking	Invalid configuration (State change received from master is not possible due to invalid register or object settings.)
	Red, double flash	Application watchdog timeout (Sync manager watchdog timeout)
	Red(1)	Application controller failure (Interface in EXEPTION)
IN/OUT	These LEDs indicate the EtherCAT link status and activity.	

EtherCAT Interface		
	Off	Link not sensed (or no power)
	Green	Link sensed, no traffic detected
	Green, flickering	Link sensed, traffic detected
SI	Green	Sensor OK
	Flashing red	Power too low
	Blue	Pure USB operation
	Flashing red & green	Self Test or Boot
	Flashing blue	Shows Seconds for AUTOZERO button
FL	Off	No flow
	Flashing blue	Flow Indicator: Flashes proportional to actual flow
	Blue on	100% Flow

Protocol

The MF1 with EtherCAT interface supports the CAN application layer over EtherCAT (CoE) protocol and the Process Data Objects (PDO) protocol.

Data Format		
Data Type	Bit Size	Comment
USINT	8	Unsigned short integer
UINT	16	Unsigned integer
UDINT	32	Unsigned double integer
DINT	32	Double integer
REAL	32	Real / 32 bit float
STRING(n)	8 * 2	String; n= length

Process Data Objects (PDO) protocol

TxPdo (0x1A00) - Available TxPDOs of the MF1			
Name	Index	SubIndex	DataType
HighLimitAlarm	0x34ec	0	USINT
LowLimitAlarm	0x34ed	0	USINT
SystemError	0x34ee	0	USINT
High2LimitAlarm	0x34ef	0	USINT
Low2LimitAlarm	0x34f0	0	USINT
ValveClosed	0x34f1	0	USINT
Purge	0x34f2	0	USINT
OverTemperature	0x34f3	0	USINT

ValveDriveAlarm	0x34f4	0	USINT
CalibrationRecommended	0x34f5	0	USINT
Uncalibrated	0x34f6	0	USINT
ControllerError	0x34f7	0	USINT
MemoryFailure	0x34f8	0	USINT
UnexpectedCondition	0x34f9	0	USINT
ThermalMassFlowRate	0x34fa	0	DINT
InternalTemperature	0x34fb	0	DINT
ValveDriveLevel	0x34fc	0	DINT

RxPdo (0x1600) - Available RxPDOs of the MF1			
Name	Index	SubIndex	DataType
ValveOverride	0x33ed	0	USINT
Autozero	0x33ee	0	USINT
ReportDiag	0x33ef	0	USINT
WinkStatus	0x33f0	0	USINT
EnableTotalizer	0x33f1	0	USINT
ResetTotalizer	0x33f2	0	USINT
ResetStatus	0x33f3	0	USINT
SelectGasTable	0x33f4	0	USINT
EnGasCorrection	0x33f5	0	USINT
FlowSetpoint	0x33f6	0	DINT

CAN application layer over EtherCAT (CoE) - Objects

The standard object dictionary is implemented according to the DS301 communication profile (Index 0x1000 - 0x1c33).

Index	*Name*	*Sub-Index*	*Description*	*DataType*	*Access*	*Comment*
0x1000	Device type	0	Device type	UDINT	ro	0x00000000 (No profile)
0x1001	Error register	0	Error register	USINT	ro	
0x1003	Pre-defined error field	0	Number of errors	USINT	rw	
	1 ... 5		Number of errors	UDINT	ro	
0x1008	Device name	0	Device name	STRING(11)	ro	
0x1011	Restore default parameters	0	Largest sub index supported	USINT	ro	
		1	Restore all default parameters	UDINT	rw	
0x1018	Identity	0	Identity	USINT	ro	

		1	Vendor ID	UDINT	ro	
		2	Product Code	UDINT	ro	
		3	Revision Number	UDINT	ro	
		4	Serial Number	UDINT	ro	
	DO RxPDO-Map	0	No. of mapped application objects in PDO	USINT	ro	No. of mapped objects (0.. 254)
0x1600		1 … n	Mapped object 1 … n	UDINT	ro	
	DI TxPDO-Map	0	No. of mapped application objects in PDO	USINT	ro	No. of mapped objects (0.. 254)
0x1a00		1 … n	Mapped object 1 … n	UDINT	ro	
	Sync manager type	0	Number of entries	USINT	ro	4
		1	Mailbox wr	USINT	ro	1
		2	Mailbox rd	USINT	ro	2
		3	Process Data out	USINT	ro	3
0x1c00		4	Process Data in	USINT	ro	4
	RxPDO assign	0	No. of assigned PDOs	USINT	ro	1
0x1c12		1	Assigned PDO	UINT	ro	0x1600
	TxPDO assign	0	TxPDO assign	USINT	ro	
0x1c13		1	Assigned PDO	UINT	ro	0x1A00
	SM output parameter	0	Number of entries	USINT	ro	1
0x1c32		1	Sync mode	UINT	ro	0 (FREE_RUN)
	SM input parameter	0	Number of entries	USINT	ro	1
0x1c33		1	Assigned PDO	UINT	ro	0 (FREE_RUN)
0x33ED	ValveOverride	0	ValveOverride	USINT	rw	[normal, Valve Close, Valve Purge]
0x33EE	Autozero	0	Autozero	USINT	rw	0 to 1 transition activates zeroing if (VALVE_OVERRIDE==FLOW_OFF && FLOW_SETPOINT < 5%FS)
0x33EF	ReportDiag	0	ReportDiag	USINT	rw	Not used
0x33F0	WinkStatus	0	WinkStatus	USINT	rw	0 to 1 transition sets the blue LED to blinking for 5 sec
0x33F1	EnableTotalizer	0	EnableTotalizer	USINT	rw	enable the totalizer funktion
0x33F2	ResetTotalizer	0	ResetTotalizer	USINT	rw	see Meter - ResetTotalizer
0x33F3	ResetStatus	0	ResetStatus	USINT	rw	0 to 1 transition resets totalizer to zero

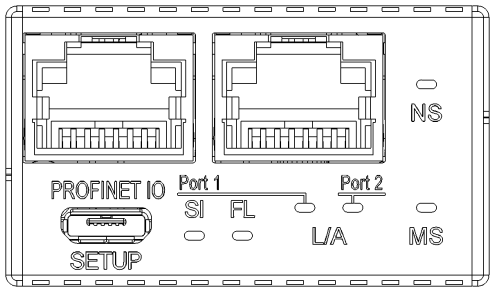
0x33F4	SelectGasTable	0	SelectGasTable	USINT	rw	0..14; 15 = default gas table is used
0x33F5	EnGasCorrection	0	EnGasCorrection	USINT	rw	enable global GCF [0 = disabled, 1 = enabled]
0x33F6	FlowSetpoint	0	FlowSetpoint	DINT	rw	in [FLOW_UNIT] in 10E-4 steps
0x34EC	HighLimitAlarm	0	HighLimitAlarm	USINT	ro	(flow > HIGH_LIMIT), Hysteresis = 0.5%)
0x34ED	LowLimitAlarm	0	LowLimitAlarm	USINT	ro	(flow < LOW_LIMIT), Hysteresis = 0.5%
0x34EE	SystemError	0	SystemError	USINT	ro	any severe error condition
0x34EF	High2LimitAlarm	0	High2LimitAlarm	USINT	ro	(flow > HIGH2_LIMIT), Hysteresis = 0.5%)
0x34F0	Low2LimitAlarm	0	Low2LimitAlarm	USINT	ro	(flow < LOW2_LIMIT), Hysteresis = 0.5%
0x34F1	ValveClosed	0	ValveClosed	USINT	ro	(THERMAL_MASS_FOW_RATE < 1%) && (VALVE_OVERWRITE == FLOW_OFF)
0x34F2	Purge	0	Purge	USINT	ro	THERMAL_MASS_FLOW_RATE > 110%
0x34F3	OverTemperature	0	OverTemperature	USINT	ro	INTERNAL_TEMP > MAX_TEMP
0x34F4	ValveDriveAlarm	0	ValveDriveAlarm	USINT	ro	VALVE_DRIVE_LEVEL > MAX_VTP
0x34F5	CalibrationRecommended	0	CalibrationRecommended	USINT	ro	TIME_TO_CAL count down expired
0x34F6	Uncalibrated	0	Uncalibrated	USINT	ro	if a disabled or no table is used
0x34F7	ControllerError	0	ControllerError	USINT	ro	abs (set - flow) greater for a longer time period
0x34F8	MemoryFailure	0	MemoryFailure	USINT	ro	E2PROM checksum error

0x34F9	UnexpectedCondition	0	UnexpectedCondition	USINT	ro	any process error condition
0x34FA	ThermalMassFlowRate	0	ThermalMassFlowRate	DINT	ro	in [FLOW_UNIT] in 10E-4 steps;
0x34FB	InternalTemperature	0	InternalTemperature	DINT	ro	temperature in [°C] (in 10E-4) steps; see System - InternalTemp
0x34FC	ValveDriveLevel	0	ValveDriveLevel	DINT	ro	0..100% (in 10E-4 steps´) 0% = valve is closed 100% = valve is in purge position (flull open) see Valve - ValvePosition
0x38EB	Model	0	Model	STRING(32)	rw	MF1..
0x38EC	SerialNumber	0	SerialNumber	STRING(16)	rw	G123456G20
0x38F2	CalDate	0	CalDate	STRING(7)	rw	Date of calibration
0x38F3	UserTag	0	UserTag	STRING(32)	rw	any 32 character string
0x37F3	RunHours	0	RunHours	DINT	ro	run time in hours

PROFINET IO

Installation

Pinout



PROFINET Pinout		
Pin	Signal	Description
		2 x RJ45
1	Tx+	
2	Tx-	
3	Rx+	
4	-	Connected to chassis ground over serial RC circuit
5	-	
6	Rx-	
7	-	Connected to chassis ground over serial RC circuit
8	-	

Power supply

The MF1 has to be powered via the Phönix MC-Series connector below the Zero switch. Therefore a mating connector is included in the delivery. For the correct power supply specification see the technical specification in Appendix A.

Cable

Cable	
Wire Construction	Solid / Stranded
Category (min.)	ISO/IEC 11801 Edition 2.0 Connector Category 5
Shielding	Yes

For further information, see “PROFINET Installation Guideline for Cabling and Assembly”, order no. 8.072 and “PROFINET Cabling and Interconnection Technology”, order no. 2.252, available for download at www.PROFINET.com.

We recommend due to the space requirements the following connector:

Manufacturer	Type	Order Code
Weidenmüller	IE-PS-RJ45-FH-BK	1963600000

Operation

Address

The addresses are defined by the master.

Feedback and Diagnostics

LED functions

PROFINET Interface		
Item	Detail	Description
NS	The LED indicates the PROFINET Network Status. Note: A test sequence is performed on this LED during startup.	
	OFF	Offline: - No Power - No connection with IO Controller
	Green	Online (RUN): - Connection with IO Controller established - IO Controller in RUN state
	Green, flashing	Online (STOP): - Connection with IO Controller established - IO Controller in STOP state
MS	The LED indicates the PROFINET Module Status. Note: A test sequence is performed on this LED during startup.	
	Off	Not Initialized
	Green	Normal Operation
	Green, 1 flash	Diagnostic event(s) present
	Green, 2 flashes	Blink: Used by engineering tools to identify the node on the network
	Red	Exception Error
	Red, 1 flash	Configuration Error
	Red, 2 flashes	IP Address Error: IP address not set
	Red, 3 flashes	Station Name Error: Station Name not set
	Red, 4 flashes	Internal Error
PORT1/2	These LEDs indicate the PROFINET link status and activity.	
	Off	No link, no communication present
	Green	Ethernet link established, no communication present
	Green, flickering	Ethernet link established, communication present
SI	Green	Sensor OK

PROFINET Interface		
	Flashing red	Power too low
	Blue	Pure USB operation
	Flashing red & green	Self Test or Boot
	Flashing blue	Shows Seconds for AUTOZERO button
FL	Off	No flow
	Flashing blue	Flow Indicator: Flashes proportional to actual flow
	Blue on	100% Flow

Protocol

Modules

Modules				
Name	**Fixed In Slot**	**Type**	**Category**	**Comment**
Bitfield	1	Unsigned16	input	See Input Bitfield description
FlowSetpoint	2	Integer32	input	in [FLOW_UNIT] in 10E-4 steps valve switched off if setpoint < 1% valve switched on if setpoint > 2%
Bitfield	3	Unsigned16	output	See Output Bitfield description
ThermalMassFlowRate	4	Integer32	output	in [FLOW_UNIT] in 10E-4 steps
InternalTemperature	5	Integer32	output	temperature in °C
ValveDriveLevel	6	Integer32	output	0 .. 100% (in 10E-4 steps) 0% = valve is closed 100% = valve is in purge position (full open)
FlowTotalized	7	Integer32	output	in sl / sm3 (in 10E-4 steps) i.e. min. 298 days for a 500 range.

Bitfields

Input Bitfield (Type: Unsigned16)			
Name	**Bit Offset**	**Bit Length**	**Comment**
ValveOverride	0	2	NORMAL, FLOW_OFF, PURGE
Autozero	2	1	0 to 1 transition activates zeroing if (VALVE_OVERRIDE==FLOW_OFF && FLOW_SETPOINT < 5%FS)
Reserved	3	3	
WinkStatus	6	1	0 to 1 transition sets the LED to blink red/green for 3 seconds
EnableTotalizer	7	1	0 = disabled, 1 = enabled
ResetTotalizer	8	1	0 to 1 transition resets totalizer to zero
ResetStatus	9	1	0 to 1 transition resets error status bits
SelectGasTable	10	4	0..14; 15 = default gas table is used
EnGasCorrection	14	1	0 = disabled, 1 = enabled
Reserved	15	1	

Output Bitfield (Type: Unsigned16)			
Name	**Bit Offset**	**Bit Length**	**Comment**
HighLimitAlarm	0	1	(flow > HIGH_LIMIT), Hysteresis = 0.5% *
LowLimitAlarm	1	1	(flow < LOW_LIMIT) , Hysteresis = 0.5% *
SystemError	2	1	any severe system error condition
High2LimitAlarm	3	1	(flow > HIGH2_LIMIT), Hysteresis = 0.25%
Low2LimitAlarm	4	1	(flow < LOW2_LIMIT), Hysteresis = 0.25%
ValveClosed	5	1	(THERMAL_MASS_FLOW_RATE < 1%) && (VALVE_OVERRIDE == FLOW_OFF)
Purge	6	1	THERMAL_MASS_FLOW_RATE > 110%
OverTemperature	7	1	INTERNAL_TEMP > MAX_TEMP
ValveDriveAlarm	8	1	VALVE_DRIVE_LEVEL > MAX_VTP
CalibrationRecommended	9	1	TIME_TO_CAL count down expired
Uncalibrated	10	1	if a disabled or no table is used
ControllerError	11	1	abs (setp - flow) greater for a longer time period
MemoryFailure	12	1	E2PROM checksum error
UnexpectedCondition	13	1	any process error condition
Reserved	14	2	

*) Hysteresis is +/- 0.25% (i.e. 0.5% in total) based on current limit

Chapter 6: Gas Correction Factor (GCF)

The Gas Correction Factor (GCF):

A Gas Correction Factor (GCF) is used to indicate the ratio of flow rates of different gases which will produce the same output signal from a mass flow meter / controller. The GCF is a function of specific heat, density, and the molecular structure of the gases. Nitrogen (N_2) is normally used as the baseline gas (GCF = 1) since flow meters and controllers are usually calibrated with nitrogen.

GCF (N2) = 1

Appendix C lists the gas correction factors for many commonly used pure gases. If the gas you are using is not listed in there, you must calculate its GCF. The equations for calculating gas correction factors are described below.

How To Calculate the GCF for Pure Gases

To calculate the Gas Correction Factor for any pure gas (X), use the following equation:

$$GCF_x = \frac{0.3106 * s}{\rho_{x*} cp_x}$$

where:

GCF_x	= gas correction factor for gas X
0.3106	= (standard density of nitrogen) • (specific heat of nitrogen)
s	= molecular structure correction factor where S equals:
	1.030 for monoatomic gases
	1.000 for diatomic gases
	0.941 for triatomic gases
	0.880 for polyatomic gases
d_x	= standard density of gas X, in g/l (at 0° C and 1013,25 mbar)
cp_x	= specific heat of gas X, in cal/g° C

How To Calculate the GCF for Gas Mixtures

For gas mixtures, the calculated Gas Correction Factor is not simply the weighted average of each component's GCF. Instead, the GCF (relative to nitrogen) is calculated by the following equation:

$$GCF_x = \frac{0{,}3106 * (a_1 s_1 + a_2 s_2 + ...a_n s_n)}{a_1 \rho_1 cp_1 + a_2 \rho_2 cp_2 + ... a_n \rho_n cp_n}$$

where:

GCF_m	= gas correction factor for a gas mixture
0.3106	= (standard density of nitrogen) (specific heat of nitrogen)
a_1, a_2,..an	= fractional flow of gases 1 through n *Note*: a_1 through a_n must add up to 1.0
s_1, s_2,...sn	= Molecular Structure correction factor for gases 1 through n where S equals: 1.030 for monatomic gases 1.000 for diatomic gases 0.941 for triatomic gases 0.880 for polyatomic gases
d1 through dn	= standard density for gases 1 through n, in g/l (at 0° C and 760 mmHg)
cp1 through cpn	= specific heat of gases 1 through n, in cal/g° C

Note

1. When using the GCF, the accuracy of the flow reading may vary by ± 5%, however, the repeatability will remain ± 0.2% of FS.
2. The linearity and accuracy may be improved by calibrating the unit with the process gas or using a gas with equivalent properties (surrogate gas). Contact MKS for more information.
3. All MKS readouts have gas correction adjustment controls to provide direct readout.

Example

Calculate the GCF for a gas mixture of argon (gas 1) flowing at 150 sccm and nitrogen (gas 2) flowing at 50 sccm, where:

Argon (Ar)	**Nitrogen (N_2)**
$a_1 = \frac{150}{200} = 0.75$	$a_2 = \frac{50}{200} = 0.25$
$s_1 = 1.030$	$s_2 = 1.000$
$d_1 = 1.782$ g/l	$d_2 = 1.250$ g/l
$cp_1 = 0.1244$ cal/g ° C	$cp_2 = 0.2485$ cal/g ° C

$$GCF_M = \frac{(0.3106)\ [(0.75)(1.030)+(0.25)(1.000)]}{(0.75)(1.782)(0.1244)\ +(0.25)(1.250)(0.2485)}$$

$$= \frac{(0.3106)\ [(0.7725)+(0.25)]}{(0.1663)\ +(0.0777)}$$

$$= \frac{(0.3106)\ (1.0225)}{0.244}$$

$$= \frac{0.3176}{0.244}$$

$$GCF_M = 1.302$$

Mass Flow Rate at a Different Reference Temperature

The equations for calculating the GCF assume that the MFC was calibrated at a reference temperature of 0° C (~273.15 K). If you want to read the mass flow as if the MFC was calibrated at a different reference temperature, adjust the calculated GCF value using the following equation:

$$GCF_X = GCF \times \frac{T_x}{T_N}$$

where:

T_X = actual reference temperature in Kelvin K

T_N = international standard temperature 273.15 K (= 0° C)

Note All MKS readouts have gas correction adjustment controls to provide direct readout. The analog setpoint output signal is generated accordingly.

Chapter 7: Theory of Operation

Technique of Measurement and Control, Electronics

The design of the MF1 flow controller incorporates an advanced flow sensor, a new control valve and an optimized bypass. The latest generation two-element sensing circuit provides accurate, repeatable performance even in low flow ranges (< 10 sccm). Low temperature effect from ambient temperature change and a low attitude sensitivity effect are also ensured. The newly optimized sensor/bypass arrangement minimizes the flow splitting error for gases with different densities, which dramatically improves measurement accuracy when gases other than the calibration gas are used.

The surface mount digital, processor controlled electronic circuitry allows optimum adjustment of the sensing and signal conditioning circuitry and provides tuned flow control for fast response to any set point in common with excellent stability.

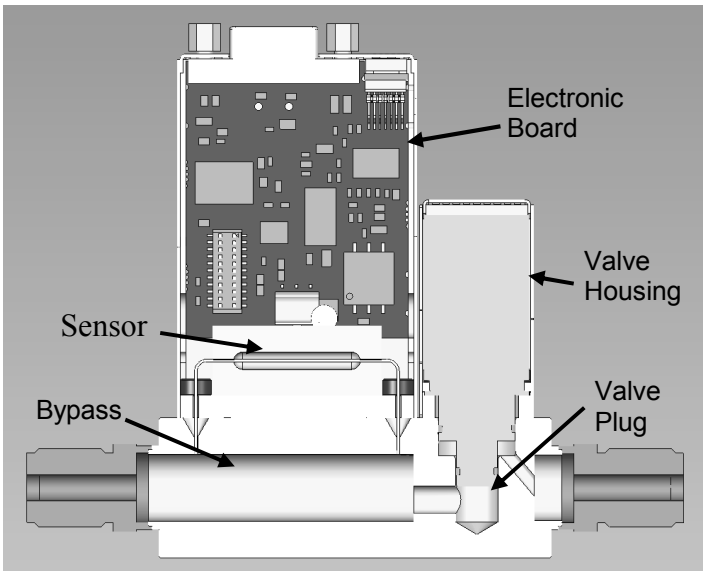


Figure 11: Assembly

The flow controller type MF1 measures and controls the gas flow rate according to a given setpoint signal, which may be an analog signal or a digital command when using a MF1 with digital interface. The control range is from 2 % to 100% of full scale. The accuracy of the flow measurement is ± (0.5 % of Reading + 0.2 % of F.S.).

Flow Path

Upon entering the flow controller, the gas stream passes first through the metering section of the instrument for its mass flow to be measured. The gas moves on through the control valve for its rate of flow to be regulated according to the given set point, and then exits the instrument at the established rate of flow.

The metering section consists of one of the following:

- A sensor tube for ranges $\leq$ 10 sccm (N_2 equivalent)
- A sensor tube and parallel bypass for ranges > 10 sccm (N_2 equivalent)

The geometry of the sensor tube, in conjunction with the specified full scale flow rate, ensures fully developed laminar flow in the sensing region. The bypass elements, in those instruments containing them, are specifically matched to the characteristics of the sensor tube to achieve a laminar flow splitting ratio which remains constant throughout each range.

Measurement Technique

The flow measurement is based on differential heat transfer between temperature sensing heater elements, which are attached symmetrically to the sensor tube. This senses the thermal mass movement, which is converted to mass flow via the specific heat, C_p, of the gas. The resulting signal is then amplified, digitalized and linearized. The corrected digital signal is then transferred to the control section (controllers only) and also converted into a 0 – 5 V analog signal (Default setting).
Analog versions of the units described herein provide the analog flow signal and via the USB Setup Interface the digital information, Profibus, RS485 or USB versions provide just the digital information without the analog signal.
The measurement principle of keeping temperatures constant results in much shorter response time than conventional principles.

Control Circuitry

In the digital control section the flow rate is compared to the setpoint value and a control signal (digital) is generated.

The digital control signal is then conditioned by a PID-algorithm, optimized for fastest controlling and finally fed into the control circuitry which steers the solenoid control valve. The digital control reduces overshoots to a minimum and for completely regulating the flow until the difference from the setpoint is zero. Typical settle time is 0.8 s, for faster tuning contact MKS.

The control valve is closed when no power is applied (Normally Closed, N.C.). Controlling flow is done by levitating the valve plug from the valve orifice. The plug is mounted at the front end of the solenoid armature.

Control Valve

The control valve is a specially designed solenoid driven valve. The armature is suspended by two radial springs. This design provides frictionless movement and thus precise control. Mounted at the front end of the cylindrical armature is the valve plug which incorporates the seal disc of FKM or NBR or FFKM (ref. to *Appendix A, Specifications*). By preload force of the two above mentioned springs the seal disc is pressed against the valve orifice, closing its flow channel. Therefore the valve is closed when not activated. It is a „Normally Closed“ (N.C.) valve.

The inside diameter of the orifice determines the conductance. Each flow controller incorporates a valve orifice with a conductance in accordance to the full scale range. The valve orifice in standard units is sized that with a pressure difference between inlet and outlet fitting of typical 0.7 bar to 2.75 bar the specified full scale flow rate will be achieved. (related to air or nitrogen). For more information refer to *Appendix A, Specifications*.

For special applications with low pressure conditions, e.g. vaporizer sources, configurations can be provided. In this case the valve will have an orifice with higher conductance (=larger diameter of the flow channel). Mass flow controllers for applications where only 200 mbar (or less) are available have been realized.

At high line pressures in combination with high flow rates it may be necessary to have an orifice with smaller conductance installed.

The mass flow monitor MF1M has no valve!

Chapter 8: Maintenance

General

After proper installation and correct setup there is typically only the need for occasionally checking and - if necessary - readjusting the zero flow signal. In general no further maintenance is required. How often the calibration and the valve should be checked depends on physical influences, e.g. temperature, vibrations, dust etc., is also related to the required accuracy and last not least on how the process gas affects the wetted parts inside the unit.

If a controller fails to operate properly upon receipt, check for shipping damage, and check the power/signal cable for correct continuity. Any damage should be reported to the carrier and MKS Instruments immediately.

Zero Adjustment

To achieve optimum accuracy and reliability you should periodically check the zero readout and - if necessary - readjusting it.

Checks and Recalibration

Checks and recalibrations can be done by any service center of MKS (refer to section *Repair*). If nothing else is specified or shorter intervals are necessary we recommend annual maintenance and recalibration at a service center of MKS.

MKS offers many standard equipment for checking and calibrating mass flow meters / controllers to allow you making all testing and calibration even in situ.

For electronic testing and trouble shooting we recommend to do all measurements directly at the interface connector of the unit. This eliminates or detects erratic diagnosis, typically generated by incorrect grounding. MKS offers for this purpose so called breakout connectors. These are switched between the connector of the unit and the cable and provide a test pin for each wire, thus allowing direct access for a volt meter or oscilloscope etc.

Profibus Support Kit

This kit allows convenient setup and diagnosis of a Profibus mass flow meter/controller. It can be ordered from MKS as Profibus Support Kit, part no. 1179-PB-SUPPORT, consisting of

- 1 Disc 3,5“
- 1 RS 232 cable
- 1 Converter RS232/RS485
- 1 Instruction paper

Customer Support

Standard maintenance and repair services are available at all of our regional MKS Calibration and Service Centers, listed at the end of this manual. In addition, MKS accepts the instruments of other manufacturers for recalibration using the Primary and Transfer Standard calibration equipment located at all of our regional service centers. Should any difficulties arise in the use of your instrument, or to obtain information about companion products MKS offers, contact any authorized MKS Calibration and Service Center. If it is necessary to return the instrument to MKS, the MKS Calibration and Service Center will inform you about any formal requirements.

You will find a list of MKS Calibration and Service Centers and a form for Declaration of Contamination at the end of this handbook.

Warning  **All returns to MKS Instruments must be free of harmful, corrosive, radioactive, or toxic materials.**

Troubleshooting

Symptoms	Possible Cause	Remedy
No output or overrange at zero (after warm-up)	Improper cable	Check cable for type
	Valve override function applied (Mass flow controller)	Disconnect / disable valve override
	Electronics malfunctioning	Return for service
Unit indicates a negative flow	Unit installed in gas stream backwards	Reinstall unit in proper flow direction
Controller does not track set point.	Improper zero adjustment	Zero meter output
	Improper grounding(s)	Check all ground connections. Check signals, if possible directly at the unit's connector
Controller does not function	Electronics malfunctioning	Return for service
	Valve sticking, clogged, contaminated, corroded.	Check compatibility of the process gas with materials wetted (corrosion is typically also visible inside the process fittings) return for service
	Shutoff valve upstream or downstream closed	Open shutoff valve first, then apply again setpoint to the unit.
	No inlet pressure	Regulate inlet pressure
Oscillation	Supply pressure unstable, e.g. defective pressure regulator.	Check manufacturers' specifications
	Supply pressure too high	Reduce upstream pressure
Excessive closed conductance	Inadequate valve preload	return for service
	Valve seat elastomer damaged	Check compatibility of process gas with seat material return for service to replace or change valve seat elastomer
Unit does not achieve full flow	Upstream pressure too low	Increase upstream pressure
	Excessive valve preload	return for service
	Valve seat disc damaged, e.g. swollen	Check compatibility of process gas with seat material return for service to replace or change valve seat elastomer

Table 7 Troubleshooting

Appendix A: Product Specifications

Specifications

Full Scale Ranges (nitrogen equivalent)[1] All metal sensor	10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000 sccm
MEMS sensor	50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000 sccm
Accuracy[2](with calibration gas)	
All metal sensor	± (0.5 % of reading plus 0.20 % of full scale)
MEMS sensor	TBD
Repeatability	
All metal sensor	± 0.20 % of full scale
MEMS sensor	TBD
Resolution	
All metal sensor	0,1 % of F.S.
MEMS sensor	TBD
Measurement (Dynamic) Range	
All metal sensor	1 % to 100% of full scale
MEMS sensor	TBD
Control Range	
All metal sensor	2.0 % to 100% of full scale
MEMS sensor	TBD
Controller Settling Time[3]	
All metal sensor	< 800 msec (350 msec on request)
MEMS sensor	TBD
Maximum Inlet Pressure	10 bar (g)

[1] sccm = std. cm^3 / min ; standard (std.) condition: 1013.25 mbar and 0 °C.

[2] includes non-linearity, hysteresis and non-repeatability.

[3] per SEMI E17-91

(continued from previous page)

Operating Differential Pressure (MFC only)[5]	
10 to 5000 sccm	0.7 bar (g) to 2.75 bar (g)
10000 to 20000 sccm	1 bar (g) to 2.75 bar (g)
Pressure Coefficient	< 0.02 % of reading/psi
Operating Temperature Range	0 – 40 °C
Temperature Coefficient on Zero	
All metal sensor	< 0.04 % of full scale /°C (400 ppm)
MEMS sensor	TBD
Temperature Coefficient on Span	
All metal sensor	< 0.08 % of reading /°C
MEMS sensor	TBD
Warm Up Time	ca. 15 min

Environmental specifications

Storage Humidity Range	0 to 95 % relative humidity, non-condensing
Storage Temperature Range	-20 to 50°C

Electrical Specifications

Connectors:	
Power	Phoenix MC-series, 3.81 pitch
USB Setup Interface	micro-B
Analog Process Interface	Sub D 9-poles, pin
Profibus Process Interface	Sub D 9-poles, socket
RS 485/ Modbus Process Interface	Sub D 9-poles, socket
USB Process Interface	B
EtherCAT, PROFINET IO	2 x RJ45
Supply Voltage/Current Required	± 15 V or + 24 V (20 to 31.5 V)
Maximum supply current	300 mA @ + 24 V
Maximum idle current	100 mA @ + 24 V (for USB, Analog, RS 485 and Profibus interfaces)

[5] Referenced to an MFC outlet at atmosphere

Output Signal, analog	Default setup: 0- 5 VDC; Configurable: Zero: 0 to 2 VDC F.S.: 5 to 10 VDC
Set Point Command Signal, analog	default setup: 0 - 5 VDC; Configurable (= Output Signal setting): Zero: 0 to 2 VDC F.S.: 5 to 10 VDC

Physical Specifications

Dimensions	refer to Figure 2
Fittings: Standard Optional	 Cajon® 4-VCR® male compatible Cajon® 4-VCO® male compatible 1/4“ Swagelok compatible DN 16 KF MKS Surface Mount
Leak Integrity (mbar·l/s He) External Through closed Valve (MFC only)	 $< 1 \times 10^{-9}$ $< 1 \times 10^{-5}$
Materials Wetted All Metal Sensor: Mass Flow Controller: Optional seals and valve seal MEMS Sensor:	 1.4301 SST, FKM , Nickel NBR, FFKM TBD
Mass	ca. 0.7 kg

Due to continuing research and development activities, these product specifications are subject to change without notice.

Appendix B: Model Code

The model is identified as follows:

MF1 X YYY ZZZ C A E O

X = Variant

YYY = Gas Identification

ZZZ = Full Scale Range

C = Fittings (compatible with)

A = Interface

E = Seals

Variant (X)

Variant	Ordering Code
Controller with all metal sensor	C
Meter with all metal sensor	M
1179 compatible footprint with all metal sensor	E
179 compatible footprint with all metal sensor	N

Gas Identification (YYY)

Gas	Code	Symbol
Acetone	184	C3H6O
Acetylene	42	C2H2
Air	8	Air
Ammonia	29	NH3
Argon	4	Ar
Arsine	35	AsH3
Boron Trichloride	70	BCl3
Boron Trifluoride	48	BF3
Bromine	21	Br2
Bromine Trifluoride	76	BrF3
Butane	117	C4H10
Carbon Dioxide	25	CO2
Carbon Disulfide	40	CS2
Carbon Monoxide	9	CO
Carbon Tetrachloride	101	CCl4
Carbon Tetrafluoride (R-14)	63	CF4

Carbonyl Sulfide	34	COS
Chlorine	19	Cl2
Chlorine Trifluoride	77	ClF3
Chlorodifluoromethane (R-22)	57	CHClF2
Chloroform (Trichloromethane)	71	CHCl3
Chloropentafluoroethane (R-115)	119	C2ClF5
Chlorotrifluoromethane (R-13)	74	CClF3
Cyclopropane	61	C3H6
Deuterium	14	D2
Diborane	58	B2H6
Dichlorodifluoromethane (R-12)	84	CCl2F2
Dichlorofluoromethane (R-21)	65	CHCl2F
Dichlorosilane	67	SiH2Cl2
1,2-Dichlorotetrafluoroethane (R-114)	125	C2Cl2F4
Disilane	97	Si2H6
Ethane	54	C2H6
Ethanol	136	C2H6O
Ethylene	38	C2H4
Ethylene Oxide	45	C2H4O
Fluorine	18	F2
Germane	43	GeH4
Germanium Tetrachloride	113	GeCl4
Helium	1	He
Hexafluoroethane (R-116)	118	C2F6
Hexafluoropropylene	138	C3F6
Hexane	127	C6H14
Hydrogen	7	H2
Hydrogen Bromide	10	HBr
Hydrogen Chloride	11	HCl
Hydrogen Fluoride	12	HF
Hydrogen Selenide	23	H2Se
Hydrogen Sulfide	22	H2S
Isobutane	111	C4H10
Isobutylene	106	C4H8
Krypton	5	Kr
Methane	28	CH4
Neon	2	Ne
Nitric Oxide	16	NO
Nitrogen	13	N2
Nitrogen Dioxide	26	NO2
Nitrogen Trifluoride	53	NF3
Nitrous Oxide	27	N2O
Octafluorocyclobutane (R-c318)	129	C4F8
Oxygen	15	O2
Ozone	30	O3
Phosgene	60	CCl2O
Phosphine	31	PH3
Phosphorous Oxychloride	102	POCl3
Propane	89	C3H8
Propylene	69	C3H6

Silane	39	SiH4
Silicon Tetrachloride	108	SiCl4
Silicon Tetrafluoride	88	SiF4
Sulfur Dioxide	32	SO2
Sulfur Hexafluoride	110	SF6
Sulfuryl Fluoride	87	SO2F2
Tetrafluoroethane (R-134a)	156	C2H2F4
Titanium Tetrachloride	114	TiCl4
Trichlorofluoromethane (R-11)	91	CCl3F
Trichlorosilane	147	SiHCl3
Trichlorotrifluoroethane (R-113)	126	C2Cl3F3
Trifluoromethane (Fluoroform R-23)	49	CHF3
Tungsten Hexafluoride	121	WF6
Xenon	6	Xe

Full Scale Range (ZZZ)[3]

The full scale range is indicated by three digits. The full scale range is referring to the gas type given by the SEMI gas code. The calibration is done with nitrogen using GCF.

Full scale flow range (sccm)	Ordering code
10	11C or 101
20	21C or 201
50	51C or 501
100	12C or 102
200	22C or 202
500	52C or 502
1000	13C or 103
2000	23C or 203
5000	53C or 503
10.000	14C or 104
20.000[4]	24C or 204
Full scale flow range (slm)	
10	11L
20	21L

[3] Max. 20000 sccm N2 equivalent, other gases on request.

[4] Not in conjunction with FFKM seal material.

Fittings (C)

There are different fittings available, designated by a single letter code.

Fitting Type	Ordering Code
Swagelok 4 VCR male	R
1/4" Swagelok compatible	S
6 mm Swagelok compatible	M
Swagelok 4 VCO male	G
DN 16 KF	D
MKS Surface Mount	E
1/8" Swagelok compatible	P

Interface (A)

Interface Type	Ordering Code
Profibus DPV1	P
Profibus DPV0 (1179B compatible)	4
Analog, 9 Pin Sub D Connector	A
USB	U
RS485	5
ModBus	M
EtherCAT	T
PROFINET IO	F

Seal Material (E)

Seal Material	Ordering Code
FKM	V
FFKM [5]	K
NBR (on request only)	B

[5] Not for F.S. larger than 10 slm N2 equivalent.

Extras/ options (O)

		Meaning of extension behind
No extras	**0**	**firmware**
Special	S	Special number
Initial configuration file supplied	C	File name

Appendix C: Gas Correction Factors

Please read also the instructions in Chapter 6: Gas Correction Factor (GCF)and the notes at the end of this table.

GAS	SYMBOL	SPECIFIC HEAT, Cp cal/g^{o}C	DENSITY g/l @ 0^{o}C	CONVERSION FACTOR
Air	- - -	0.240	1.293	1.00
Ammonia	NH_3	0.492	0.760	0.73
Argon	Ar	0.1244	1.782	1.39[1]
Arsine	AsH_3	0.1167	3.478	0.67
Boron Trichloride	BCl_3	0.1279	5.227	0.41
Bromine	Br_2	0.0539	7.130	0.81
Carbon Dioxide	CO_2	0.2016	1.964	0.70[1]
Carbon Monoxide	CO	0.2488	1.250	1.00
Carbon Tetrachloride	CCl_4	0.1655	6.86	0.31
Carbon Tetraflouride (Freon - 14)	CF_4	0.1654	3.926	0.42
Chlorine	Cl_2	0.1144	3.163	0.86
Chlorodifluoromethane (Freon - 22)	$CHClF_2$	0.1544	3.858	0.46
Chloropentafluoroethane (Freon - 115)	C_2ClF_5	0.164	6.892	0.24
Chlorotrifluoromethane (Freon - 13)	$CClF_3$	0.153	4.660	0.38
Cyanogen	C_2N_2	0.2613	2.322	0.61
Deuterium	D_2	1.722	0.1799	1.00
Diborane	B_2H_6	0.508	1.235	0.44
Dibromodifluoromethane	CBr_2F_2	0.15	9.362	0.19
Dichlorodifluoromethane (Freon - 12)	CCl_2F_2	0.1432	5.395	0.35
Dichlorofluoromethane (Freon - 21)	$CHCl_2F$	0.140	4.592	0.42
Dichloromethysilane	$(CH_3)_2SiCl_2$	0.1882	5.758	0.25

(Table continued on next page)

GAS	SYMBOL	SPECIFIC HEAT, Cp cal/g^{O}C	DENSITY g/l @ 0^{O}C	CONVERSION FACTOR
Dichlorosilane	SiH_2Cl_2	0.150	4.506	0.40
1,2-Dichlorotetrafluoroethane (Freon - 114)	$C_2Cl_2F_4$	0.160	7.626	0.22
1,1-Difluoroethylene (Freon - 1132A)	$C_2H_2F_2$	0.224	2.857	0.43
2,2-Dimethylpropane	C_5H_{12}	0.3914	3.219	0.22
Ethane	C_2H_6	0.4097	1.342	0.50
Fluorine	F_2	0.1873	1.695	0.98
Fluoroform (Freon - 23)	CHF_3	0.176	3.127	0.50
Freon - 11	CCl_3F	0.1357	6.129	0.33
Freon - 12	CCl_2F_2	0.1432	5.395	0.35
Freon - 13	$CClF_3$	0.153	4.660	0.38
Freon - 13 B1	$CBrF_3$	0.1113	6.644	0.37
Freon - 14	CF_4	0.1654	3.926	0.42
Freon - 21	$CHCl_2F$	0.140	4.592	0.42
Freon - 22	$CHClF_2$	0.1544	3.858	0.46
Freon - 23	CHF_3	0.176	3.127	0.50
Freon - 113	$C_2Cl_3F_3$	0.161	8.360	0.20
Freon - 114	$C_2Cl_2F_4$	0.160	7.626	0.22
Freon - 115	C_2ClF_5	0.164	6.892	0.24
Freon - 116	C_2F_6	0.1843	6.157	0.24
Freon - C318	C_4F_8	0.185	8.397	0.17
Freon - 1132A	$C_2H_2F_2$	0.224	2.857	0.43
Helium	He	1.241	0.1786	.- - -^{2}
Hexafluoroethane (Freon - 116)	C_2F_6	0.1843	6.157	0.24
Hydrogen	H_2	3.419	0.0899	.- - -^{2}
Hydrogen Bromide	HBr	0.0861	3.610	1.00
Hydrogen Chloride	HCl	0.1912	1.627	1.00
Hydrogen Fluoride	HF	0.3479	0.893	1.00
Isobutylene	C_4H_8	0.3701	2.503	0.29
Krypton	Kr	0.0593	3.739	1.543
Methane	CH_4	0.5328	0.715	0.72

(Table continued on next page)

GAS	SYMBOL	SPECIFIC HEAT, Cp cal/g^{O}C	DENSITY g/l @ 0^{O}C	CONVERSION FACTOR
Methyl Fluoride	CH_3F	0.3221	1.518	0.56
Molybdenum Hexafluoride	MoF_6	0.1373	9.366	0.21
Neon	Ne	0.246	0.900	1.46
Nitric Oxide	NO	0.2328	1.339	0.99
Nitrogen	N_2	0.2485	1.250	1.00
Nitrogen Dioxide	NO_2	0.1933	2.052	.- - -[2]
Nitrogen Trifluoride	NF_3	0.1797	3.168	0.48
Nitrous Oxide	N_2O	0.2088	1.964	0.71
Octafluorocyclobutane (Freon - C318)	C_4F_8	0.185	8.937	0.17
Oxygen	O_2	0.2193	1.427	0.993
Pentane	C_5H_{12}	0.398	3.219	0.21
Perfluoropropane	C_3F_8	0.194	8.388	0.17
Phosgene	$COCl_2$	0.1394	4.418	0.44
Phosphine	PH_3	0.2374	1.517	0.76
Propane	C_3H_8	0.3885	1.967	0.36
Propylene	C_3H_6	0.3541	1.877	0.41
Silane	SiH_4	0.3189	1.433	0.60
Silicon Tetrachloride	$SiCl_4$	0.1270	7.580	0.28
Silicon Tetrafluoride	SiF_4	0.1691	4.643	0.35
Sulfur Dioxide	SO_2	0.1488	2.858	0.69
Sulfur Hexafluoride	SF_6	0.1592	6.516	0.26
Trichlorofluoromethane (Freon - 11)	CCl_3F	0.1357	6.129	0.33
Trichlorosilane	$SiHCl_3$	0.1380	6.043	0.33
1,1,2-Trichloro - 1,2,2-Trifluoroethane (Freon - 113)	CCl_2FCClF_2 or ($C_2Cl_3F_3$)	0.161	8.360	0.20
Tungsten Hexafluoride	WF_6	0.0810	13.28	0.25
Xenon	Xe	0.0378	5.858	1.32

[1]Empirically defined

[2]Consult MKS Instruments, Inc. for special applications.

NOTE: Standard Pressure is defined as 1013,25 mbar (760 mmHg;14.7 psia), Standard Temperature is defined as 0^{O}C.

Appendix D: CE Declaration of Conformity

mks

CE Declaration of Conformity

Application of Council Directive(s):
2004/108/EC Electromagnetic Compatibility (EMC) Directive,

Standard(s) to which conformity is declared:
Electrical equipment for measurement, control and laboratory use - EMC requirements
EN 61326-2-3 2007-05

Emission Standards:
EN 55011 2007-11

Immunity Standards:
EN 61000-4-2 2001-12
EN 61000-4-3 2008-06
EN 61000-4-4 2005-07
EN 61000-4-5 2007-06
EN 61000-4-6 2008-04
EN 61000-4-11 2005-02

Manufacturers Name:
MKS Instruments Deutschland GmbH
Schatzbogen 43
81849 München
Germany

Importer's Name: _____

Importer's Address: _____

Type of Equipment:
Mass Flow Controller or Mass Flow Meter
Model Number: MF1 *

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s) and Standard(s), when installed in accordance with manufacturer's specifications.

Place: Munich, Germany

Date: July 1, 2009

Rev: 1

(Signature)

Dr. Peter Hofmann
(Full Name)

Managing Director
(Position)

* See manual for application requirements

MKS Worldwide Calibration & Service Centers

UNITED STATES

MKS Instruments, Inc.
Corporate Service Center
651 Lowell Street
Methuen, MA 01844
Tel. (978) 682-4567
Fax (978) 682-8543

MKS Instruments, Inc.
HPS Division,
Vacuum Components,
Valves & Gauging
5330 Sterling Drive
Boulder, CO 80301
Tel. (303) 449-9861
Tel. (800) 345-1967
Fax (303) 442-6880

CANADA

MKS Instruments, Canada Ltd.
30 Concourse Gate
Nepean, Ontario, Canada K2E 7V7
Tel. (613) 723-3386
(800) 267-3551 (CAN only)
Fax (613) 723-9160

FRANCE

MKS Instruments, France s.a.
43, Rue du Commandant Rolland
B.P. 41
F-93352 Le Bourget, Cedex,
France
Tel. 33(1)48.35.39.39
Telex 233817 F
Fax 33(1)48.35.32.52

TAIWAN

MKS Instruments, Taiwan
10F, No.93, Shoei-Yuan Street
Hsinchu City 300
Taiwan, R.O.C.
Tel. 886-3-575 3040
Fax 886-3-575 3048

GERMANY/BENELUX

MKS Instruments,
Deutschland GmbH
Schatzbogen 43
D-81829 München
Tel. 49-89-420008-0
Fax 49-89-42-41-06
Email:mks-germany@mksinst.com

ITALY

G. Gambetti Kenologia Srl.
Via A. Volta No. 2
20082 Binasco (MI), Italy
Tel. 39-2-90093082
Fax 39-2-905.2778

JAPAN

MKS Japan, Inc.
Harmonize Building
5-17-13, Narita-Higashi
Suginami-Ku, Tokyo 166, Japan
Tel. 81-3-3398-8219
Fax 81-3-3398-8984

KOREA

MKS Korea Co., Ltd.
1st Floor DK Plaza-I
375-1 Geumgok-dong
Bundang-gu,Seongnam Kyonggi-do
Korea 463-805
Tel 82-31-717-9244
Fax 82-31-714-9244

UNITED KINGDOM

MKS Instruments, U.K. Ltd.
2 Cowley Way
Weston Road
Crewe, Cheshire
CW1 6AE, England
Tel. 44-1270 253400
Fax 44-1270 848382

Next page: Declaration of Contamination.

Contact your MKS location if the form is missing.

mks
Technology for Productivity

HEALTH AND SAFETY FORM

THIS FORM MUST BE COMPLETED AND RETURNED WITH EQUIPMENT OR SERVICE WILL NOT BE PERFORMED

RETURN MATERIAL AUTHORIZATION NUMBER (RMA#):	
RETURN TO STOCK NUMBER/RTS# (If applicable):	**Trade in number (if applicable):**

Section 1: (one instrument per form)	**MKS Part Number:**
	MKS Serial Number:

Section 2: Has this equipment been used? *(Please check appropriate boxes)*

☐	**No – Still in MKS packaging**
☐	**No – Unit unpacked, but never installed in a system.**
☐	**Yes -- Used only with clean, dry inert gas (For Example: Air, N2, Ar, He).**
☐	**Yes -- Used with chemicals, non-inert gases, biological or radioactive agents.) Identify all materials:**
☐	**Yes -- Used in a Semiconductor Copper process. Equipment must be double bagged. Label outside bag and packing slip, Copper Part. Label final shipping container Copper Part and place a strip of ORANGE TAPE on the container.**
	Has equipment been purged? ☐ No ☐ yes purged with what?
	Has equipment been flushed? ☐ No ☐ yes flushed with what?
	Has equipment been decontaminated? ☐ no ☐ yes, explain process:
	How many months in use?

Section 3: Detailed failure information or description or required service or reason for return.

Section 4: Company or Organization (mandatory information)

Company:		
Address:		
City:	**State:** **Zip:**	
Printed Name:	**Signature:**	
Date:	**Phone #:**	
Email:	**Fax #:**	
End User (if applicable):		

For MKS USE only:

MKS Subsidiary or Agent:
Contact Name:
Customer #
Maximum Credit allowed (TBD after inspection)

ALL PRODUCTS MUST BE RETURNED IN SEALED BAGS

MKS will not accept delivery of equipment that has been chemically, radioactively or biologically contaminated, without written evidence of decontamination or laboratory analysis. Alternately, we will require evidence that the biological process is not harmful.