Hall effect current & voltage sensors

Mors Smitt   Industrial Technology

Industrial current & voltage sensors
Mors Smitt    Industrial Technology

Industrial sensors
Closed loop current & voltage sensors meeting major standards
Mors Smitt has extended its product portfolio focusing on market sectors like power generation, transmission and distribution, factory automation, petro-chemical, water treatment plants and general industrial requirements.

**Industrial sensors**
Today, more and more applications that used to be mechanical are changing to fully electronic control offering increased reliability, improved regulation standards and higher energy efficiency.

For motors with inverter control total energy consumed savings of up to 50% are achievable. The inverter control requires reliable, accurate current measurements.

For renewable sources, power electronics also play a key role in energy savings. Modern systems are becoming more complex and require precise coordination between the power semiconductors, the system controller, mechanics and the feedback sensors. The sensors provide all necessary information of the load to fulfill that function.

Other power electronics applications involving sensors are: motor drives, UPS, welding, robotics, cranes, cable cars, ski lifts, elevators, medical systems, power supplies for computer servers and telecom.

Mors Smitt closed loop sensors ensure high accuracy of current measuring in power electronics equipments for a full protection against overload or underload, control and regulation of the power equipment.

**Reliability**
Worldwide availability is assured by a network of professional, trained and dedicated subsidiaries, distributors and agents, offering local service and support.

Mors Smitt offers customizable protection solutions, enhancing safety and performance. Not just our products and services but also our production sites are focused on environmental performance improvements by certification of the ISO 9001:2008 and ISO 14001 standards.

The company strategy for the future is based upon further responsible development and expansion of its high quality components, responding to tomorrow’s needs in the many current sectors it serves. It is based upon putting the skills and talents of its staff to work for company, clients and mankind. Keeping that part of the world’s operation for which it plays a role, working successfully, without question and without failure.

Mors Smitt is part of Wabtec Corporation, the NYSE stock exchange listed, global supplier of highly engineered components and solutions for rail and selected industrial markets. Operations in 17 countries and world wide sales in over 100 countries.

Wabtec Corporation holds over 1,200 patents and has world class internal processes based on lean manufacturing and continuous improvement principles (Wabtec Performance System).

Within the Wabtec group Mors Smitt has its own name & identity and is focused on satisfying the needs of customers in the power grid, industry and installation sectors.

September 2015

Mors Smitt continuously improves its products and services. Specifications are changed without prior notice. No rights can be derived from specifications in this brochure. Changes and printed errors reserved.
**Industrial sensors**

**Principle**
With over 25 years experience in measurement for railway equipment, Mors Smitt introduces a new range of sensors based on closed loop technology, to supply the industry market. These sensors allow measurement of all current waveforms, with high galvanic insulation between the primary and secondary circuits.

**Closed loop sensors**
The probe placed in the air gap of the magnetic circuit, provides a voltage proportional to this flux. The electronic circuit amplifies the signal from the primary current $I_p$ or voltage $U_p$ flowing across the sensor and generates a current into the secondary $I_s$.

This secondary current multiplied by the number of turns $N_s$ of secondary winding cancels out the primary magnetic flux that created it. The global flow is equal to zero. The formula $N_p \times I_p = N_s \times I_s$ is true at any time which means the measuring of instantaneous values.

The secondary output current $I_s$ is exactly proportional to the primary current and can be passed through a measuring resistance $R_m$. The measuring voltage $V_m$ at the terminals of this resistance is therefore proportional to the primary current $I_p$.

**Current sensors**

**Voltage sensors**

**Output connection**
Molex output connector for MSA sensors  MS output connectors for MSV sensors

**High galvanic isolation**
Dielectric strength of 3.8 kV...6 kV - 50 Hz -1 min

**Measuring of all waveforms**
DC, AC, impulse currents

**Excellent accuracy, immunity and response time**
From ± 1.5 % to ± 0.5 % at rated current over -40 °C...+85 °C with linearity < 0.1 %, and over a large frequency from DC to AC and impulse waveforms. Response time <1 µs

**Form fit function**
The sensors can be mounted vertically or horizontally and provide form fit functions with other sensors

**EMC compliant**
All sensors include EMC compliancy

**Compliant to major industrial standards**
- EN 50178  Electronic equipment for use in power installations
- EN 61000-6-2  Electromagnetic compatibility - immunity for industrial environments
- EN 61000-6-4  Electromagnetic compatibility - emission standard for industrial environments

**Dedicated customer service & production**
Mors Smitt ensures customer support throughout the product life cycle, moreover we are able to adapt our capacity of production and reactivity to exceed our customer on time delivery and after sales service.

**5 year warranty**
Mors Smitt return of experience in the railway sector facing the harshest environments and strictest standards allow us to provide our customers a 5 year warranty on all our industrial sensors.
Applications

Motor and renewable energy inverters

![Diagram of motor and renewable energy inverters]

Typical applications:
- Machine tools, printing, paper, textile, plastic
- Steel mills
- Lifts
- Cranes
- Robotics
- Pumps
- Energy inverters for all kind of renewable energies (wind, sun, hydrogen, ocean currents, energy storage etc.)

Uninterruptible power supplies

![Diagram of uninterruptible power supplies]

Typical applications:
- EDP systems
- Telecom
- Security systems
Power supplies for welding applications

Typical applications:
• Test & measurement in laboratories & universities
• Medical X ray and imaging equipment
• Electrolysis, currents monitoring
• Inductive heating
• Energy management systems, monitoring of load currents
• Overcurrent protection
• Control and safety systems
• Electrical traction

Battery supplied applications

Typical applications:
• Electric vehicles (zero emission vehicles)
• Forklift trucks
• Wheel chairs
• Solar power supplies
## Current sensors

<table>
<thead>
<tr>
<th></th>
<th>MSA 305</th>
<th>MSA 505</th>
<th>MSA 1005</th>
<th>MSA 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary nominal RMS current (lpn)</strong></td>
<td>300 A</td>
<td>500 A</td>
<td>1000 A</td>
<td>2000 A</td>
</tr>
<tr>
<td><strong>Primary current measuring range</strong></td>
<td>± 500 A</td>
<td>± 800 A</td>
<td>± 1500 A</td>
<td>± 3000 A</td>
</tr>
<tr>
<td><strong>Output measuring resistance (Rm) 70 °C</strong></td>
<td>20 Ω max for 500 A @ 15 V</td>
<td>7 Ω max for 800 A @ 15 V</td>
<td>7 Ω max @ 15 V</td>
<td>11 Ω max @ 24 V</td>
</tr>
<tr>
<td>54 Ω max for 500 A @ 24 V</td>
<td>60 Ω max for 800 A @ 24 V</td>
<td>25 Ω max @ 24 V</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Secondary nominal RMS current (Isn)</strong></td>
<td>150 mA</td>
<td>100 mA</td>
<td>200 mA</td>
<td>400 mA</td>
</tr>
<tr>
<td><strong>Conversion ratio¹</strong></td>
<td>1:2000</td>
<td>1:5000</td>
<td>1:5000</td>
<td>1:5000</td>
</tr>
<tr>
<td><strong>Auxiliary supply (VC)</strong></td>
<td>± 12 V ± 24 VDC (± 5%)</td>
<td>± 12 V ± 24 VDC (± 5%)</td>
<td>± 15 V ± 24 VDC (± 5%)</td>
<td>± 15 V ± 24 VDC (± 5%)</td>
</tr>
<tr>
<td><strong>Current consumption (Ic)</strong></td>
<td>± 20 mA + Is @ 15 VDC</td>
<td>± 22 mA + Is @ 15 VDC</td>
<td>± 22 mA + Is @ 15 VDC</td>
<td>± 33 mA + Is @ 15 VDC</td>
</tr>
<tr>
<td><strong>Dielectric test¹</strong></td>
<td>3.8 kV</td>
<td>4 kV</td>
<td>4 kV</td>
<td>6 kV</td>
</tr>
<tr>
<td><strong>Overall accuracy</strong></td>
<td>± 0.5 % at 25 °C</td>
<td>± 0.5 % at 25 °C</td>
<td>± 0.5 % at 25 °C</td>
<td>± 0.5 % at 25 °C</td>
</tr>
<tr>
<td>1 % at -40 °C...+85°C</td>
<td>1 % at -40 °C...+85°C</td>
<td>1 % at -40 °C...+85°C</td>
<td>1 % at -40 °C...+85°C</td>
<td>1 % at -40 °C...+85°C</td>
</tr>
<tr>
<td><strong>Linearity</strong></td>
<td>&lt; 0.1%</td>
<td>&lt; 0.1%</td>
<td>&lt; 0.1%</td>
<td>&lt; 0.1%</td>
</tr>
<tr>
<td><strong>Offset current at lp = 0 - TA=25 °C</strong></td>
<td>± 0.25 mA</td>
<td>± 0.25 mA</td>
<td>± 0.25 mA</td>
<td>± 0.25 mA</td>
</tr>
<tr>
<td><strong>Response time @ 90% of lpn and di/dt 100 A / µs</strong></td>
<td>&lt;1 µs</td>
<td>&lt;1 µs</td>
<td>&lt;1 µs</td>
<td>&lt;1 µs</td>
</tr>
<tr>
<td><strong>Frequency bandwidth (-1 dB)</strong></td>
<td>DC to 100 kHz by technology</td>
<td>DC to 100 kHz by technology</td>
<td>DC to 100 kHz by technology</td>
<td>DC to 100 kHz by technology</td>
</tr>
<tr>
<td><strong>Operating temperature</strong></td>
<td>-40 °C...+85 °C</td>
<td>-40 °C...+85 °C</td>
<td>-40 °C...+85 °C</td>
<td>-40 °C...+85 °C</td>
</tr>
<tr>
<td><strong>Storage temperature</strong></td>
<td>-50 °C...+90 °C</td>
<td>-50 °C...+90 °C</td>
<td>-50 °C...+90 °C</td>
<td>-50 °C...+90 °C</td>
</tr>
<tr>
<td><strong>Secondary coil resistance @ 70 °C</strong></td>
<td>30 Ω</td>
<td>60 Ω</td>
<td>30 Ω</td>
<td>25 Ω</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>110 g (± 5%)</td>
<td>210 g (± 5%)</td>
<td>550 g (± 5%)</td>
<td>1550 g (± 5%)</td>
</tr>
<tr>
<td><strong>Molex connector¹</strong></td>
<td>✔️ ✔️ ✔️ ✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Horizontal / vertical / chassis</strong></td>
<td>✔️ ✔️ ✔️ ✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>5 year warranty</strong></td>
<td>✔️ ✔️ ✔️ ✔️</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹ other conversion ratio, dielectric, outputs on request
### Voltage sensors

<table>
<thead>
<tr>
<th></th>
<th>MSV 100</th>
<th>MSV 200</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary nominal RMS voltage (lpn)</strong></td>
<td>950 V</td>
<td>1000 V</td>
</tr>
<tr>
<td></td>
<td>2000 V</td>
<td>3000 V</td>
</tr>
<tr>
<td><strong>Primary current measuring range</strong></td>
<td>± 1400 A</td>
<td>± 1500 A</td>
</tr>
<tr>
<td><strong>Output measuring resistance (Rm) 25 °C</strong></td>
<td>220 Ω max for 1400 V</td>
<td>tba</td>
</tr>
<tr>
<td><strong>Secondary nominal RMS current (Isn)</strong></td>
<td>50 mA for 1000 V</td>
<td>50 mA</td>
</tr>
<tr>
<td><strong>Conversion ratio</strong></td>
<td>1000 V / 50 mA</td>
<td>1/5</td>
</tr>
<tr>
<td><strong>Auxiliary supply (VC)</strong></td>
<td>± 12 V... ± 24 VDC (± 5%)</td>
<td>± 12 V... ± 24 VDC (± 5%)</td>
</tr>
<tr>
<td><strong>Current consumption (Ic)</strong></td>
<td>± 20 mA + Is @ 15 VDC</td>
<td>± 33 mA + Is @ 24 VDC</td>
</tr>
<tr>
<td><strong>Dielectric test</strong></td>
<td>3.8 kV</td>
<td>10 kV</td>
</tr>
<tr>
<td><strong>Overall accuracy</strong></td>
<td>± 0.5 % at 25 °C</td>
<td>± 1 % at -40 °C... +85°C</td>
</tr>
<tr>
<td><strong>Linearity</strong></td>
<td>&lt; 0.1%</td>
<td>&lt; 0.1%</td>
</tr>
<tr>
<td><strong>Offset current at lp = 0 - TA=25 °C</strong></td>
<td>± 0.25 mA</td>
<td>± 0.2 mA</td>
</tr>
<tr>
<td><strong>Response time @ 90% of lpn and di/dt 100 A / µs</strong></td>
<td>&lt;1 µs</td>
<td>&lt;100 µs</td>
</tr>
<tr>
<td><strong>Frequency bandwidth (-1 dB)</strong></td>
<td>DC to 100 kHz by technology</td>
<td>DC to 100 kHz by technology</td>
</tr>
<tr>
<td><strong>Operating temperature</strong></td>
<td>-50 °C...+85 °C</td>
<td>-50 °C...+85 °C</td>
</tr>
<tr>
<td><strong>Storage temperature</strong></td>
<td>-50 °C...+90 °C</td>
<td>-50 °C...+90 °C</td>
</tr>
<tr>
<td><strong>Secondary coil resistance @ 70 °C</strong></td>
<td>60 Ω ± 7%</td>
<td>60 Ω ± 7%</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>500 g (+ 10%)</td>
<td>800 g (+ 10%)</td>
</tr>
<tr>
<td><strong>Molex connector</strong></td>
<td>✔ ✔ ✔</td>
<td>✔ ✔ ✔</td>
</tr>
<tr>
<td><strong>Horizontal / vertical / chassis</strong></td>
<td>✔ ✔ ✔</td>
<td>✔ ✔ ✔</td>
</tr>
<tr>
<td><strong>5 year warranty</strong></td>
<td>✔ ✔</td>
<td>✔ ✔</td>
</tr>
</tbody>
</table>

1 other conversion ratio, dielectric, outputs on request
Current sensors

General data
- The housing and insulation resin (UL94 V0) are self-extinguishable upon fire
- Mounting holes are provided in the housing mold for two positions on a base or flat mount through a plate
- Direction of current: a primary current flowing in the direction of the top arrow on the sensor generates a positive secondary output current on terminal M

Primary connection
- Hole for primary conductor
- The temperature of the primary conductor in contact with the housing shall not exceed 100 °C

Secondary connection
- Molex HE14 type connector
- Other output on request

Wiring and mounting instructions
These general instructions are not exhaustive and provide basis for proper installation of the sensors. Each configuration being different, please consult us for particular advice. (Note that non proper installation or incorrect use of the sensor can result in sensor poor performances or malfunction)

Wiring diagram
- Direction of current: a primary current $I_p$ flowing in the direction of the top arrow on the sensor generates a positive secondary output current on terminal M
- Auxiliary supply voltage: bipolar voltage $-V_{DC}...0\ V...+V_{DC}$
Mechanical mounting
- Any mounting position is possible
- Recommended fixing: by screws and flat washers
- The busbar (or cable) must be centred

Precautions in electromagnetic environment
Due to their principle of operation (measure of magnetic field by the Hall effect probe), closed loop hall effect current sensors can be sensitive to strong magnetic fields. It is recommended to avoid positioning them to close to high current power cables.

Processing of the sensor output signal
Standard codes of practice advise that, before the signal is processed, a low-pass filter adapted to the bandwidth of the sensor is used. Also, in the case of digital processing of the signal, it is also recommended that the sampling frequency is adapted to the bandwidth of both the signal to be measured and the sensor.

In the event of sensor failure, the processing of the output signal should take into account deterioration in performance (i.e. absence of signal or saturated signal) and rapidly and safely shut the system down.

Safety instructions

Our sensors must be used in electrical or electronic equipment with respect to relevant standards and safety requirements in accordance with the manufacturer's operating instructions.

Caution, risk of electrical shock

When operating the sensor, certain parts of the module can carry hazardous voltage (e.g. primary terminals, power supply). Ignoring this warning can lead to injury and/or cause serious damage.

This sensor is a built-in device, whose conducting parts must be inaccessible after installation. A protective housing or additional shield could be used. Main supply must be able to be disconnected.
Current sensors

MSA 305-S

300 A, closed loop

Industrial applications, current measuring of all waveforms AC, DC

- Chassis mount
- Closed loop
- High dielectric strength
- Precise linearity
- Precise accuracy
- High dynamic response
- No Foucault losses in the magnetic circuit

Ordering reference
MSA 305-S1

Primary nominal RMS voltage
Primary voltage measuring range
Output measuring resistance
Secondary nominal RMS current
Conversion ratio
Auxiliary supply voltage
Current consumption
Dielectric strength between:
primary and secondary circuit

Electrical characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary nominal RMS voltage</td>
<td>$V_{pn} = 300$ A</td>
</tr>
<tr>
<td>Primary voltage measuring range</td>
<td>$V_p = \pm 300$ A</td>
</tr>
<tr>
<td>Output measuring resistance</td>
<td>$R_m = 20$ Ω max for 500 A @ 15 V 70 °C</td>
</tr>
<tr>
<td>Secondary nominal RMS current</td>
<td>$I_{Sn} = 150$ mA</td>
</tr>
<tr>
<td>Conversion ratio</td>
<td>$K_n = 1:2000$</td>
</tr>
<tr>
<td>Auxiliary supply voltage</td>
<td>$V_c = \pm 12$ to $\pm 20$ VDC ±5 %</td>
</tr>
<tr>
<td>Current consumption</td>
<td>$I_c = \pm 20$ mA + Is @ 15 VDC</td>
</tr>
<tr>
<td>Dielectric strength between: primary and secondary circuit</td>
<td>$V_{D1} = 3.8$ kV · 50 Hz · 1 min</td>
</tr>
</tbody>
</table>

Overall accuracy @ $I_{pn} = 25$ °C
Overall accuracy @ $I_{pn} = -40$ °C...85 °C
Linearity
Offset current @ $I_{p} = 0$ · $T_A = 25$ °C
Thermal drift of $I_{p}$ between -40 °C...+85 °C
Resp. time @ 90% of $I_{pn}$, and di/dt 100 A / μs

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall accuracy @ $I_{pn} = 25$ °C</td>
<td>$X_a = \pm 0.5$ %</td>
</tr>
<tr>
<td>Overall accuracy @ $I_{pn} = -40$ °C...85 °C</td>
<td>$X_a = \pm 1$ %</td>
</tr>
<tr>
<td>Linearity</td>
<td>$E_t = &lt; 0.1$ %</td>
</tr>
<tr>
<td>Offset current @ $I_{p} = 0$ · $T_A = 25$ °C</td>
<td>$I_o = \pm 0.25$ mA max</td>
</tr>
<tr>
<td>Thermal drift of $I_{p}$ between -40 °C...+85 °C</td>
<td>$I_{tT} = \pm 1$ mA max</td>
</tr>
<tr>
<td>Resp. time @ 90% of $I_{pn}$ and di/dt 100 A / μs</td>
<td>$T_s = &lt; 1$ μs</td>
</tr>
<tr>
<td>di/dt accuracy followed</td>
<td>$di/dt &gt; 50$ A / μs</td>
</tr>
<tr>
<td>Frequency bandwidth (-3 dB)</td>
<td>$f = DC$ to 100 kHz by technology</td>
</tr>
</tbody>
</table>

General characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature</td>
<td>$T_A = -40$ °C...+85 °C</td>
</tr>
<tr>
<td>Storing temperature</td>
<td>$T_s = -50$ °C...+90 °C</td>
</tr>
<tr>
<td>Secondary coil resistance @ 70 °C</td>
<td>$R_s = 30$ Ω</td>
</tr>
<tr>
<td>Weight</td>
<td>$m = 110$ g ± 5 %</td>
</tr>
</tbody>
</table>
Connections

+ M -

Is \( R_m \)

+ VDC 0 V - VDC

MSA 305

Dimensions

[Image of the MSA 305 dimensions diagram]
Current sensors

**MSA 505-S**

500 A, closed loop

Industrial applications, current measuring of all waveforms AC, DC

- Chassis mount
- Closed loop
- High dielectric strength
- Precise linearity
- Precise accuracy
- High dynamic response
- No Foucault losses in the magnetic circuit

---

**Electrical characteristics**

| Primary nominal RMS voltage \( V_p \) | 500 A |
| Primary voltage measuring range \( V_p \) | ±800 A |
| Output measuring resistance \( R_m \) | 7 Ω max for 800 A @ 15 V 70 °C |
| | 60 Ω max for 800 A @ 24 V 70 °C |

**Secondary nominal RMS current**

\( I_{SN} \)

100 mA

**Conversion ratio**

\( K_n \)

1:5000

**Auxiliary supply voltage**

\( V_c \)

±12 to ±24 VDC ±5 %

**Current consumption**

\( I_c \)

±22 mA + Is @ 15 VDC

**Dielectric strength between primary and secondary circuit**

\( V_{D1} \)

4 kV - 50 Hz - 1 min

---

**Electrical characteristics**

Overall accuracy @ \( I_{SN} \), \( T_A = 25 °C \) \( X_g \)

±0.5 %

Overall accuracy @ \( I_{SN} \), \( T_A = -40 °C...85 °C \) \( X_g \)

±1 %

Linearity \( E_L \)

< 0.1 %

Offset current @ \( I_p = 0 \), \( T_A = 25 °C \) \( I_o \)

±0.25 mA max

Thermal drift of \( I_o \) between -40 °C...+85 °C \( I_{OT} \)

±1 mA max

Resp. time @ 90% of \( I_{SN} \), and \( di/dt 100 A / μs \) \( T_r \)

< 1 μs

\( di/dt \) accuracy followed

\( f \)

DC to 100 kHz by technology

---

**Frequency bandwidth (-3 dB)\( f \)**

DC to 100 kHz by technology

---

**General characteristics**

- Operating temperature \( T_A \)

-40 °C...+85 °C

- Storing temperature \( T_s \)

-50 °C...+90 °C

- Secondary coil resistance @ 70 °C \( R_s \)

60 Ω

- Weight \( m \)

210 g ± 5 %

---

**Ordering reference**

MSA 505-S1
Connections

MSA 505

Dimensions

[Diagram showing dimensions and technical specifications]
Current sensors

**MSA 1005-S**

**1000 A, closed loop**

Industrial applications, current measuring of all waveforms AC, DC

- Chassis mount
- Closed loop
- High dielectric strength
- Precise linearity
- Precise accuracy
- High dynamic response
- No Foucault losses in the magnetic circuit

**Electrical characteristics**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary nominal RMS voltage</td>
<td>$V_{PN}$ = 1000 A</td>
</tr>
<tr>
<td>Primary voltage measuring range</td>
<td>$V_P = ±1500$ A</td>
</tr>
<tr>
<td>Output measuring resistance</td>
<td>$R_M = 7$ Ω max @ 15 V 70 °C, 25 Ω max @ 24 V 70 °C</td>
</tr>
<tr>
<td>Secondary nominal RMS current</td>
<td>$I_{SN} = 200$ mA</td>
</tr>
<tr>
<td>Conversion ratio</td>
<td>$K_N = 1:5000$</td>
</tr>
<tr>
<td>Auxiliary supply voltage</td>
<td>$V_C = ±15$ to ±24 VDC ±5 %</td>
</tr>
<tr>
<td>Current consumption</td>
<td>$I_C = ±22$ mA + Is @ 15 VDC</td>
</tr>
<tr>
<td>Dielectric strength between primary and secondary circuit</td>
<td>$V_{DI} = 4$ kV - 50 Hz - 1 min</td>
</tr>
</tbody>
</table>

**Electrical characteristics**

- Overall accuracy @ $l_{PN} = 0$ - $T_A = 25$ °C: $X_0 = ±0.5\%$
- Overall accuracy @ $l_{PN} = -40$ °C...85 °C: $X_0 = ±1\%$
- Linearity: $E_L < 0.1\%$
- Offset current @ $l_{IS} = 0$ - $T_A = 25$ °C: $I_0 = ±0.25$ mA max
- Thermal drift of $I_0$ between -40 °C...+85 °C: $I_{IT} = ± 1$ mA max
- Resp. time @ 90% of $l_{IS}$ and $di/dt$ 100 A / μs: $T_r < 100$ μs
- $di/dt$ accuracy followed: $di/dt > 100$ A / μs
- Frequency bandwidth (-3 dB): $f = $ DC to 100 kHz by technology

**General characteristics**

- Operating temperature: $T_A = -40$ °C...+85 °C
- Storing temperature: $T_S = -50$ °C...+90 °C
- Secondary coil resistance @ 70 °C: $R_S = 30$ Ω
- Weight: $m = 550$ g ± 5%

**Ordering reference**

MSA 1005-S1
Connections

MSA 1005

Dimensions

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www.morssmitt.com
Current sensors

MSA 2005-S

2000 A, closed loop

Industrial applications, current measuring of all waveforms AC, DC

- Chassis mount
- Closed loop
- High dielectric strength
- Precise linearity
- Precise accuracy
- High dynamic response
- No Foucault losses in the magnetic circuit

Electrical characteristics

**Primary nominal RMS voltage**  \( V_{PN} \) 2000 A
**Primary voltage measuring range**  \( V_P \) ± 3000 A
**Output measuring resistance**  \( R_M \) 11 Ω max @ 24 V 70 °C

**Secondary nominal RMS current**
**Conversion ratio** \( K_N \) 1:5000

**Auxiliary supply voltage**  \( V_C \) ±15 to ±24 VDC ±5 %
**Current consumption**  \( I_C \) ± 22 mA + Is @ 15 VDC

**Dielectric strength between: primary and secondary circuit**  \( V_{DI} \) 6 kV - 50 Hz - 1 min

**Electrical characteristics**

Overall accuracy @ \( I_{PN} \), \( T_A = 25 °C \) \( X_G \) ± 0.7%
Overall accuracy @ \( I_{PN} \), \( T_A = -40 °C...85 °C \) \( X_G \) ± 1%
**Linearity** \( E_I \) < 0.1%
**Offset current @ \( I_p = 0 \), \( T_A = 25 °C \) \( I_0 \) ± 0.25 mA max
**Thermal drift of \( I_p \), between -40 °C...+85 °C \( I_{0T} \) ± 1 mA max
**Resp. time @ 90% of \( I_{PN} \), and \( di/dt \) 100 A / µs** \( T_{di/dt} \) < 100 µs
**di/dt accuracy followed** \( Tr \) > 100 A / µs
**Frequency bandwidth (-3 dB)** \( f \) DC to 100 kHz by technology

**General characteristics**

**Operating temperature**  \( T_A \) -40 °C...+85 °C
**Storing temperature**  \( T_S \) -50 °C...+90 °C
**Secondary coil resistance @ 70 °C**  \( R_S \) 25 Ω
**Weight**  \( m \) 1550 g ± 5%

**Ordering reference**
MSA 2005-S1
Connections

MSA 2005

Dimensions

[Diagram of dimensions with measurements]
Features

Voltage sensors

General data
- The housing and insulation resin (UL94 V0) are self-extinguishable upon fire
- Mounting holes are provided in the housing mold for base mount, 2 fastening slots of Ø 6.5 mm
- Direction of current: a positive primary differential potential (Uh+ - Uh- > 0) generates a positive secondary output current on terminal M
- Power supply is protected against polarity reversal

Primary connection
- Primary 2 x M5 insert
- Tightening torque value 2.2 Nm

Secondary connection
- Secondary 3 x M5 insert
- Tightening torque value 2.2 Nm
- EMC shield optional, other output on request

Wiring and mounting instructions
These general instructions are not exhaustive and provide basis for proper installation of the sensors. Each configuration being different, please consult us for particular advice. (Note that non proper installation or incorrect use of the sensor can result in sensor poor performances or malfunction)

Wiring diagram
- Connect primary voltage Vp to measure to HT+ and HT-
- Auxiliary supply voltage: bipolar voltage −VDC…0 V…+VDC

![Wiring Diagram](image-url)
Mechanical mounting

• Base mounting, heatsink on the top or on the side, with fins in vertical position
• Recommended fixing: by 2 x M6 screws with flat washers
• M5 inserts with tightening torque 2.2 Nm for primary and secondary connections

Precautions in electromagnetic environment
Due to their principle of operation (measure of magnetic field by the Hall effect probe), closed loop hall effect current sensors can be sensitive to strong magnetic fields. It is recommended to avoid positioning them to close to high current power cables.

Processing of the sensor output signal
Standard codes of practice advise that, before the signal is processed, a low-pass filter adapted to the bandwidth of the sensor is used. Also, in the case of digital processing of the signal, it is also recommended that the sampling frequency is adapted to the bandwidth of both the signal to be measured and the sensor.

In the event of sensor failure, the processing of the output signal should take into account deterioration in performance (i.e. absence of signal or saturated signal) and rapidly and safely shut the system down.

Safety instructions

Our sensors must be used in electrical or electronic equipment with respect to relevant standards and safety requirements in accordance with the manufacturer’s operating instructions.

Caution, risk of electrical shock

When operating the sensor, certain parts of the module can carry hazardous voltage (e.g. primary terminals, power supply). Ignoring this warning can lead to injury and/or cause serious damage.

This sensor is a built-in device, whose conducting parts must be inaccessible after installation. A protective housing or additional shield could be used. Main supply must be able to be disconnected.
Voltage sensors

MSV 100

950 V, closed loop

Industrial applications, voltage measuring of all waveforms AC, DC

- Chassis mount
- Closed loop (compensated)
- High dielectric strength
- Precise linearity
- Precise accuracy
- High dynamic response
- No Foucault losses in the magnetic circuit
- EMC shielding (optional)

Ordering reference
MSV 100   MSV100-1-D-2-3-2-N
MSV 100 with EMC shield connection
MSV 100   MSV100-1-D-2-3-2-Y

Electrical characteristics

Primary nominal RMS voltage
Primary voltage measuring range
Output measuring resistance
Secondary nominal RMS current
Conversion ratio
Auxiliary supply voltage
Current consumption
Dielectric strength between:
- primary and secondary circuit
- shield and secondary circuit

950 V
± 1400 V
220 Ω max for 1400 V @ 24 V 70 °C
50 mA for 1000 V
1000 V / 50 mA
±15 to ±24 VDC ±5 %
± 33 mA + Is @ 24 VDC
Vp 6 kV - 50 Hz - 1 min
Vp 1.5 kV - 50 Hz - 1 min

Electrical characteristics

Overall accuracy @ Ipn - Tp=25 °C
Linearity
Offset current @ Ipn =0 - Tp=25 °C
Thermal drift of Ipn between -50 °C...+85 °C
Response time @ 90% of Vpn
Frequency bandwidth (-3 dB)

± 0.7%
< 0.1%
± 0.2 mA max
± 1 mA max
< 100 µs
f DC to 100 kHz by technology

General characteristics

Operating temperature
Storing temperature
Secondary coil resistance @ 70 °C
Weight

-50 °C...+85 °C
-50 °C...+90 °C
60 Ω ± 7%
500 g ± 5%
Electrical characteristics

- Primary nominal RMS voltage: VPN 950 V
- Primary voltage measuring range: VP ± 1400 V
- Output measuring resistance: RM 220 Ω max for 1400 V @ 24 V 70 °C
- Secondary nominal RMS current: ISN 50 mA for 1000 V
- Conversion ratio: KN 1000 V / 50 mA
- Auxiliary supply voltage: VC ±15 to ±24 VDC ±5 %
- Current consumption: IC ± 33 mA + Is @ 24 VDC
- Dielectric strength between:
  - Primary and secondary circuit: VD1 6 kV - 50 Hz - 1 min
  - Shield and secondary circuit: VD2 1.5 kV - 50 Hz - 1 min

Overall accuracy @ IPN - TA=25 °C: XG ± 0.7%
Linearity: EL < 0.1%
Offset current @ IP =0 - TA=25 °C: I0 ± 0.2 mA max
Thermal drift of I0 between -50 °C...+85 °C: I0T ± 1 mA max
Response time @ 90% of VPN: Tr < 100 µs
Frequency bandwidth (-3 dB): f DC to 100 kHz by technology

General characteristics

- Operating temperature: TA -50 °C...+85 °C
- Storing temperature: TS -50 °C...+90 °C
- Secondary coil resistance @ 70 °C: RS 60 Ω ± 7%
- Weight: m 500 g ± 5%

Connections

Dimensions

(EMC shield is an option available with M5 secondary connection. EMC shield to be connected to ground or 0 V or -VDC)
Voltage sensors

MSV 200

1000 V / 2000 V / 3000 V / 4000 V / 5000 V, closed loop

Industrial applications, voltage measuring of all waveforms AC, DC

- Chassis mount
- Closed loop (compensated)
- High dielectric strength
- Precise linearity
- Precise accuracy
- High dynamic response
- No Foucault losses in the magnetic circuit
- EMC shielding (optional)

Ordering reference

<table>
<thead>
<tr>
<th>Voltage Range</th>
<th>Ordering Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 V</td>
<td>MSV200-1-D-2-3-2-N</td>
</tr>
<tr>
<td>2000 V</td>
<td>MSV200-2-D-2-3-2-N</td>
</tr>
<tr>
<td>3000 V</td>
<td>MSV200-3-D-2-3-2-N</td>
</tr>
<tr>
<td>4000 V</td>
<td>MSV200-4-D-2-3-2-N</td>
</tr>
<tr>
<td>5000 V</td>
<td>MSV200-5-D-2-3-2-N</td>
</tr>
</tbody>
</table>

Secondary coil resistance @ 70 °C

<table>
<thead>
<tr>
<th>Voltage Range</th>
<th>Secondary Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 V</td>
<td>60 Ω ± 7%</td>
</tr>
</tbody>
</table>

Weight

800 g ± 5%

Electrical characteristics

Primary nominal RMS voltage

<table>
<thead>
<tr>
<th>Voltage Range</th>
<th>Nominal Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 V</td>
<td>1000 V</td>
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<td>4000 V</td>
<td>4000 V</td>
</tr>
<tr>
<td>5000 V</td>
<td>5000 V</td>
</tr>
</tbody>
</table>

Primary voltage measuring range

<table>
<thead>
<tr>
<th>Voltage Range</th>
<th>Measuring Range</th>
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</thead>
<tbody>
<tr>
<td>1000 V</td>
<td>± 1500 V</td>
</tr>
<tr>
<td>2000 V</td>
<td>± 3000 V</td>
</tr>
<tr>
<td>3000 V</td>
<td>± 4000 V</td>
</tr>
<tr>
<td>4000 V</td>
<td>± 6000 V</td>
</tr>
</tbody>
</table>

Primary resistance @ 25 °C

100 kΩ

Output measuring resistance

tba

Secondary nominal RMS current

50 mA for 1000 V

Primary windings

10000 / 20000 / 30000 / 40000 / 50000

Secondary windings

2000

Conversion ratio

Np / Ns

Auxiliary supply voltage

±15 to ±24 VDC ±5%

Current consumption

±33 mA + Is @ 24 VDC

Dielectric strength between:

primary and secondary circuit

6 kV - 50 Hz - 1 min

shield and secondary circuit

1.5 kV - 50 Hz - 1 min

Overall accuracy @ Ip, - Ta=25 °C

± 0.7%

Linearity

< 0.1%

Offset current @ Ip =0 - Ta=25 °C

± 0.2 mA max

Thermal drift of Ip between -50 °C...+85 °C

± 1 mA max

Response time @ 90% of VPn

< 100 µs

Frequency bandwidth (-3 dB)

DC to 100 kHz by technology

General characteristics

Operating temperature

-50 °C...+85 °C

Storing temperature

-50 °C...+90 °C

Secondary coil resistance @ 70 °C

60 Ω ± 7%

Weight

800 g ± 5%
Electrical characteristics

Primary nominal RMS voltage $V_{PN}$: 1000 V / 2000 V / 3000 V / 4000 V / 5000 V

Primary voltage measuring range $V_{P}$: ± 1500 V / ± 3000 V / ± 4000 V / ± 6000 V

Primary resistance @ 25 °C $R_{P}$: 100 kΩ

Output measuring resistance $R_{M}$: tba

Secondary nominal RMS current $I_{SN}$: 50 mA for 1000 V

Primary windings $N_{P}$: 10000 / 20000 / 30000 / 40000 / 50000

Secondary windings $N_{S}$: 2000

Conversion ratio $K_{N}$: $N_{P}$ / $N_{S}$

Auxiliary supply voltage $V_{C}$: ±15 to ±24 VDC ±5%

Current consumption $I_{C}$: ±33 mA + $I_{S}$ @ 24 VDC

Dielectric strength between:
- Primary and secondary circuit $V_{D1}$: 6 kV - 50 Hz - 1 min
- Shield and secondary circuit $V_{D2}$: 1.5 kV - 50 Hz - 1 min

General characteristics

Operating temperature $T_{A}$: -50 °C...+85 °C

Storing temperature $T_{S}$: -50 °C...+90 °C

Secondary coil resistance @ 70 °C $R_{S}$: 60 Ω ± 7%

Weight $m$: 800 g ± 5%

Connections

Dimensions

(EMC shield is an option available with MS secondary connection. EMC shield to be connected to ground or 0 V or -VDC)
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