

## SEISMOMETERS FOR SPECIAL OPERATING CONDITIONS

Aiming to keep the sensors operational under special environmental conditions, R-sensors LLC developed dedicated housings for the **CME-4XXX** sensor's series. These housings differ from the standard ones by the Ingress Protection rating (aka IP) as well as by dimensions and weight. Meanwhile the noise performance and electrical parameters are similar to that of standard sensors of the same type.

**CME-4311** - A low noise compact broadband molecular-electronic seismometer can be equipped with the following housings:

- Borehole version (down to 250 m depth, steel case) **CME-4311BH150**
- Off-shore version (fully hermetic for underwater installation down to 10 m depth)  
- **CME-4311WP10**
- Ocean-bottom version (for use with external hermetic sphere, light case and low power)  
- **CME-4311OBS**

**CME-4211** - A compact inexpensive three-component broadband molecular-electronic seismometer for noisy environment (when the ambient noise is higher than the NLNM). The following options for **CME-4211** are available:

- Borehole (down to 250 m depth, steel case) version **CME-4211BH150**
- Post hole (down to 10-15 m depth, plastic case) version **CME-4211BH15**
- Off-shore version (fully hermetic for underwater installation down to 10 m depth)  
**CME-4211WP10**
- Ocean-bottom version (for use with external hermetic sphere, light case and low power)  
**CME-4211OBS**

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Some of presented features and parameters apply to specific versions of a seismometer. Specifications are subject to change without notice.

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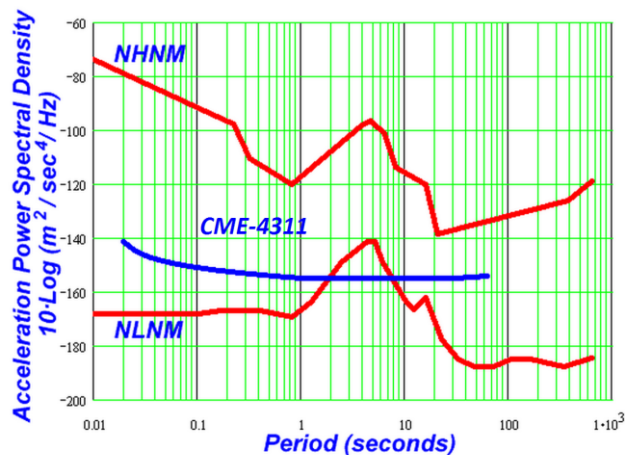
BOREHOLE BROADBAND SEISMOMETER CME-4311-BH150



Configuration	Triaxial, orthogonal – Vertical, North, East
Sensitivity	2000 V/(m/s) or customized
Maximum input signal	5 mm/sec
Frequency bandwidth <i>Limiting values</i>	0,0167 (60 sec) – 50 Hz 0,0083 (120 sec) - 50 Hz
Maximum output swing	±10 V, differential mode
Output impedance	1000 Ohms
Dynamic range at 1 Hz	123.5 dB
Integral noise in the band 0,0167 (60 sec) – 50 Hz 0,1 (10 sec) – 20 Hz	35.6 nm/sec (71,2 μV) 9 nm/sec (18 μV)
Self-noise	See plot below
Cross-axis sensitivity	-60 dB
Non-linearity at 1 Hz	0.5%
Temperature range	Standard -12°C - +55°C ( 10.4°F - 131°F) Low-temperature -40°C - +55°C ( -40°F - 131°F)
Supply voltage	Standard 10,5 .. 16 V DC, 12 V DC nominal
Supply current	25mA
Settling time till correct readings after power on	15 - 45 minutes, depending on the low frequency cut-off
Mass Lock , Mass Centering	None required
Self-calibration	Not available
Connector type, cable	Russian PC-10TB type, 10 pin with additional hermetic sealing, geophysical cable of required length with hermetical connector counterpart
Case accessories	Lifting ring, 3 feet for on-surface testing
Weight	7.5 kg (16,53 lbs)
Dimensions including ring, diameter x height	105 x 454 (507) mm 4.13” x 17.87” (19.96”)

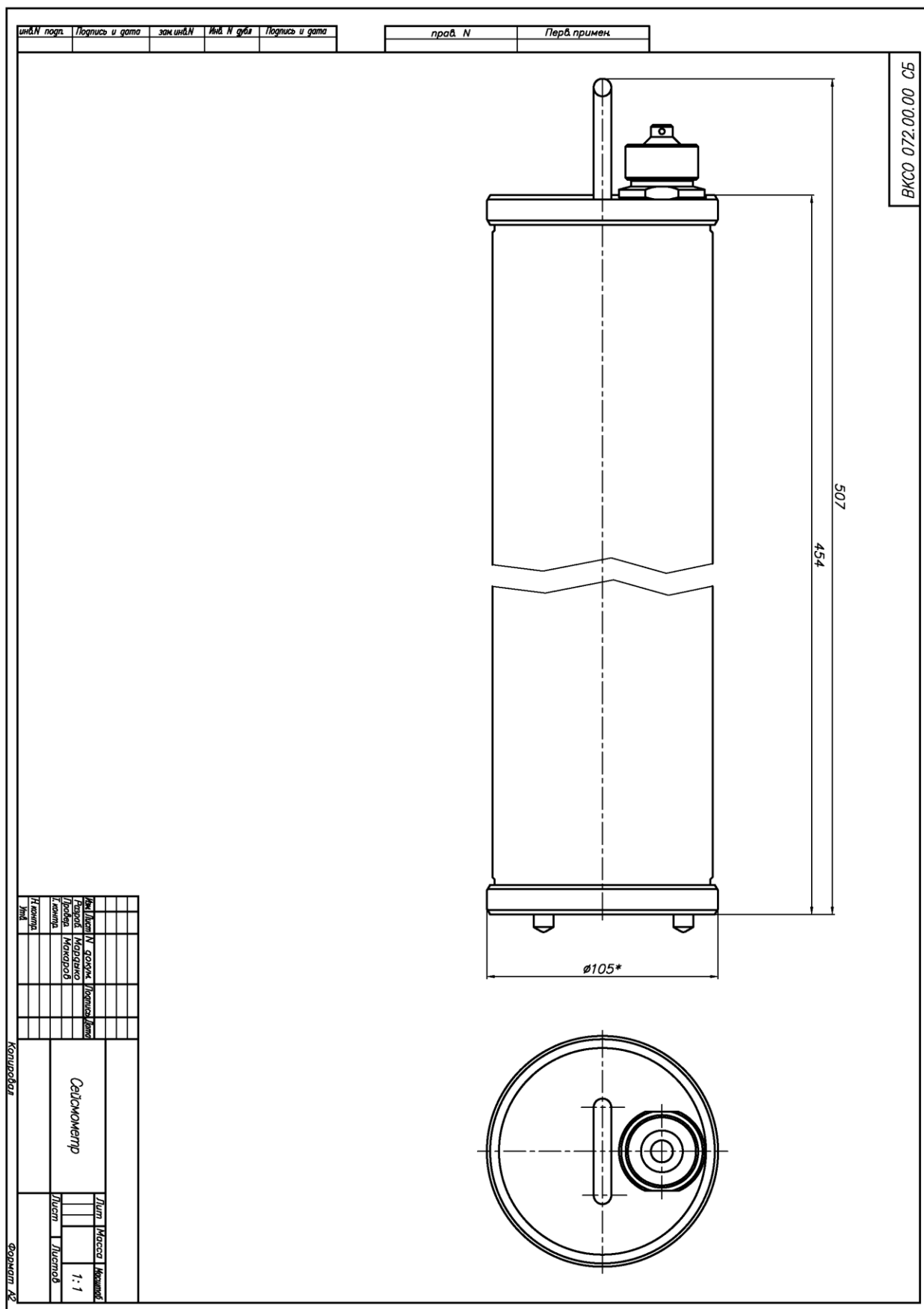
The three-component broadband low-noise seismometer **CME-4311-BH150** is designed for permanent or long term installation in boreholes down to 250 meters both dry and flooded.

The sensor is equipped with a hermetic connector and a lifting ring for going in hole and subsequent surfacing. The device is very rugged, does not require any adjustment or mass-centering.



Source: Center for Molecular Electronics, Moscow Institute of Physics and Technology, 2012

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BOREHOLE BROADBAND SEISMOMETER CME-4211-BH150

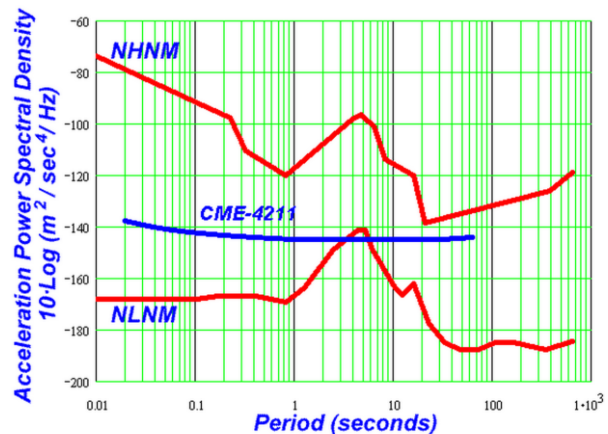


The CME-4211-BH150 is a 3-component inexpensive broadband seismometer designed for use in boreholes down to 250 meters both dry and flooded.

The sensor is equipped with a hermetic connector and a lifting ring for going in hole and subsequent surfacing. The device is very rugged, does not require any adjustment or mass-centering.



<b>Configuration</b>	Triaxial, orthogonal – Vertical, North, East
<b>Sensitivity</b>	2000 V/(m/s) or customized
<b>Maximum input signal</b>	5 mm/sec
<b>Frequency bandwidth</b>	0,033 (30 sec) – 50 Hz
<b>Limiting values</b>	0,0167 (60 sec) – 100 Hz
<b>Maximum output swing</b>	±10 V, differential mode
<b>Output impedance</b>	1000 Ohms
<b>Dynamic range at 1 Hz</b>	113 dB
<b>Integral noise in the band</b>	
0,033 (30 sec) – 50 Hz	76 nm/sec (152 μV)
0,1 (10 sec) – 20 Hz	28,4 nm/sec (57.8 μV)
<b>Self-noise</b>	See plot below
<b>Cross-axis sensitivity</b>	-60 dB
<b>Temperature range</b>	Standard -12°C - +55°C ( 10.4°F - 131°F) Low-temperature -40°C - +55°C ( -40°F - 131°F)
<b>Supply voltage</b>	Standard 10,5 .. 16 V DC, 12 V DC nominal
<b>Supply current</b>	25mA
<b>Settling time till correct readings after power on</b>	10 - 30 minutes, depending on the low frequency cut-off
<b>Mass Lock , Mass Centering</b>	None required
<b>Self-calibration</b>	Not available
<b>Connector type, cable</b>	Russian PC-10TB type, 10 pin with additional hermetic sealing, geophysical cable of required length with hermetical connector counterpart
<b>Case accessories</b>	Lifting ring, 3 feet for on-surface testing
<b>Weight</b>	4.5 kg (9,92 lbs)
<b>Dimensions including ring, diameter x height</b>	105 x 233 (303) mm 4.13” x 9.17” (11.93”)



Source: Center for Molecular Electronics, Moscow Institute of Physics and Technology, 2012

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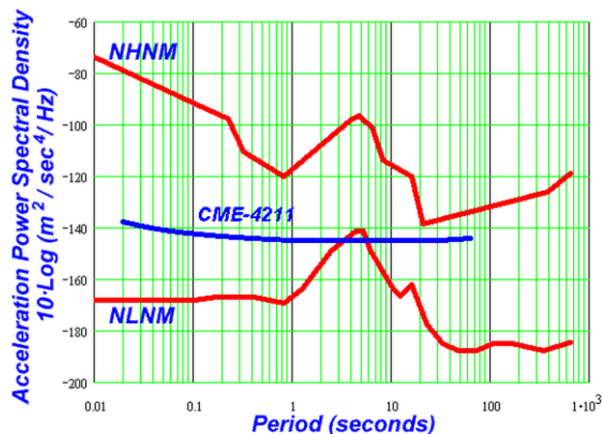
BOREHOLE BROADBAND SEISMOMETER CME-4211-BH15



The **CME-4211-BH15** is a 3-component inexpensive broadband seismometer designed for use in pits or post-holes down to 15 meters depth both dry and flooded.

The sensor is equipped with a hermetic connector and a lifting ring for going in hole and subsequent surfacing. The device is very rugged, does not require any adjustment or mass-centering.

<b>Configuration</b>	Triaxial, orthogonal – Vertical, North, East
<b>Sensitivity</b>	2000 V/(m/s) or customized
<b>Maximum input signal</b>	5 mm/sec
<b>Frequency bandwidth</b>	0,033 (30 sec) – 50 Hz
<i>Limiting values</i>	0,0167 (60 sec) – 100 Hz
<b>Maximum output swing</b>	±10 V, differential mode
<b>Output impedance</b>	1000 Ohms
<b>Dynamic range at 1 Hz</b>	113 dB
<b>Integral noise in the band</b>	
0,033 (30 sec) – 50 Hz	76 nm/sec (152 μV)
0,1 (10 sec) – 20 Hz	28,4 nm/sec (57.8 μV)
<b>Self-noise</b>	See plot below
<b>Cross-axis sensitivity</b>	-60 dB
<b>Temperature range</b>	Standard -12°C - +55°C ( 10.4°F - 131°F) Low-temperature -40°C - +55°C ( -40°F - 131°F)
<b>Supply voltage</b>	Standard 10,5 .. 16 V DC, 12 V DC nominal
<b>Supply current</b>	25mA
<b>Settling time till correct readings after power on</b>	10 - 30 minutes, depending on the low frequency cut-off
<b>Mass Lock , Mass Centering</b>	None required
<b>Self-calibration</b>	Not available
<b>Connector type, cable</b>	Russian PC-10TB type, 10 pin with additional hermetic sealing, geophysical cable of required length with hermetical connector counterpart
<b>Case accessories</b>	Lifting ring, 3 feet for on-surface testing
<b>Weight sensor / 15 meters cable</b>	2.5 kg (5,51 lbs) / 1.5 kg (3,31 lbs)
<b>Dimensions including ring, diameter x height</b>	105 x 250 mm ( 4.13” x 9.84”)



Source: Center for Molecular Electronics, Moscow Institute of Physics and Technology, 2012

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OFFSHORE SEISMOMETERS CME-4X11-WP10



The **CME-4211-WP10** and **CME-4311-WP10** are the off-shore versions of the **CME-4211/CME-4311** broadband seismometers.

The seismometers are supplied with waterproof cases made of strong plastic and a stainless steel bottom, which allow its underwater installation down to 10 m depth. The heavy stainless bottom ensures the certain orientation of the sensor at the seabed.

The seismometers are very rugged and can be used both on sea bottom and on land.

<b>Configuration</b>	Triaxial, orthogonal – Vertical, North, East
<b>Sensitivity</b>	2000 V/(m/s)
<b>Maximum input signal</b>	5 mm/sec
<b>Frequency bandwidth 4311</b> <i>Limiting values</i>	0,0167 (60 sec) – 50 Hz 0,0083 (120 sec) - 50 Hz
<b>Frequency bandwidth</b> <i>Limiting values</i>	0,033 (30 sec) – 50 Hz 0,0167 (60 sec) – 100 Hz
<b>Maximum output swing</b>	±10 V, differential mode
<b>Output impedance</b>	1000 Ohms
<b>Dynamic range at 1 Hz</b> 4311 / 4211	123.5 dB / 113 dB
<b>Integral noise in the band 4311</b> 0,0167 (60 sec) – 50 Hz 0,0167 (60 sec) – 20 Hz	35.6 nm/sec (71.2 μV) 22,5 nm/sec (45 μV)
<b>Integral noise in the band 4211</b> 0,033 (30 sec) – 50 Hz 0,1 (10 sec) – 20 Hz	76 nm/sec (152 μV) 28,4 nm/sec (57.8 μV)
<b>Self-noise</b>	See plot for a standard sensor
<b>Cross-axis sensitivity</b>	-60 dB
<b>Non-linearity at 1 Hz</b>	0.5%
<b>Temperature range</b>	Standard -12°C - +55°C ( 10.4°F - 131°F)
<b>Supply voltage</b>	9.5 .. 16 V DC, 12 V DC nominal
<b>Supply current</b>	27 mA – standard 8 mA – low power
<b>Settling time till correct readings after power on</b>	10 - 45 minutes, depending on the low frequency cut-off
<b>Mass Lock , Mass Centering</b>	None required
<b>Self-calibration</b>	Not available
<b>Connector type, cable</b>	Russian PC-10TB type, 10 pin with additional hermetic sealing, geophysical cable of required length with hermetical connector counterpart
<b>Case accessories</b>	Lifting ring, 3 feet for on-surface testing
<b>Weight 4311 / 4211</b>	3.9 kg (8.6 lbs) / 3.9 kg (7.94 lbs)
<b>Dimensions including ring, diameter x height</b>	178 x 172 mm ( 7” x 6.77”)



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OCEAN-BOTTOM SEISMOMETERS CME-4X11-OBS



The **CME-4211-OBS** and **CME-4311-OBS** seismometers are specially adapted models for ocean bottom applications. These models share technical parameters with the corresponding regular versions, but have a specially designed compact lightweight case, flat flexible signal cable and consume little power. Being pervious itself, these sensors are designed for installation inside titanium or glass deep-water spheres, which are used in ocean bottom installation.

The **CME-4211-OBS** is the lightest model of a three-component seismometer among our products.

<b>Configuration</b>	Triaxial, orthogonal – Vertical, North, East
<b>Sensitivity</b>	2000 V/(m/s)
<b>Maximum input signal</b>	5 mm/sec
<b>Frequency bandwidth 4311</b> <i>Limiting values</i>	0,0167 (60 sec) – 50 Hz 0,0083 (120 sec) - 50 Hz
<b>Frequency bandwidth 4211</b> <i>Limiting values</i>	0,033 (30 sec) – 50 Hz 0,0167 (60 sec) – 100 Hz
<b>Maximum output swing</b>	±10 V, differential mode
<b>Output impedance</b>	1000 Ohms
<b>Dynamic range at 1 Hz</b> 4311 / 4211	123.5 dB / 113 dB
<b>Integral noise in the band 4311</b> 0,0167 (60 sec) – 50 Hz 0,0167 (60 sec) – 20 Hz	35,6 nm/sec (71,2 μV) 22,5 nm/sec (45 μV)
<b>Integral noise in the band 4211</b> 0,033 (30 sec) – 50 Hz 0,1 (10 sec) – 20 Hz	76 nm/sec (152 μV) 28,4 nm/sec (57.8 μV)
<b>Self-noise</b>	See plot for a standard sensor
<b>Cross-axis sensitivity</b>	-60 dB
<b>Non-linearity at 1 Hz</b>	0.5%
<b>Temperature range</b>	Standard -12°C - +55°C ( 10.4°F - 131°F)
<b>Supply voltage</b>	9.5 .. 16 V DC, 12 V DC nominal
<b>Supply current</b>	8 mA
<b>Settling time till correct readings after power on</b>	10 - 45 minutes, depending on the low frequency cut-off
<b>Mass Lock , Mass Centering</b>	None required
<b>Self-calibration</b>	Not available
<b>Connector type, cable</b>	Two-row 10-pin flat cable connector IDCC-10MR. Flat cable FRC-10 1.27mm with a connector IDC-10F
<b>Case accessories</b>	Pointer, 3 feet for on-surface testing
<b>Weight 4311 / 4211</b>	2.6 kg (5.72 lbs) / 2.2 kg (4.85 lbs)
<b>Dimensions, diameter x height</b>	160 x 116(127)mm ( 6.3” x 5”)



Fig 2. The CME4211-OBS installation into a deep-water sphere.  
Photo by courtesy of GeoPro GmbH, Germany

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