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THREE-COMPONENT BROADBAND SEISMOMETER
CME-4111

OPERATION MANUAL

Model	CME-4111
Serial number	
Frequency band	60 sec – 50 Hz
Sensitivity	4000 V/(m/sec)

Outgoing inspection:		_____
	Date	Signature
Delivery:		_____
	Date	Signature

1. TECHNICAL SPECIFICATIONS

The compact three-component broadband molecular-electronic seismometer model **CME-4111** is designed for the measurement of the seismic ground motion in three orthogonal directions and gives the analog output signal proportional to the velocity of the external signal.

The seismometer can be used at surface observatories and subsurface vaults as far as for portable applications.

The main features and advantages of the seismometer CME-4111:

- the highest-sensitivity molecular-electronic transducer and liquid inertial mass;
- low noise level;
- 60 sec – 50 Hz frequency range;
- very rugged, no moving mechanical parts to break or wear out;
- no parasitic mechanical resonances;
- no maintenance, mass locking and centering required;
- compact size, light weight;
- low power consumption.

Arrangement. The seismometer includes 3 (1 vertical and 2 horizontal) high-sensitive molecular-electronic transducers (sensors); the sensitivity axes of the transducers are oriented in three orthogonal directions. The 3 sensors and the electronic board are mounted on the common base plate and installed in the sealed aluminium external case.

The vertical sensor is enclosed in the aluminium container housing, diameter 100 mm and height 80 mm. The horizontal sensors has the form of toroid (diameter 95 mm) made of ceramic. External aluminium case (housing) has the diameter 180 mm and height 140 mm. On the top of the case there is a cable connector.

Principle of operation. The external mechanical signal (e.g. the seismic vibration of the ground) causes the liquid flow inside the transducer elements. The convective flow of the liquid moves the charged ions of the solution in the space between metallic electrodes of the transducer and produces the electric current variations, which give the variations of electric output signal. The electronic board amplifies and corrects the electric signal of the transducers and gives the output voltage proportional to the velocity of the external mechanical signal.

The distinctive features of the used molecular-electronic transducers are the highest sensitivity, very low self noise and widest dynamic range.

The seismometer has no explosive, flammable or toxic danger, and does not produce any environmental contamination.

Seismometer delivery set:

1) the seismometer in shipping pack;
2) cable with the connector (standard cable length – 1.5 m);
3) 3 legs and 2 pointers;
4) the operational manual.

Warranty and Service: The warranty period for the seismometer is 2 years. Within this period the instrument which proves defective should be returned to the manufacturer. It will be repaired or replaced free of charge. After this period the regular repairing charges will apply.

Manufacturer:
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SPECIFICATIONS

seismometer CME-4111

Standard gain	4000 V/(m/sec)
Output	analog, differential
Clip level	± 20 V (or ± 5 mm/sec)
Standard bandwidth	60 sec – 50 Hz
Max. installation tilt	± 15°
Temperature range	– 12..+55°C (option: – 40..+55°C)
Housing material	duraluminium
Housing dimension – diameter / height	180 mm / 140 mm
Weight	5.1 kg
Power supply	12 V DC
Consumption	20 mA (option: 7.5 mA)
Self noise	see Fig. 2 below
Output resistance	2*500 Ohm
Cable connector	RS-10 (PC-10)

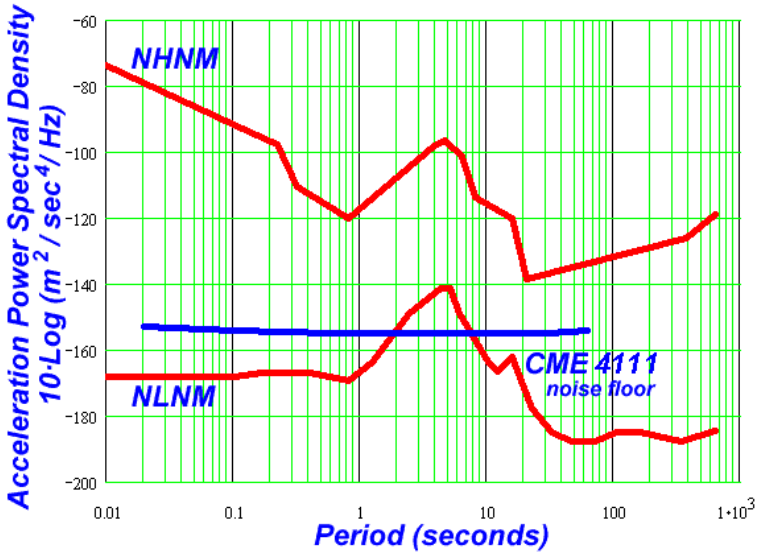

Fig. 2. Self noise of the seismometer CME-4111.

2. INSTALLATION AND OPERATION

Unlike traditional broadband electromechanical seismometers, the MET seismometer is very rugged and is not equipped with arresters and other special devices for handling, packing, unpacking and transportation.

Instrument does not require mass centering and thus does not have mass position outputs and centering inputs.

The seismometer does not require leveling and will be fully functional with installation tilts of up 15°.

Installation and Connection

Power requirements: nominal input voltage is 12 V DC, with an acceptable range of 10 to 15 V DC.

Nominal consumption is 18 mA. Peak consumption for several minutes after the power is on may be up to 50 mA. Therefore it's necessary to use a power supply capable of producing such current.

The seismometer power input is protected from reasonable excessive voltage and improper polarity.

Before using screw legs and pointers in threaded holes on the lower cover of the seismometer.

Place the seismometer on the base and orient "N" arrow on the upper cover to the North. Use pointers on the lower cover for accurate orientation along North-South direction.

Connect cable wires (see. "The Cable Marking" Appendix # 2) according to the following table:

GRN	GROUND "–" of the power source and data recorder signal ground
+U	POWER "+" of the power source
+X (North), –X +Y (East) , –Y +Z (Up), –Z	Differential inputs of the data recorder

Connect the cable to the seismometer and turn the power on.

Operation

If the seismometer is unpacked, installed and connected as instructed above, the instrument will be operational within 10-15 min.

Within first 48 to 72 hours, depending on ambient conditions, the noise level will be little higher and sparse spikes may occur in output signal. The spikes are more clearly manifested on the horizontal channels. This is normal for settling and is the result of the small drops of the electrolyte slipping down from the transducer walls.

The seismometer is well protected from pressure and temperature. For additional protection from sudden changes and air flows, a styrofoam box may be placed over the seismometer.

Moisture protection

The environmental protection grade is IP 54.

The seismometer must not be immerse into water or install in a flooded place without additional protection.

Calibration

The seismometer is factory calibrated and adjusted (within ± 1 dB) to provide ground velocity-flat response in the pass band.

The transfer function is geven in the Appendix # 3 (below).

Transportation and Storage

The seismometer is very rugged and virtually impervious to damage during transportation. Use package provided with the seismometer or any standard packing materials to prevent damage to the connector or scratching of the case.

The storage temperature range is – 15 to + 70 °C (for low-temperature version: – 40 .. +70°C). The short time (~ 4 hours) storage temperatures a little below or above these limits are permissible.

APPENDIX # 1.

THE SEISMOMETER INSTALLATION AND CABLE CONNECTION

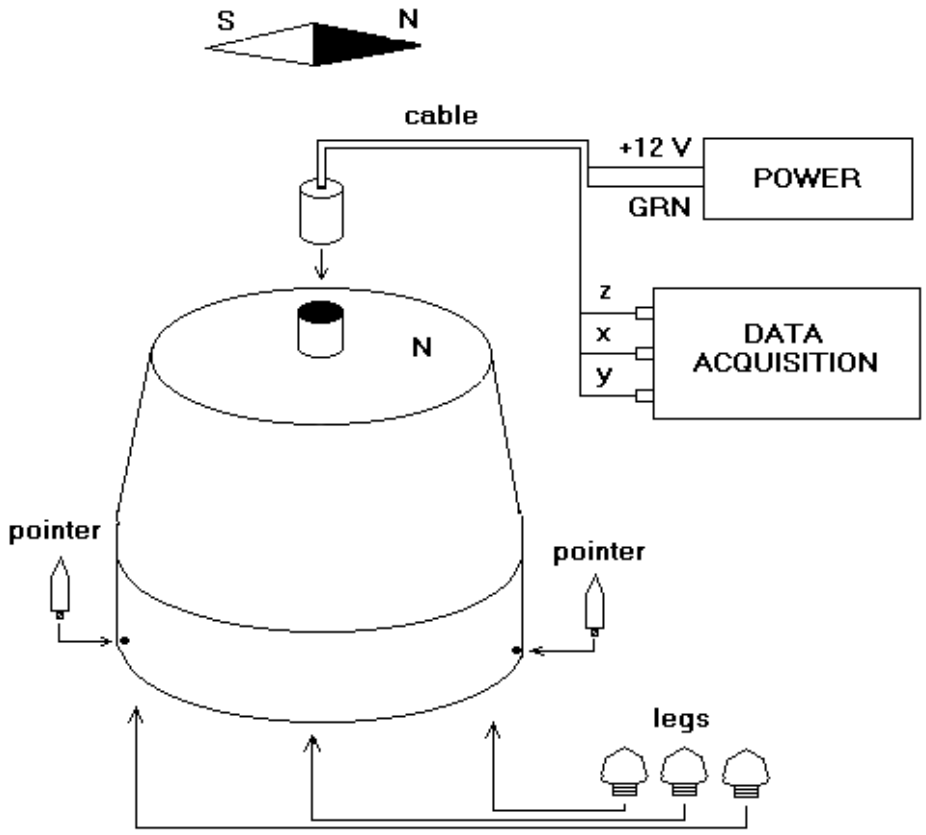

Fig. 3. The seismometer installation and cable connection.

APPENDIX # 2.

CABLE MARKING

Power	**«+U»**	**– Broun**
Ground	**«GRN»**	**–Yellow**
Chanel X	**«X+»**	**– Blue**
Chanel X	**«X-»**	**– Blue-white**
Chanel Y	**«Y+»**	**– Orange**
Chanel Y	**«Y-»**	**– Orange-white**
Chanel Z	**«Z+»**	**– Green**
Chanel Z	**«Z-»**	**– Green-white**

APPENDIX # 3.

TRANSFER FUNCTION

The CME-4111 seismometer transfer function can be approximated by the following expression (in the form of poles and zeros):

$$W(f) = \frac{4000 \cdot f^4}{\prod_{n=1}^{6}(f - p_n)},$$

here, f — frequency (in Hz), p_n — the transfer function poles:

$p_1 = p_2 = 0.01i$,

$p_3 = p_4 = 0.004i$,

$p_{5,6} = \pm 35 + 35i$;

(i – imaginary unit).

For amplitude vs. frequency response, see the plot below:

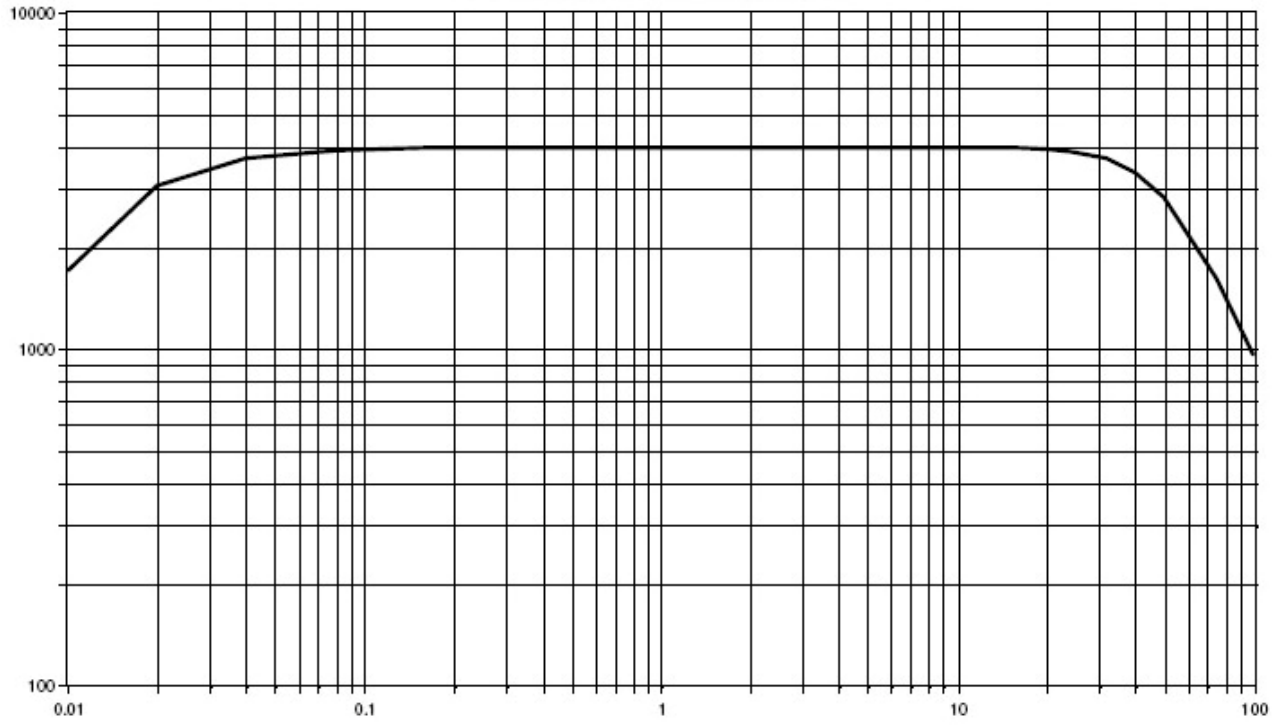

Fig. 4. Seismometer CME-4111 — amplitude vs. frequency response; horizontal axis – frequency, Hz; vertical axis – sensitivity, V/(m/sec).