

## STRONG MOTION FEEDBACK ACCELEROMETER

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The CMG-5T accelerometer is a three axis strong motion force feedback accelerometer in a sealed case. The sensor system is self-contained except for the power source. An internal dc-dc converter ensures a completely isolated sensor system and allows the system to operate from 10 to 36 Volts.

The CMG-5T sensor system has an extremely large dynamic range. In order to exploit the complete output dynamic range two separate differential outputs are provided as high and low gain outputs. Nominally the high gain outputs are set to have a 10 times larger output than the low gain outputs. CMG-5T sensor outputs are all differential with an output impedance of 47 ohms. A single signal ground line is provided as a return line for all the sensor outputs.

The CMG-5 sensors use low noise components, high feedback loop gain, and computer aided design to produce a linear, wide dynamic range, precision transducer. Full-scale low-gain sensitivity is user-adjustable from 2.0 g down to 0.1 g with an external resistor on each axis. The standard frequency pass band is flat to acceleration from dc to 100 Hz. Other low pass corners from 50 Hz to 100 Hz can be ordered. A high frequency option provides flat acceleration from dc to 200 Hz.

CMG-5T is supplied with different output clip levels. The most common output sensitivity is set to be 5 Volts for 1 g (9.81 m/s<sup>2</sup>) input acceleration. Detailed sensor calibration information is provided with every CMG-5T sensor, providing sensor dc calibration levels, frequency response of the instrument and the transfer function in poles/zeros notation.

It is extremely simple to install the CMG-5T sensor as no sensor levelling is required and just one central fixing bolt is sufficient to securely fix the sensor onto a surface.

The sensor output offsets are adjusted electronically without exposing the insides of the accelerometer. The output offset adjustment screws are accessed by removing an 'O' ring sealed cap next to the sensor connector.

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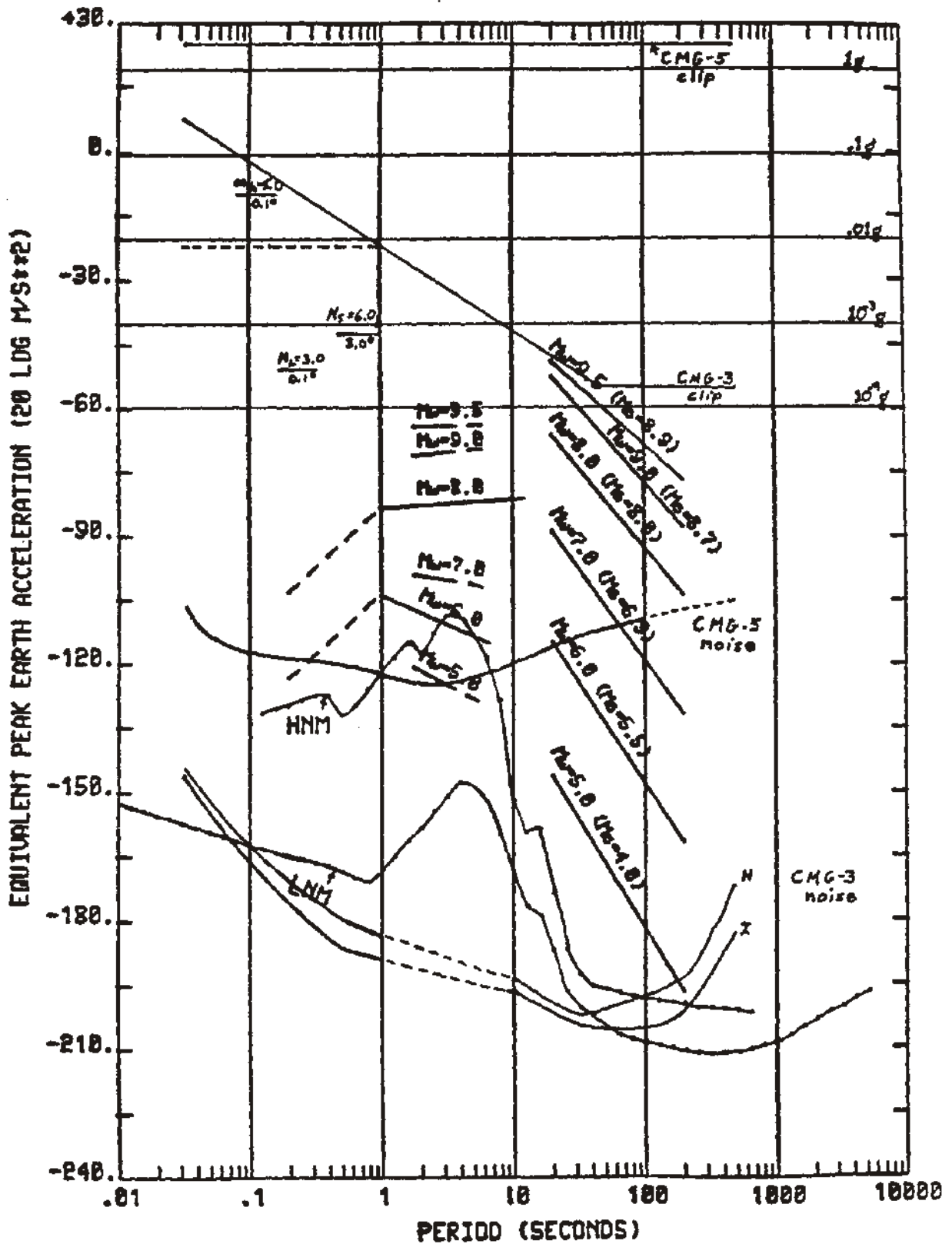
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# SIGNAL AND NOISE LEVELS

The figure below contains a typical estimate of CMG-5T system noise power plotted as (thick line) non-coherent power for the vertical and horizontal sensors. The Low Noise Model, together with CMG-3T noise, is also plotted as a reference.



## DOWNHOLE CMG-5T ACCELEROMETER



The photograph opposite shows the posthole, or downhole, CMG-5TB package. A waterproof connector together with double 'O' ring seals and stainless steel construction ensures that the system will be reliable and suitable for long term downhole applications.

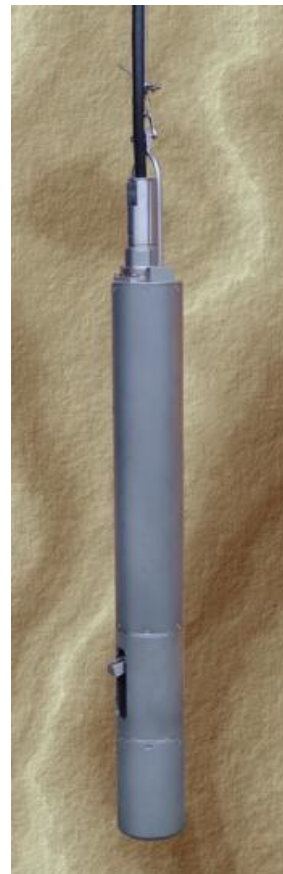
The CMG-5TB sensor can be installed to depths of 250 metres (other options are available).

CMG-5TB is supplied with remote mass centring mechanism which ensures that the dc-coupled outputs of the accelerometer offset can be reduced as low as  $\pm 1$  mV.

The mass centring mechanism is operated with a dc motor which is commanded from the surface with the use of an Handheld Control Unit or user furnished dc voltages.

## DOWNHOLE CMG-5T SENSOR and BOREHOLE HOLELOCK.

The sensor modules are mounted both above and below the holelock clamp assembly, which provides a stable 'platform' for the operation of the system. This holelock clamp unit is a vital element of the borehole system, and it meets a number of specifications. It must align the sonde body parallel to the borehole axis, holding it firmly in place when fixed, thus preventing any tendency to twist or slip under the influence of ground vibrations. In addition, it must be quick and positive in its locking action, not transmitting any stresses to the seismic sensors, and it must be able to maintain this positive clamping over a prolonged period without attention. This is achieved in the unit by a pair of passive locating skids working in conjunction with an active clamping arm. The single locking arm of the clamp assembly swings out from the side of the sonde, forcing the body against the borehole wall by means of the compression spring. It is located there in a vertical position by the two long skids located on the side of the instrument, away from the arm. The skid ends and the locking arm form a five point clamp, preventing misalignment.



The operation of the single jaw holelock mechanism is based on a single arm; this swings upwards and outwards, pushing the body of the holelock against the borehole casing. The arm of the holelock has a serrated steel jaw which is designed to bite into the borehole casing.

This arm is pushed against the borehole by a large spring which provides about 60kg of force at its locking position. A dc actuator is used to retract the arm of the holelock body so that the sensor mechanism can be lowered into or pulled out of the borehole. The clamp can be operated from a control box, the holelock control units and at the surface, and has a separate power system.

## CMG-5 TRANSDUCER SPECIFICATIONS

### Outputs and Response

Low gain output options:	2g	1g	0.5g	0.1g
Corresponding high gain:	0.2g	0.1g	0.05g	0.01g
Dynamic range for 2g F.S	Standard			
0.005 to 0.05 Hz	<140 dB			
3 to 30 Hz	<127 dB			
Standard frequency band:	dc to 100 Hz (-3dB point)			
Optional low pass corner:	50, 100 or 200 Hz			
Linearity:	0.1% of full scale			
Cross axis rejection:	0.001 g/g			
Clip level and self noise:	See plot on Page 3.			

### Calibration Controls

Open loop response:	Provided (pin on connector)
Closed loop response:	Provided (pin on connector)
Step function response:	May be added to open and closed loop calibrations
External inputs:	Sine, step and pseudo-random inputs may be inserted

### Physical

Lowest spurious resonance:	450 Hz
Operating temperature range:	- 20 to + 70 deg. C
Pressure jacket material	Hard anodised aluminium
Power/signal connector:	Milspec connector on sensor housing (KPT02E-14-19P)
Dimensions:	
Single axis:	3" square by 2" height
Triaxial:	6" diameter by 4" height
Weights:	
Single axis:	2 lbs
Triaxial:	5 lbs

### Power

Current at $\pm 12$ Vdc	$\pm 3$ mA per axis
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### Downhole Sonde

Outside diameter with lock:	3.5" (10Kg)
Outside diameter without lock	3.2" (6kg)
Length:	25.1" (640 mm)