

VW TEMPERATURE SENSOR VWTS-6000

INSTRUCTION
MANUAL



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1.0 INTRODUCTION

This manual is intended for all users of the **Geosense® VWTS-6000 Temperature Sensor** and provides information on its installation, operation and maintenance.



It is VITAL that personnel responsible for the installation and use of this VW TEMPERATURE SENSOR , READS and UNDERSTANDS this manual, prior to working with the equipment.



1.1 General Description

The **Geosense® VWTS-6000 Temperature Sensor** is designed for accurate measurements of temperature.

The sensor consists of a tensioned wire clamped inside a stainless steel cylinder. Changes in temperature cause the stainless steel body to expand and contract at a different rate to that of the vibrating wire thus altering the resonant frequency.

1.2 How it works

The sensor operates on the principle that when plucked, a tensioned wire vibrates at its resonant frequency. The square of this frequency is proportional to the strain in the wire. Around the wire is a magnetic coil which when pulsed by a vibrating wire readout or data logger interface plucks the wire and measures the resultant resonant frequency of vibration.

The thermal response of the **Geosense® VWTS-6000 Temperature Sensor** is relatively slow and is therefore not suitable for measuring rapidly changing temperatures.

The **Geosense® VWTS-6000 Temperature Sensor** vibrating wire temperature sensor is fitted with an internal Thermistor and gas-discharge tube for lightning protection.

1.3 Applications

Monitoring temperatures in or on:

- Dams
- Concrete structures
- Geothermal wells
- Soil & rock temperatures
- Water temperature

It is suitable for automatic data acquisition.

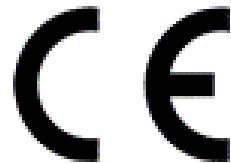
2.0 CONFORMITY

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Declaration of Conformity



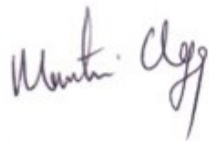
We Geosense Ltd at above address declare under our sole responsibility that the product detailed below to which this declaration relates complies with protection requirements of the following harmonized EU Directives:

- Electromagnetic Compatibility Directive 2004/108/EC
- Waste electrical and electronic equipment (WEEE) 2002/96/EC
- Restriction on the use of certain Hazardous Substances (RoHS) 2002/95/EC

| | |
|------------------------------|--|
| <i>Equipment description</i> | Vibrating Wire Temperature Sensor |
| <i>Make/Brand</i> | Geosense |
| <i>Model Numbers</i> | VWTS-6000 |

Compliance has been assessed with reference to the following harmonised standard:
EN 61326-1:2013 Electrical equipment for measurement, control and laboratory use.
EMC requirements. General requirements.

A technical file for this equipment is retained at the above address


A handwritten signature in black ink, appearing to read "Martin Clegg".

Martin Clegg
Director

Rougham

July 2013

3.0 MARKINGS

| | | |
|---|-----------|---|
| VW TEMPERATURE SENSOR | PRODUCT | VW Temperature Sensor |
| | TYPE | VWTS-6000 |
| | RANGE | -20 degC to 80 degC |
| | SERIAL NO | 330872 2000 to 3500Hz |
|  | | www.geosense.co.uk t +44(0)1359 270457 |



The **Geosense® VWTS-6000 Temperature Sensor** is labelled with the following information:-

Manufacturers name & address

Product type

Model

Serial number

CE mark

WEEE mark

4.0 DELIVERY

4.1 Packaging

Geosense® VWTS-6000 Temperature Sensors are packed for transportation to site. Packaging is suitably robust to allow normal handling by transportation companies. However, inappropriate handling techniques may cause damage to the packaging and the enclosed equipment. The packaging should be carefully inspected upon delivery and any damage **MUST** be reported to both the transportation company and Geosense.

4.2 Handling

Whilst they are a robust devices, **Geosense® VWTS-6000 Temperature Sensor** is a sensitive measuring device and must be handled carefully as to avoid sudden shocks.

Once the shipment has been checked (see below), it is recommended that the **Geosense® VWTS-6000 Temperature Sensor** remains in its original packaging for storage or transportation.

Cable should be handled with care. Do not allow it to be damaged by sharp edges, rocks for example, and do not exert force on the cable as this may damage the internal conductors/vent line and render the instrument useless.

4.3 Inspection

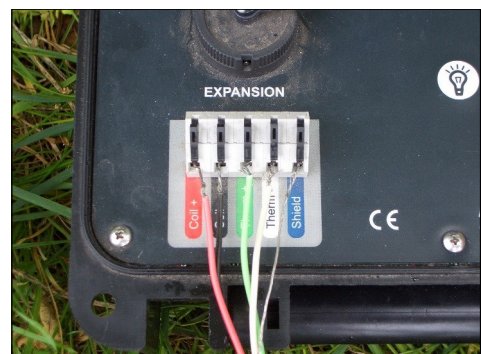
It is vital to check all the equipment in the shipment as soon as possible after taking delivery and well before installation is to be carried out. Check that all the components that are detailed on the documents are included in the shipment. Check that the equipment has not been physically damaged.

Although the system is not fully assembled, a function check can still be carried out by connected the VW Cable to the Readout as in picture.

The displayed values of the strain gauge reading and temperature, should be reasonably stable (+/- 3 full digits) for this check.

Where possible, select the audio function on the readout and listen to the 'ring' of the gauge. The 'ring' should be clear and un-distorted.

If components are missing or damaged, contact the delivery company, the supplier and / or Geosense.



Typical readout panel and connections

4.4 Storage

The **Geosense® VWTS-6000 Temperature Sensor** should be stored in an environment that is protected from direct sunlight and in a dry environment to prevent moisture migrating along the cable in the unlikely event of prolonged submersion of exposed conductors.

Storage areas should be free from rodents as they have been known to damage connecting cables.

No other special requirements are needed for medium or long-term storage although temperature limits should be considered when storing or transporting associated components, such as readout equipment.

5.0 INSTALLATION

The following sections describe a typical installation for **Geosense® VWTS-6000 Temperature Sensor**

It is VITAL that personnel responsible for the installation and use of the Temperature Sensor READS and UNDERSTANDS the manual, prior to working with the equipment.



As stated before, it is vital to check all the equipment in the shipment soon after taking delivery and well before installation is to be carried out. Check that all components that are detailed on the shipping documents are included.



5.1 Installation

The **Geosense® VWTS-6000 Temperature Sensor** can be installed in boreholes, cast into concrete or buried in fills.

No specific requirements are needed apart from protecting the body and cable from sharp objects.

A functionality test should always be done before installing.

6.0 DATA HANDLING



The function of the instrument is to provide useful and reliable data. Accurate recording and handling of the data is essential if it is to be of any value.

6.1 Taking readings

6.1.1 Portable Readouts

Geosense® offer a range of readout and data logging options. Specific operation manuals are supplied with each readout device.

Below is a brief, step-by-step procedure for use with the **VW2106** portable readout.

1. Connect signal cable from the sensor to the readout following the wiring colour code. Conductor colours may vary depending upon the extension cable used.

| | | |
|-------|---|------|
| RED | = | VW + |
| BLACK | = | VW - |
| GREEN | = | Temp |
| WHITE | = | Temp |

2. Switch on the unit and, where necessary, select range B
3. The readout displays the current VW reading (in $\text{Hz}^2/1000$) and a temperature reading in degrees Centigrade.

Whilst it is not critical that the polarity be observed for most VW instruments, a stronger signal may be obtained if the correct polarity is adopted. Since the temperature sensor is a Thermistor, its connection polarity is not important.

6.1.2 Data Loggers

A number of data loggers are available to automatically excite, interrogate and record the reading from Vibrating Wire instruments. These include devices manufactured by Geosense in both single and multi-channel configurations, together with equipment manufactured by independent suppliers.

Geosense® configure and supply equipment manufactured by both Campbell Scientific Ltd and DataTaker Ltd. These are the most commonly adopted third party manufacturers of data loggers that can be readily used with Vibrating Wire Settlement Systems. Specific configuration and programming advice can be obtained from Geosense® and or the manufacturers documentation.

6.2 Data Reduction

Overview

The tension of a sensor wire can be measured by detecting the frequency (note) at which it naturally vibrates. The following is a description of the units commonly used by the instrumentation industry.

Frequency Units (Hz). If the wire is 'excited' electronically the frequency at which it vibrates can be measured. The units used to express frequency are Hertz (Hz) or Kilo Hertz (kHz).

The disadvantage of these units is that there is no 'linear' conversion from 'change in Hertz' to 'change in wire tension'.

Linear Digits (B). In order to overcome the problem of a linear conversion described above, the frequency value can be squared, thereby rendering it linear, but quite large. To reduce its size, it is often divided by 1000 (or multiplied by 10^3). The expression $\text{Hz}^2/1000$ (or $\text{Hz}^2 \times 10^{-3}$) is the most commonly adopted as a 'linear' digital output.

Calibration Factor. Each instrument is supplied with a Calibration Certificate, to enable conversion from the raw data (in the units described above) into engineering units such as degrees Celsius .

The temperature (T) is given by the following formula:-

$$T = G (R_1 - R_0)$$

Where: R_0 = the initial reading from the calibration sheet

R_1 = the subsequent reading

An example of a calibration certificate is shown in 13.0

6..3 Thermistor Linearization

USING STEINHART & HART LOG

Thermistor Type. YSI 44005, Dale 1C 3001 B3, Alpha 13A3001-B3

Resistance/ temperature equation:-

$$T = (1 / (A + B (\ln R) + C(\ln R)^3)) - 273.2$$

Where:-

T = Temperature in degrees Centigrade
 LnR= Natural log of Thermistor resistance.
 A= 1.4051×10^{-3}
 B= 2.369×10^{-4}
 C= 1.019×10^{-7}

Resistance versus temperature table

| Ohms | Temp | Ohms | Temp | Ohms | Temp | Ohms | Temp | Ohms | Temp |
|--------|------|--------|------|-------|------|-------|------|-------|------|
| 201.1K | -50 | 16.60K | -10 | 2417 | 30 | 525.4 | 70 | 153.2 | 110 |
| 187.3K | -49 | 15.72K | -9 | 2317 | 31 | 507.8 | 71 | 149.0 | 111 |
| 174.5K | -48 | 14.90K | -8 | 2221 | 32 | 490.9 | 72 | 145.0 | 112 |
| 162.7K | -47 | 14.12K | -7 | 2130 | 33 | 474.7 | 73 | 141.1 | 113 |
| 151.7K | -46 | 13.39K | -6 | 2042 | 34 | 459.0 | 74 | 137.2 | 114 |
| 141.6K | -45 | 12.70K | -5 | 1959 | 35 | 444.0 | 75 | 133.6 | 115 |
| 132.2K | -44 | 12.05K | -4 | 1880 | 36 | 429.5 | 76 | 130.0 | 116 |
| 123.5K | -43 | 11.44K | -3 | 1805 | 37 | 415.6 | 77 | 126.5 | 117 |
| 115.4K | -42 | 10.86K | -2 | 1733 | 38 | 402.2 | 78 | 123.2 | 118 |
| 107.9K | -41 | 10.31K | -1 | 1664 | 39 | 389.3 | 79 | 119.9 | 119 |
| 101.0K | -40 | 9796 | 0 | 1598 | 40 | 376.9 | 80 | 116.8 | 120 |
| 94.48K | -39 | 9310 | 1 | 1535 | 41 | 364.9 | 81 | 113.8 | 121 |
| 88.46K | -38 | 8851 | 2 | 1475 | 42 | 353.4 | 82 | 110.8 | 122 |
| 82.87K | -37 | 8417 | 3 | 1418 | 43 | 342.2 | 83 | 107.9 | 123 |
| 77.66K | -36 | 8006 | 4 | 1363 | 44 | 331.5 | 84 | 105.2 | 124 |
| 72.81K | -35 | 7618 | 5 | 1310 | 45 | 321.2 | 85 | 102.5 | 125 |
| 68.30K | -34 | 7252 | 6 | 1260 | 46 | 311.3 | 86 | 99.9 | 126 |
| 64.09K | -33 | 6905 | 7 | 1212 | 47 | 301.7 | 87 | 97.3 | 127 |
| 60.17K | -32 | 6576 | 8 | 1167 | 48 | 292.4 | 88 | 94.9 | 128 |
| 56.51K | -31 | 6265 | 9 | 1123 | 49 | 283.5 | 89 | 92.5 | 129 |
| 53.10K | -30 | 5971 | 10 | 1081 | 50 | 274.9 | 90 | 90.2 | 130 |
| 49.91K | -29 | 5692 | 11 | 1040 | 51 | 266.6 | 91 | 87.9 | 131 |
| 46.94K | -28 | 5427 | 12 | 1002 | 52 | 258.6 | 92 | 85.7 | 132 |
| 44.16K | -27 | 5177 | 13 | 965.0 | 53 | 250.9 | 93 | 83.6 | 133 |
| 41.56K | -26 | 4939 | 14 | 929.6 | 54 | 243.4 | 94 | 81.6 | 134 |
| 39.13K | -25 | 4714 | 15 | 895.8 | 55 | 236.2 | 95 | 79.6 | 135 |
| 36.86K | -24 | 4500 | 16 | 863.3 | 56 | 229.3 | 96 | 77.6 | 136 |
| 34.73K | -23 | 4297 | 17 | 832.2 | 57 | 222.6 | 97 | 75.8 | 137 |
| 32.74K | -22 | 4105 | 18 | 802.3 | 58 | 216.1 | 98 | 73.9 | 138 |
| 30.87K | -21 | 3922 | 19 | 773.7 | 59 | 209.8 | 99 | 72.2 | 139 |
| 29.13K | -20 | 3748 | 20 | 746.3 | 60 | 203.8 | 100 | 70.4 | 140 |
| 27.49K | -19 | 3583 | 21 | 719.9 | 61 | 197.9 | 101 | 68.8 | 141 |
| 25.95K | -18 | 3426 | 22 | 694.7 | 62 | 192.2 | 102 | 67.1 | 142 |
| 24.51K | -17 | 3277 | 23 | 670.4 | 63 | 186.8 | 103 | 65.5 | 143 |
| 23.16K | -16 | 3135 | 24 | 647.1 | 64 | 181.5 | 104 | 64.0 | 144 |
| 21.89K | -15 | 3000 | 25 | 624.7 | 65 | 176.4 | 105 | 62.5 | 145 |
| 20.70K | -14 | 2872 | 26 | 603.3 | 66 | 171.4 | 106 | 61.1 | 146 |
| 19.58K | -13 | 2750 | 27 | 582.6 | 67 | 166.7 | 107 | 59.6 | 147 |
| 18.52K | -12 | 2633 | 28 | 562.8 | 68 | 162.0 | 108 | 58.3 | 148 |
| 17.53K | -11 | 2523 | 29 | 543.7 | 69 | 157.6 | 109 | 56.8 | 149 |

7.0 TROUBLESHOOTING

It is generally accepted that when a Vibrating Wire instrument is producing a stable reading on a suitable readout, the value will be correct. Only on very rare occasions will this be untrue.

In almost all cases, a fluctuating reading is a sign of a faulty signal from the sensor. The fault could be in either the sensor, the connecting cable, any switch boxes or the readout. The best way to fault find an instrument is to isolate it from all other instruments and connections.

Check the resistance of the cable.

The normal resistance between the black and red conductors is $180\Omega \pm 5\Omega$ plus cable resistance which is $20\Omega/300m$).

The normal resistance between the green and white conductors is temperature dependent (see chart). If the resistance does not match look for cable damage.

8.0 MAINTENANCE

The **Geosense[®] VWTS-6000 Temperature Sensor** is maintenance free.

9.0 SPECIFICATION

| | |
|-----------------------------|----------------------------|
| Temperature range* | 100°C |
| Operating temperature range | -20°C to +80°C* |
| Non linearity | <0.5% FS |
| Operating frequency | 2000 to 3500 Hz |
| Cable | 4 x 22 AWG |
| Weight | 210 g |
| Dimension | 20mm diameter x 140mm long |

* Other ranges available upon request

10.0 SPARE PARTS

There are no spare parts are available.

11.0 RETURN OF GOODS

11.1 Returns procedure

If goods are to be returned for either service/repair or warranty, the customer should contact Geosense for a **Returns Authorisation Number**, request a **Returned Equipment Form QF034** and, where applicable, a **Returned Goods Health and Safety Clearance Form QF038** prior to shipment. Numbers must be clearly marked on the outside of the shipment.

Complete the **Returned Equipment Form QF034**, including as much detail as possible, and enclose it with the returned goods.

All returned goods are also to be accompanied by a completed **Returned Goods Health and Safety Clearance Form QF038** attached to the outside of the package (to be accessible without opening the package) and a copy of both forms should be faxed in advance to the factory.

11.1.1 Chargeable Service or Repairs

Inspection & estimate

It is the policy of Geosense that an estimate is provided to the customer prior to any repair being carried out. A set charge for inspecting the equipment and providing an estimate is also chargeable.

11.1.2 Warranty Claim

(See Limited Warranty Conditions)

This covers defects which arise as a result of a failure in design or manufacturing. It is a condition of the warranty that the **Geosense® VWTS-6000 Temperature Sensor** must be installed and used in accordance with the manufacturer's instructions and has not been subject to misuse.

In order to make a warranty claim, contact Geosense and request a **Returned Equipment Form QF034**. Tick the warranty claim box and return the form with the goods as above. You will then be contacted and informed whether your warranty claim is valid.

11.2 Packaging and Carriage

All used goods shipped to the factory **must** be sealed inside a clean plastic bag and packed in a suitable carton. If the original packaging is not available, Geosense should be contacted for advice. Geosense® will not be responsible for damage resulting from inadequate returns packaging or contamination under any circumstances.

11.3 Transport & Storage

All goods should be adequately packaged to prevent damage in transit or intermediate storage.

12.0 LIMITED WARRANTY

The manufacturer, **Geosense Ltd** warrants the **Geosense® VWTS-6000 Temperature Sensor** manufactured by it, under normal use and service, to be free from defects in material and workmanship under the following terms and conditions:-

Sufficient site data has been provided to **Geosense** by the purchaser as regards the nature of the installation environment to allow **Geosense** to check material compatibility of the **Geosense® VWTS-6000 Temperature Sensor** and other component parts.

In the absence of any site data being provided by the purchaser standard construction materials will be supplied. All costs for subsequent modifications will be borne by the purchaser.

The **Geosense® VWTS-6000 Temperature Sensor** shall be installed in accordance with the manufacturer's recommendations.

The equipment is warranted for 1 year from the date of shipment from the manufacturer to the purchaser.

The warranty is limited to replacement of part or parts which, are determined to be defective upon inspection at the factory. Shipment of defective part or parts to the factory shall be at the expense of the Purchaser. Return shipment of repaired/replaced part or parts covered by this warranty shall be at the expense of the Manufacturer.

Unauthorised alteration and/or repair by anyone which, causes failure of the unit or associated components will void this **LIMITED WARRANTY** in its entirety.

The Purchaser warrants through the purchase of the Geosense® VWTS-6000 Temperature Sensor that he is familiar with the equipment and its proper use. In no event shall the manufacturer be liable for any injury, loss or damage, direct or consequential, special, incidental, indirect or punitive, arising out of the use of or inability to use the equipment sold to the Purchaser by the Manufacturer.

The Purchaser assumes all risks and liability whatsoever in connection with the **Geosense® VWTS-6000 Temperature Sensor** equipment from the time of delivery to Purchaser.

NOTES



Geosense Ltd

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