Operating instructions
Magnetic-inductive flow sensor
efector300
SM6004
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1 Preliminary note

1.1 Symbols used

▶ Instruction
>

Reaction, result

[…] Designation of buttons, switches or indications

→ Cross-reference

⚠ Important note

Non-compliance can result in malfunctions or interference.

2 Safety instructions

• Please read this document prior to installing the unit. Ensure that the product is suitable for your application without any restrictions.

• Improper or non-intended use may lead to malfunctions of the unit or to unwanted effects in your application. That is why installation, electrical connection, set-up, operation and maintenance of the unit must be carried out by qualified personnel authorised by the plant operator.

• In all applications test the compatibility of the product materials (→ 12 Technical data) with the media to be measured.

For the scope of validity cULus:

The device shall be supplied from an isolating transformer having a secondary Listed fuse rated either

a) max 5 amps for voltages 0~20 Vrms (0~28.3 Vp) or

b) 100/Vp for voltages of 20~30 Vrms (28.3~42.4 Vp).
3 Functions and features

The unit monitors liquids.
It detects the process categories volumetric flow and medium temperature.

Application area
Conductive liquids with the following properties:
- conductivity: ≥ 20 µS/cm
- viscosity: < 70 mm²/s at 40 °C (< 70 cSt at 104°F).

4 Function

4.1 Processing of the measured signals
- The unit displays the current process values.
- It generates 2 output signals according to the parameter setting.
  - OUT1: analogue signal for temperature.
  - OUT2: analogue signal for volumetric flow.

4.2 Volumetric flow monitoring
The medium flows through a magnetic field. It generates a signal voltage which is directly proportional to the volumetric flow.
- An analogue signal proportional to the volumetric flow (4...20 mA) is provided on output 2. For the analogue functions → 4.4.

In addition to the flow velocity, the unit also detects the flow direction. The positive flow direction is marked on the unit by an arrow (“flow direction” → 5.2).
- Flow = “flow direction”: process value and display positive.
- Flow against the “flow direction”: process value and display negative.

Only positive process values are processed for the signal output.

4.3 Monitoring of temperatures
- An analogue signal proportional to the temperature (4...20 mA) is provided on output 1. For the analogue functions → 4.4.
4.4 Volumetric flow or temperature monitoring / analogue function

- The analogue start point [ASP] determines at which measured value the output signal is 4 mA.
- The analogue end point [AEP] determines at which measured value the output signal is 20 mA.
- Minimum distance between [ASP] and [AEP] = 20 % of the final value of the measuring range.

Example volumetric flow monitoring

<table>
<thead>
<tr>
<th>Factory setting</th>
<th>Measuring range scaled</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

MEW = final value of the measuring range
In the set measuring range the output signal is between 4 and 20 mA.
It is also indicated:
Volumetric flow above the measuring range: output signal > 20 mA.

5 Installation

5.1 Installation location

- Install the unit so that the measuring pipe is always completely filled.
- Arrange for inlet and outlet pipe lengths. Disturbances caused by bends, valves, reductions, etc. are compensated for. It applies in particular: no shut-off and control devices are allowed directly in front of the unit.
S = disturbance; D = pipe diameter; F = flow direction

► Install in front of or in a rising pipe.

F = flow direction

► Avoid the following installation locations:
  • Directly in front of a falling pipe.
  • In a falling pipe.
• At the highest point of the pipe system.
• Directly in front of the spout of a pipe.

![Diagram showing flow direction](image1)

F = flow direction

The unit can be installed independently of the orientation if the following is ensured:
- No air bubbles can form in the pipe system.
- The pipes are always completely filled.
• On the suction side of a pump.

![Diagram showing flow direction](image2)

F = flow direction

⚠️ If installed in an ungrounded pipe system (e.g. plastic pipes) the unit must be grounded.

![Diagram showing grounding](image3)

Ground brackets for the G½ thread are available as accessories (order number E40196).
A = cable lug (not included in the scope of supply).
5.2 Installation in pipes

The unit is installed in the pipe using adapters. Adapters have to be ordered separately as accessories.

- Order no. E40199: 2 adapters for R½ pipes + 2 seals.
- Order no. E40200: 2 adapters for pipes ½” NPT + 2 seals.

1. Screw the adapter (B) into the pipe (A).
2. Place the seals (C) and install the unit according to the marked flow direction.
3. Screw the adapter (B) with the threads (D) until it is hand-tight.
4. Tighten the two adapters in opposite direction (tightening torque: 30 Nm).

The unit can also be used in G¾ fittings. To do so, first screw an adapter G½ - G¾ (B) with O-ring (C) on both threads (D) of the unit.

Place the seals (A) and install the unit according to the marked flow direction.

Adapters have to be ordered separately as accessories.


After installation air bubbles in the system can affect the measurement. Help:

► Rinse the system after installation for ventilation (rinsing quantity > 3 l/min. / 1 gpm).

In cases of horizontal installation: As a result of design requirements a small quantity of the medium always remains in the measuring channel after switching off the pump.
5.3 Protection against high medium temperatures

For medium temperatures over 50 °C (122 °F) some parts of the housing can heat up to over 65 °C (140 °F).

► Protect the housing against contact with flammable substances and unintentional contact.

6 Electrical connection

⚠️ The unit must be connected by a qualified electrician.

The national and international regulations for the installation of electrical equipment must be adhered to.
Voltage supply to EN50178, SELV, PELV.

► Disconnect power.
► Connect the unit as follows:

<table>
<thead>
<tr>
<th>Pin1</th>
<th>Ub+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin3</td>
<td>Ub-</td>
</tr>
<tr>
<td>Pin4 (OUT1)</td>
<td>Analogue signal for temperature.</td>
</tr>
<tr>
<td>Pin2 (OUT2)</td>
<td>Analogue signal for volumetric flow.</td>
</tr>
</tbody>
</table>

For information about available sockets/connectors see:
www.ifm.com → Products → Accessories
7 Operating and display elements

1 to 8: Indicator LEDs
- LED 1 = current volumetric flow in litres/minute.
- LED 2 = current volumetric flow in cubic metres/hour.
- LED 3 = current volumetric flow in gallons per minute (gpm).
- LED 4 = current volumetric flow in gallons per hour (gph).
- LED 5 = current medium temperature in °C.
- LED 6 = current medium temperature in °F.
- LED 7, LED 8 = not used.

9: Alphanumeric display, 4 digits
- Indication of the current volumetric flow (if [SELd] = [FLOW] is set).
- Indication of the current medium temperature (if [SELd] = [TEMP] is set).
- Indication of the parameters and parameter values.

10: Mode/Enter pushbutton
- Selection of the parameters and acknowledgement of the parameter values.

11: Set pushbutton
- Setting of the parameter values (scrolling by holding pressed, incremental by pressing briefly).
- Change of the display unit in the normal operating mode (Run mode).
In the Run mode, different display units are accessible (depending on the setting of the parameters [SELd], [Uni.F] and [Uni.T], → 10.2).
## 8.2 Explanation of the menu

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASP1</td>
<td>Analogue start value for temperature.</td>
</tr>
<tr>
<td>AEP1</td>
<td>Analogue end value for temperature.</td>
</tr>
<tr>
<td>ASP2</td>
<td>Analogue start value for volumetric flow.</td>
</tr>
<tr>
<td>AEP2</td>
<td>Analogue end value for volumetric flow.</td>
</tr>
<tr>
<td>EF</td>
<td>Extended functions / opening of menu level 2.</td>
</tr>
<tr>
<td>HI.F</td>
<td>Maximum value memory for volumetric flow.</td>
</tr>
<tr>
<td>LO.F</td>
<td>Minimum value memory for volumetric flow.</td>
</tr>
<tr>
<td>HI.T</td>
<td>Maximum value memory for temperature.</td>
</tr>
<tr>
<td>LO.T</td>
<td>Minimum value memory for temperature.</td>
</tr>
<tr>
<td>FOU1</td>
<td>Behaviour of output 1 in case of an internal fault.</td>
</tr>
<tr>
<td>FOU2</td>
<td>Behaviour of output 2 in case of an internal fault.</td>
</tr>
<tr>
<td>dAP</td>
<td>Measured value damping / damping constant in seconds.</td>
</tr>
<tr>
<td>diS</td>
<td>Update rate and orientation of the display.</td>
</tr>
<tr>
<td>Uni.F</td>
<td>Standard unit of measurement for volumetric flow: litres/minute (l/min), cubic metres/hour (m³/h), gallons per minute (gpm) or gallons per hour (gph).</td>
</tr>
<tr>
<td>Uni.T</td>
<td>Standard unit of measurement for temperature: °C or °F.</td>
</tr>
<tr>
<td>SELd</td>
<td>Standard process category of the display: volumetric flow value or medium temperature.</td>
</tr>
<tr>
<td>res</td>
<td>Restore factory setting.</td>
</tr>
</tbody>
</table>
9 Parameter setting
During parameter setting the unit remains in the operating mode. It continues its monitoring function with the existing parameters until the parameter setting has been completed.

9.1 General parameter setting
3 steps must be taken for each parameter set:

<table>
<thead>
<tr>
<th></th>
<th>Parameter selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Press [Mode/Enter] until the requested parameter is displayed.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Setting of the parameter value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Press [Set] and keep it pressed.</td>
</tr>
<tr>
<td></td>
<td>Current setting value of the parameter flashes for 5 s.</td>
</tr>
<tr>
<td></td>
<td>After 5 s: The setting value is changed: incremental by pressing briefly or scrolling by holding pressed.</td>
</tr>
<tr>
<td></td>
<td>Numerical values are incremented continuously. If the value is to be reduced: let the display move to the maximum setting value. Then the cycle starts again at the minimum setting value.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Acknowledgement of the parameter value</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Press [Mode/Enter] briefly.</td>
</tr>
<tr>
<td></td>
<td>The parameter is displayed again. The new setting value is stored.</td>
</tr>
</tbody>
</table>

Setting of other parameters:
► Start again with step 1.

Finishing the parameter setting:
► Press [Mode/Enter] several times until the current measured value is displayed or wait for 15 s. |
|   > The unit returns to the operating mode. |
• Change from menu level 1 to menu level 2:

<table>
<thead>
<tr>
<th>► Press [Mode/Enter] until [EF] is displayed.</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Image of display showing EF]</td>
</tr>
</tbody>
</table>

| ► Press [Set] briefly. |
| > The first parameter of the sub-menu is displayed (here: [HI.F]). |
| ![Image of display showing HI.F] |

• Locking / unlocking

The unit can be locked electronically to prevent unintentional wrong settings.

| ► Make sure that the unit is in the normal operating mode. |
| ► Press [Mode/Enter] + [Set] for 10 s. |
| > [Loc] is displayed. |
| ![Image of display showing Loc] |

| During operation: > [Loc] is briefly displayed if you try to change parameter values. |
| ► Press [Mode/Enter] + [Set] for 10 s. |
| > [uLoc] is displayed. |
| ![Image of display showing uLoc] |

When delivered: unlocked.

• Time out:

If during parameter setting no pushbutton is pressed for 15 s, the unit exits the parameter setting mode. The parameter value is not changed.

For medium temperatures over 50 °C (122 °F) some parts of the housing can heat up to over 65 °C (140 °F).

In this case do not press the pushbuttons manually; instead use an object.
9.2 Scaling of the analogue value for temperature

- Select [ASP1] and set the value at which 4 mA is provided.
- Select [AEP1] and set the value at which 20 mA is provided.

9.3 Scaling of the analogue value for volumetric flow

- Select [ASP2] and set the value at which 4 mA is provided.
- Select [AEP2] and set the value at which 20 mA is provided.

9.4 User settings (optional)

9.4.1 Determine the standard unit of measurement for volumetric flow

- Select [Uni.F] and set the unit of measurement:
  - [L/min], [m³/h], [GPM] or [GPH].

9.4.2 Determine the standard unit of measurement for temperature

- Select [Uni.T] and set the unit of measurement: [°C] or [°F].

9.4.3 Configuration of the standard display

- Select [SELd] and determine the standard process category.
  - [FLOW] = display shows the current volumetric flow value in the standard unit of measurement.
  - [TEMP] = display indicates the current medium temperature in the standard unit of measurement.
- Select [diS] and determine the update rate and orientation of the display:
  - [d1] = update of the measured values every 50 ms.
  - [d2] = update of the measured values every 200 ms.
  - [d3] = update of the measured values every 600 ms.
  - [rd1], [rd2], [rd3] = display as for d1, d2, d3; rotated by 180°.
  - [OFF] = the display is switched off in the operating mode.

9.4.4 Setting the damping of the measured values

- Select [dAP] and the damping constant in seconds (t value 63%).
## 9.4.5 Setting the error behaviour of OUT1 / OUT2

- Select [FOU1] and determine the value:
  - [On] = the analogue signal goes to the upper end stop value.
  - [OFF] = the analogue signal goes to the lower end stop value.
  - [OU] = the analogue signal corresponds to the measured value.
- Select [FOU2] and determine the value:
  - [On] = the analogue signal goes to the upper end stop value.
  - [OFF] = the analogue signal goes to the lower end stop value.
  - [OU] = the analogue signal corresponds to the measured value.

## 9.5 Service functions

### 9.5.1 Reading the min./max. values for volumetric flow

- Select [HI.F] or [LO.F] and press [Set] briefly.
  - [HI.F] = maximum value, [LO.F] = minimum value.
- Delete memory:
  - Select [HI.F] or [LO.F].
  - Press [Set] and keep it pressed until [--] is displayed.
  - Press [Mode/Enter] briefly.
- It makes sense to delete the memories as soon as the unit works under normal operating conditions for the first time.

### 9.5.2 Reading the min./max. values for temperature

- Select [HI.T] or [LO.T] and press [Set] briefly.
  - [HI.T] = maximum value, [LO.T] = minimum value.
- Speicher löschen:
  - Select [HI.T] or [LO.T].
  - Press [Set] and keep it pressed until [--] is displayed.
  - Press [Mode/Enter] briefly.
- It makes sense to delete the memories as soon as the unit works under normal operating conditions for the first time.

### 9.5.3 Reset all parameters to the factory setting

- Select [rES], then press [Set] and keep it pressed until [--] is displayed.
- Press [Mode/Enter] briefly.
- The factory setting is listed at the end of the instructions (→ 13 Factory setting).
- It makes sense to write your own settings in this table before executing the function.
10 Operation
After power on and expiry of the power-on delay time (approx. 5 s) the unit is in
the Run mode (= normal operating mode). It carries out its measurement and eval-
uation functions and generates output signals according to the set parameters.

- Operation indication → chapter 7 Controls and indicating elements.
- The output signals are at the maximum value during the power-on delay time.

10.1 Read the set parameters
► Press [Mode/Enter] until the requested parameter is displayed.
► Press [Set] briefly.
> The unit displays the corresponding parameter value for approx. 15 s. After
another 15 s the parameter is displayed again, then the unit returns to the Run
mode.

10.2 Changing the display unit in the Run mode
► Press [Set] briefly in the Run mode. Press the pushbutton to move to the next
display unit.
> The unit displays the current measured value for approx. 15 s, the correspond-
ing LED lights.

2 groups of display units are accessible (depending on the setting of the param-
eters [SELd] and [Uni.F] and [Uni.T]):
- [Lmin], [m3h] and the temperature unit selected in [Uni.T].
- [GPM], [GPH] and the temperature unit selected in [Uni.T].
When setting [SELd] = [FLOW], [Uni.F] = [Lmin] and [Uni.T] = [°C], for example,
[Lmin] is displayed as a standard. By pressing [Set] the display unit changes to
[m3h], [°C] and back to [Lmin].

10.3 Error indication

| [OL]  | Detection zone of volumetric flow or temperature exceeded:
       | measured value between 120 % and 130 % of VMR. |
| [UL]  | Below the detection zone of volumetric flow or temperature:
       | measured value between -120 % and -130 % of VMR. |
| [Err] | - Unit faulty / malfunction.
       | - Measured value greater than 130 % of VMR or smaller than -130 % of VMR. |
| [Loc] | Setting pushbuttons locked, parameter change rejected. |

VMR = final value of the measuring range
10.4 General operating conditions

► Avoid deposits, accumulated gas and air in the pipe system.

⚠️ For medium temperatures over 50 °C some parts of the housing can heat up to over 65 °C.

► In this case do not touch the unit.
► Protect the housing against contact with flammable substances and unintentional contact.
► Do not press the pushbuttons manually; instead use an object.

11 Scale drawing

Dimensions are in millimeters
## 12 Technical data

### Application
Conductive liquids

### Conductivity
\( \geq 20 \, \mu S/cm \)

### Viscosity
\( < \, 70 \, mm^2/s \) at 40°C (\( < \, 70 \, cSt \) at 104°F)

### Operating voltage [V]
20...30 DC\(^1\)

### Current consumption [mA]
120 (24 V)

### Analogue outputs
4...20 mA; measuring range scaleable

### Max. load [Ω]
500

### Power-on delay time [s]
5

### Flow monitoring

<table>
<thead>
<tr>
<th>l/min</th>
<th>m³/h</th>
<th>gpm</th>
<th>gph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range</td>
<td>0.1...25</td>
<td>0.005...1.5</td>
<td>0.03...6.60</td>
</tr>
<tr>
<td>Resolution</td>
<td>0.05</td>
<td>0.005</td>
<td>0.01</td>
</tr>
<tr>
<td>Display range</td>
<td>-30...30</td>
<td>-1.8...1.8</td>
<td>-7.92...7.92</td>
</tr>
</tbody>
</table>

### Response time [ms]
\(< 150 \, (dAP = 0)\)

### Damping flow signal (dAP) [s]
0.0...5.0

### Accuracy
\(< \pm (2\% \, MV + 0.5\% \, VMR)\)

### Repeatability [% VMR]
\( \pm 0.2\)

### Pressure loss (dP) / flow rate (Q)

![Graph showing the relationship between dP (mbar) and Q (l/min)]

### Temperature monitoring

<table>
<thead>
<tr>
<th>Measuring range [°C / °F]</th>
<th>-20...80 / -4...176</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution [°C / °F]</td>
<td>0.2 / 0.5</td>
</tr>
<tr>
<td>Response time [s]</td>
<td>T09 = 30 (Q &gt; 1 l/min / 0.26 gpm)</td>
</tr>
<tr>
<td>Accuracy [°C / °F]</td>
<td>± 2.5 (Q &gt; 1 l/min) / ± 4.5 (Q &gt; 0.26 gpm)</td>
</tr>
</tbody>
</table>
Operating temperature [°C] ................................................................. -10..60
Medium temperature [°C] ................................................................. -10..70
Pressure resistance [bar] .................................................................. 16
Material (wetted parts) ................................................................. stainless steel (316S12); PEEK; FKM
Housing materials ................................................................. stainless steel (316S12); PBT-GF 20; PC (Makrolon); EPDM/X (Santoprene)
Protection ...................................................................................... IP 67 / III
Insulation resistance [MΩ] ................................................................. > 100 (500 V DC)
Shock resistance [g] ................................................................. 20 (DIN / IEC 68-2-27, 11ms)
Vibration resistance [g] ................................................................. 5 (DIN / IEC 68-2-6, 55 - 2000 Hz)
EMC
IEC 1000/4/2 ESD: .................................................................................. 4 / 8 KV
IEC 1000/4/3 HF radiated: ................................................................. 10 V/m
IEC 1000/4/4 Burst: .................................................................................. 2 KV
IEC 1000/4/5 Surge: .................................................................................. 0.5 / 1 KV
IEC 1000/4/6 HF conducted: ................................................................. 10 V

1) to EN50178, SELV, PELV
MV = measured value; VMR = final value of the measuring range

12.1 Setting ranges

<table>
<thead>
<tr>
<th>FLOW</th>
<th>ASP2</th>
<th>AEP2</th>
<th>ΔQ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min</td>
<td>max</td>
<td>min</td>
</tr>
<tr>
<td>l/min</td>
<td>0.00</td>
<td>20.00</td>
<td>5.00</td>
</tr>
<tr>
<td>m³/h</td>
<td>0.000</td>
<td>1.200</td>
<td>0.300</td>
</tr>
<tr>
<td>gpm</td>
<td>0.00</td>
<td>5.28</td>
<td>1.32</td>
</tr>
<tr>
<td>gph</td>
<td>0.0</td>
<td>317.0</td>
<td>79.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEMP</th>
<th>ASP1</th>
<th>AEP1</th>
<th>ΔT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min</td>
<td>max</td>
<td>min</td>
</tr>
<tr>
<td>°C</td>
<td>-20.0</td>
<td>60.0</td>
<td>0.0</td>
</tr>
<tr>
<td>°F</td>
<td>-4.0</td>
<td>140.0</td>
<td>32.0</td>
</tr>
</tbody>
</table>

(ΔQ, ΔT = step increment)
## 13 Factory setting

<table>
<thead>
<tr>
<th></th>
<th>Factory setting</th>
<th>User setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASP1</td>
<td>-20.0</td>
<td></td>
</tr>
<tr>
<td>AEP1</td>
<td>80.0</td>
<td></td>
</tr>
<tr>
<td>ASP2</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>AEP2</td>
<td>25.00</td>
<td></td>
</tr>
<tr>
<td>FOU1</td>
<td>OFF</td>
<td></td>
</tr>
<tr>
<td>FOU2</td>
<td>OFF</td>
<td></td>
</tr>
<tr>
<td>dAP</td>
<td>0.6</td>
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Technical data and further information at www.ifm.com