Innovative Digital Instrumentation For Geotechnical Monitoring

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YieldPoint Inc.

ME/MO CONFERENCE
"INNOVATIONS INMINING"

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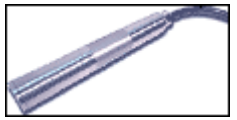
Sensing the future

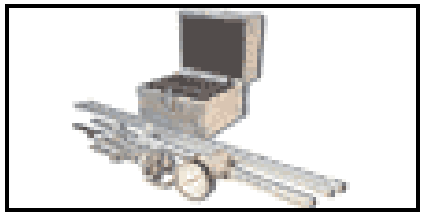
www.yieldpoint.com

Conventional Geotechnical Instrumentation

Load cells

Strain Gauges





Piezometers

Data-loggers

- Expensive
- Conservative design.
- Retrievable deployment strategies
- Designed for permanent civil structures

Analog Sensors : Limitations

- High Cost – especially for those products widely used in civil engineering
- Reliability??
  - (i) mV output susceptible to water ingress
  - (ii) potentiometers poor survivability after blasting
- Suspect Sensor Performance in dynamic mining scenarios
  - (i) vulnerable lead-wires. 1 channel /wire
  - (ii) Money spent protecting leadwires
- Esoteric analog data (V, mV, mA, Hz) needs to be converted into real world units

Today, 99% of geotechnical sensors are analog

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The Digital Opportunity

Beyond Geotechnical field over last decade, design of instrumentation affected by two factors:

1. The ongoing revolution in computation and telecommunications

2. Explosion of sensor utilization in the automotive industry

A decade ago state-of-the-art sensing technology was largely confined to government, military and university laboratories. *Today, low mass produced commercial components are the state-of-the-art.*

More cost effective geotechnical sensors can be built using digital as opposed to analog technology

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Point 1. Ongoing revolution in computation

IBM - XT

Speed: *4.77 MHz*
RAM: *64k*
ROM: *64k*
I/O: *RS232* +
Cost: UKP1000-1500

Micro-Controller (MCU)

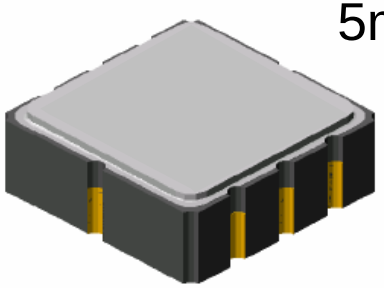
"*Micro-computer on a chip***"**

Speed: *20 MHz*
RAM: *1K*
ROM: *8K FLASH*
I/O: *UART (RS-232)*
Cost: $2-5

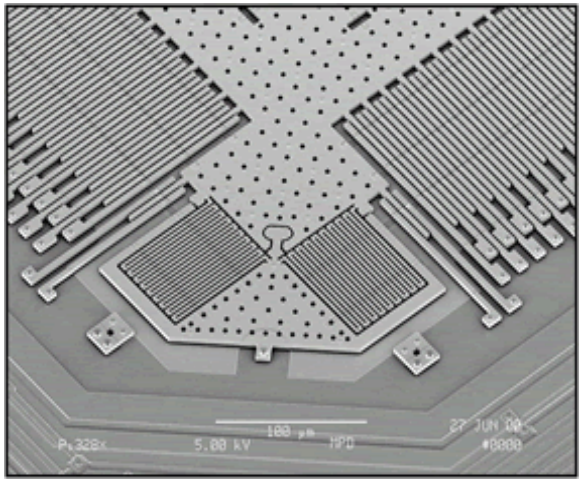
"Embedded Systems"

POINT 2: Transducers in Automobiles

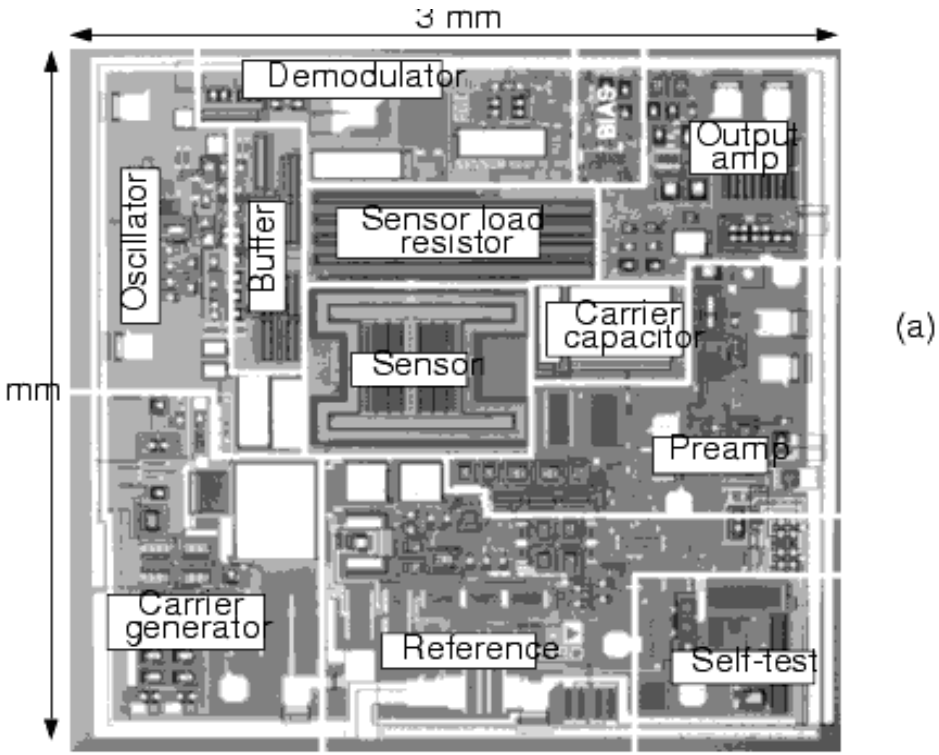
5mm x 5mm



$10-25 (in Qty)



100μm



(a)

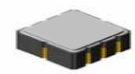
MEMS +/- 1.3g Accelerometer

ANALOG DEVICES

Digital Sensors Architecture

=

2.



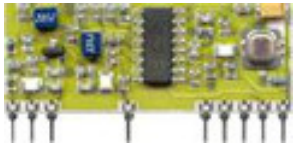
Transducers

+

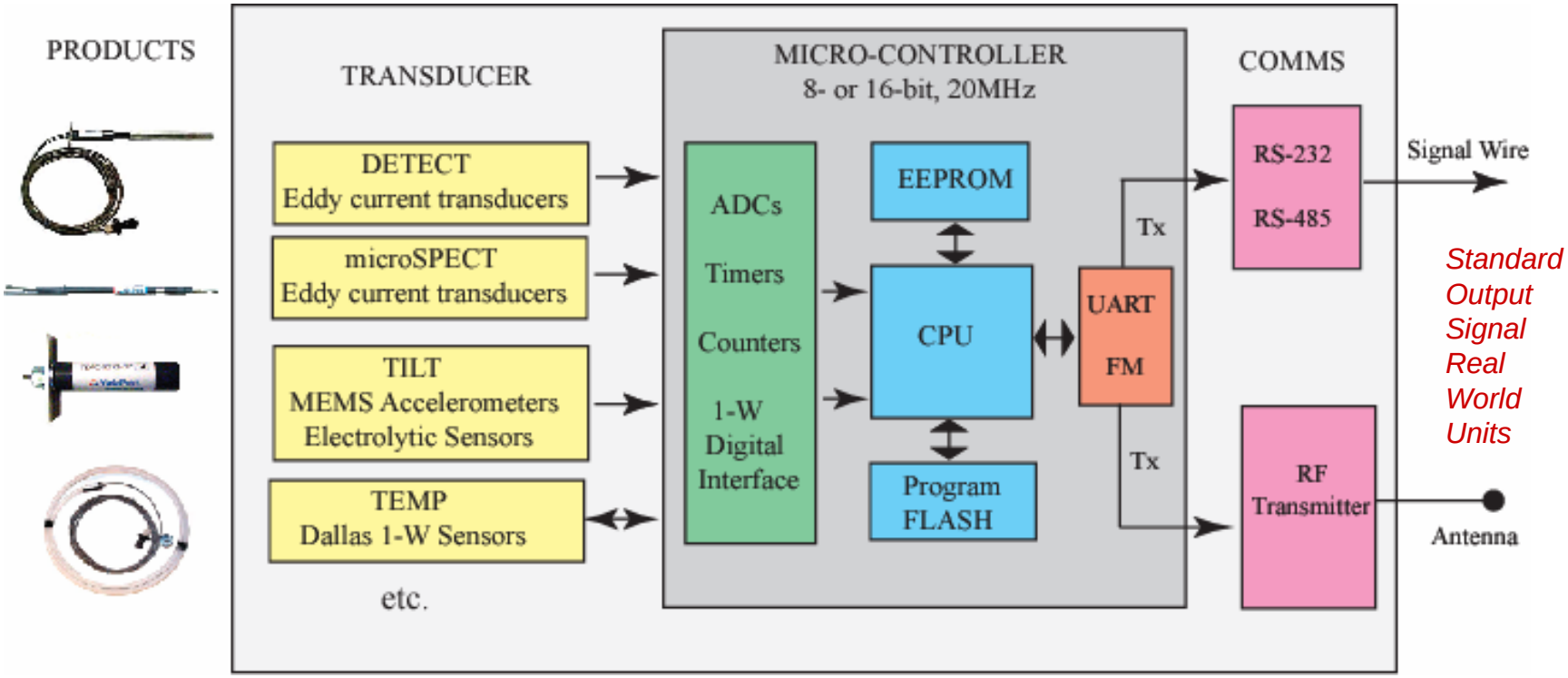
1.

MCU

+/-

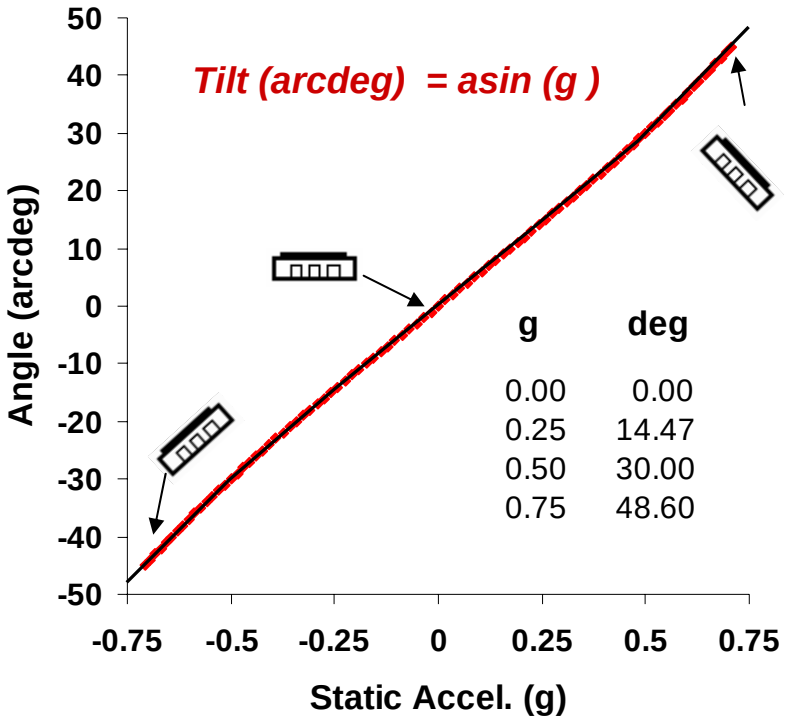


RF Transceiver



MCU Tasks: Conversion + Filtering

1. Units conversion:



2. Digital Signal Processing (DSP):

Take 10,000 readings over 2s period and average

- *Reduce noise floor*
- *Increase effective resolution*

3. Output Signal

Transmit Standard Digital Output Signal

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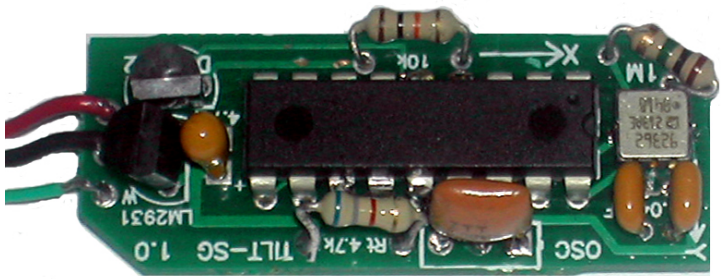
TILT (Tilt, Inclination, and Leveling Technology)

Static Application:

Dual Axis TILT-SG sensor



- Sill Mat monitoring
- Crown pillars
- Brow monitoring
- Roof monitoring

Range +/- 30 arcdeg. Res. 0.01arcdeg

Dynamic Application:

Biggest Opportunity: Seismic monitoring over mine communications system. Low cost Digital wireless micro-seismic Systems (5kHz bandwidth)

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DETECT - Digital Extensometer Technology using Eddy Current Transducers

Measurement of movement around underground excavations is the most fundamental indicator of instability.

DETECT-GMM

<40% price of Pot. GMM

DETECT-6EX

<50% price of SMART MPBX

DETECT-CABLE

Patents Pending

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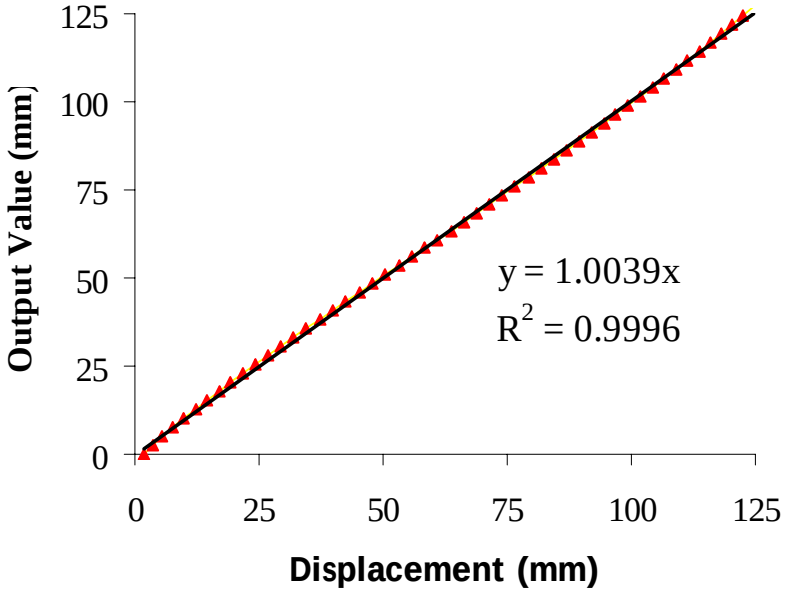
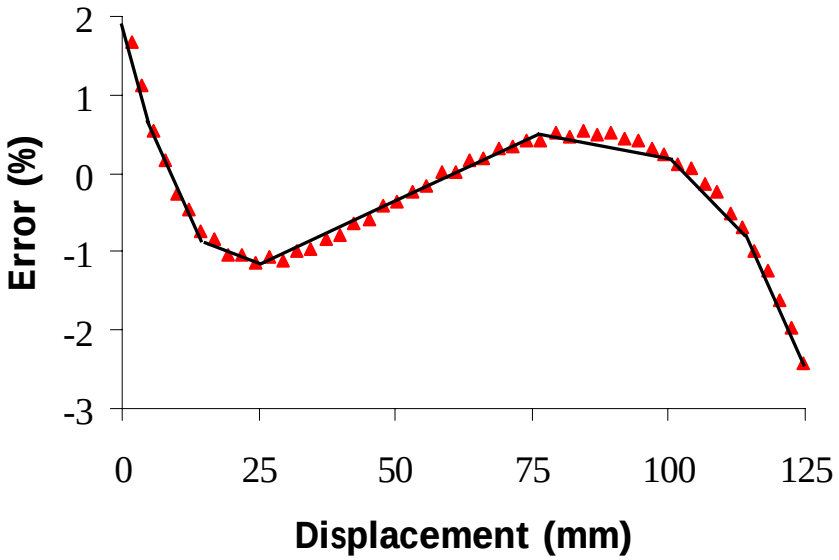
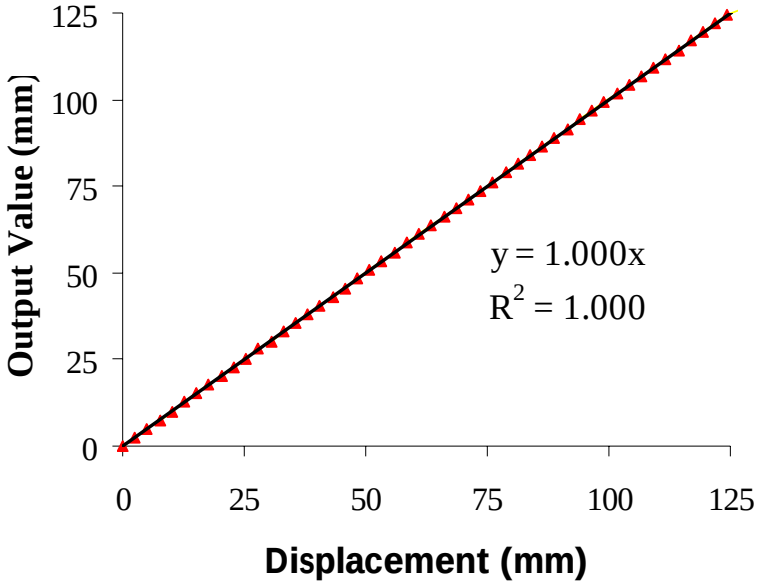
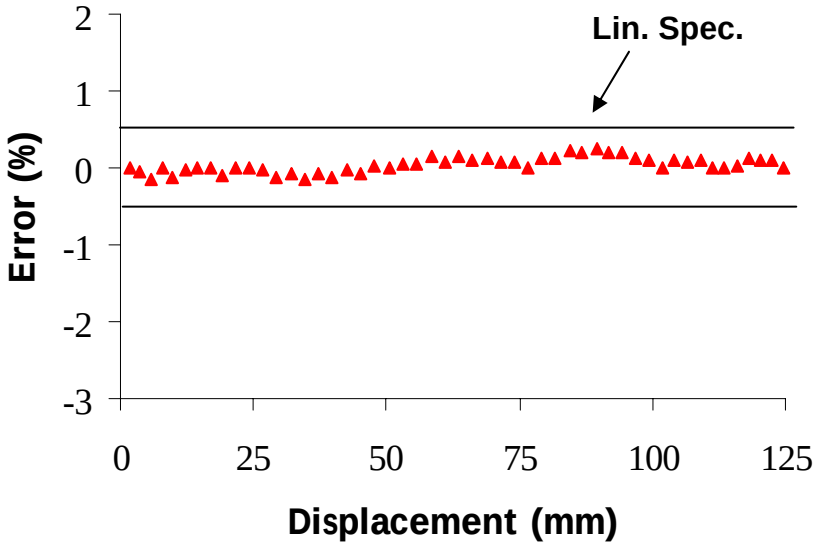
MCU Task: 3. Linearity Correction









7 Reasons Why Digital Sensors are Better

1. Improved Accuracy (i.e. Linearity)
2. Improved Reliability (e.g. non-contact)
3. Output in Real World Units. All digital sensors have standard readout signal.
4. Output signal includes SensorID+ SensorType
5. Many channels on a single wire.
6. Simplified Low-cost Peripherals (e.g.Dataloggers)
7. Simplified Data Transmission(ESG Seismic System, MRS leaky feeder, El-Equip leaky feeder)
8. Simpler Data Management

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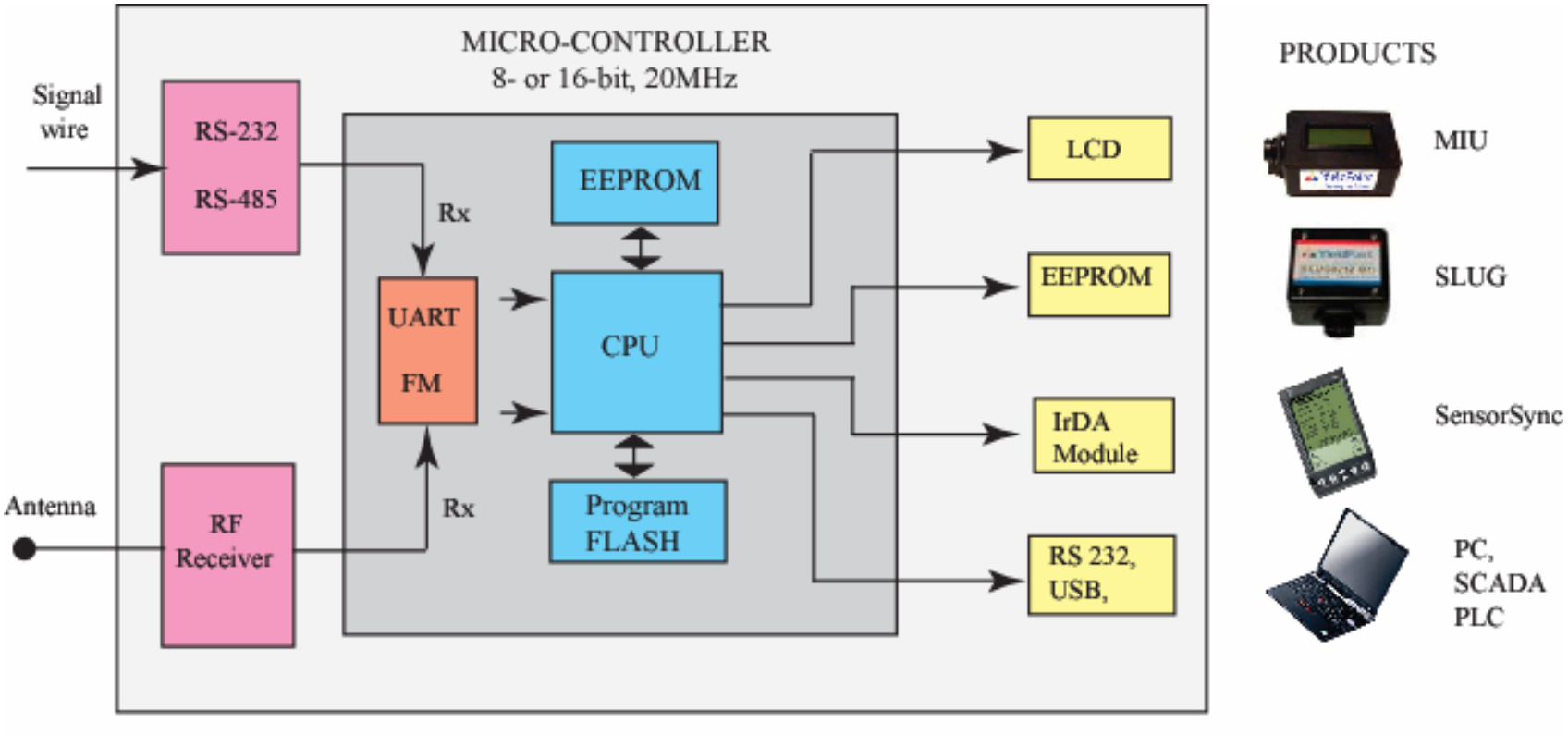
Peripheral Devices

Periperal devices communicate with digital sensors and display, store or transmit data



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SLUG – Sensor Logger for UnderGround

Key Points:

Simple:
Parse data to memory

No Configuration:
Recognizes sensor type
Plug ‘n Play

Low power consumption:
100 days at 1rdg/hr
½ year at 1 rdg/day

SLUG

SLUG 4

Low Cost:
20% (i.e. 80% less) cost analog data-loggers

DESTINY

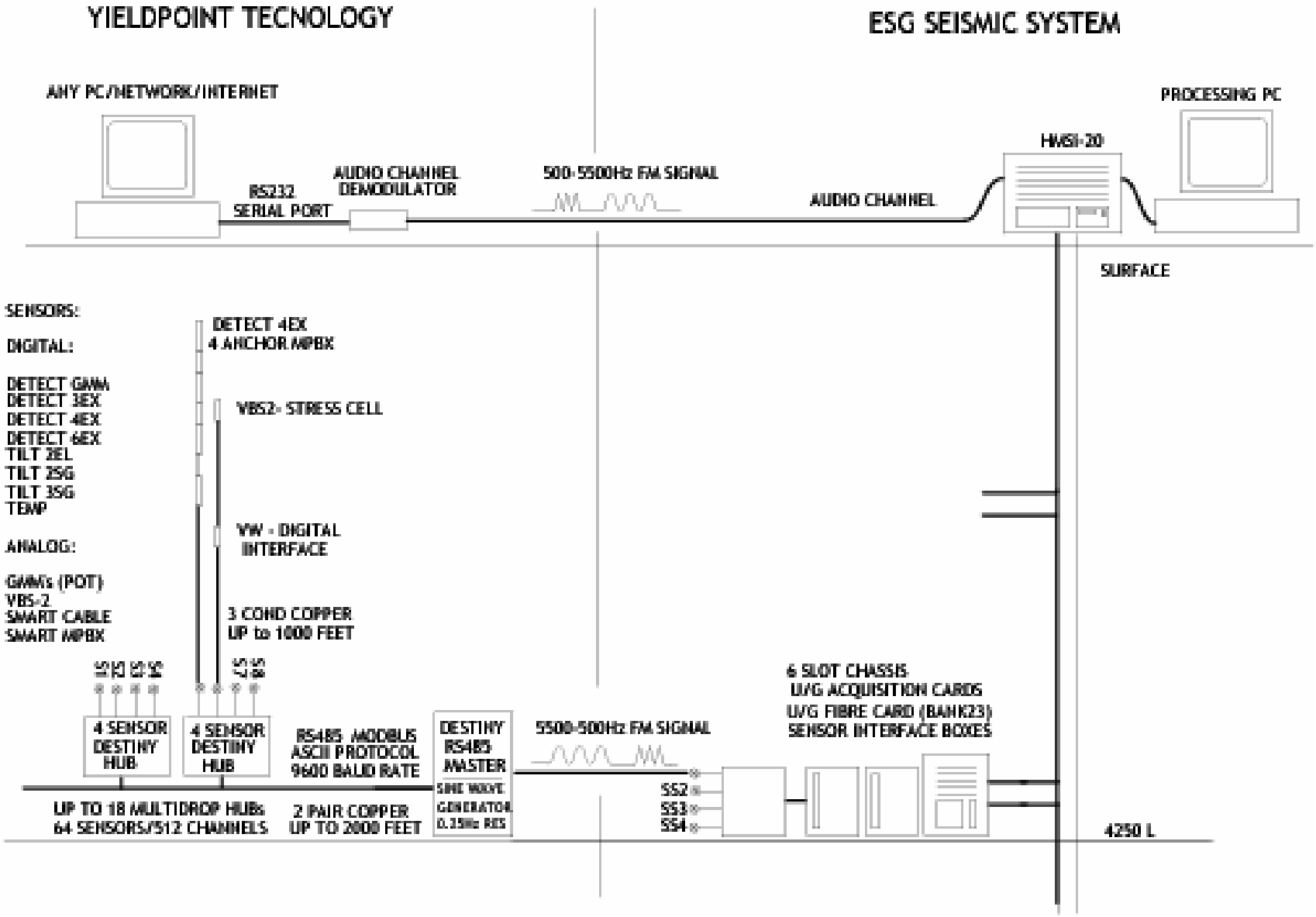
Digitally **E**nabled **S**ensor **T**ransducer **+**
Instrumentation **N**etwork **by** **Y**ieldpoint

Network sensors + Interface with existing mine communications Infrastructure

DESTINY RF SLAVE

- 10 RF channels between 433 and 434MHz
- Open Air Range of **200m**
- 9600 baud rate
- Wired version: mulidrop RS485 enabled
- Modbus ASCii Protocol
- Ethernet Option also available

Cost Effective: compared with $1000's spent protecting lead-wires



64 Sensors/512 Channels of Conventional Instrumentation over 1 seismic channel

Data Management: MineScape

DATA IS ALREADY IN REAL WORLD UNITS

- No need for transformations, temperature compensation
- Feed data directly into structured Database
- Monitor Trends in the data and compare with alert thresholds
- When alarms triggered e-mail alerts
- FTP offending data to internet server (HTML + XML)
- Data viewed by technicians, engineers, consultants

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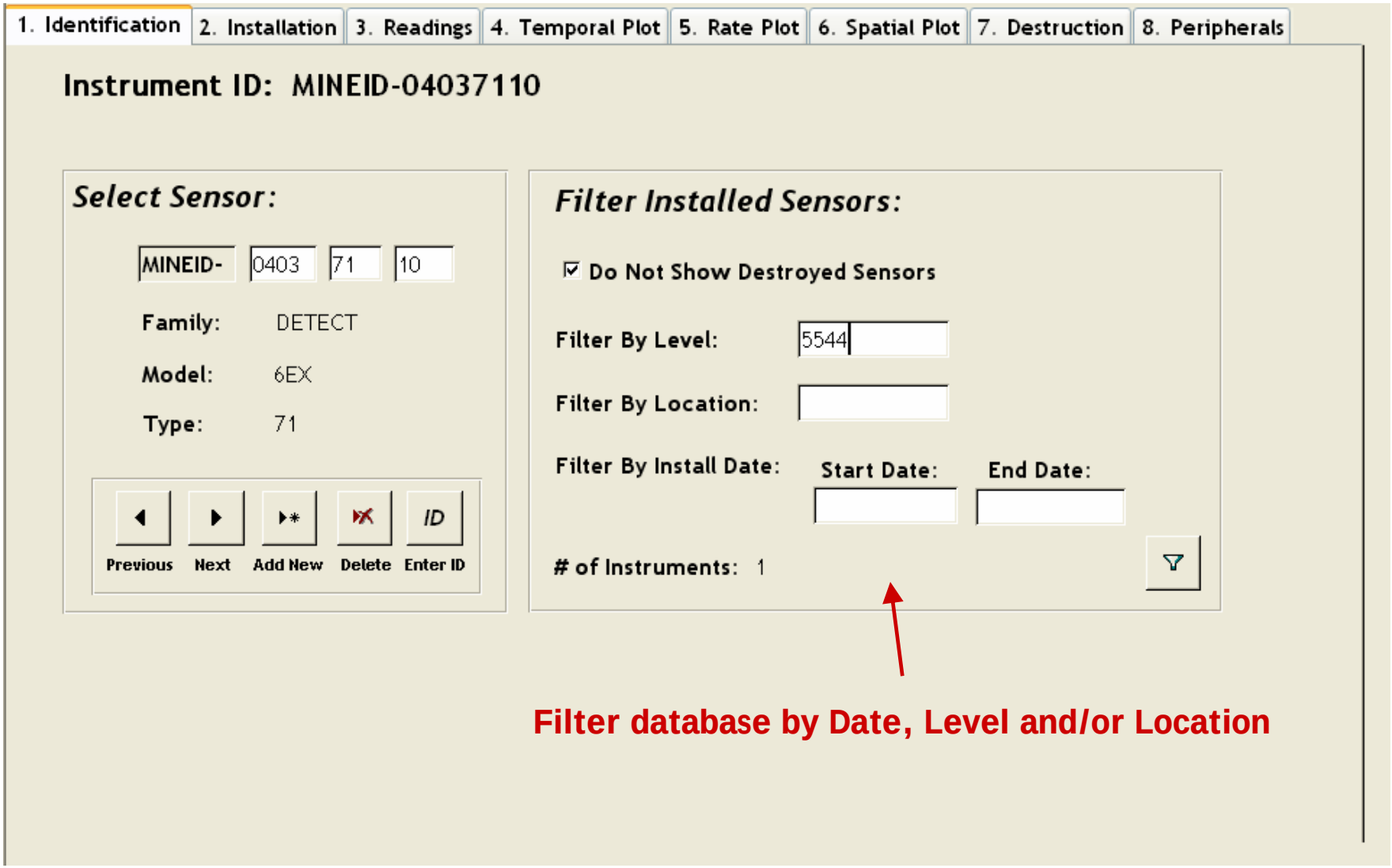
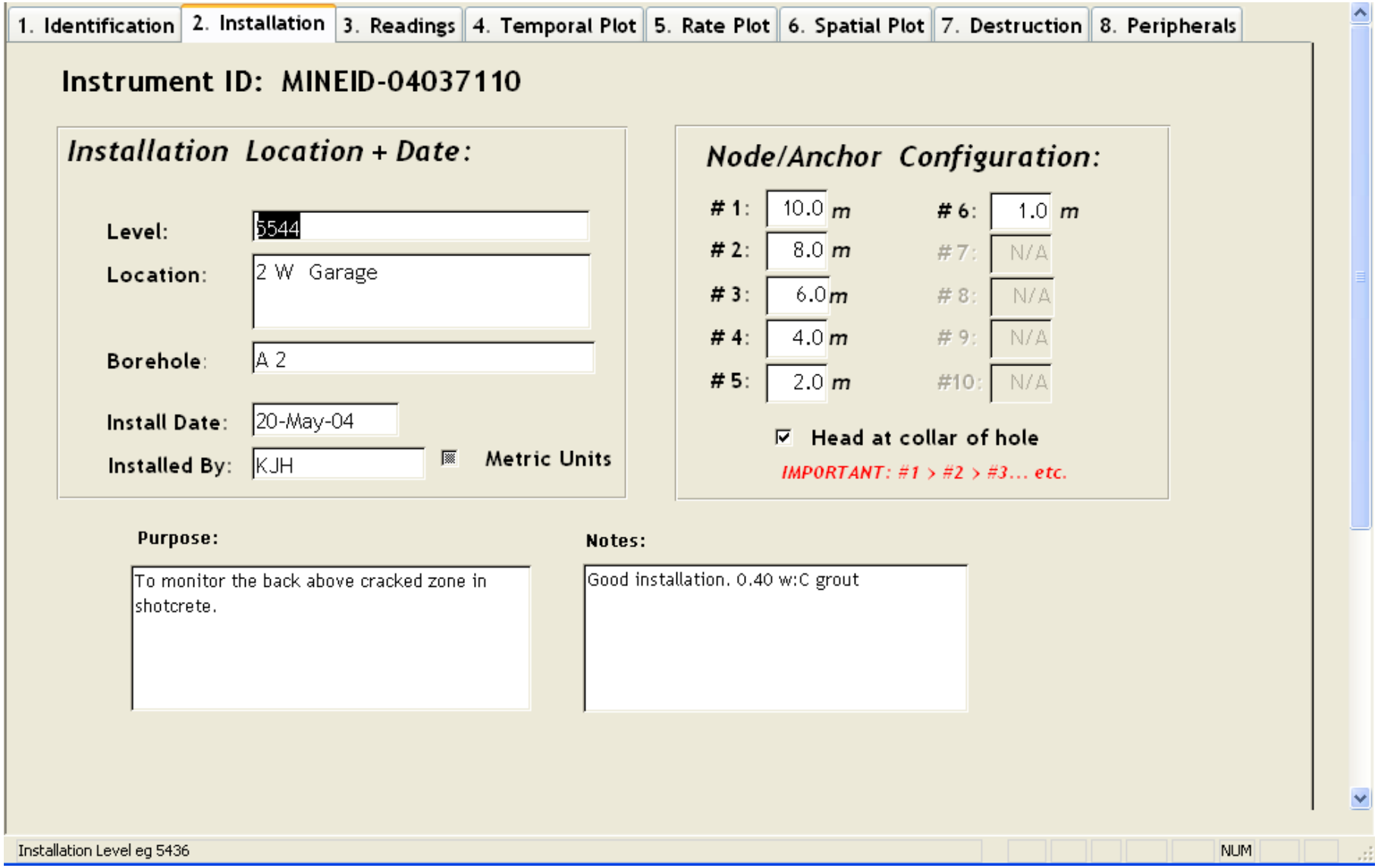
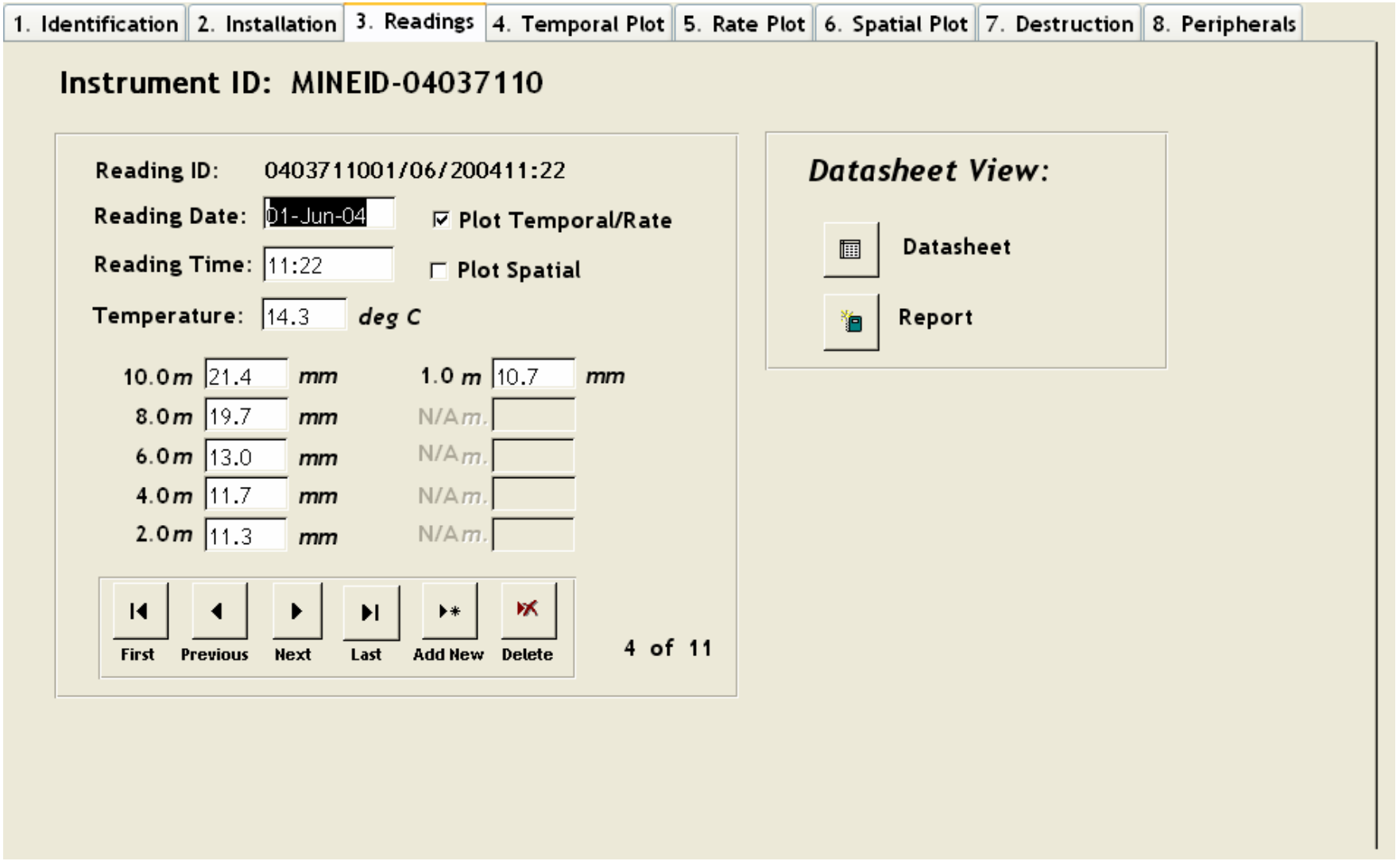
MineScape: DataBase (not Spreadsheet) Oriented



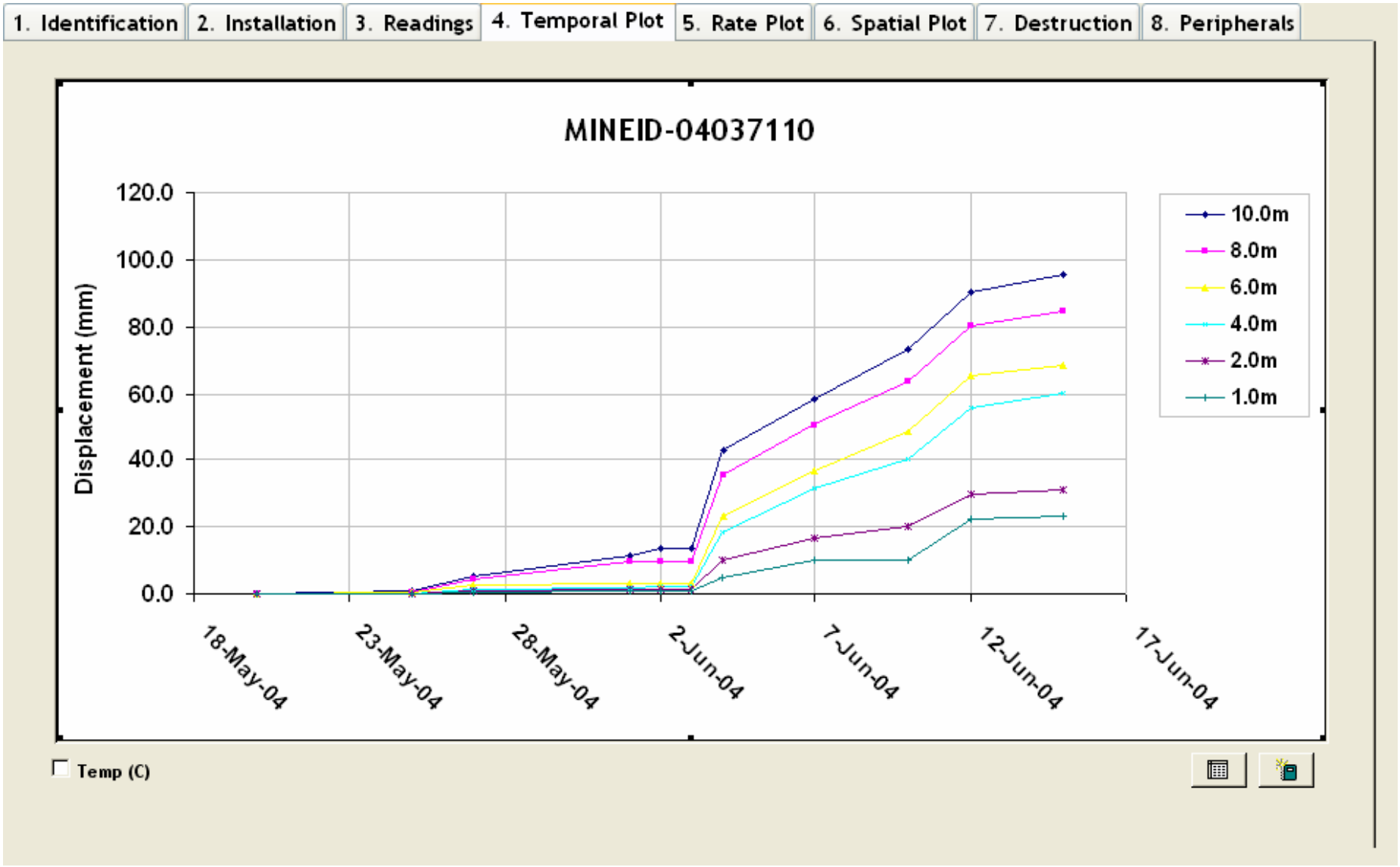
MineScape: 2. Installation



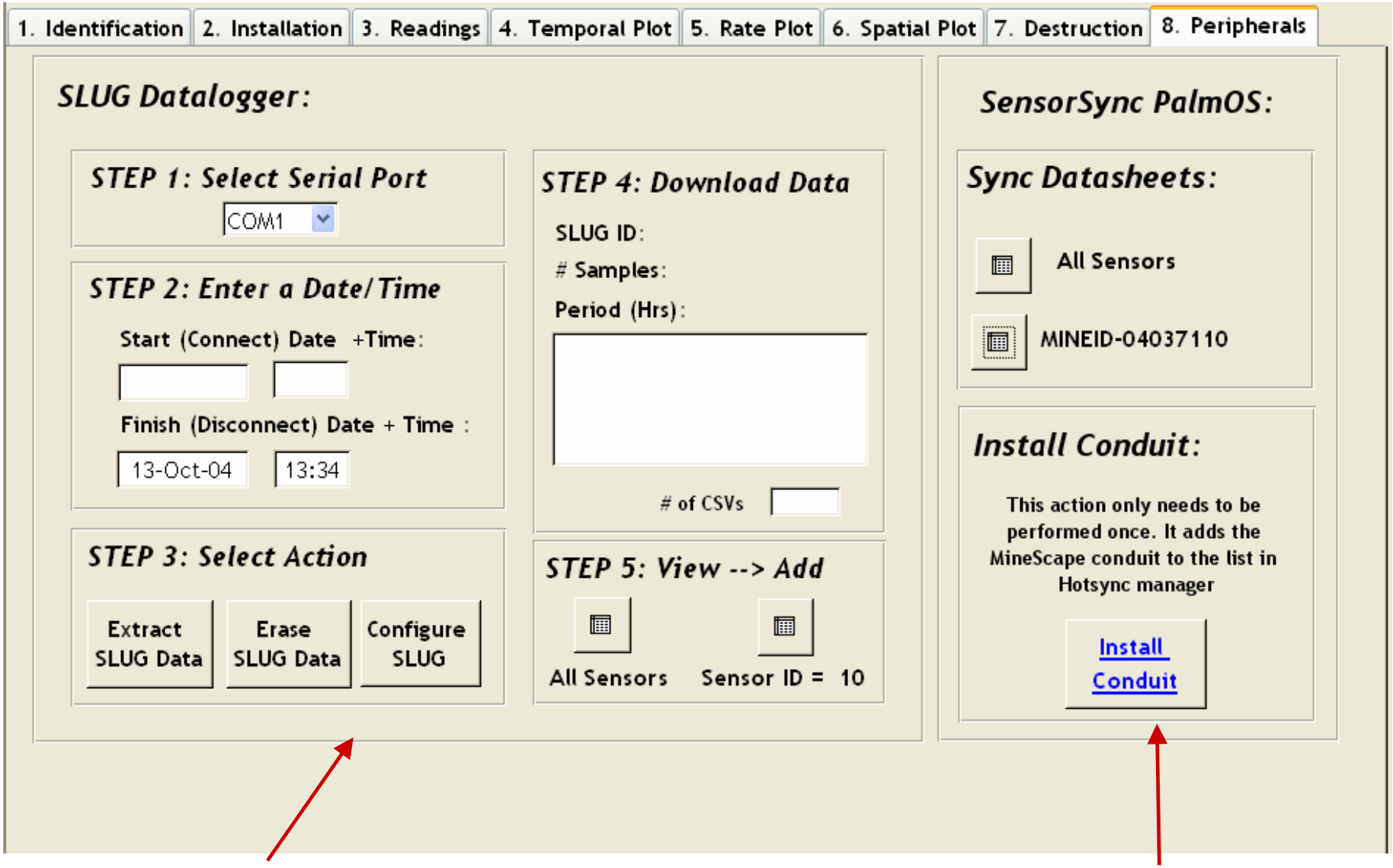
MineScape: 3. Readings



MineScape 4. Temporal Plot



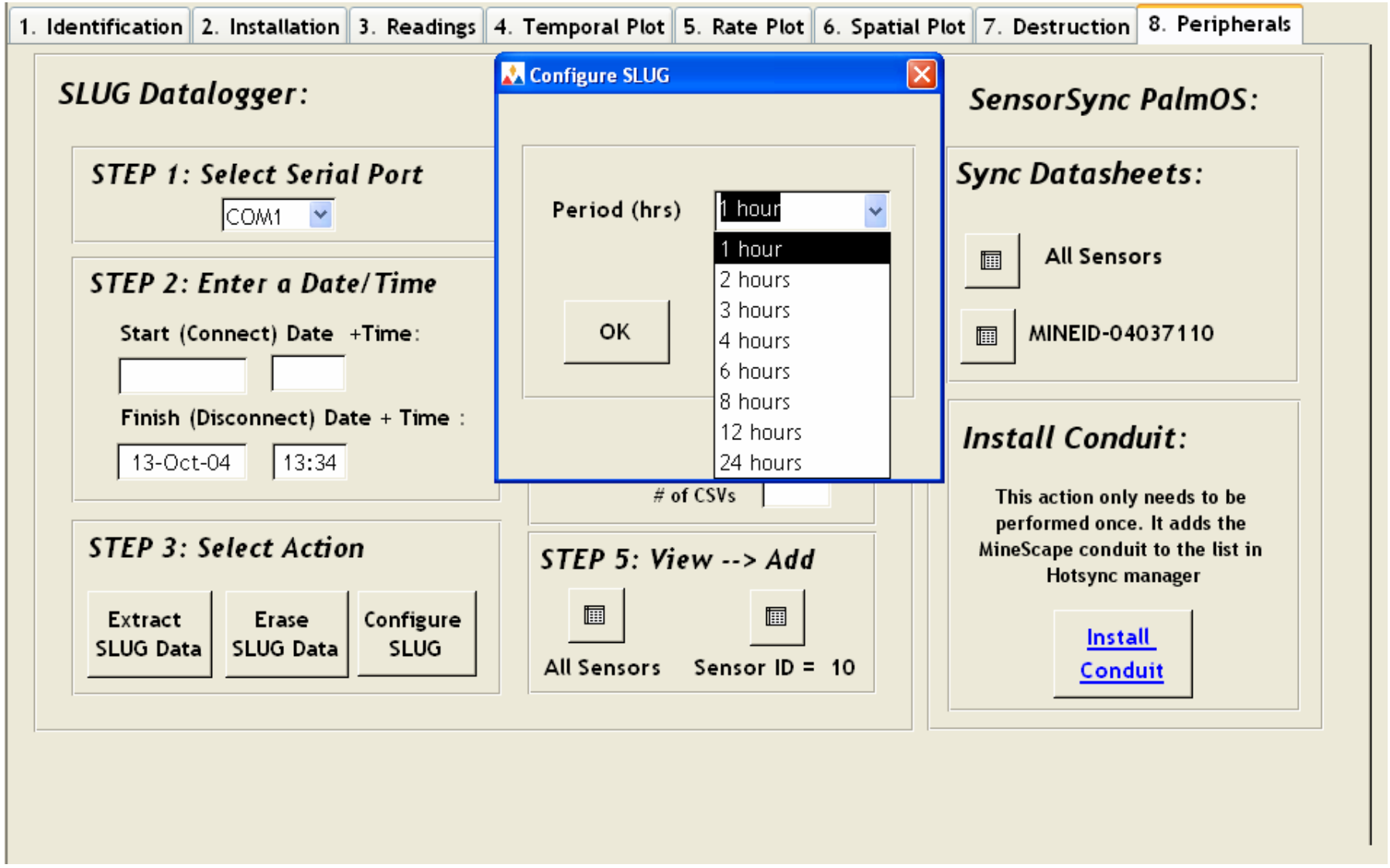
MineScape: 8. Peripherals



SLUG Interface

SensorSync - PalmOS

MinesCAPE: Configure Slug?



DIGITAL GEOTECHNICAL SENSORS WITHIN THE DIGITAL MINE

- Digital sensors are typical 40-60% less expensive than analog sensors with even bigger savings in overall cost.

- Low cost peripheral devices integrate geotechnical sensors into the digital mine

- Data transmission over leaky feeder (MRS, El Equip) or MAN (ethernet) is routine. E-mail alerts+ data uploaded to internet.

- Data integrated with ESG seismic system

- YieldPoint seeks mining operations to demonstrate Case Studies for this new exciting technology.

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