YieldPoint’s **d-GMM(SPECTRE)** displacement sensor integrates magnetostriuctive technology to produce a high precision digital instrument comprising a non-contact displacement sensor and digital temperature sensor. An on-board microcontroller applies temperature compensation and outputs a digital signal. Both the resolution (<0.01mm) and accuracy (0.25% linearity typical) are significantly better than for similarly priced technology.

The output signal includes the instrument’s unique Sensor_ID, the Sensor_Type as well as the temperature and displacement data. A balanced differential RS485 output signal is widely recognized for reliability in harsh environments. The signal can be routinely transmitted over 500m of lead-wire.

The **d-GMM** is easy to install either (i) as a GMM by attaching to a 5/8” rock-bolt, or (ii) in a wide range of other crack-meter configurations. The device is fully retrievable. The electronics are hermetically sealed and the sensor can be submerged indefinitely.

Each instrument is individually calibrated to ensure that the resolution (<0.01mm) and accuracy (0.5% linearity typical) are an order of magnitude better than for similarly priced technology. The inherently digital form of the signals eliminates the necessity for expensive analog-to-digital conversion and results in low cost monitoring peripherals that output data in real world units (mm and degC).

**Features:**

- On-board digital signal processing
- Digital (d-tech) 125mm (5 inch) stroke length
- High accuracy (0.5% FS) and resolution (0.01% FS)
- Individual calibration with coefficients stored in memory
- RS485 Output signal (9600,8,N,1) ASCII encoded
- Microcontroller provides output in real world units (mm and ºC)
- Unique ID facilitates plug ‘n play networking
- Digital temperature sensor for accurate compensation
- Magnetostrictive technology provides immunity to hostile environment
- Easy to interface with dataloggers (d-LOGGER), Ethernet and WiFi (DESTINY)
- Competitively priced
## Installation

The d-GMM is typically installed using a mechanical rock-bolt in a borehole as shown in the figure below. However different customers have found various ingenious ways to monitor deformation.

![Installation configuration](image)

**Fig 1:** Installation configuration.

If installed in borehole the d-GMM target can be tightened with socket wrench (purchased separately). The GMM itself is usually secured using rock-bolt resin or expandable foam. In wet holes it is important to use a drain tube.

## Shear Displacement

When deployed as a crack-meter, SPECTRE can measure a combination of shear and dilation. This creates opportunities for monitoring large displacements on cracks subjected to mixed mode deformations.

![Effect of shear on d-GMM](image)

**Fig 2:** Effect of shear on d-GMM

## Manual Readout

Readout can be made using YieldPoint’s low cost manual readout box, which performs diagnostics on the lead-wires, recognizes the sensor type and ID and outputs the displacement and temperature data directly in mm and °C.

## Automated Data Retrieval

### BluPoint

Instruments can be wirelessly enabled using BluLink which provides a Bluetooth 5.0 connection which has a range of 100m LOS. BluLink can transmit data to BluGateways which are WiFi or LTE-M enabled. These devices can upload data to VantagePoint, YieldPoint’s data aggregation and visualization tool.

BluLink also functions as a local data-logger storing 30,000 readings. Wireless download can be by any Bluetooth enabled Android device using the BluPoint app.

![Blulink and the BluPoint app](image)

**Fig. 3. BluLink and the BluPoint app.**

![The BluLogger app](image)

**Fig. 4. The BluLogger app.**
### Telemetry

#### 900MHz 1for1 Telemetry

For longer range deployments the d-Rebar operate with YieldPoint’s 900MHz 1for1 mesh radio telemetry system. Individual radios have a LOS range of 300m.

![An installed 1 for radio](image)

*Fig 5: An installed 1 for radio*

![The 1for1 Gateway](image)

*Fig 6: The 1for1 Gateway*

### Case Study 1

#### Case Study 1: Monitoring in a salt mine

YieldPoint’s d-GMM is widely used to monitor movements in salt and potash mines. The hermetically sealed design resists the harsh environment. The d-GMM can be configured as either (i) a closure station, or (ii) a roof monitoring station. Alternatively the d-GMM can be used to monitor any structure that may be moving and potentially unstable. Increasingly YieldPoint is providing salt and potash mines with 900MHz d-Mesh telemetry which transmits particularly well in room and pillar mines.

![d-GMM monitoring a structure in a potash Mine.](image)

*Fig 7: d-GMM monitoring a structure in a potash Mine.*

![Displacement measured by d-GMM in mm. The data is collected using d4loggers.](image)

*Fig 8: Displacement measured by d-GMM in mm. The data is collected using d4loggers.*
Case Study 2

**Monitoring a dam buttress**

Fig 9: A d-GMM monitoring a crack in a dam buttress.

**Specifications**

- **Borehole size**: 30mm+
- **Range (F.S.)**: 250mm, 125mm, 100mm or 50mm. Temp: -40 to 125°C
- **Core Technology**: 126mm magnetostrictive + temperature sensor
- **Output Signal**: RS485(9600,8,N,1) ASCII encoded string with Sensor_ID, Temp, and Displacement values.
- **Displ. Resolution**: 0.01mm with hand held readout
- **Displ. Hysteresis**: 0.025mm
- **Displ. Repeatability**: 0.025mm
- **Displ. Linearity**: typically 0.01mm
- **Temp. Range**: -40 - 125°C
- **Temp Accuracy**: +/- 2°C
- **Temp Resolution**: 0.1°C

Fig 10: Monitoring cracks on an exterior basement wall. RHS scale is temperature.