GEOKON®

Instruction Manual

Model 1450

DC-DC LVDT
Displacement Transducers

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EQUATIONS

1. INTRODUCTION

GEOKON Model 1450 DC-DC LVDT sensors are designed for displacement or position measurement in dynamic and/or high-temperature applications. LVDT sensors can be used in place of Model 4450 transducers for the electronic readout of borehole extensometers. They can also be used in place of, or in concert with, dial gauges to monitor piles, as shown in Figure 1 and Figure 2.
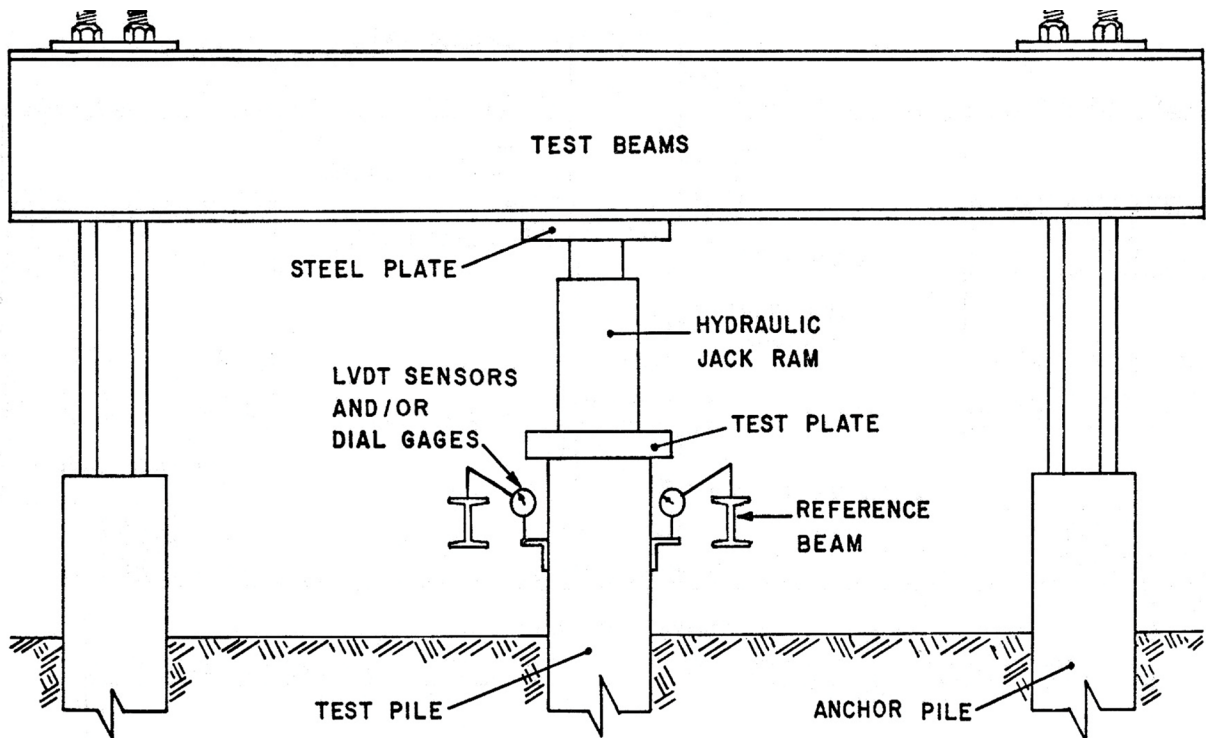
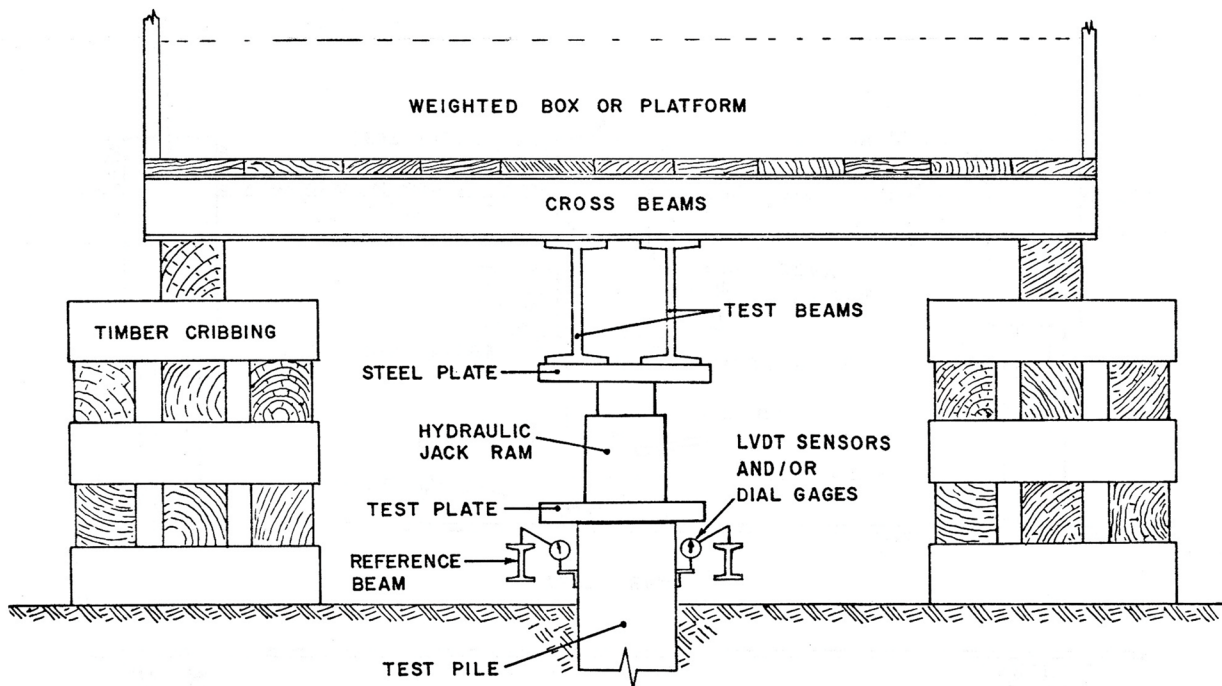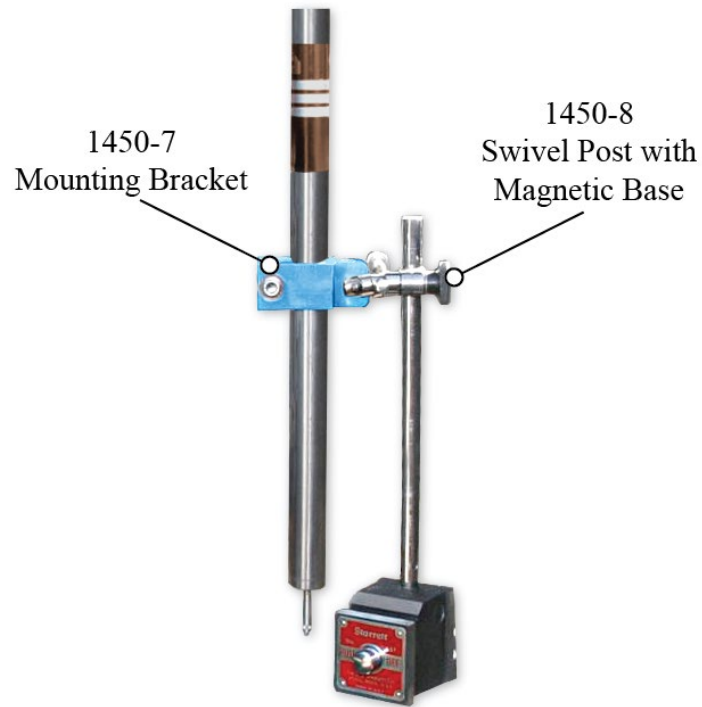**Figure 1 - Pile Installation Example #1**

Figure 2 - Pile Installation Example #2

A mounting bracket (model #1450-7) and magnetic mounting base with swivel post (model #1450-8) are available to facilitate mounting the LVDT sensors.

Figure 3 - Optional Accessories

2. THEORY OF OPERATION

An internal spring keeps tension on the bearing guided transducer shaft, pushing it outward to maintain contact with the surface being measured. This type of transducer is beneficial where it is not practical to connect the transducer shaft to the surface being measured. Standard ranges include 50 mm (2"), 100 mm (4"), and 150 mm (6").

Model 1450 transducers use the Linear Variable Differential Transformer (LVDT) principle, a robust and reliable sensor type. The main benefit of LVDT sensors is that there is no electrical contact across the transducer position sensing element. This produces clean data with infinite resolution and gives the sensor a very long life. Model 1450 transducers have all the benefits of the LVDT sensor principle with the added convenience a dc supply and dc output.

LVDT Displacement Transducers utilize three coils: a primary coil, and two secondary coils connected in opposition. At the center of the measurement stroke, the voltages of the two secondary coils are equal, but because they are connected in opposition, the resulting output from the sensor is zero. The transfer of current between the primary and the secondary coils is controlled by the position of a magnetic core called an armature. As the armature moves away from center there is an increase in voltage in one of the secondary coils and a decrease in the other. This change in voltage is reflected in the sensor output. The sensor output can be converted to a measurement of displacement as described in Section 4.

An oscillator/demodulator circuit built into the transducer supplies the excitation and converts the return signal to a dc voltage.

3. SENSOR WIRING

Table 1 details the standard wiring for model 1450 LVDT sensors.

RDP LVDT Internal Wiring	GEOKON 02-250V6 Blue Cable Conductors	10-Pin Wiring	Designation
Yellow	N/C	N/C	Tied to Brown
Brown	N/C	N/C	Tied to Yellow
Red	Red	A	5-18 VDC
Blue	Black	B	Power GND
Green	White	C	RDP Output +
Black	Green	D	RDP Output -
N/C	Shield	E	Shield

Table 1 - 1450 Wiring Chart

4. DATA REDUCTION

The sensor is normally read using a voltmeter or datalogger. The output of the transducer can be converted to a displacement using Equation 1.
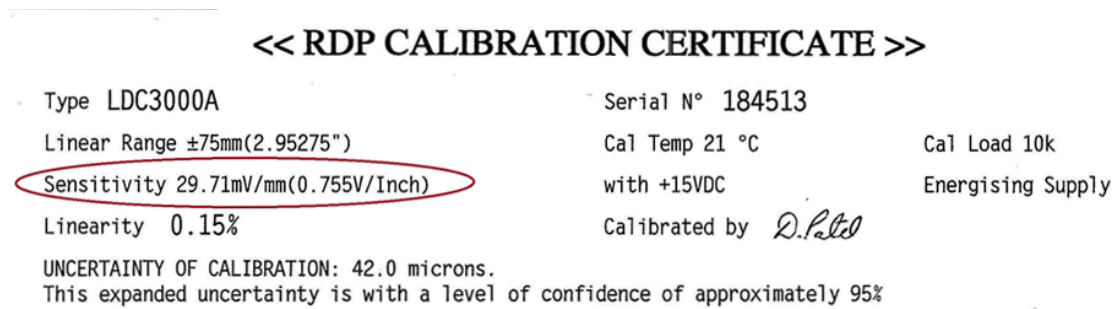
$$\text{Displacement in Millimeters/Inches} = \left(\frac{1}{S}\right) \times V$$

Equation 1 - Convert Transducer Output to Millimeters or Inches

Where;
S = Sensitivity factor (mV/mm or V/inch) shown on the calibration certificate provided with the transducer (see Figure 4).
V = Output of the transducer in millivolts or volts

<< RDP CALIBRATION CERTIFICATE >>

Type LDC3000A   Serial N° 184513
Linear Range ±75mm(2.95275")   Cal Temp 21 °C   Cal Load 10k
Sensitivity 29.71mV/mm(0.755V/Inch)   with +15VDC   Energising Supply
Linearity 0.15%   Calibrated by D.Patel

UNCERTAINTY OF CALIBRATION: 42.0 microns.
This expanded uncertainty is with a level of confidence of approximately 95%

Figure 4 - Model 1450 Sample Calibration Certificate

Consider the following examples, which use the sensitivity factors from the sample calibration certificate shown in Figure 4.

For millimeters:
If;
S = 29.71 mV/mm
V = 25.75 millivolts

Then;
The displacement = (1/29.71) × 25.75 = 0.867 millimeters

For inches:
If;
S = 0.755 V/Inch
V = 0.55 Volts

Then;
The displacement = (1/0.755) × 0.55 = 0.728 inches

5. TROUBLESHOOTING

Troubleshooting of Model 1450 DC-DC LVDT sensors is confined to periodic checks of cable connections and maintenance of terminals. Should difficulties arise, consult the following list of problems and possible solutions. Return any faulty gauges to the factory. **Gauges should not be opened in the field.** For additional troubleshooting and support, contact GEOKON.

Symptom: Sensor Readings are Unstable

- ✓ Is there a source of electrical noise nearby? Most probable sources of electrical noise are motors, generators, transformers, arc welders, and antennas. Make sure the shield drain wire is connected to ground whether using a portable readout or datalogger.
- ✓ Does the readout work with another sensor? If not, the readout may have a low battery or be malfunctioning. Consult the appropriate readout manual for charging or troubleshooting directions.
- ✓ Is the filter clogged? Remove piezo (if possible) and inspect.

Symptom: Sensor Fails to Read

- ✓ Is the cable cut or crushed? This can be checked with an ohmmeter (voltage output sensors only). If the resistance reads very high or infinite (megohms), a cut wire must be suspected. If the resistance reads very low (<100Ω), a short in the cable is likely.
- ✓ Does the readout or datalogger work with another sensor? If not, the readout or datalogger may be malfunctioning. Consult the readout or datalogger manual for further direction.

Symptom: Thermistor resistance is too high

- ✓ It is likely that there is an open circuit. Check all connections, terminals, and plugs. If a cut is located in the cable, splice according to instructions in Section 4.7.

Symptom: Thermistor resistance is too low

- ✓ It is likely that there is a short. Check all connections, terminals, and plugs. If a short is located in the cable, splice according to instructions in Section 4.7.
- ✓ Water may have penetrated the interior of the sensor. There is no remedial action.

APPENDIX A. SPECIFICATIONS

Model:	1450-2	1450-4	1450-6
Range	±25 mm (±1")	±50 mm (±2")	±75 mm (±3")
Linearity error (% F.S.)	<±0.5/±0.25/±0.1	<±0.5/±0.25/±0.1	<±0.5/±0.25/±0.1
Excitation/Supply (Acceptable)	5V to 18V dc, 60mA typical		
Output	±2.2V		
Output Load	2k Ohms (minimum)		
Output Ripple	30 mV (peak-to-peak)		
Output Impedance	2 Ohms		
Temperature Coefficient (Span)	±0.017% F.S. /°F (typical)		
Operating Temperature Range	-40 to +70 °C		
Electrical Output Bandwidth	200 Hz (flat)		
Cable Type	Two twisted pair (four conductor) 22 AWG Foil shield, PVC jacket, nominal OD=6.3 mm (0.250")		

Table 2 - Model 1450 Specifications

The specifications in Table 3 correspond to the labels shown in Figure 5.

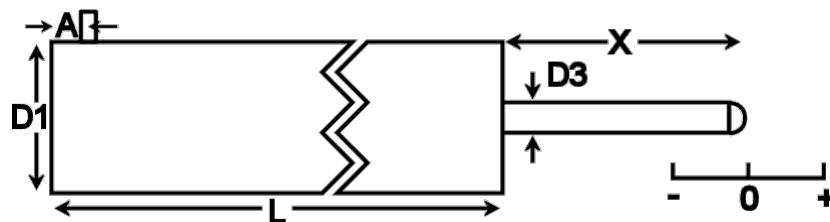| Model:	1450-2	1450-4	1450-6
Dimension A:	0.35"	0.35"	0.35"
Dimension D1:	0.81"	0.81"	0.81"
Dimension D3:	0.187"	0.187"	0.187"
Dimension L:	8.27"	12.76"	17.17"
Dimension X:(Nominal)	2.5"	3.0"	4.5"
Spring force at X (Nominal):	7 oz	6 oz	1 lb.
Spring rate (Nominal):	3 oz/inch	2 oz/inch	3 oz/inch
Inward over-travel:	0.1"	0.3"	0.6"
Outward over-travel:	0.39"	0.55"	0.59"

Table 3 - Dimensions

Figure 5 - Model 1450 Dimension Key

APPENDIX B. SAMPLE CR6 PROGRAM

```
'CR6 Datalogger with 8032 Multiplexer
'To read 4ea model 1450 RDP LVDTs connected to Multiplexer

'Zero readings and Gage factor are set to store Volts by default for 1450.

'Wiring:
'Multiplexer Enable U5
'Multiplexer Clock C4
'Model 1450 LVDT Supply SW12V and Ground
'Model 1450 LVDT Output Diff Ch U1/U2

Public Result(4)              'Result of 1450 sensors being stored
Public BattV                  'Datalogger voltage from battery
Public PTemp_C                'Datalogger panel temperature in degrees Celsius
Public GageFactor(4)          'Calibration factor for sensor
Public ZeroReading(4)         'Zero reading for sensor

Dim Var(16)          'Generic Variable
Dim I                'Generic Counter

Const CRControlB = C4      'C4 for clocking through MUX channels

'Table to Store Data
DataTable(Table1,True,-1)
  Sample(1,BattV,IEEE4)             'Battery Voltage
  Sample(1,PTemp_C,IEEE4)          'Panel temperature
  Sample(4,Result(1),IEEE4)         '1450 Sensor readings
EndTable

Sub PulseP (Chan)
  'Subroutine to Clock through each MUX channel
  'Chan Parameter Determines 32 or 16 Channel mode. When 32 Channel mode
  'only one PulsePort per clock is needed 16 Channel mode requires both
  'PulsePorts to clock through
  If Chan >= 16 Then PulsePort(CRControlB,10000)
  If Chan = 16 Then PulsePort(CRControlB,10000)
EndSub

Sub ReadVolt
  'Commands to retrieve Voltage from 1450 LVDT
  'Power up sensor with SW12 volts
  SW12(1,1)
  'Delay to allow power to reach desired voltage
  Delay (1,100,mSec)
```

'Command to retrieve voltage from sensor
VoltDiff (Var(14),1,AutoRange,U1,False,0,60,.001,0)

'Apply Zero Reading and Gage Factor
Result(I)=(Var(14)-ZeroReading(I))*GageFactor(I)

'Clear variable used
Var(14)=0

'Power down before clocking through channel on MUX
SW12(1,0)
'Delay to allow power to reach desired voltage
Delay (1,100,mSec)
EndSub

'Main Program
BeginProg

'Zero readings for 4ea Model 1450 RDP LVDTs
ZeroReading(1) = 0
ZeroReading(2) = 0
ZeroReading(3) = 0
ZeroReading(4) = 0

'Gage factor for 4ea Model 1450 RDP LVDTs
GageFactor(1) = 1
GageFactor(2) = 1
GageFactor(3) = 1
GageFactor(4) = 1

'Main Scan
 'Scan every 60 Seconds
Scan(60,Sec,1,0)
 'Read Datalogger Battery Voltage measurement 'BattV'
 Battery(BattV)
 'Read Panel Temperature measurement 'PTemp_C'
 PanelTemp(PTemp_C,_60Hz)

 'Raise the control port to enable MUX #1
 PortSet (U5,1)
 Delay (0,125,mSec)

 'Determine channel position of MUX
 For I=1 To 4
  'Clock through MUX channels Parameter is either 16 or 32 channel mode.
  Call PulseP(16)

```
    'Read Model 1450
     Call ReadVolt


   Next
   'Lower the control port to deactivate MUX port enabled
   PortSet (U5,2)


   'Call Data Tables and Store Data
   CallTable(Table1)
 NextScan
```