RUSS COLLEGE of Engineering and Technology

Getting Started with IEEE 1451 Smart Sensors

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OHIO UNIVERSITY

Use of TEDS Based Sensors and Data Acquisition Field Applications

- ORITE
- Analog sensors used
- Current field applications
- APLF
- Use of TEDS based sensors and data acquisition acquisition

Ohio Research Institute for Transportation and the Environment

Field Evaluation of Pavements

- Ohio SHRP Test Road, US23 Delaware, Ohio
- US33, SR2, US50 Ohio
- I 490 Rochester, New York
- Accelerated Pavement Load Facility

Ohio SHRP Test Road

- 33 Instrumented test sections
- Sensors used to measure environmental factors
  - Pavement Temperature
  - Soil Moisture
- Sensors used for dynamic response monitoring
  - LVDTs used for pavement deflection
  - Strain Gauges
  - Pressure Cells

Other Pavement Projects

- Multiple sensors used to measure deflection, pressure and strain due to environmental factors factors and dynamic loading

Sensors Used

- Over 700 strain gauges used
  - Dynatest Embedment gauges
  - Vishay Micro Measurement Embedment Gauges
  - Geokon Vibrating Wire Strain Gauges
- Over 600 LVDTs Used
  - Lucas Shaevitz
  - Macro Sensors
  - Sensotec

Sensors Used

- Over 200 Pressure Cells Used
  - Geokon
  - Sensotec
- Thermocouples
  - Omega Engineering
- Kistler Accelerometers

Sensor Installation

- Award winning in-situ sensor installation procedures
- Provides minimal disturbance to contractor
- Assures high sensor survivability rate
- Provides most accurate data collection

Sensor Installation

Sensor Installation

Sensor Installation

Sensor Installation

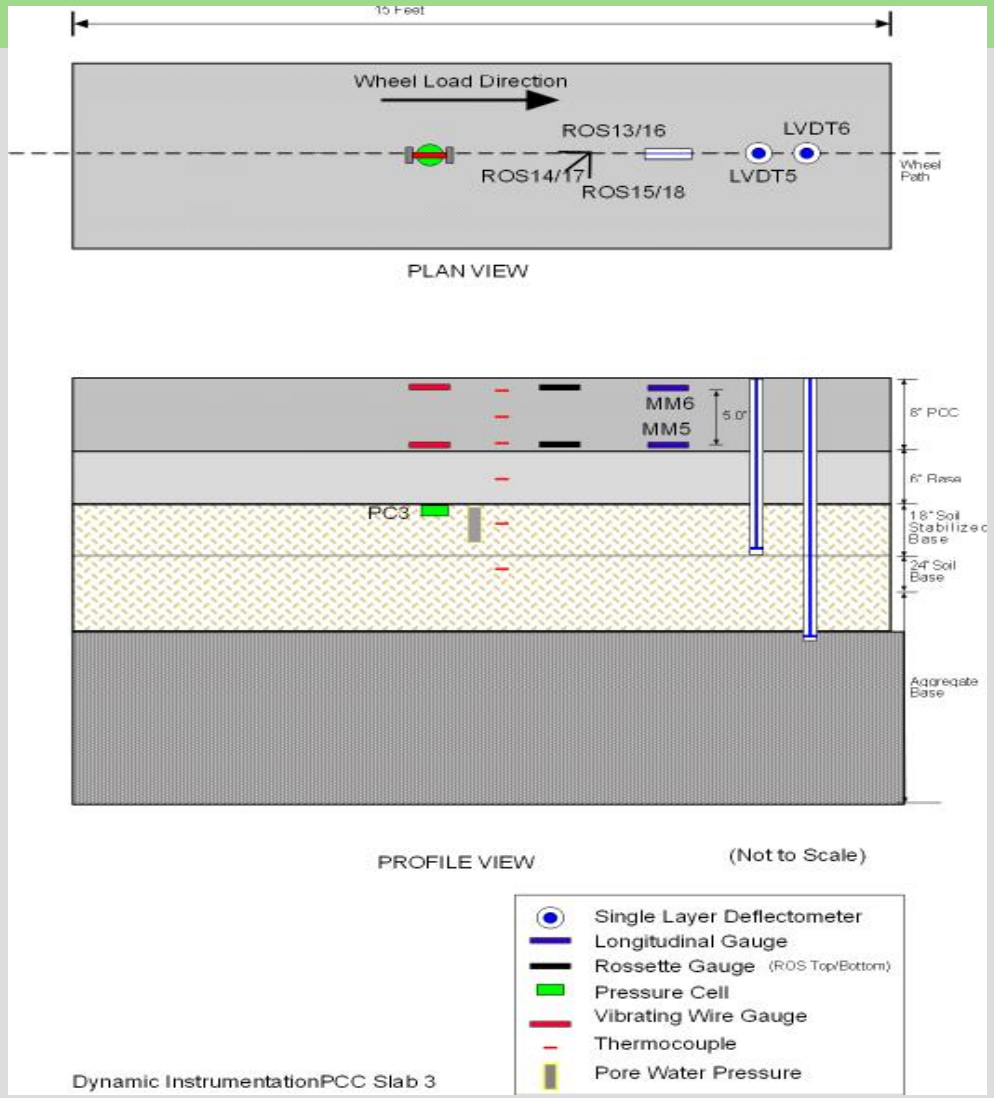
Sensor Installation in AC

Current Method for Sensor Management

- Label all sensors after receipt of shipment
- Check calibration on all sensor
- Use wire numbers to designate each sensor
- Use heat shrink labels at end of each sensor wire wire to identify serial numbers and location information
- Create data tables to cross reference sensor labels labels with field locations

Sensor Connections

Typical Field Installation Guide



System Shortcoming

- Inability to verify sensor identity after placement in placement in the pavement
- Possible damage to wire labels in the field
  - Contractor/Equipment
  - Weathering
  - Rodents

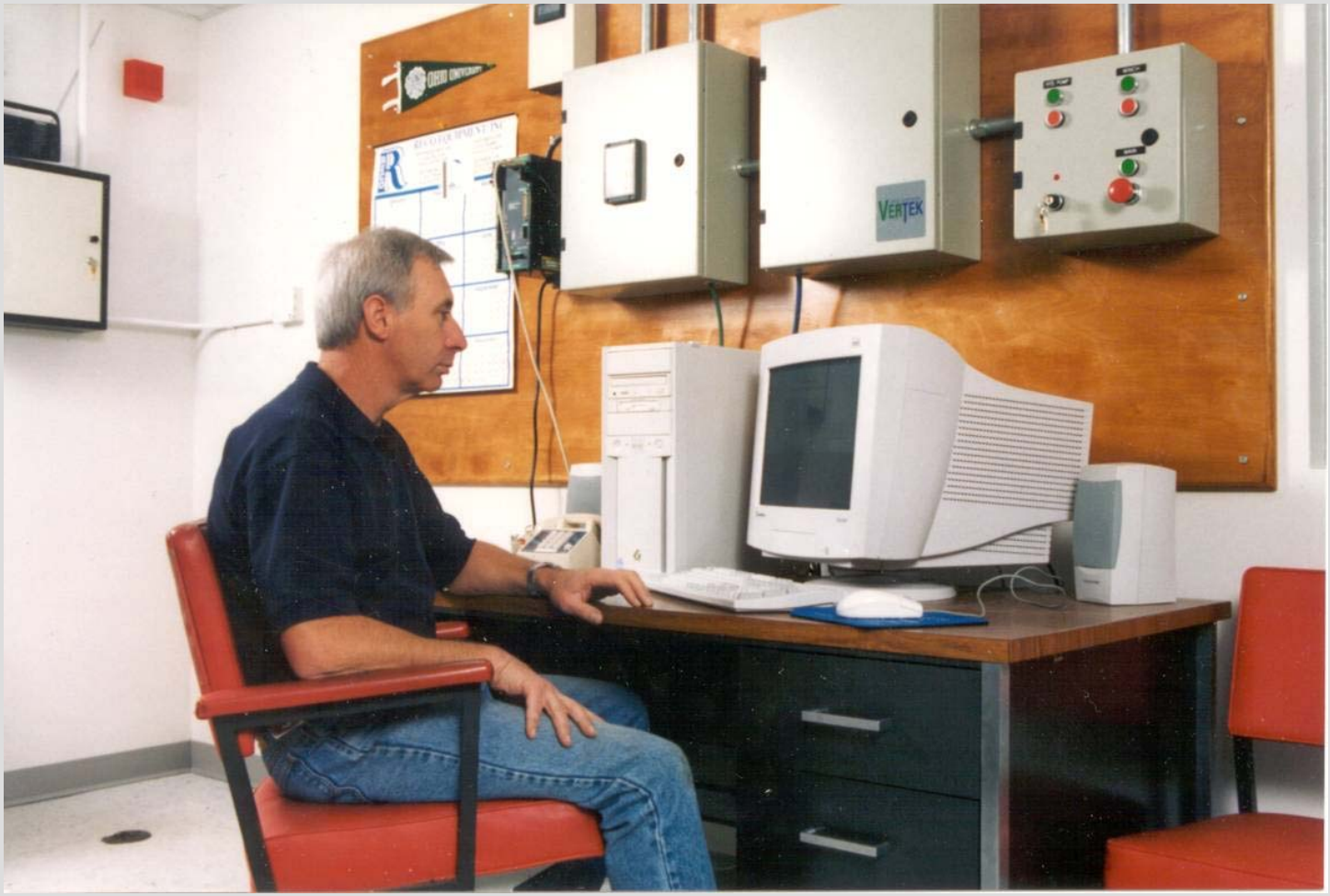
Accelerated Pavement Load Test Facility

- Owner/Operator: Ohio University,
  Ohio State University
- Location: Lancaster, Ohio, USA
- Enclosed Chamber with Controlled Loading, Air Air Temperature and Subgrade Moisture
- Test Pit: 13.7 m x 11.6 m x 2.4 m deep

Accelerated Pavement Load Test Facility

Accelerated Pavement Load Test Facility

Accelerated Pavement Load Test Facility

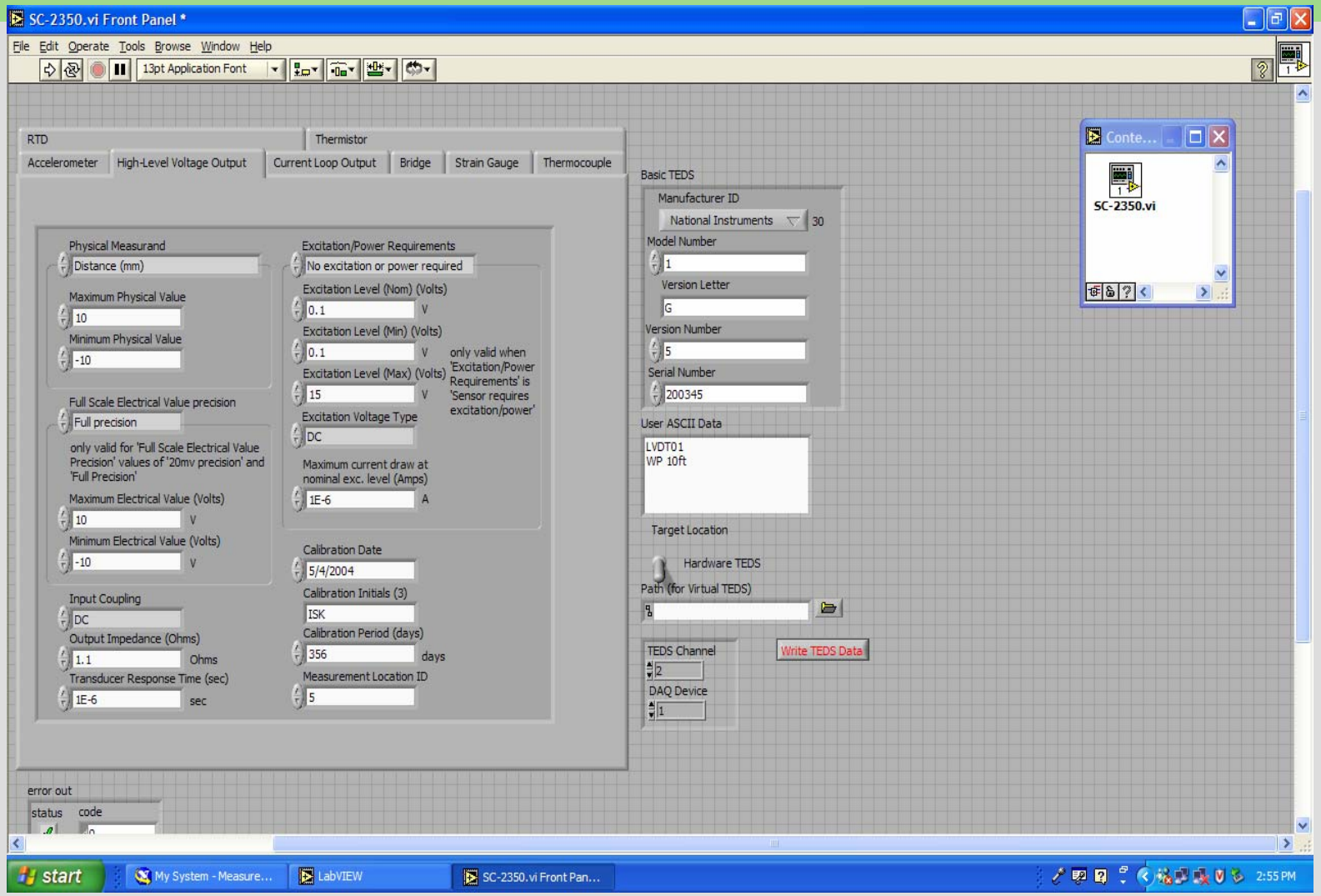


Use of TEDS Based Sensors/Data Acquisition

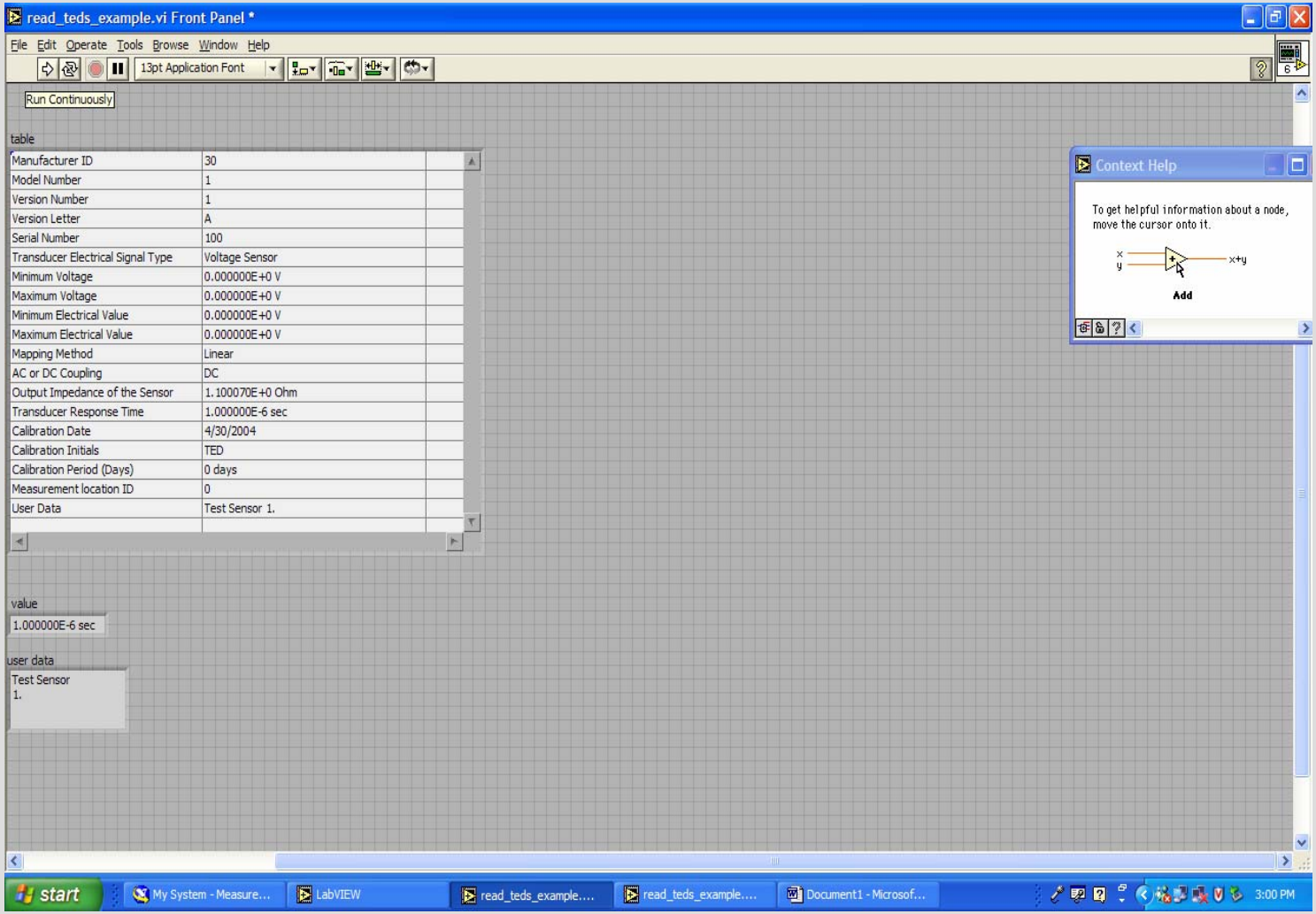
IEEE 1451 Smart Sensors

- National Instruments DAQCard-6062E
- National Instruments SC2350
- Sensotec S3C LVDT
- Weed Instruments SP101 TEDS thermocouple
- Dallas Semiconductor DS2433 EEPROM

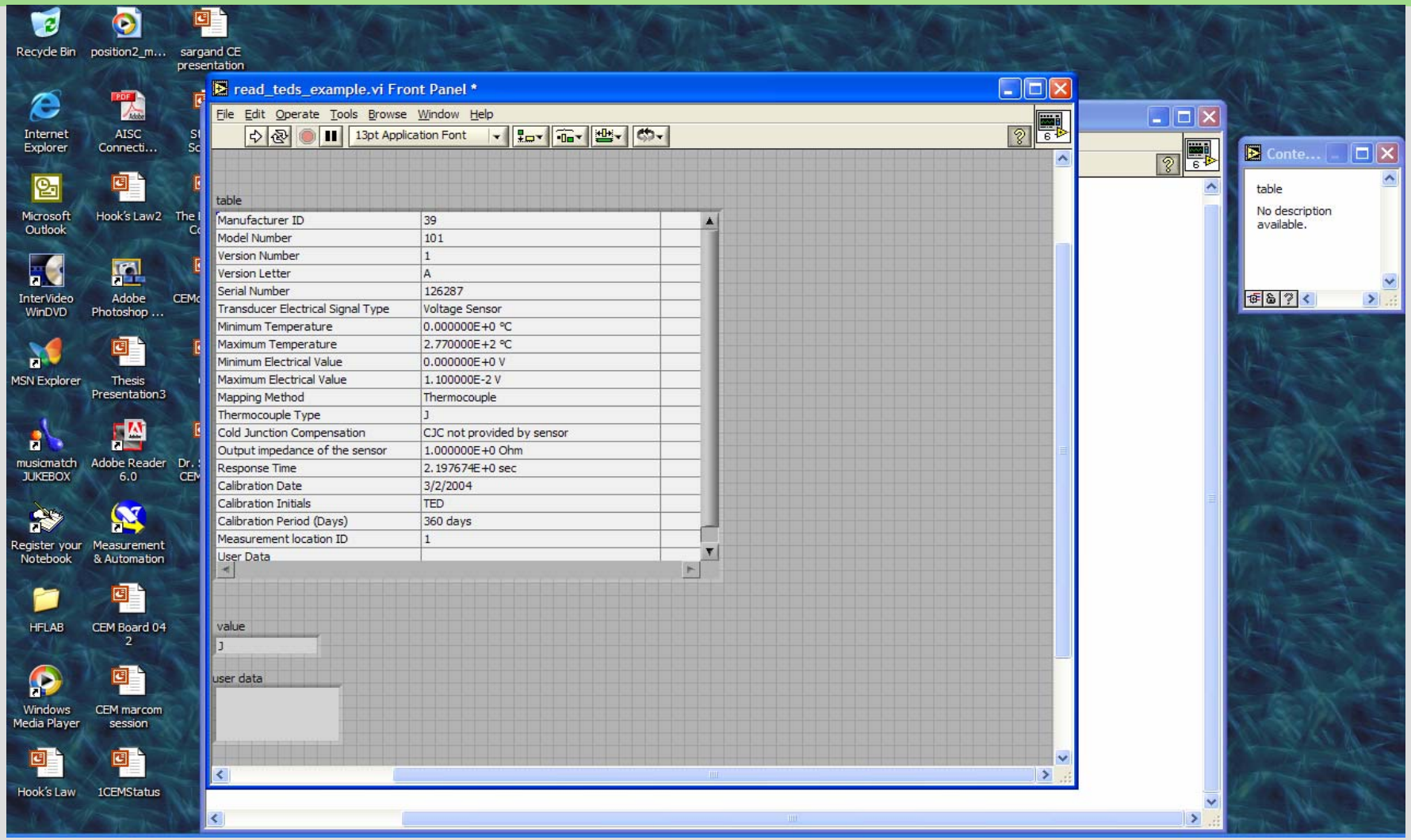
EEPROM Programming Procedure



EEPROM Readout



Thermocouple TEDS Readout



Current Data Acquisition Procedure

Standard Analogue Sensor Connections

- Match each channel with appropriate sensor using using sensor wire labels
- Manually program each channel to match sensor sensor
  - Calibration information
  - Other sensor requirement

TEDS enabled Data Acquisition

- Able to extract sensor information
- Able to automatically program each channel for the for the appropriate sensor information extracted extracted
- Unaffected by sensor wire labels

Conclusions

- TEDS based sensors/data acquisition successfully successfully tested
- We were able to program and extract information information from programmable chips
- Simpler to program channels with TEDS enabled enabled sensors
- Costs savings due to reduced amount of labor required to label all sensor wires

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