Electromagnetic Flowmeter with AC Magnetic Field Excitation
Models: DS21_ / DS4_F

Instruction Bulletin
D184B064U02 Rev. 03 / 08.02

For Converters:
MAG-SM Model 50SM1000
FILL-MAG Model 50ES7000
You have purchased a high quality, modern Electromagnetic Flowmeter System from ABB Automation. We appreciate your purchase and the confidence you have expressed in us.

This Instruction Bulletin contains information relating to the assembly and installation of the instrument and the specifications as well the testing of this instrument design. ABB Automation reserves the right to make hardware and software improvements without prior notice. Any questions which may arise that are not specifically answered by these instructions should be referred to our main plant in Göttingen, Germany or to one of our Technical Sales Bureaus. Their addresses, telephone and FAX numbers may be found on the back cover.

This interference resistance of this converter complies with the NAMUR-Recommendations "EMC-Guidelines for Manufacturers and Users of Electrical Instruments and Equipment " Part 1, 5/93 and EMC-Guideline 89/336/EWG (EN50081-1, EN50081-2)

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Introductory Safety Notes for the EMF System

Regulated Usage
The Electromagnetic Flowmeter System (EMF) is manufactured to state of the art designs and is safe to operate.
The flowmeter is to be installed exclusively in applications which are in accord with the specifications.
Every usage which exceeds the specifications is considered to be non-specified. Any damages resulting therefrom are not the responsibility of the manufacturer.
The user assumes all risk for such usage.
The applicable specifications include the installation, start-up and service requirements specified by the manufacturer.

Assembly, Start-Up and Service Personnel
Please read this Instruction Bulletin and the safety notes before attempting installation, start-up or service.
Only qualified personnel should have access to the instrument.
The personnel should be familiar with the warnings and operating requirements contained in this Instruction Bulletin.
Assure that the interconnections are in accordance with the Interconnection Diagrams. Ground the flowmeter system.

Observe the warning notes designated in this document by the symbol:

Hazardous Material Information
If a repair is required, the following information should be noted:
In view of the Disposal Law of 27 Aug. 86 (AbfG. 11 Special Wastes) the owner of special wastes is responsible for its care and the employer also has, according to the Hazardous Material Law of 01 Oct. 86 (GefStoffV, 17 General Protection Responsibility), a responsibility to protect his employees, we must make note that
a) all flowmeter primaries and/or flowmeter converters which are returned to ABB Automation Products for repair are to be free of any hazardous materials (acids, bases, solvents, etc.).
b) the flowmeter primaries must be flushed so that the hazardous materials are neutralized. There are cavities in the primaries between the metering tube and the housing. Therefore after metering hazardous materials, these cavities are to be neutralized (see Hazardous Material Law -GefStoffV). For two piece housings the housing screws should be loosened. For flowmeter primaries ≥ 14”/DN 350 the drain plug at the bottom of the housing is to be removed in order to neutralize any hazardous material in the magnet coil and electrode areas.
c) for service and repairs written confirmation is required that the measures listed in a) and b) have been carried out.
d) any costs incurred to remove and neutralize the hazardous materials during a repair will be billed to the owner of the equipment.
EG-Konformitätserklärung

EC-Certificate of Compliance


Herewith we confirm that the listed instruments are in compliance with the council directives of the European Community. The safety and installation requirements of the product documentation must be observed.

Modell: 50SM1000
Model: 10DS21...
     10DS31...
     DS21...
     DS41...

Richtlinie: EMV Richtlinie 89/336/EWG *
Directive: EMC directive 89/336/EEC *

Europäische Norm: EN 50081-1, 3/93 *
European Standard: EN 50082-2, 2/96 *

Richtlinie: Niederspannungsrichtlinie 73/23/EWG *
Directive: Low voltage directive 73/23/EEC *

Europäische Norm: EN 61010-1, 3/94 *
European Standard:  

* einschließlich Nachträge including alterations

Göttingen, 10.05.2000

Unterschrift / Signature

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UGA-Nr.: DE 115 300 020

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Vorsitz des Aufsichtsrates:
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BLZ: 500 400 00

BZ-13-3101, Rev. 2, 1699
EG-Konformitätserklärung  
EC-Certificate of Compliance


Herewith we confirm that the listed instruments are in compliance with the council directives of the European Community. The safety and installation requirements of the product documentation must be observed.

Modell: 50ES7000
Model: 10DS21.. 10DS31..
       DS21..   DS41..

Richtlinie: EMV Richtlinie 89/336/EWG
           EMC directive 89/336/EEC

Europäische Norm: EN 50081-1, 3/93
          European Standard: EN 50082-2, 2/96
Richtlinie: Niederspannungsrichtlinie 73/23/EWG
           Directive: Low voltage directive 73/23/EEC

Europäische Norm: EN 61010-1, 3/94
          European Standard: 

* einschließlich Nachträge
   including alterations

Göttingen, 10.05.2000

Unterschrift: Signature

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Registereintrag: Göttingen
Handelsregister: HRB 423

Vorsitz des Aufsichtsrates: Bengt Pini
Geschäftsführung: Uwe Alwardt (Vorsitz)
Burkhard Blöck
Erk Huggare
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Flowmeter Primary, Model DS21_/DS4_F

1. Flowmeter Primary and Converter Coordination

Note

- This flowmeter system utilizes AC magnetic field excitation. The metering system consists of a flowmeter primary which is

installed in the pipeline and a converter mounted separately. In order to assure trouble free operation it is essential to assure that only converters Model Numbers 50SM1000 or 50ES7000 are connected to the flowmeter primary. The complete Model Numbers are listed on the instrument tags of the instruments.

Flowmeter System with AC Magnetic Field Excitation

1.1 Application Areas for MAG-SM
These electromagnetic flowmeters provide an economical and precise means to meter the flow of liquids, slurries and sludges whose electrical conductivity is above 20 µS/cm (option, 0.5 µS/cm). The metering system is especially suitable for fast changing processes, two-phase liquids, continuous or pulsating flows (piston pump operation).

1.2 Application Areas for FILL-MAG
These electromagnetic flowmeters are especially designed for batch, fill and injection processes, for filling the smallest volumes all the up to the largest containers.

1.3 Model Number Coordination

<table>
<thead>
<tr>
<th>Flowmeter Primary</th>
<th>Converter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stainless Steel Housing Series 2000</td>
<td>MAG-SM 50SM1000</td>
</tr>
<tr>
<td>10DS2111/10DS2112, DS21...</td>
<td>FILL-MAG 50ES7000</td>
</tr>
<tr>
<td>Aluminum Housing Series 3000/4000</td>
<td>MAG-SM 50SM1000</td>
</tr>
<tr>
<td>10D1422/10DI1425/10DS3111/10DS3112/10DS3121/DS41F/DS44F</td>
<td>FILL-MAG 50ES7000</td>
</tr>
</tbody>
</table>

1.4 Instruction Bulletins

<table>
<thead>
<tr>
<th>Flowmeter Primary</th>
<th>Converter</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABB Part No.: D184B064U01 Rev.02</td>
<td>MAG-SM ABB Part No.: D184B085U01 Rev.01</td>
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<tr>
<td>FILL-MAG</td>
<td>D184B066U01</td>
</tr>
</tbody>
</table>

1.5 Specification Sheets, Metering System

<table>
<thead>
<tr>
<th>Flowmeter Primary</th>
<th>Converter</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAG-SM</td>
<td>ABB Part No.: D184S034U01 Rev.01</td>
</tr>
<tr>
<td>FILL-MAG</td>
<td>D184S033U01</td>
</tr>
</tbody>
</table>
2. Overview, Flowmeter Primary Designs

### Flowmeter Primary

#### Model Number
- **DS21**
- **DS21F**
- **DS21W**
- **DS41F**

#### Accuracy
1% of rate

#### Flowmeter primary housing material
- Stainless Steel Housing Complete Series 2000
- Alum Hsg. Series 4000

### Process Connections

<table>
<thead>
<tr>
<th></th>
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<th></th>
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</thead>
<tbody>
<tr>
<td>DS21F</td>
<td>1/10”–1-1/2” / DN3-DN40</td>
<td>3–100</td>
<td>10 F</td>
<td>1/10”–4”</td>
<td>CL 150–300</td>
<td>1/10”–40”</td>
<td>CL 150–300</td>
<td>1/10”–1-1/2” / DN3-DN40</td>
<td>3–100</td>
<td>10 F</td>
<td>1/10”–4”</td>
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<td>1/10”–1-1/2” / DN3-DN40</td>
<td>3–100</td>
<td>10 F</td>
<td>1/10”–4”</td>
</tr>
</tbody>
</table>

#### Accuracy

<table>
<thead>
<tr>
<th>Flowmeter primary housing material</th>
<th>Stainless Steel Housing Complete Series 2000</th>
<th>Alum Hsg. Series 4000</th>
</tr>
</thead>
</table>

### Variable Connections

- **1/10”–1-1/2” / DN3-DN40**
- **2”–4” / DN 50–DN 100**

### Fixed Flange

- **W**
- **H**

### Fixed Flange

- **W**
- **H**

### Wafer Design

- **W**
- **H**

### Flange Type

- **DIN 2501**
- **ANSI B16.5**
- **FAB1B DIN 11864-2B**
- **Flanges DIN 11864-1B**
- **Flanges ANSI B16.5**
- **Flanges DIN 2501**
- **Flanges FAB1B DIN 11864-2B**
- **Flanges ANSI B16.5**
- **Flanges DIN 2501**
- **Aseptic connection, DIN 11864-1B**
- **Food Industry fitting, DIN 11851**
- **Threaded connection, SMS 1145**
- **Weld stubs DIN 11850**
- **Weld stubs DIN 2463**
- **Weld stubs ISO 2037**
- **Tri-Clamp DIN 32676**
- **Tri-Clamp ISO 2852**
- **Fixed clamp**
- **External threads ISO 228**
- **Internal threads ISO 228**
- **PVC-Cement sleeve**
- **Hose connector**
- **1/8” Sanitary connector**

### Liner

- **PEEK**
- **Torlon (<1/10” : DN3)**
- **PFA (≥3/32” : DN2)**

### Conductivity

- ≥ 20 µS/cm Option
- ≥ 0.5 µS/cm

### Electrodes

- SS 316Ti/1.4571, SS 1.4539, Hastelloy B-2/C-4, Platinum-Iridium, Tantalum, Titanium

### Process connection material

- SS 316Ti/1.4571
- SS 316Ti/1.4571
- - Steel, SS 316Ti/1.4571

### Fluid temperature

- -25 to 130 °C
- -25 to 130 °C/180°C

### Approvals

- Hygienic and sterile requirements
- CIP/SIP-capable FML, 3A, EHEDG (Cleanability)
- CIP-capable

---

**Note**

- The maximum signal cable length between the flowmeter primary and the converter is 50 m. When a preamplifier is installed for low conductivity applications the max. signal cable length is 200 m. The flow velocity must be reduced, <1 m/s, when the fluid conductivity is low and the ε∗ value is high (for demineralized water ε∗ = 78).
3. Functional Description

ABB Automation Electromagnetic Flowmeters »EMF« are the ideal flow metering instruments for liquids, slurries and sludges which have a specific minimum electrical conductivity. The instruments measure accurately, add no additional pressure drop, have no moving or protruding parts, are wear free and chemically resistant. The flowmeters can be readily installed in existing pipelines.

The ABB Automation EMFs have been proven over many years of service and are the preferred flowmeters in the Chemical Industry, Municipal Water and Waste Water treatment facilities, the Food and Beverage Industry as well as in the Pulp and Paper Industry.

Principle of Operation

The basis for the operation of electromagnetic flowmeters are Faraday’s Laws of Induction. A voltage is induced in a conductor as it moves through a magnetic field.

This measurement principle is applied to a conductive fluid which flows in a pipe through which a magnetic field is generated perpendicular to the flow direction, see Electromagnetic Flowmeter Schematic.

\[ U_E \sim B \cdot D \cdot v \]

The voltage which is induced in the fluid is measured at two electrodes located diametrically opposite to each other. This flow signal voltage \( U_E \) is proportional to the magnetic induction \( B \), the electrode spacing \( D \) and the average fluid velocity \( v \).

Noting that the magnetic induction \( B \) and the electrode spacing \( D \) are constant values indicates that a proportionality exists between the flow signal voltage \( U_E \) and the average flow velocity \( v \). The equation for calculating the volume flowrate shows that the signal voltage \( U_E \) is linear and proportional to the volume flowrate.

\[ U_E \sim q_v \]

Design

An electromagnetic flowmeter system includes a flowmeter primary and a converter. The flowmeter primary is installed in the pipeline while the converter which processes the flow signals can be mounted locally or in a central control room.

! Note:

Please observe the specified coordination between the flowmeter primaries and the converters shown on Page 1.

Principle of Operation MAG-SM with Capacitive Signal Measurements

The voltage which is induced in the fluid is measured at two electrodes located diametrically opposite to each other. This flow signal voltage \( U_E \) is proportional to the magnetic induction \( B \), the electrode spacing \( D \) and the average fluid velocity \( v \).

Each electrode forms a coupling capacitor with the inside wall of the lined meter tube on which the flow signal potential exists whose dielectric is the liner material. The flowrate proportional measurement signal is fed to the input of an integrated preamplifier over this coupling capacitor.

This flow signal voltage \( U_E \) is proportional to the magnetic induction \( B \), the electrode spacing \( D \) and the average fluid velocity \( v \).

\[ \text{Flow Signal Voltage} = \frac{D^2 \pi}{4} \cdot v \]

Fig. 1 Electromagnetic Flowmeter Schematic
4. Assembly and Installation

4.1 Inspection
Before installing the electromagnetic flowmeter primary check for mechanical damage due to possible mishandling during shipping. All claims for damage are to be made promptly to the shipper prior to installation.

4.2 Installation Requirements Flowmeter Primary

The flowmeter primary and the signal cables should not be installed in close proximity to strong electromagnetic fields. The flowmeter primary must be installed so that the meter tube is always completely filled with fluid and cannot drain. A slight upward slope of approx. 3% is desirable to prevent gas build up within the flowmeter (Fig. 2).

Vertical installations are ideal when the fluid flows in an upward direction. Installations in drop lines, i.e., the fluid flows from the top to the bottom are to be avoided because experience has shown that it is not possible to guarantee that the pipeline will always remain 100% full and that an equilibrium condition between the upward flowing gas and the downward flowing fluid will not occur.

Generally, the flowmeter primary should be installed in the pipeline with the cable connectors pointing downward. If the flow direction with this arrangement does not agree with the flow direction indicated by the arrow on the flowmeter primary, the procedures described in Section Preliminary Checks should be employed.

**Comments**

- The figures for the EMF flanged designs shown in Section Installation Requirements Flowmeter Primary also apply to the other process connection types e.g. Wafer Design, aseptic connections, 1/8"sanitary connections, hose connectors, Tri-Clamp, screwed flanges and others.
In a free flow outlet (drop line) the flowmeter primary should not be installed at the highest point or in the discharge of the pipeline (meter tube could drain, air bubbles, Fig. 6).

For heavily contaminated fluids a bypass line as shown in Fig. 8, Design A is recommended, so that the flowmeter may be mechanically cleaned without shutting down the process.

The measurement principle is independent of flow profile as long as standing eddies do not extend into the measurement section (e.g. after double elbows, tangential inflows or half open valves upstream of the flowmeter primary). In such situations, measures to condition the flow are required. Experience indicates that in most cases a straight upstream section with a length of 3 x D and a downstream section of 2 x D is sufficient (D = flowmeter primary size Fig. 7). The reference conditions for test stands, per DIN 19200, require a straight upstream length of 10 x D and a 5 x D straight length downstream. For Volume Flow Integrators additional installation requirements are mandatory. See Installation of the Certified Designs Section 4.2.5 on Page 9.

Wafer valves are to be installed in such a manner that the wafer, when open, does not extend into the flowmeter. Valves or other shut off devices should be installed downstream so that the flowmeter primary cannot drain.

An automatic empty pipe detector option is available in the converter which uses the existing electrodes for its input.
4.2.1 Installation of the Flowmeter Primary

The electromagnetic flowmeter can be installed at any arbitrary location in the pipeline as long as the installation requirements (Page 4) are satisfied. Installation dimensions may be found in the appropriate Specification Sheet. At the same time, care should be exercised when selecting the installation site to assure that moisture cannot enter into the connection area. Exercise care to assure that the housing cover gaskets are correctly seated when installing the covers after the installation and start-up have been completed.

Electrode Axis

For installations in horizontal pipelines make sure that neither electrode is located at the highest point. Any gas or air bubbles which may be present in the fluid could interrupt the electrical connection between the electrodes and the fluid. The ideal installation conditions for an EMF are assured in a vertical installation. The preferred orientations are shown in Fig. 10.

Gaskets

It is essential to use the gaskets which are included with the flowmeter primary shipment. Only when these gaskets are used and the flowmeter primary has been installed correctly can leaks be avoided. Observe the information in Table 1.

Wafer Design flowmeter primaries with are shipped without gaskets. The installation (axisymmetric and parallel) is made directly into the pipeline without gaskets. Only when a ground- ing plate is installed is an additional gasket required (generating plate / pipeline flange). See Table 3 for torque specifications.

For all other flanged flowmeter primary designs commercially available gaskets are to used made of materials compatible with the fluid being metered and suitable for the operating temperatures (rubber, It, PTFE, etc.). See Tables 2 and 3 for torque specifications.

Note:

Graphite should not be used to lubricate the flange or process connection gaskets because an electrically conductive coating could form on the inside surface of the meter tube adversely affecting operation.

The flowmeter primary should not be installed in close proximity to strong electromagnetic fields. Steel parts (e.g. mounting brackets should be spaced at least 100 mm distant from the flowmeter primary). Vacuum shocks should be avoided to prevent damage to the liner.

Comment:

A vacuum resistant liner is available in the program.

FILL-MAG Flowmeter Primary Installation

Generally, the flowmeter primary should be installed in the pipeline with the cable connectors pointing downward.

If the flow direction with this arrangement does not agree with the flow direction indicated by the arrow on the flowmeter primary the following procedure can be employed so that the contact outputs respond correctly for reverse flow conditions.

Steps to reverse the direction indication:

a) For a Standard- and Ex-flowmeter primaries the shielded signal leads (only at the primary) are to be interchanged.
   Interchange terminal 1 with terminal 2.
   Interchange terminal 1S with terminal 2S.

b) For flowmeter primaries with preamplifiers only terminals 1 and 2 (at the flowmeter primary) are to be interchanged because terminals 1S and 2S are used for the preamplifier supply voltage U+ and U- of ±12 V DC.

Control, Signal and Supply Voltage Cables

Note:

The flowmeter primary should not be installed in close proximity to strong electromagnetic fields. It is recommended that the control-, signal- and supply power cables be routed separate from one another. It is advantageous to install the cables in grounded metal conduits. Multiple cables of the same type may be installed in the same conduit.

Any valves or relays used in the system should incorporate appropriate measures to reduce interference signals such as protection diodes, varistors or R-C combinations (VDE 0580)
**Flowmeter Primary, Model DS21/DS4_F**

**Gasket Surfaces on the Mating Flanges**

In all installations parallel mating flange surfaces should be provided and suitable gaskets used. Only then can leaks be avoided. The flange gaskets for the flowmeter primary must be installed concentrically to achieve optimum measurement results. The parallel gasket surface requirements for the mating flanges are:

![Parallel Gasket Surfaces](image)

**Protection Plates**

The protection plates for the PTFE/PFA/ETFE lined flowmeter primaries have been installed to prevent damage to the liner during shipment. Remove these protection plates only when ready to install the meter in the pipeline. Be careful not to cut or otherwise damage the liner in order to prevent leakage. The Dimension Drawings for your instrument design may be found in the Specification Sheet.

**Torque Specifications for Flanges**

The mounting bolts are to be tightened equally in the usual manner without excessive one-sided tightening. We recommend that the bolts be greased prior to tightening and that they be tightened using a wrench with a normal length, in a crisscross pattern as shown in Fig. 11. Tighten the bolts during the first pass to approx. 50%, during the second pass to approx. 80% and only during the third pass to 100% of the max. torque value. The max. torque values should not be exceeded, see the following tables.

![Fig. 11](image)

---

**Table 1**

<table>
<thead>
<tr>
<th>Flowmeter Primary DN</th>
<th>Required Parallel Gasket Surface</th>
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<tr>
<td></td>
<td>∅ Inside mm</td>
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<tr>
<td>1/10 – 1/4</td>
<td>3 – 6</td>
</tr>
<tr>
<td>3/8</td>
<td>10</td>
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<tr>
<td>1/2</td>
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<tr>
<td>3</td>
<td>80</td>
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<tr>
<td>4</td>
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**Table 2**

**Max. Torque Values for PTFE-Envelope Gaskets**

<table>
<thead>
<tr>
<th>Liner</th>
<th>Meter Size</th>
<th>Process Connection</th>
<th>Bolts</th>
<th>Torque Max. NM</th>
<th>PN bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFA</td>
<td>1/10-3/8 3-10</td>
<td>Flanges, Wafer Design</td>
<td>4 x M12</td>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td>PFA</td>
<td>1/2</td>
<td>15</td>
<td>4 x M12</td>
<td>10</td>
<td>40</td>
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<tr>
<td>PFA</td>
<td>1/4</td>
<td>20</td>
<td>4 x M12</td>
<td>12</td>
<td>40</td>
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<tr>
<td>PFA</td>
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<td>25</td>
<td>4 x M16</td>
<td>15</td>
<td>40</td>
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<tr>
<td>ETFE</td>
<td>2</td>
<td>50</td>
<td>4 x M16</td>
<td>34</td>
<td>40</td>
</tr>
<tr>
<td>ETFE</td>
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<td>8 x M16</td>
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<td>100</td>
<td>8 x M16</td>
<td>49</td>
<td>40</td>
</tr>
</tbody>
</table>

**Table 3**

**Torque Specifications**

<table>
<thead>
<tr>
<th>Liner</th>
<th>Meter Size</th>
<th>Process Connection</th>
<th>Bolts</th>
<th>Torque Max. NM</th>
<th>PN bar</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFA</td>
<td>1/10-3/8 3-10</td>
<td>Flanges, Wafer Design</td>
<td>4 x M12</td>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td>PFA</td>
<td>1/2</td>
<td>15</td>
<td>4 x M12</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>PFA</td>
<td>1/4</td>
<td>20</td>
<td>4 x M12</td>
<td>12</td>
<td>40</td>
</tr>
<tr>
<td>PFA</td>
<td>1/2</td>
<td>25</td>
<td>4 x M16</td>
<td>15</td>
<td>40</td>
</tr>
<tr>
<td>ETFE</td>
<td>2</td>
<td>50</td>
<td>4 x M16</td>
<td>34</td>
<td>40</td>
</tr>
<tr>
<td>ETFE</td>
<td>2-1/2</td>
<td>65</td>
<td>8 x M16</td>
<td>39</td>
<td>40</td>
</tr>
<tr>
<td>ETFE</td>
<td>3</td>
<td>80</td>
<td>8 x M16</td>
<td>49</td>
<td>40</td>
</tr>
<tr>
<td>ETFE</td>
<td>4</td>
<td>100</td>
<td>8 x M16</td>
<td>49</td>
<td>40</td>
</tr>
</tbody>
</table>
4.2.2 Installations for Protection Class IP 68
For flowmeter primaries for Protection Class IP 68 the maximum permanent submerged depth is 5 m. In place of the standard cable connectors, hose enclosed Pg-cable connectors are utilized. The cable is installed inside a 1/2" hose from connection box to the maximum water surface height. Above this level the cable is installed in a watertight cable connector included with the shipment. The 1/2" hose is then sealed and secured to the hose connectors using threaded hose clamps. After the installation has been completed the connection box cover must be carefully reinstalled.

4.2.4 Installation in Larger Size Pipelines
The flowmeter can readily be installed in larger size pipelines through utilization of flanged transition sections (e.g. Flanged Reducers per DIN 28545). The pressure drop resulting from the reduction can be determined from Diagram Fig. 14 using the following procedure:
1. Calculate the diameter ratio d/D.
2. Calculate the flow velocity as a function of the meter size and the flowrate:
   \[ v = \frac{Q}{(\text{Instantaneous Flowrate})} \]
   Primary Constant
   The flow velocity can also be determined from the Flow Rate Nomograph.
3. The pressure drop can be read on the -Y- axis at the intersection of the flow velocity value and the "Diameter Ratio d/D" value on -X- axis in Fig. 14

4.2.3 Installation of the High Temperature Design
Please see the Installation Notes in Sections 4.2 and 4.2.1.

The connection box in the high temperature design for fluid temperatures <180 °C, is spaced away from the lower section of the flowmeter primary by a pipe nipple. This provides thermal insulation between the connection box and the lower section of the flowmeter primary. The insulation for the pipeline and the flowmeter primary should be installed as shown in Fig. 13.

---

**Signal cable or magnetic field supply cable**

**Watertight cable connector**

**1/2"-Hose extends above max. water level**

for enclosing the signal cable and magnetic field supply cable. Seal hose to the cable connectors.

---

**Max. Submergence Depth 5m**

---

**Fig. 12 Installation IP 68 (Hose Connections)**

**Fig. 13 Insulated Pipeline**

---

**Fig. 14 Pressure Drop Nomograph**
4.2.5 Installation of the Certified Designs

Essentially the installation requirements described in the Section Installation Requirements Flowmeter Primary also apply to the flowmeters certified for custody transfer. There are some additional requirements which must be observed that are listed in the Certification for Electromagnetic Volume Flow Integrators certified for intrastate custody transfer.

The instrument design “Electromagnetic Volume Flow Integrator with Electrical Counter” has been approved by the Physikalisch-Technischen Bundesanstalt [National Institute of Science and Technology] in Braunschweig, Germany for intrastate custody transfer. For the Volume Flow Integrator MAG-SM, consisting of a flowmeter primary and a converter, the following approvals have been granted.

5.721 Electromagnetic Volume Flow Integrator
with Electrical Counter for filling Beer Kegs

5.721 Electromagnetic Volume Flow Integrator
with Electrical Counter for Liquids, other than Water (Milk, Beverage Concentrates or Syrups, Beer, Wort, Brine). The approval also applies to chemical liquids.

For the Electromagnetic Volume Flow Integrators with Electrical Counters with approval 5.721/87.05 Liquids other than Water, the Certification Regulation (EO) of 15 Jan. 1975 also applies, which was subsequently revised by the 6th Revision to the Certification Regulation of 08 Mar 1985 (BGBl IS.568), and specifically the “General Requirements” (EO AV) with Appendix 5 (EO 5) “Measurement Instruments for Determining the Volume or Mass of Flowing Fluids other than Water”, Section 2, Part 1.

Approved Flowmeter Sizes for “Liquids other than Water”

<table>
<thead>
<tr>
<th>Inch</th>
<th>Meter Size</th>
<th>Minimum Metered Flowrates</th>
<th>Fluids</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DN</td>
<td>Flowrates Liter/min.</td>
<td>Liquids other than Water, also Chemical Liquids - Examples:</td>
</tr>
<tr>
<td>1</td>
<td>25</td>
<td>2</td>
<td>Milk, Beverage Concentrate Beer</td>
</tr>
<tr>
<td>1-1/4</td>
<td>32</td>
<td>5</td>
<td>Beer, Milk</td>
</tr>
<tr>
<td>1-1/2</td>
<td>40</td>
<td>20</td>
<td>Beer, Milk</td>
</tr>
<tr>
<td>2</td>
<td>50</td>
<td>200</td>
<td>Beer, Wort</td>
</tr>
<tr>
<td>2-1/2</td>
<td>65</td>
<td>500</td>
<td>Beer, Wort, Milk</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
<td>500</td>
<td>Beer, Wort, Milk</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>2000</td>
<td>Beer, Wort, Milk</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
<td>2000</td>
<td>Wort, Brine</td>
</tr>
</tbody>
</table>

Note:

- The flow ranges are to be selected as prescribed in the above tables. Subsequent flow range changes require a recalibration on a certified test stand.
- Please specify the desired flow range in your order based on the specification in the above tables. Consideration should be given to the maximum flowrate for the particular size as well as to the prescribed flow range steps.
- Example: 1" : DN 25; minimum selectable flow range Qmax = 60 l/min; any flow range can be set between 60 l/min and 200 l/min in steps of 10 l/min.

Calibration

The calibrations of the Electromagnetic Volume Flow Integrator are carried out in the ABB test stands in Goettingen, Germany which have been approved for certified calibrations. After the calibration has been completed those parameters which impact the certification may only be changed in the presence of a Certification Official.

Accessories

Additional instruments such as volume flow rate indicators, recorders or controllers as well as approved printers, flow controllers or remote totalizers may be connected to the Volume Flow Integrator.

Printers, flow controllers and remote totalizers, when required, must be connected to the Volume Flow Integrator during its calibration.

Installation Requirements

Up- and downstream of the flowmeter primary straight pipe sections are to be installed with the same inside diameter as the inlet opening of the flowmeter. Upstream of the flowmeter primary the length must be at least 10 times the diameter of the flowmeter primary and the downstream length must be at least 5 times the diameter of the flowmeter primary, see Fig. 15.

The flowmeter primary must always be completely filled with fluid.

The distance (signal cable length) between the flowmeter primary and the converter may not exceed 50 m.

![Fig. 15](image-url)
KEG-Filling with the FILL-MAG System

Four keg sizes with their corresponding beer volumes can be entered and selected using the external contacts (e.g. optical beer keg size recognition). The corresponding anticipatory contact can also be individually set. The automatic overflow correction continuously reflects the current operating conditions.

When underfills occur the Fill-MAG checks if the fill volume is within the certified error limits and announces the error. The same applies to overfills. The coupling of the control technology and the integration of the Fill-MAG in the fill system is accomplished in cooperation with the equipment manufacturer.

Contact Outputs

Anticipatory Contact
E.g. 27 Liter (for 30 l KEG)
E.g. 47 Liter (for 50 l KEG)

End Contact
E.g. 30 Liter
E.g. 50 Liter

Control Inputs

Note:

- To provide galvanic isolation the control inputs are designed as optocoupler inputs. The various input functions require a 24 V DC voltage supply which is to be provided by the customer.

Fill (Batch) Start (Terminals G2, 68)
The fill or batch cycle is initiated by an ext. Start pulse (e.g. from a SPC).

Fill (Batch) Stop (Terminals G2, 69)
The fill or batch cycle is terminated by an ext. Stop contact.

External Fill Volume Selection (Terminals G2, A1,A2)
a) from a switch
b) from a keg size recognition device

1) For ext. keg size recognition a separate override switch must be included for filling a Certified-KEG (30 Liter), because its size is equivalent to a 50 Liter KEG.
### 4.3 Replaceable Parts List, Connection Box, Aluminum Housing ≤ 12” / DN 300

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Connection board, standard 3/4” - 12”: DN 20 - 300</td>
<td>D685 A669U01</td>
</tr>
<tr>
<td></td>
<td>Connection board, standard 1/10” - 1/2”: DN 3 - 15</td>
<td>D685 A669U03</td>
</tr>
<tr>
<td>1.1</td>
<td>Connection board, preamplifier 3/4” - 12”: DN 20 - 300</td>
<td>D685 A688U03</td>
</tr>
<tr>
<td></td>
<td>Connection board, preamplifier 1/10” - 1/2”: DN 3 - 15</td>
<td>D685 A688U05</td>
</tr>
<tr>
<td>2</td>
<td>Sheet metal screw 2.9 x 6.5 DIN 7981</td>
<td>D055E106CZ01</td>
</tr>
<tr>
<td>2.1</td>
<td>Serrated washer A 3.2 DIN 6798</td>
<td>D085G017AU32</td>
</tr>
<tr>
<td>3</td>
<td>Slotted cheese head screw M6 x 8 DIN 84</td>
<td>D002F107AU20</td>
</tr>
<tr>
<td>4</td>
<td>Lower section with cable connector M20 x 1.5</td>
<td>D612A153U01</td>
</tr>
<tr>
<td>4.1</td>
<td>Lower section with cable connector Pg 13.5</td>
<td>D612A153U02</td>
</tr>
<tr>
<td>4.2</td>
<td>Lower section with cable connector, hose Pg 13.5 and IP 68</td>
<td>D612A153U18</td>
</tr>
<tr>
<td>5</td>
<td>Cover complete.</td>
<td>D612A152U01</td>
</tr>
<tr>
<td>6</td>
<td>Cap screw, hex socket head M 4 x 18 DIN 912</td>
<td>D009G113AU20</td>
</tr>
<tr>
<td>6.1</td>
<td>Flat washer B 4.3 DIN 125</td>
<td>D085A021BU20</td>
</tr>
<tr>
<td>6.2</td>
<td>Security ring</td>
<td>D160A001U25</td>
</tr>
<tr>
<td>7</td>
<td>Cover gasket</td>
<td>D333F022U01</td>
</tr>
<tr>
<td>8</td>
<td>Ground accessories</td>
<td>D614L607U01</td>
</tr>
<tr>
<td>9</td>
<td>Cable connector M20 x 1.5</td>
<td>D150A008U15</td>
</tr>
<tr>
<td>9.1</td>
<td>Cable connector Pg 13.5</td>
<td>D150A008U02</td>
</tr>
<tr>
<td>9.2</td>
<td>Cable connector, hose Pg 13.5 and IP 68</td>
<td>D150A006U02</td>
</tr>
<tr>
<td>9.2.1</td>
<td>Hose nipple IP 68 Sn 88</td>
<td>D356A027U01</td>
</tr>
<tr>
<td>9.2.2</td>
<td>Screw hose clamp SGL 12 - 20 Sn 88</td>
<td>1D108D1016</td>
</tr>
<tr>
<td>9.2.3</td>
<td>PE - hose 5/8” 15 x 13 mm, black UV-resistant</td>
<td>D109A001U07</td>
</tr>
<tr>
<td>9.2.4</td>
<td>Hose nipple IP 68 Sn 88 Snl for the Pg at the end of the cable</td>
<td>D385A020U01</td>
</tr>
</tbody>
</table>

![Fig. 16](image-url)
### 4.4 Replaceable Parts List, Connection Box, Aluminum, Flowmeter Primary 14” - 16” : DN 350 - 400

#### Fig. 17

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lower section</td>
<td>D323D550U01</td>
</tr>
<tr>
<td>2</td>
<td>Center section</td>
<td>D674A613U02</td>
</tr>
<tr>
<td>3</td>
<td>O-Ring</td>
<td>D101A019U01</td>
</tr>
<tr>
<td>4</td>
<td>Interconnection Diagram</td>
<td>D338C499U01</td>
</tr>
<tr>
<td>5</td>
<td>Cover</td>
<td>D612A126U02</td>
</tr>
<tr>
<td>6</td>
<td>Cable connector</td>
<td>D150A008U02</td>
</tr>
<tr>
<td>7</td>
<td>Cable connector</td>
<td>D150A008U08</td>
</tr>
<tr>
<td>8</td>
<td>Cover plate</td>
<td>D351A025U01</td>
</tr>
<tr>
<td>9</td>
<td>Spring washer M4.0 DIN 137</td>
<td>D085D020AU20</td>
</tr>
<tr>
<td>10</td>
<td>Slotted cheese head screw M4.0 x 6 DIN 84</td>
<td>D002G106AU20</td>
</tr>
<tr>
<td>11</td>
<td>Lock washer M6.0 x DIN 7980</td>
<td>D005L026ZU20</td>
</tr>
<tr>
<td>12</td>
<td>Cap screw, hex socket head M6.0 x 30 DIN 912</td>
<td>D009J118AU20</td>
</tr>
<tr>
<td>13</td>
<td>Lock washer M 6.0 DIN 7980</td>
<td>D085L026ZU20</td>
</tr>
<tr>
<td>14</td>
<td>Slotted cheese head screw M6.0 x 25 DIN 7964</td>
<td>D024J116AU20</td>
</tr>
</tbody>
</table>
4.5 Replaceable Parts List, Connection Box, Aluminum, Flowmeter Primary ≥ 20” : DN 500

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lower section</td>
<td>D323D550U01</td>
</tr>
<tr>
<td>2</td>
<td>Center section</td>
<td>D674A613U02</td>
</tr>
<tr>
<td>3</td>
<td>O-Ring</td>
<td>D101A019U01</td>
</tr>
<tr>
<td>4</td>
<td>Interconnection Diagram</td>
<td>D338C499U01</td>
</tr>
<tr>
<td>5</td>
<td>Cover</td>
<td>D612A126U02</td>
</tr>
<tr>
<td>6</td>
<td>Cable connector</td>
<td>D150A008U02</td>
</tr>
<tr>
<td>7</td>
<td>Cable connector</td>
<td>D150A008U08</td>
</tr>
<tr>
<td>8</td>
<td>Cover plate</td>
<td>D351A025U01</td>
</tr>
<tr>
<td>9</td>
<td>Spring washer M4.0 DIN 137</td>
<td>D085D020AU20</td>
</tr>
<tr>
<td>10</td>
<td>Slotted cheese head screw M4.0 x 6 DIN 84</td>
<td>D002G106AU20</td>
</tr>
<tr>
<td>11</td>
<td>Lock washer M 6.0 x DIN 7980</td>
<td>D085L026ZU20</td>
</tr>
<tr>
<td>12</td>
<td>Cap screw, hex socket head M6.0 x 30 DIN 912</td>
<td>D009J118AU20</td>
</tr>
<tr>
<td>13</td>
<td>Lock washer M6.0 DIN 7980</td>
<td>D085L026ZU20</td>
</tr>
<tr>
<td>14</td>
<td>Slotted cheese head screw M6.0 x 25 DIN 7964</td>
<td>D024J116AU20</td>
</tr>
<tr>
<td>15 (230 V)</td>
<td>Fuse 5 x 20 MM 0.160 A-slow blow</td>
<td>D151B001U09</td>
</tr>
<tr>
<td>16 (230 V)</td>
<td>Fuse identification tag</td>
<td>1D338C1201</td>
</tr>
<tr>
<td>15 (115 V)</td>
<td>Fuse 5 x 20 MM 0.315 A-slow blow</td>
<td>D151B001U01</td>
</tr>
<tr>
<td>16 (115 V)</td>
<td>Fuse identification tag</td>
<td>1D338C1195</td>
</tr>
</tbody>
</table>

Fig. 18
4.6 Replaceable Parts, Flowmeter Primary

When repairs to the liner, electrodes or magnet coils are required, the flowmeter primary must be returned to the ABB Factory in Göttingen, Germany. Please note the information in the "Introductory Safety Notes for the EMF System."

---

### Replaceable Parts, Connection Box, Stainless Steel Flowmeter Primary ≤ 4" : DN100

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Connection board standard</td>
<td>D685A869U01</td>
</tr>
<tr>
<td>1</td>
<td>Connection board with preamplifier</td>
<td>D685A098U03</td>
</tr>
<tr>
<td>2</td>
<td>Lower section SS 304 / No. 1.4301</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Models 10DS2111/2112, DS21</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Model 10DS3112 1/10&quot; - 1/2&quot;: DN 3-15</td>
<td>D612A128U01</td>
</tr>
<tr>
<td></td>
<td>Model 10DS3112 /3/4&quot;: 1-1/2&quot;: DN 20-40</td>
<td>D612A128U03</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D612A128U04</td>
</tr>
<tr>
<td></td>
<td></td>
<td>D612A128U05</td>
</tr>
<tr>
<td>3</td>
<td>Gasket (conductive)</td>
<td>D333F016U01</td>
</tr>
<tr>
<td>4</td>
<td>Phillister head screw M3 x 6 DIN 7985</td>
<td>D004F106AU20</td>
</tr>
<tr>
<td>5</td>
<td>Serrated washer A3.2 DIN 6798</td>
<td>D085G017AU32</td>
</tr>
<tr>
<td>6</td>
<td>Connection thread gasket ring PE Pg 13.5</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Cable connector Pg 13.5 plastic gray</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Spacer</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Machine screw, hex hd M4 x 14 DIN 7964 SS</td>
<td>D024G110AU20</td>
</tr>
<tr>
<td>10</td>
<td>Washer &quot;Nyltite-Siegel&quot; F.M4</td>
<td>D115B004U01</td>
</tr>
<tr>
<td>11</td>
<td>Cover SS 304 / No. 1.4301</td>
<td>D612A127U01</td>
</tr>
<tr>
<td>12</td>
<td>Interconnection Diagram Std.</td>
<td>D338D283U01</td>
</tr>
</tbody>
</table>

IP 68 design upon request
4.7 Replaceable Parts List with Preamplifier

Flowmeter primary for metering fluids with a conductivity from 0.5 μS/cm.

Replaceable Parts

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lower section with connection box</td>
<td>D612A111U01</td>
</tr>
<tr>
<td>2</td>
<td>O-Ring</td>
<td>D101A009U01</td>
</tr>
<tr>
<td>3</td>
<td>Cover, large</td>
<td>D612A182U01</td>
</tr>
<tr>
<td>4</td>
<td>Cover, small</td>
<td>D379D024U02</td>
</tr>
<tr>
<td>5</td>
<td>Gasket</td>
<td>D333F004U01</td>
</tr>
<tr>
<td>6</td>
<td>Cable connector M20 x 1.5</td>
<td>D150A008U15</td>
</tr>
<tr>
<td>7</td>
<td>Preamplifier board</td>
<td>D685A442U02</td>
</tr>
<tr>
<td>8</td>
<td>Preamplifier input</td>
<td>D685A859U03</td>
</tr>
<tr>
<td>9</td>
<td>Cover</td>
<td>D379B037U01</td>
</tr>
<tr>
<td>10</td>
<td>Hex head screw M6 x 16 DIN 33 Stn Stl</td>
<td>D022J112A020</td>
</tr>
<tr>
<td>11</td>
<td>Spring washer DIN 137 Stn Stl</td>
<td>D085D026A020</td>
</tr>
<tr>
<td>12</td>
<td>Interconnection Diagram</td>
<td>D338C330U01</td>
</tr>
</tbody>
</table>
5. Safety Relevant Section of the Instruction Bulletin

5.1 Electrical Connections Anschluss

5.1.1 Grounding

The grounding procedure described is to be observed. According to VDE 0100, Part 540 a Cu-wire with a cross section of at least 4 mm² is to be connected between the ground screw on the flowmeter primary (on the flange or the housing) and ground. For measurement reasons the ground potential should be identical to the pipeline potential if possible. An additional ground connection at the terminals is not required.

When installed in plastic or lined insulating pipelines the connections to ground are made from a grounding plate or grounding electrode. If there are stray potentials in the fluid the installation of a grounding plate on both sides of the flowmeter primary is recommended.

Three grounding procedures are described below. In cases a) and b) the fluid is in electrical contact with the pipeline. In case c) the fluid is insulated from the pipeline.

Note:

- The ground screw in flowmeter primaries Model DS21_ is located on the lower section of the connection box. For instrument designs with aseptic connectors, Tri-Clamp and hose connectors the meter tube is in electrical contact with the fluid. It is only necessary to connect the ground connection on the flowmeter primary to ground, see Fig. 32 and Fig. 33.

a) Metal pipe with fixed flanges

1) Drill blind holes in the flanges on the pipeline (18 mm deep).

2) Tap holes, (M6, 12 mm deep).

3) Attach the ground strap to the flange using a screw (M6), spring washer and flat washer and connect to the ground connection on the flowmeter primary.

4) Connect a 4 mm² CU wire between the ground connection on the flowmeter primary and a good ground.
b) Metal Pipe with Loose Flanges

1) In order to assure a trouble free ground connection to the fluid and the flowmeter primary in a pipeline with loose flanges, M6 threaded studs should be welded directly to the pipeline.

2) Attach the ground strap to the flange using a nut, spring washer and flat washer and connect to the ground connection on the flowmeter primary.

3) Connect a 4.0 mm² CU wire between the ground connection on the flowmeter primary and a good ground.

c) Plastic, Concrete or Pipelines with Insulating Liners

1) Install EMF in pipeline with a grounding plate.

2) Connect the connection tab on the grounding plate to the ground connection on the flowmeter primary with the ground strap.

3) Connect a 4.0 mm² CU wire between the ground connection on the flowmeter primary and a good ground.
5.1.2 Supply Power Connections
The supply power is connected in accord with the specifications on the Instrument Tag to terminals L (phase) and N (Neutral), L+ and L-, or 1L1 and 1L2 at the flowmeter converter over a main fuse and a main switch.

The Electromagnetic Flowmeter Primary is connected to the converter using a signal/reference voltage and a supply cable. For detailed interconnection cabling information see the appropriate Instruction Bulletin for the converter.

5.1.3 Magnet Coil Supply
The type of supply power to the magnet coils is a function of the size of the flowmeter primary. The appropriate Interconnection Diagram should be used!

Flowmeter Primary 1/25” to 16” : DN 1 to 400:
The supply power for the magnet coils is provided by the converter directly over terminals M1, M3 with a cable, e.g. shielded 2 x 1.5 mm².

Flowmeter Primary 20” to 40” : DN 500 to 1000:
The magnet coils are supplied directly from the line and not from the converter. It is essential that both the flowmeter primary and the converter be supplied from the same main fuse and main switch.

5.1.4 Power Consumption
The values for the supply voltage and current are specified on the instrument tag on the flowmeter primary. The cable cross section and the fuse rating must be compatible (VDE 0100). The power is ≤ 30 VA (flowmeter primary including the converter).
5.1.5 Signal Cable Connections

**Warning:**

The signal cable connections vary with the size of the flowmeter primary. The appropriate Interconnection Diagram should be used!

The signal cable conducts signals of only a few millivolts and should therefore be installed using the shortest path. The cables should not be routed in the vicinity of large electrical machinery or switch gear equipment which could induce stray fields, pulses and voltages. The signal cable should not be fed through branch fittings or terminals strips.

The maximum allowable signal cable length is 50 m for designs without a preamplifier, Ex-Instruments and certified Volume Flow Integrators. If a preamplifier is installed in the flowmeter primary for low conductivity metering, the maximum signal cable length limit is increased to 200 m. A shielded reference voltage cable is located parallel to the signal leads in the cable assembly so that only two cables (a signal/reference voltage cable and a supply cable for the magnet coils) are required between the flowmeter primary and the converter. The signal cable is designed with a woven copper shield (common potential) which surrounds the individually shielded signal leads and the shielded reference voltage leads. The signal lead shields serve as “Driven Shields” for the flow signal transmission.

To shield against magnetic pickup the cable incorporates an outer steel shield which is to be connected to the SE Terminals.

**Note:**

- If plant conditions make it impossible to avoid proximity to electrical machinery or switch gear equipment, it is advisable to install the signal cable in a grounded metallic conduit.

The preamplifiers in the flowmeter primaries, when this option are supplied with a DC voltage at terminals U- and U+.

The signal-reference voltage cable connections at the flowmeter primary and converter are to be made in accordance with the appropriate Interconnection Diagram. If the actual flow direction does not agree with the flow direction arrow on the flowmeter primary connections at terminals 1 and 1S must be interchanged with 2 and 2S at one end of the cable. In flowmeter primaries with preamplifiers only terminals 1 and 2 should be interchanged.

The potential on terminal 3 is at the common of the flowmeter primary and is connected to ground or PA per VDE 0100/VDE 0160.

---

**Note:**

- The shields of the signal leads may not contact each other or the outer shield (signal short circuit).

5.1.6 Interconnection Diagram

![Diagram](image-url)
5.1.7 Connection Area
The signal cable leads should be installed using the shortest path to the connection terminals. Loops are to be avoided, (see Fig. 37 and Fig. 38).

Connection Box with Screwless Spring Loaded Terminals
Operation: Lead (2), with the insulation stripped, can be inserted into the terminal when spring (1) is depressed. Release the pressure (3) on the spring (Fig. 35).

When replacing and tightening the cover care should be exercised. Check that the gasket is properly seated. Only then will Protection Class IP 67 be assured.

! Note:
- When installing the signal/excitation cable to the flowmeter primary a water trap should be provided, (Fig. 36).
Flowmeter Primary, Model DS21_/DS4_F

<table>
<thead>
<tr>
<th>Terminal Designation</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 + 2</td>
<td>Electrode flow signal leads</td>
</tr>
<tr>
<td>1S + 2S (U+/U-)</td>
<td>Electrode flow signal lead shields ( ) voltage supply for preamplifier</td>
</tr>
<tr>
<td>16</td>
<td>Reference voltage lead</td>
</tr>
<tr>
<td>3a</td>
<td>Reference voltage lead shield</td>
</tr>
<tr>
<td>3</td>
<td>Inner shield (copper) common potential</td>
</tr>
<tr>
<td>M1 + M3</td>
<td>Connections for magnetic field excitation (from converter)</td>
</tr>
<tr>
<td>*) L + N</td>
<td>for ≥ 20&quot;:DN 500 supply power see Instrument Tag</td>
</tr>
<tr>
<td>M2 + B</td>
<td>Test point</td>
</tr>
</tbody>
</table>

≥ 20": DN 500 *)

< 20": DN 500

Fig. 38 Connection Box Flowmeter Primary
6. Start-Up

The start-up procedure of the EMF system can be initiated after the installation of the flowmeter primary and converter have been completed. A preliminary check of the flowmeter primary should be made. Checking of the flowmeter primary with the converter is described in Section 7. Testing and Error Search of the Flowmeter Primary Using the Converter*).

6.1 Preliminary Checks

Check to assure that

• the flow direction of the fluid agrees with the direction indicators in the display.
• the installation requirements in Section 4.2 have been considered.
• the cable connections agree with the Interconnection Diagram.
• the ambient conditions do not exceed the specified limits.
• the ground connections agree with the specifications in 5.1.1.
• the configured parameters agree with the operating conditions.
• the system zero software adjustment was completed, (see Section 6.2 Zero Check).
• that the parameters Flowmeter Primary Model and Operating Mode are correctly entered in the converter.

General Information:

- If the flow direction indicators in the display do not agree with the actual flow directions it may be because the signal lead connections were interchanged. Interchange the connections at terminals 1 with 2 and 1S with 2S at the flowmeter primary.

For the designs with a preamplifier only connections at terminals 1 and 2 should be interchanged.

The coordination between the flow direction and the direction indicators in the display can also be reversed in the parameter “Flow Direction” by selecting “Normal or Inverse”.

6.2 Zero Check

During start-up or when checking the system the System Zero is to be set in the converter after the warm up phase has been completed. The fluid in the flowmeter primary must be at an absolute standstill and the meter tube must be completely filled with fluid. The parameter “System Zero” in the converter can then be utilized to manually set or automatically adjust the zero. Select the parameter using ENTER and with the arrow keys select either “automatic” or “manual” and accept by pressing ENTER. During an automatic adjustment the converter counts in the second display line from 0 to 256 seven times, after which the automatic zero adjustment is completed. The adjustment procedure takes approx. 20 seconds and the resultant value should be within the range of ±1500 Hz.

6.3 Maintenance

The flowmeter primary is essentially maintenance free. The ambient conditions (air circulation, humidity), seal integrity of the process connections, cable connectors and cover screws, functional reliability of the supply voltage, lightning protection and the grounds should be checked annually.

The electrodes should be cleaned if the flow indicated by the converter changes even though the flowrate has not. Higher flow indications are due to insulating coatings while decreases in the indications are due to conductive coatings.

Note:
- Repairs or maintenance tasks should only be performed by qualified personnel.

See the note (Hazardous Material Information), if the flowmeter primary is to be returned to the ABB Factory in Göttingen, Germany!
# Testing and Error Search of the Flowmeter Primary Using the Converter

**Warning**

When the housing cover is removed the EMC and Personnel Contact protection is voided.

<table>
<thead>
<tr>
<th>Connections agree with the Interconnection Diagram? Was the total measurement system checked?</th>
<th>no</th>
<th>Check the complete measurement system. See the Instruction Bulletin for the converter under “Error Search”.</th>
</tr>
</thead>
<tbody>
<tr>
<td>yes</td>
<td>1) Test points are located on the analog board in the converter. TP5 is located on the preamplifier and integrator module (see Fig. 39).</td>
<td>no</td>
</tr>
<tr>
<td>yes</td>
<td>3) Not used for flowmeter primaries with preamplifiers. Test points see Page 20.</td>
<td>no</td>
</tr>
<tr>
<td>yes</td>
<td>3) Are the measured values from electrode 1 to 3 and from electrode 2 to 3 the same within ± 5%.</td>
<td>no</td>
</tr>
<tr>
<td>yes</td>
<td>Measure the reference voltage and the magnet coil current. These values are used to calculate the Calibration Factor $C = \frac{I_{Coil}}{U_{Ref}}$ $I_{Coil}$ is measured in series with the cable connected to M1 or M3 and $U_{Ref}$ across connection terminals 16-3A using a high impedance digital AC multi meter. These connections are located in the calibration unit of the flowmeter primary. Does the calculated Calibration Factor agree with the value recorded in the Calibration Report?</td>
<td>no</td>
</tr>
<tr>
<td>yes</td>
<td>Flowmeter primary operational.</td>
<td></td>
</tr>
</tbody>
</table>

*) Checks for 10DS3111, 10DI1425, DS41 ≥ D20° : DN 500 upon request.

1) Test points are located on the analog board in the converter.

2) TP5 is located on the preamplifier and integrator module (see Fig. 39). TP101 is located on the analog board.

3) Not used for flowmeter primaries with preamplifiers.

4) Test points see Page 20.
Fig. 39 Preamplifier and Integrator Module