User Manual

AC-23 Accelerometer

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DOCUMENT REVISION

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1	11.04.00	Format/Font changes	JG	GCO	
2	05.07.01	Update pictures and connector description for new 12 poles version. Added principle of operation.	SR	JG	
3	30.05.2003	Changes for new housing	LG	JG	
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19	03.03.2023	Updated electrical connector information & photos	KEC	ALB	VAG
20	03.06.2023	Added internal connector pinout picture	KEC	ALB	VAG

TABLE OF CONTENTS

LIST OF FIGURES

Warnings and Safety

☞ *The sensor housing provides no protection against explosive atmosphere. It must not be directly operated in area where explosive gases are present.*

1 Basic Specifications

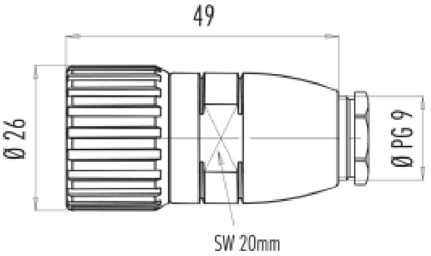
Sensor Series	AC-23
Input range	Acceleration, ±0.2, ±0.5, ±1.0 g, ±2.0 g or ±4.0 g
Output range	0 ± 10 Volt differential output OR 0 ± 5 Volt differential output OR 2.5 ± 2.5 Volt single-ended output OR 0 – 20 mA Current-loop (OPTION)
Frequency range	from 0.1 Hz to 100 Hz (optional 200 Hz)
Protections	All connector pins protected by Transzorb diodes and VDR
Power supply	10 – 15 VDC
Current drain	Average 90 mA @ 15 VDC

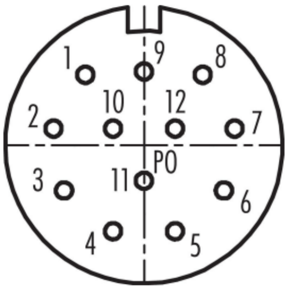
2 Electrical Connector

All AC-2x accelerometers are supplied as standard with a 2 m connection cable. Based on the intended use, the 12-pin metallic-style connectors will be supplied in one of the following options: Binder Serie 623 or Binder Serie 423.

2.1 Binder Serie 623

GeoSIG	P/N #J_CIR.012.002.F
Binder Serie 623	P/N 99 4606 00 12





(pin view)

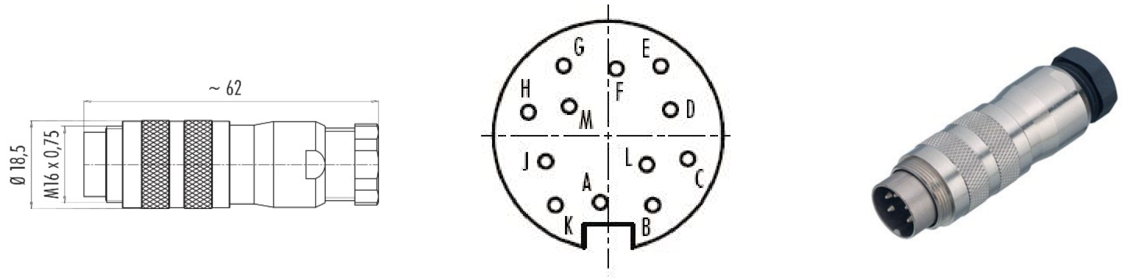
Figure 1, Binder Serie 623 Connector

The cable gland nut is determined as per cable external diameter and must be ordered separately. It also provides the cable shield connection to connector case.

2.2 Binder Serie 423

12

GeoSIG	P/N #J_CIR.012.010.M
Binder Serie 423	P/N 99 5629 00 12



(pin view)

Figure 2, Binder Serie 423 connector

The cable gland nut is determined as per cable external diameter and must be ordered separately. It also provides the cable shield connection to connector case.

2.3 Internal Connector Pinout

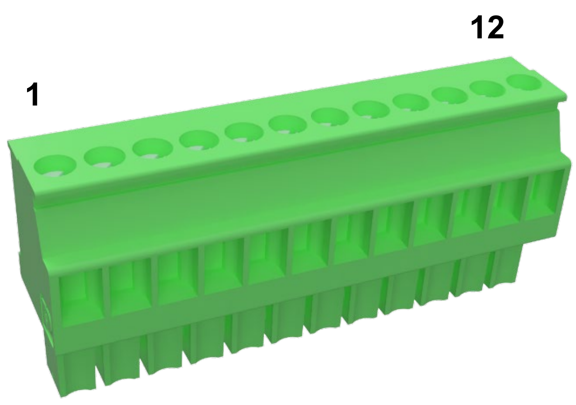
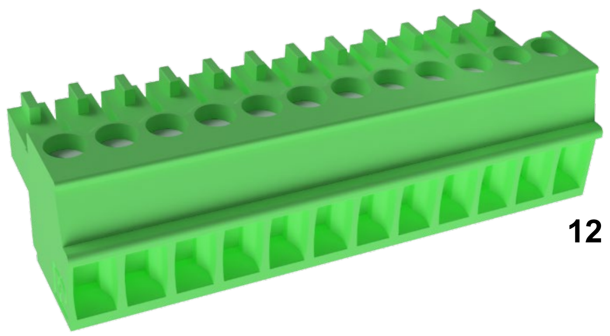
GeoSIG	P/N: #J_WIR.012.003.F	*GeoSIG*	P/N: #J_WIR.012.002.F
Phoenix Contact	P/N: 1862959	Phoenix Contact	P/N: 1840463
			

Figure 3, Internal sensor connector

2.4 Connector Pin Description (Voltage Output)

The connector pin assignment and cable colour code can be observed in the table below:

Binder Connector		SIGNAL	Comment	Colour	
Serie 623	Serie 423				
Pinout	Pinout				
1	A	OUTPUT X (+)	0 V ± 10 V voltage output, 47 Ω output impedance	White	
2	B	OUTPUT X (-)	0 V ± 10 V voltage output inverted, 47 Ω output impedance	Brown	
3	C	OUTPUT Y (+)	0 V ± 10 V voltage output, 47 Ω output impedance	Green	
4	D	OUTPUT Y (-)	0 V ± 10 V voltage output inverted, 47 Ω output impedance	Yellow	
5	E	OUTPUT Z (+)	0 V ± 10 V voltage output, 47 Ω output impedance	Grey	
6	F	OUTPUT Z (-)	0 V ± 10 V voltage output inverted, 47 Ω output impedance	Pink	
7	G	TEST INPUT	Test input, output will result in a sensor step response	Blue	
8	H	GND	Connected to Recorder's GND	Red	
9	J	+12 VDC power	Power input, +9.5 to +18 VDC range, 90 mA @ +15 VDC	Black	
10	K	0 VDC power	Power return	Violet	
11	L	N/C	Reserved	Grey/Pink	
12	M	N/C	Reserved	Red/Blue	

Table 1. AC-2x Connector Pin Assignment and Cable Colour Code

2.5 Connector Pin Description (Current Output)

The connector pin assignment and the standard cable colour code can be observed in the table below:

Connector			SIGNAL	Comment	Colour	
Serie 623	Serie 423	Int. Conn				
Pin	Pin	Pin				
1	A	1	OUTPUT X	4 – 20mA current output, X axis	White	
2	B	2	OUTPUT X (Return[1])	Current loop returns X axis (Normally not used)	Brown	
3	C	3	OUTPUT Y	4 – 20mA current output, Y axis	Green	
4	D	4	OUTPUT Y (Return[1])	Current loop returns Y axis (Normally not used)	Yellow	
5	E	5	OUTPUT Z	4 – 20mA current output, Z axis	Grey	
6	F	6	OUTPUT Z (Return[1])	Current loop returns Z axis (Normally not used)	Pink	
7	G	7	TEST INPUT	Test input, output will result in a sensor step response	Blue	
8	H	8	GND (Current Return)	Current common return (recorder GND reference)	Red	
9	J	9	+12 VDC power	Power input, +9.5 to +18 VDC range, 90 mA @ +15 VDC	Black	
10	K	10	0 VDC power	Power return	Violet	
11	L	11	N/C	Reserved	Grey/Pink	
12	M	12	N/C	Reserved	Red/Blue	

Table 2. AC-2x Connector Pin Assignment and Cable Colour Code

[1] Normally the current return pin in #8. Alternative configuration can be provided on request

3 Opening the housing

To access the sensor, simply unscrew the four hex screws positioned at each corner of the housing. Once the screws are loosened, carefully lift the sensor lid. When closing the sensor, ensure to handle it with care, avoiding any pressure on the o-ring or wires.

STATIC ELECTRICITY
The instrument contains CMOS devices and when serviced, care must be taken to prevent damage due to static electricity. This is very important to ensure long-term reliability of the unit. Such risk exists when both the instrument cover and the front panel are removed.

Under normal circumstances, there is no need to remove the lid of the sensor.
In any case, only trained person should open the sensor's lid. Moreover, untrained access may lead to serious damage to the instrument, as well as may void the warranty.

Before opening the sensor:
1. *Turn the unit off*
2. *Wait for 10 minutes*
3. *Disconnect all cables connected to the unit*

4 Mounting

Figure 4, AC-2X housing

The accelerometer has a mounting slot at its bottom, which can be slid onto the head of a single bolt existing on the installation surface. Then, utilising the 3 levelling screws, which act as the feet of the accelerometer, levelling and securing of the unit is accomplished. As the levelling screws are screwed into the surface, the accelerograph is lifted away from it, creating a secure connection between the accelerograph and the head of the single bolt.

Do not overtighten the levelling mechanism; this may damage the sensor. A torque value of 1 Nm (finger tight) is appropriate.

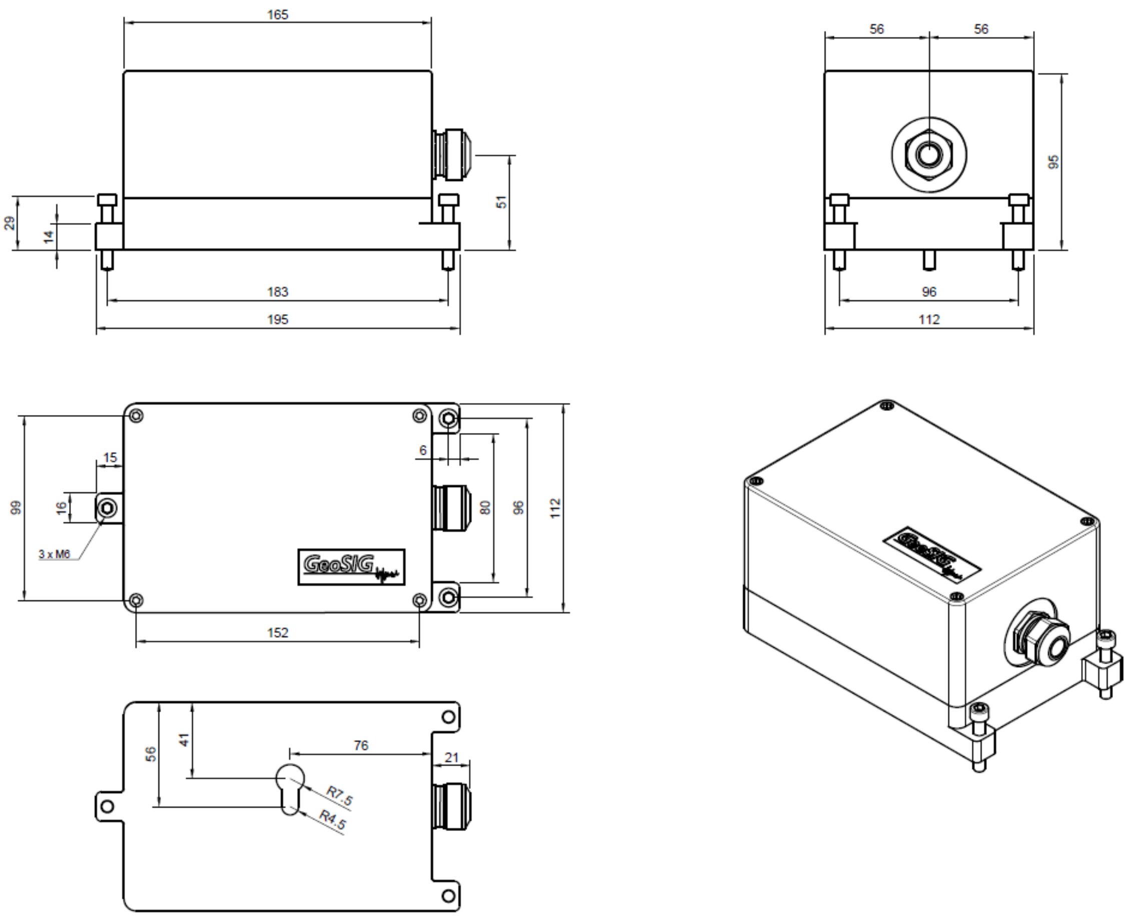


Figure 5, Sensor housing dimensions

The accelerometer must be firmly mounted to a surface and levelled, as the application requires. Check to be sure that the accelerometer is aligned to produce the desired output signals. Acceleration in the direction indicated on the case will produce a positive output signal. The orientation definitions as shipped are: **X = East**, **Y = North** and **Z = Vertical (Up)**.
The surface should have a scribed north/south orientation line accurately surveyed from reliable markers. The X-axis of the sensor must be pointed to East or to any other main direction of the structure to monitor.
One M8 expanding nut rock anchor must be used for the sensor fixation.

5 Theory of operation

5.1 Introduction

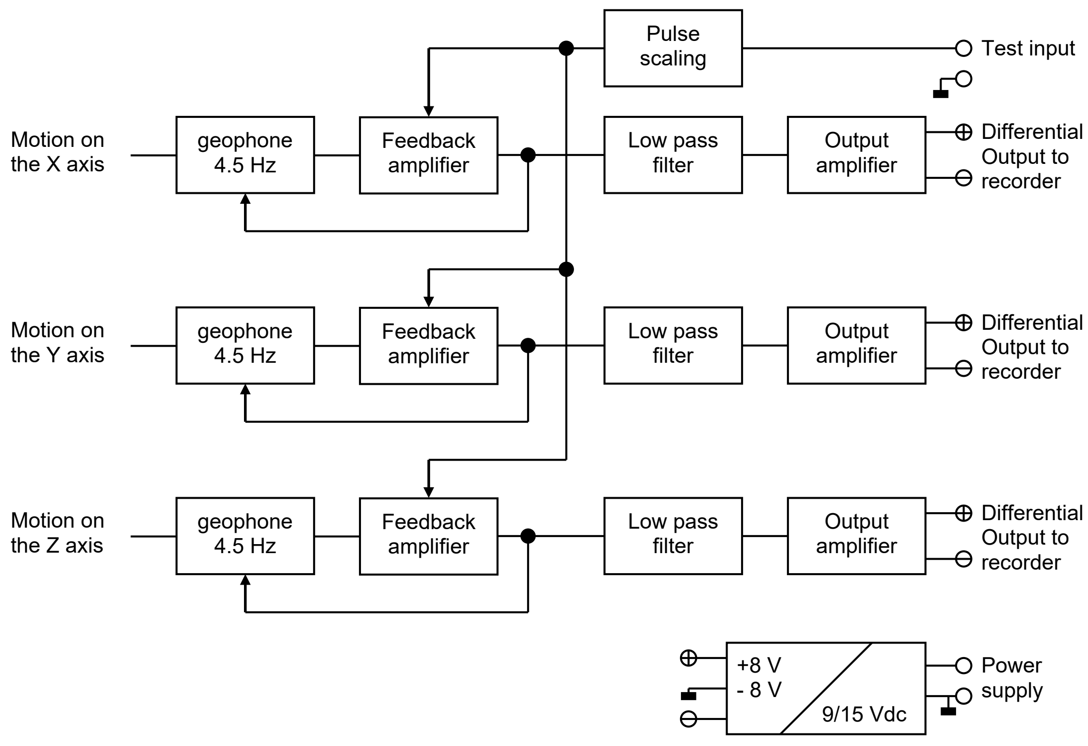
The **AC-23** sensor package is a triaxial accelerometer designed for free field and industrial applications regarding strong motion earthquake survey, monitoring and research. This sensor is well suited for applications where a high sensitivity is required.

The AC-23 sensor can be optionally delivered mounted inside various protective enclosures to provide project specific compliance.

The sensor could be installed on floor or wall with a modification of the axis organisation. With the help of the **TEST LINE,** the complete sensor can be very easily completely tested. Full scale can be selected by the user via jumpers.

5.2 Principle

The accelerometer is based on a geophone mass-spring system with electronic correction, and owing to this uncomplicated principle, it has an outstanding stability. It utilises geophones, which are damped mass spring oscillators, to convert seismic movement into electrical value proportional to the velocity. Under constant acceleration, the geophone response will reach to a maximum point at the "Natural Frequency", which is the resonant frequency of the mass-spring oscillator. Above and below this point, the geophone response will decay with one pole slope (±20 dB / decade). The state-of-the-art feedback circuit will over-damp the geophone by applying a voltage with opposite polarity, and the output response will be flat and proportional to the acceleration in this frequency band.



Note : all inputs, outputs & power supply entry are surge protected.

Figure 6 AC-23 Sensor block diagram

The geophone is connected in a resistor bridge, driven by a feedback amplifier, which applies the amplified bridge differential signal in opposite polarity. The bridge is balanced during calibration. The test-line shifts the voltage at one side of the bridge, which produces a current flow in the geophone. This current flowing in the geophone will move the seismic mass. The movement of the mass generates a voltage across the geophone, which is detected by the differential amplifier and induces an output signal.

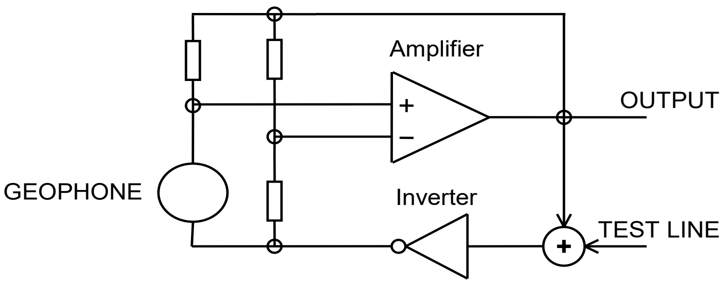


Figure 7 TEST INPUT configuration

6 Full scale selection

The full scale can be adjusted without gain re-calibration by means of jumpers with fixed 0.1% precise amplifiers.

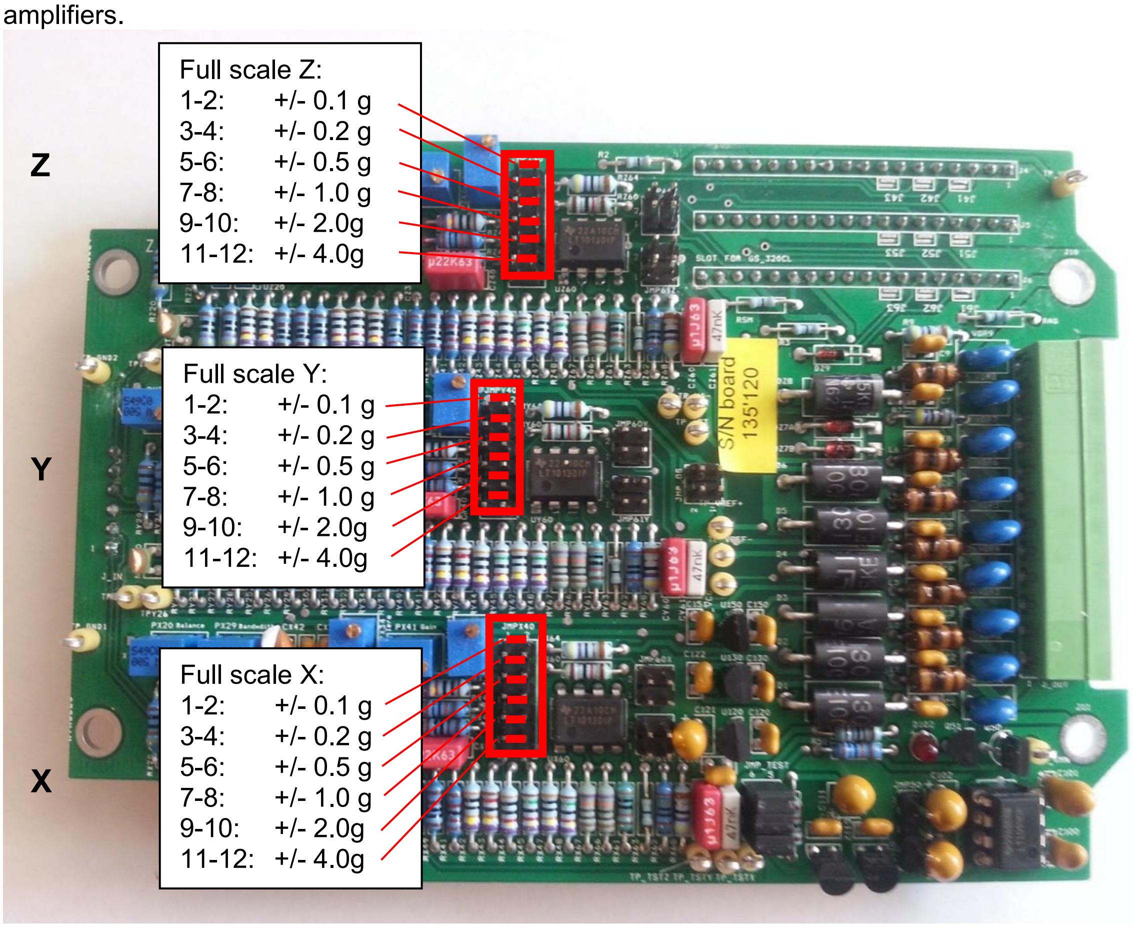


Figure 8, Full scale setting

The full scale adjustment can be:

Full scale	Jumper position
0.1 g	1-2
0.2 g	3-4
0.5 g	5-6
1.0 g	7-8
2.0 g	9-10
4.0 g	11-12

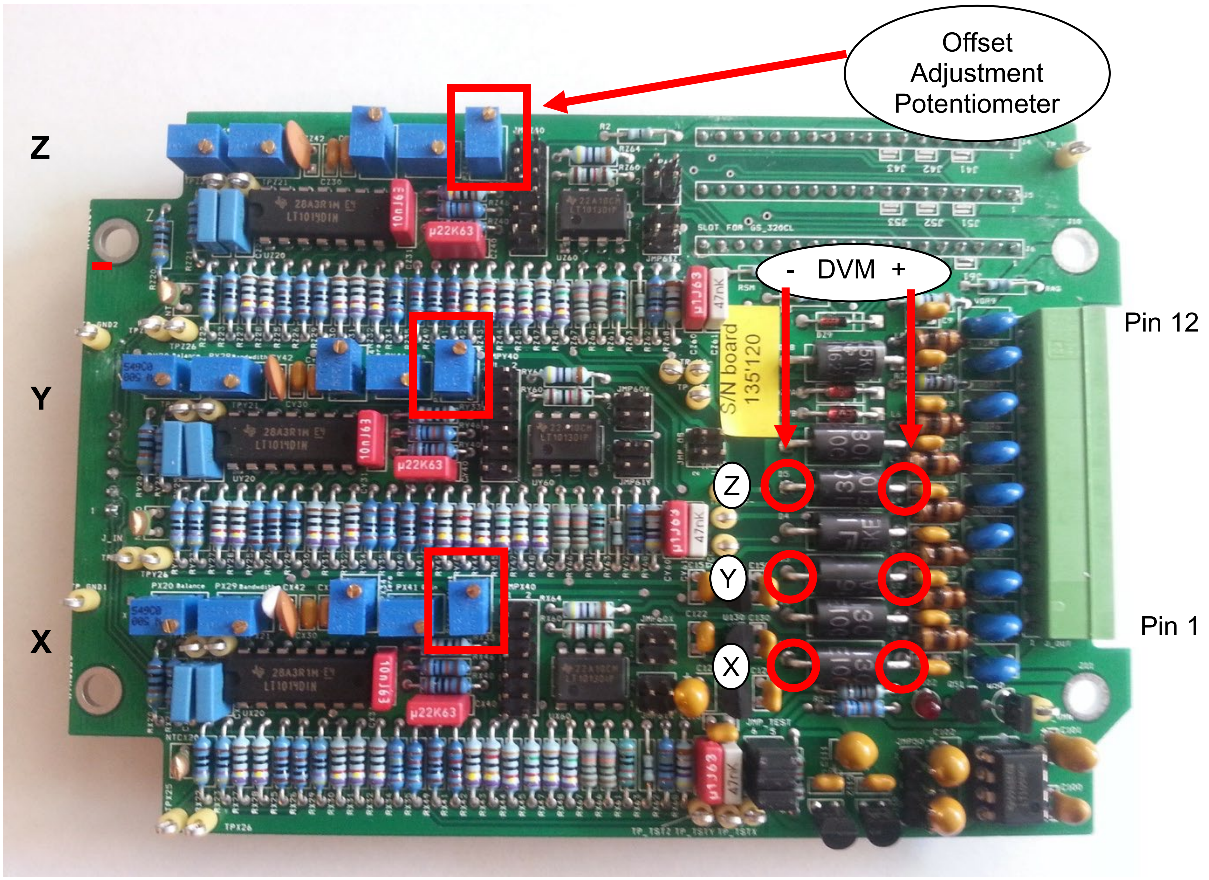


Figure 9, Offset potentiometer location

After the new full scale has been selected, the offset must be checked and if required, the offset adjustment potentiometer ° can be used to remove any small offset inaccuracy at output.

To test the output of the sensor, connect a Digital Voltmeter (DVM) as shown in Figure 7 and adjust the offset potentiometers so that the DVM readings stay within the ranges indicated in Table 2. This step must be repeated for all three axes.

Table 2 – Sensor Output Range

Sensor Label	Sensor Output Range	DVM Reading
±10 Volts	0 ± 10 Volt differential output	0.00 ±0.05 V
±5 Volts	0 ± 5 Volt differential output	0.00 ±0.05 V
2.5 ±2.5 Volts	2.5 ± 2.5 Volt single-ended output	2.50 ±0.02 V
10 ±10 mA	0 - 20 mA Current-loop (OPTION)	2.50 ±0.02 V

To verify the correct output range for your sensor, please check the sensor's label.

The DVM must be connected on the load (at recorder) for current loop.

If adjustment is necessary, ensure that you correctly identify the offset adjustment potentiometers and do not touch any other potentiometers as this would lead to voiding the sensor's calibration. Repeat this step for each of the three axes and check the output using the DVM after adjustment to ensure correct output values.

When the full scale of the sensor is changed, the LSB factor/value must also be changed on the recorder.

6 Installation Verification

Please note that temperature compensation device is mounted for each axis inside the sensor. Before accurate measurements can be performed, the temperature in the sensor has to stabilise. A minimum of 30 minutes must be allowed for temperature stabilisation to occur.