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# Model LMU 209 Load Monitoring Unit

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## 1.0 INTRODUCTION

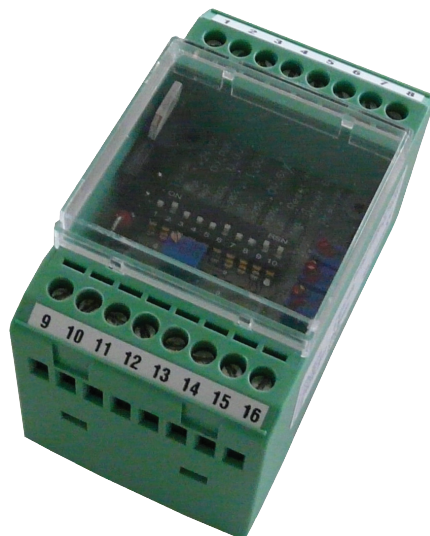


Figure 1 LMU 209 Load Monitoring Unit

## 1.1 DESCRIPTION

The LMU 209 Load Monitoring Unit is a high-precision, ultra stable DC-measuring amplifier that is capable of various low-level mV-signals. The LMU 209 offers two calibrated outputs, a voltage output and a current output, both according to the industrial standard. Coarse-gain and offset-range are selected with easily accessible DIP-Switches. Fine tuning can be accomplished by adjusting the 10-turn potentiometers. An additional low-pass filter reduces bandwidth and helps to improve signal/noise ratio. The bridge power supply can be selected between 5 V or 10 VDC. The current output is configured from 0–20 mA or 4–20 mA without any calibration.

## 1.2 TECHNICAL SPECIFICATIONS

Supply	18–28 V / 70 mA
Ripple Voltage	max. 1 V <sub>pp</sub> / 50 Hz
Voltage Output	0 to ±10 V @ R <sub>load</sub> 3 kΩ
Current Output	0/4–20 mA @ R <sub>load</sub> 0–800 Ω
Operating Temperature Range	-20 to +60 °C
Housing Dimensions	44 × 74 × 51.4 mm
Housing Material	PA, UI94 V-0 polycarbonate - aluminum (option)
Protection Class	IP 52 (polycarbonate) or IP 65 (aluminum)
Weight	100 g
EMC Tests	EN 61000-4
Frequency Response	0–500 Hz (-3 dB)
F.R. with selectable low-pass filter	0–3 kHz ( -3 dB)
Sensitivity (default)	1 mV/V
Sensitivity Ranges	Range 1 : 0.5 to 1.5 mV/V Range 2 : 1.5 to 4.0 mV/V

Adjustment Sensitivity	10-turn potentiometer
Zero Adjustment Ranges	-75% to +75%, in 5 ranges
Zero Fine Adjustment	10-turn potentiometer
Bridge power supply	5/10 VDC (selectable)
Input-resistance Sensor	5V: 120 Ω to 10 kΩ 10V: 330 Ω to 10 kΩ
Calibration Signal	100% (10 V or 20 mA), ± 0.8%
Noise	max. 20 mVpp
Linearity Error	0.05 %
TC Zero	< 0.01% / °C

## 2.0 SAFETY



**USE CAUTION AND READ THIS OPERATING MANUAL THOROUGHLY BEFORE BEGINNING YOUR INSTALLATION PROCESS. SETUP, CONFIGURATION AND OPERATION OF THE LMU 209 SHOULD ONLY BE CONDUCTED BY QUALIFIED PERSONNEL.**

### 2.1. PROPER USE OF EQUIPMENT

- The LMU 209 Load Monitoring Unit must not be used in life-supporting applications.
- The LMU 209 Load Monitoring Unit must not be used in safety-critical applications.

### 2.2 SAFETY PRECAUTIONS

Non-compliance with the safety regulations could result in serious damage to the unit.

- Always separate the signal lines from power lines (drives, converters) and never interrupt the signal lines unless using designated junction boxes.
- Attach the cable shield (braid) at both ends to a proper ground. Do not allow a ground current to flow over the cable shield.
- Attach all machine parts to one well defined potential by using large copper wires. Allowing different potentials will create currents that cannot be controlled.

## 3.0 INSTALLATION

For quick and easy installation, select the operating mode as shown in “default position” section 3.2.1.



**CAUTION:** MAKE SURE THE SWITCHES ARE IN THEIR CORRECT END POSITION. IF IN DOUBT, TOGGLE THE SWITCH AGAIN WITH THE APPROPRIATE TOOL. CONFIGURATION CAN BE DONE IN THE POWERED OPERATE MODE.

### 3.1 CONNECTION DIAGRAMS

### 3.1.1 Supply Connection and Signal Output Connection

+Ub	1	Power supply, 18–28 V
0V	2	Power supply 0 V (Ground)
Uout	3	Calibrated voltage output
Iout	4	Calibrated current output
0V	5	Signal 0 V for $U_{OUT}$ and $I_{OUT}$

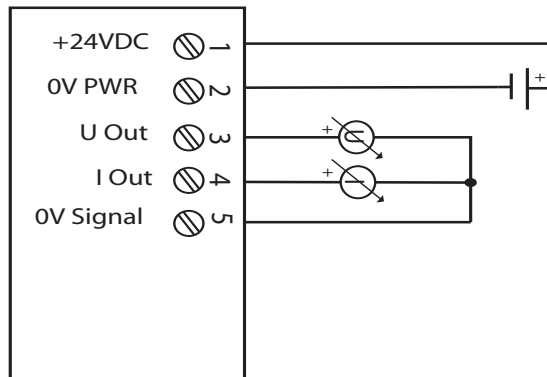


Figure 2 Connection to Power and Control Unit

### 3.1.2 Sensor Connection

+15V	16	Auxiliary supply output for external sensors (draw max. 20 mA)
E+	15	Positive bridge excitation (5 V/10 V)
Sen+	14	Sense input + (6-wire technique)
S+	13	Positive signal input
S-	12	Negative signal input
Sen-	11	Sense input – (6-wire technique)
E-	10	Negative bridge excitation 0 V
Earth	9	Connection for grounding

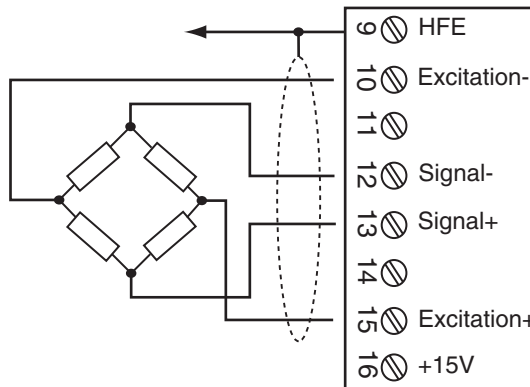


Figure 3 Connection of Resistive 4-wire Sensor

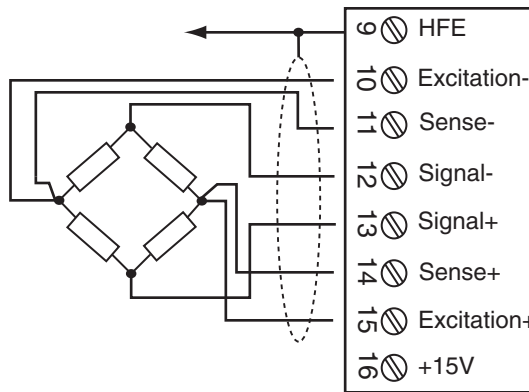


Figure 4 Connection of Resistive 6-wire Sensor (contact Magtrol SA for information)

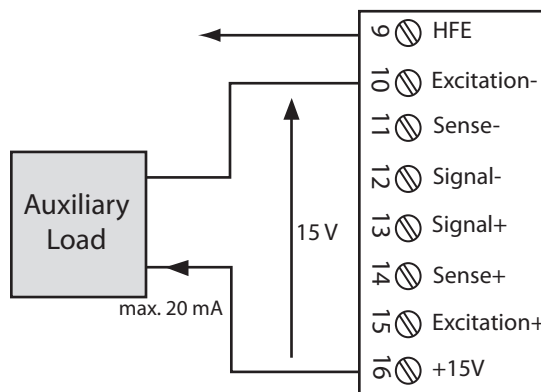


Figure 5 Use of LMU 209 Auxiliary Power

### 3.2 DIP SWITCHES

OFF Position	DIP Switches	ON Position	
Excitation 10V		Excitation 5V	
N/A		Sensitivity Range 1 ON	
N/A		Sensitivity Range 2 ON	
N/A-		Offset Range -50% ( $\pm 20\%$ )	
N/A-		Offset Range -25% ( $\pm 20\%$ )	
N/A-		Offset Range -0% ( $\pm 20\%$ )	
N/A-		Offset Range +25% ( $\pm 20\%$ )	
N/A-		Offset Range +50% ( $\pm 20\%$ )	
Cut-Off Frequency 3 kHz		LP	Cut-off Frequency 500 Hz
Zero Current Out 0 mA		4mA	Zero Current Out 4 mA

### 3.2.1 Default Position

SW 1	ON	5V Excitation
SW 2	ON	Range 1 selected
SW 3	OFF	
SW 4	OFF	
SW 5	OFF	
SW 6	ON	Offset adjusting range 0% $\pm$ 20%
SW 7	OFF	
SW 8	OFF	
SW 9	ON	Bandwidth is limited DC–500 Hz
SW 10	ON	Current Out 4–20 mA

## 4.0 OPERATION

The LMU 209 is designed to amplify low-level signals from force, pressure or strain-sensors based on strain gauge principles.

After supplying the LMU 209 with power, it is immediately ready for measuring and will deliver a measuring signal at the signal outputs which is in perfect proportion to the input signal, coming from the connected sensor. Depending on the sensor's offset, it may be necessary to adjust the potentiometer ZERO.

### 4.1 OFFSET CALIBRATION

The LMU 209 is optimized for static-measurement, as in force measuring and weighing applications. If an exact proportional signal without any offset or zero-errors is desired, the zero of the whole measuring chain has to be adjusted after installation. If the zero error is within a few percent, this error can be adjusted by using the zero potentiometer. However, if the zero-offset is larger, the DIP-switches can be used to adjust the range. The DIP-switches can also be used to adjust for preload or packaging weights.

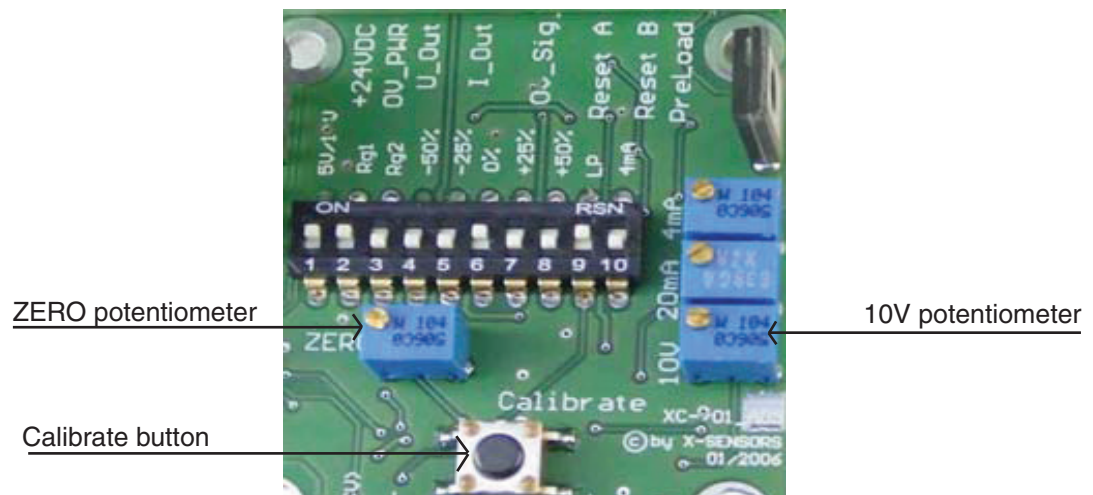


Figure 6 DIP-switches and Zero Potentiometer

## 4.2 ADJUSTING INPUT SENSITIVITY

The default input sensitivity of the LMU 209 is adjusted to 1mV/V in conjunction with a bridge supply power of 5 V. To adapt the LMU 209 to other signals, other ranges are easily selectable with the DIP-switch or by adjusting the calibration with the potentiometer in large ranges.




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CAUTION: ADJUSTING THE CALIBRATION WILL RESULT IN A LOSS OF FACTORY CALIBRATION. THEREFORE ONLY QUALIFIED PERSONNEL SHOULD RECALIBRATE THE LMU 209.

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## 4.3 CALIBRATION

The LMU 209 contains a calibration button for quick and easy calibration. By pressing the **CALIBRATE** button, the LMU 209 creates an internal signal of 1mV/V to the input.

### 4.3.1 Calibration procedure

1. Calculate the sensor signal in mV/V for a 10V output span.
2. Connect the sensor to the LMU 209.
3. Adjust the output to 0.00 V with the ZERO potentiometer (*see Figure 6*)
4. Press the **CALIBRATE** button (*see Figure 6*)
5. Adjust the voltage-output with the 10V potentiometer (*see Figure 6*), according to the following formula:

$$U_{\text{OUT}} \text{ (Volt)} = \frac{10\text{V} \times 1 \text{ (mV/V)}}{\text{Sensor signal (mV/V)}}$$

Example:

A 5 kN force-sensor should measure a force of 3.5 kN, whereas this sensor is specified with 2.00 mV/V at 5kN. Therefore, the sensor's output will be 1.40 mV/V at 3.5 kN. According to the formula above, the output needs to be adjusted to 7.143 volts when the calibration button is pressed. After this, the LMU 209 will deliver 10.00 V (or 20 mA) at the outputs when the sensor is loaded with 3.5 kN.

The voltage output can handle bipolar signals and will therefore also deliver -10 V. In the example above, negative forces can also be measured as long as the sensor itself is designed to do so.

## 4.4 CURRENT OUTPUT

The LMU 209 offers two simultaneous calibrated outputs, a voltage output and a current output. The relationship between these two outputs is strictly proportional. In other words, if the voltage output is forced to 100%, the current output will also go to 100%.

Definition:  $U_{\text{OUT}} 0 \text{ to } +10 \text{ V} = I_{\text{OUT}} 0\text{--}20 \text{ mA or } 4\text{--}20 \text{ mA}$

#### 4.5 GROUNDING (HFE)

The LMU 209 provides outstanding EMC capabilities but still needs to be connected to an earth-ground. This connection should be made with a short wire with at least AWG22. If an earth-ground is not possible, attach this connection to 0 V or a mounting plate or case. Make sure that the HFE is connected to a proper earth-ground to sink the energy which is absorbed by the EMC circuit integrated in the LMU 209.

#### 4.6 POWER

Bridge power can be selected between 5 V DC or 10 V DC. As a general rule, low impedance sensors should be driven with 5V whereas high impedance sensors can be operated with 10V. If in doubt, select the lower supply voltage. This helps to reduce sensor overheating.

#### 4.7 6-WIRE TECHNIQUE

Contact Magtrol SA for additional information

#### 4.8 LOW-PASS FILTER

The onboard low-pass filter is switched on and off by toggling the appropriate DIP Switch. It is recommended to reduce the bandwidth, because it eliminates high-frequency noise and gives more stability to the readings. If an application needs more speed, switch off the low-pass filter in order to achieve a bandwidth up to 3000 Hz.

#### 5.0 MAINTENANCE

Any repairs should be performed exclusively by Magtrol.

*1st Edition – January 2009*



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#### **MAGTROL INC**

70 Gardenville Parkway  
Buffalo, New York 14224 USA  
Phone: +1 716 668 5555  
Fax: +1 716 668 8705  
E-mail: [magtrol@magtrol.com](mailto:magtrol@magtrol.com)

#### **MAGTROL SA**

Route de Montena 77  
1728 Rossens / Fribourg, Switzerland  
Phone: +41 (0)26 407 3000  
Fax: +41 (0)26 407 3001  
E-mail: [magtrol@magtrol.ch](mailto:magtrol@magtrol.ch)

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