ENCARDIO RITE

ONE STOP MONITORING SOLUTIONS | HYDROLOGY | GEOTECHNICAL | STRUCTURAL | GEODETIC
Over 50 years of Excellence through ingenuity

DATASHEET

DIGITAL INCLINOMETER (HORIZONTAL)

MODEL EAN-26M-H

INTRODUCTION

Encardio-rite model EAN-26M-H is one of the most advanced MEMS digital horizontal inclinometer system being produced anywhere in the world. It utilizes the capability of high computational power and large high resolution colour display of today's Android OS based mobile phones as a readout and data storage unit.

FEATURES

- Advanced, light weight, shock resistant digital MEMS inclinometer system.
- Uses easily available Android OS based GSM/GPRS capable mobile phones as hand held readout unit.
- Phone provides high resolution vivid colour display of readings and graphs.
- Wireless Bluetooth connection eliminates cable between rotating reel and mobile phone readout.
- Mobile phone memory capacity allows local storage of more than 1 million data points.
- Data can be compared instantly after logging with previously logged data using different graph types.
- Data can be sent instantly to central server over GSM/GPRS connection.

APPLICATION

- To accurately measure horizontal movement including settlement and heave of storage tank, structures, landfills, etc.
- Construction control, stability investigation and monitoring of road and dam embankments, etc.

OVERVIEW

The horizontal inclinometer system consists of a traversing type digital tilt sensing probe that is connected to a reel unit kept at gage well opening. The reel unit consists of a winding reel that holds the cable and a wireless Bluetooth relay unit that sends the digital probe data to mobile phone. A rechargeable battery in the reel unit supplies power to the whole system.

The system provides significant quantitative data on magnitude of settlement/heave of foundations and its variations with time. It also provides the pattern of deformation, zones of potential danger and effectiveness of construction control measures undertaken.

The mobile phone uses wireless Bluetooth connection to communicate with the inclinometer reel unit. The EAN-26M-H Inclinometer system is much lighter in weight, easy to be carried by field personnel.

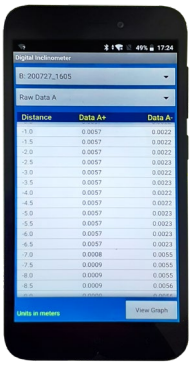
OPERATION

The access tubes are fixed to each other and installed in horizontal gage well. The inclinometer probe is then made to pass through the entire access tubing installed, taking readings at fixed distances from one side. During the process, a servo accelerometer probe senses inclination of the installed access tubes in two planes at right angles to each other. Another set of readings at same intervals are taken from the other end, thus reversing the probe to eliminate any offset error.

A set of initial base reading, taken at given intervals within the access tube forms the reference datum. All subsequent readings are taken at identical intervals over a period of time. The settlement or heave is calculated by using the formula L (sin θ1-sin θ0) where L is the gage length, 1 is the current angle of inclination, θ0 is the initial angle of inclination. A complete profile of the trench/borehole can be obtained by summing the successive readings. By comparing these profiles, the settlement or heave of the borehole over a period of time may be determined.

SYSTEM DESCRIPTION

The uniaxial inclinometer probe has a measuring range of ± 30 degrees. The probe uses a 24 bit ADC that measures the MEMS sensor output with a resolution of over 1 million counts. An embedded processor in the probe provides a digital output that gives the horizontal displacement value directly in desired engineering units.



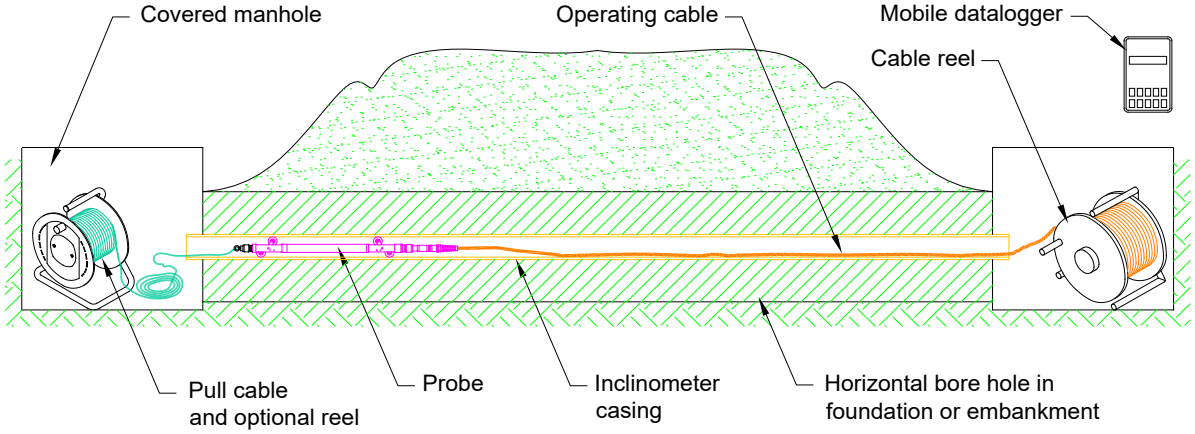
Tabular display of data over a period of time

The probe data is transferred to the reel over a thin high strength two core cable with a central high strength Kevlar core that makes the cable essentially stretch proof even with intensive use. The twin core cable carries both data and power supply to the probe from the reel unit. Transmitting data digitally to the reel allows any length of cable to be used without affecting the accuracy of the measurement.

A standard commercially available Android OS based mobile phone is used as a hand held unit. The Encardio-rite Digital Inclinometer application is loaded on the mobile phone to enable it to configure and collect data from the digital inclinometer system.

The mobile phone communicates with the reel unit of the Inclinometer system through its in-built Bluetooth wireless interface. The wireless link eliminates the traditional slip ring and cable connection between the reel unit and the handheld readout that often became unreliable due to frayed cable and slip ring problem.

Encardio-rite Android Digital Inclinometer application exploits the huge computational and image processing power of today's mobile phone to display the logged borehole data as tables or various types of graphs commonly used at back end computers to visualize the data. This allows the operator to verify the logged data and investigate any anomaly immediately at site.



The current memory capacity available in mobile phones allows storage of borehole data of all the boreholes in a site for a number of months.

Use of an off the shelf available mobile phone allows a faulty hand held readout to be serviced or replaced with another unit locally very easily eliminating delays associated with servicing a custom readout unit or a proprietary palm top computer.

The mobile phone can also be loaded with application software for other types of sensor and data loggers equipped with Bluetooth interface that are being made available by select manufacturers now a days. This will free the field operator from carrying different readout units for different types of sensors/data loggers.

A choice of mobile phones can also provide the functions of camera to record photos or video clips of site conditions, view tutorial videos on site, or fix its geographic location using the inbuilt GPS receiver besides all the functions available in a mobile phone.

SYSTEM COMPONENTS

The Encardio-rite model EAN-26M-H Inclinometer system basically consists of four components:

- Access tube and fittings
- Digital tilt sensing probe
- Interconnecting cable on a portable reel
- Pulling cable with optional reel
- Mobile phone as a readout/datalogger unit

ACCESS TUBE AND FITTINGS

ABS access tubes have longitudinal keyways, specially produced to close tolerances. Wheels of tilt sensing probe can run smoothly inside these keyways. Access tubes are 3 m (~9.85') in length. These are provided with fixed couplings. Design of these couplings ensure that correct alignment of keyways is maintained throughout depth of gage well.

EAN-AT70 self aligning access tube

Self aligning ABS tubing, 70 mm o.d., 58 mm i.d., 3 m length.

EAN-FC70 ABS fixed coupling (70 mm)

ABS fixed coupling for 70 mm o.d. access tube, 77 mm o.d. x 160 mm length

EAN-25M-H/1.1 End cap for ABS tubing (70 mm)

ABS end cap with fixed pin, for 70 mm o.d. access tube

EAN-25M-H/1.2 Top cap for ABS tubing (70 mm)

ABS end cap with removable pin, for 70 mm o.d. access tube.

Pop rivets for ABS tubing

Pop rivets packets of 100 numbers for fixed coupling.

Self tapping screws for ABS tubing

Self tapping screws packets of 100 numbers for telescopic coupling.

Pop rivet gun

Hand held manually operated.

Power drill

230 V 50 Hz operation power drill with two 3.2 mm dia drill bits.

Mastic tape

50 mm width x 10 m long mastic tape.

Sealing accessories

BOPP tape 50 mm width x 30 m long.

DIGITAL TILT SENSING PROBE

EAN-26MH/2.1 Inclinometer probe

The uniaxial digital probe consists of a precision MEMS accelerometer inside stainless steel enclosure, fitted with two pairs of pivoted sprung wheels which can rotate freely.

Standard gage length between the wheels is 500 mm. An option of 2 ft gage length (Imperial unit) is also available. The spring loaded wheel arms help to position the probe centrally inside the access casing at any required depth. The rear end of probe has provision to fix an eye bolt used to connect pull cable when taking readings. A four pin connector is provided for connection to the cable.

EAN-26MH/2.2 Dummy probe

It has the same dimension as the actual probe. It is used for checking any blockage/deformation of installed access tubing.

EAN-26MH/2.3 Calibration check jig

It enables verification of calibration of the data logger for known angles of tilt of the sensing probe.

INTERCONNECTING CABLE

EAN-26MH/3.1 Operating cable and cable reel

Two core abrasion resistant polyurethane sheathed, weather proof signal cable with high tensile straining member, graduated at every 0.5 m (or 2 ft Imperial). This is available in different lengths.

A four pin connector is provided for connecting to the probe. The cable reel comprises of a plastic winding reel on suitable frame to hold the specified length of the cable.

EAN-26H/3.2 Pulling cable with optional reel

It is used to pull inclinometer probe from the other end. This cable is always left inside the casing, stretched throughout the length, hooked to the end caps.

Mobile Phone Datalogger

Any Android Operating System (2.1 or later) based smartphone, with at least 480 x 800 pixel bright color display, minimum 512 MB RAM, 8 GB or above memory expandable with microSD card and Bluetooth connection, can be used as a hand held readout/datalogger unit. Mobile phone should be compatible with local cellular standards. A local cellular connection (SIM) is required for operation. Internet connectivity is required if data is to be transferred to remote server.

Encardio-rite Digital Inclinometer application software for Android is quite user friendly and convenient to use. A suitable mobile phone installed with Digital Inclinometer application software is generally supplied with the EAN-26M-H horizontal inclinometer system. Obtaining local cellular connection with internet connectivity is in user scope.

SPECIFICATIONS

Probe specification	
Measuring range	± 30° of vertical
Resolution (Metric)	± 0.008 mm/500 mm
Resolution (Imperial)	± 0.0004 in/2 ft
Distance between wheels	500 mm Metric (standard) 2 ft Imperial (on request)
Operating temperature	-20°C to + 70°C
Probe dimensions	Overall 32 mm dia (excluding wheel arm) x 650mm (~30.9 in) length
Probe weight	1.4 kg (~3.1 lb)
Probe casing	AISI 316L Stainless steel
Total system accuracy[1] (Metric)	± 2 mm/30 m (readings at every 500 mm)
Total system accuracy[1] (Imperial)	± 0.1 in/100 ft (readings at every 2 ft)
Cable specification	
Details	2 core polyurethane sheathed
Diameter	6 mm (~ 0.24 in)
Weight	1.9 kg/50 m (3.8 lb/150 ft); including ferrules
Cable reel specifications	
Upto 100 m (330 ft) cable reel	300 mm (~ 12 in) diameter (flange)
100 - 200 m (330-650 ft) cable reel	380 mm (~ 15 in) diameter (flange)

[1] Difference between cumulated displacements while taking readings in similar conditions repeatedly

**All specifications are subject to change without prior notice*

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