A Minimal Dot4 NCAP with a Compatible Sensor Bus

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Goals

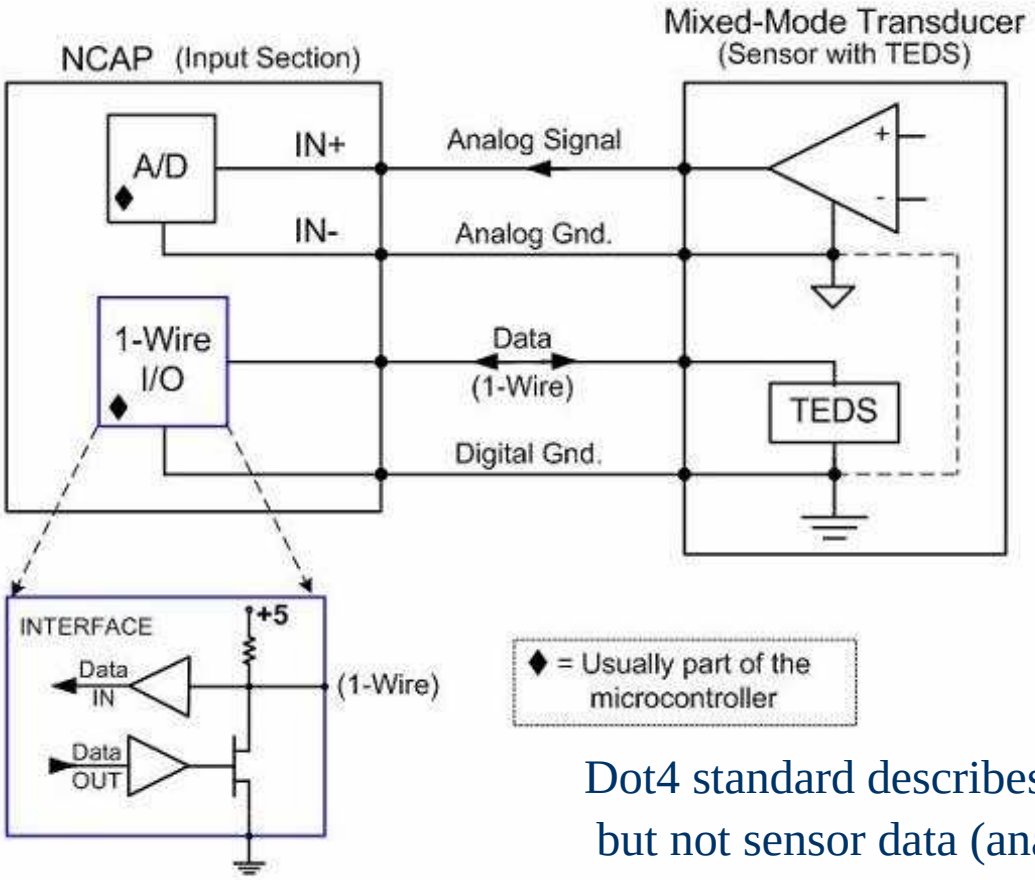
- Develop sensors with a IEEE 1451.4 (Dot4) TEDS
- Build a Dot4 TEDS Reader and Writer
- Develop a sensor bus (Dot4 bus) which will connect multiple analog sensors with TEDS
- Test a minimal Dot4 NCAP with a RS232 serial link to a PC

IEEE 1451 Parts

- IEEE 1451.0 Protocols & formats (nearly done)
- IEEE 1451.1 Object model (approved 1999)
- IEEE 1451.2 Interface (approved 1997)*
- IEEE 1451.3 Local network (approved 2003)
- IEEE 1451.4 Analog & TEDS (approved 2004)
- IEEE 1451.5 Wireless (final approval process)
- IEEE 1451.6 Open CAN (early approval process)

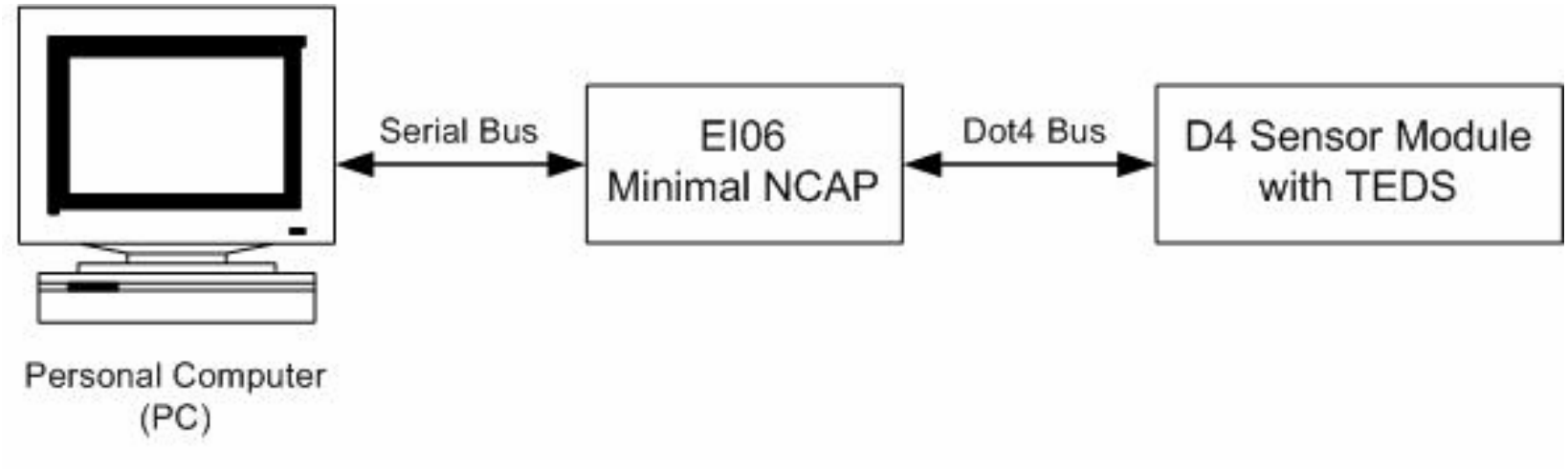
* Enhancement /revision working group in process

IEEE 1451.4 (Dot4) Mixed Mode Interface (MMI)

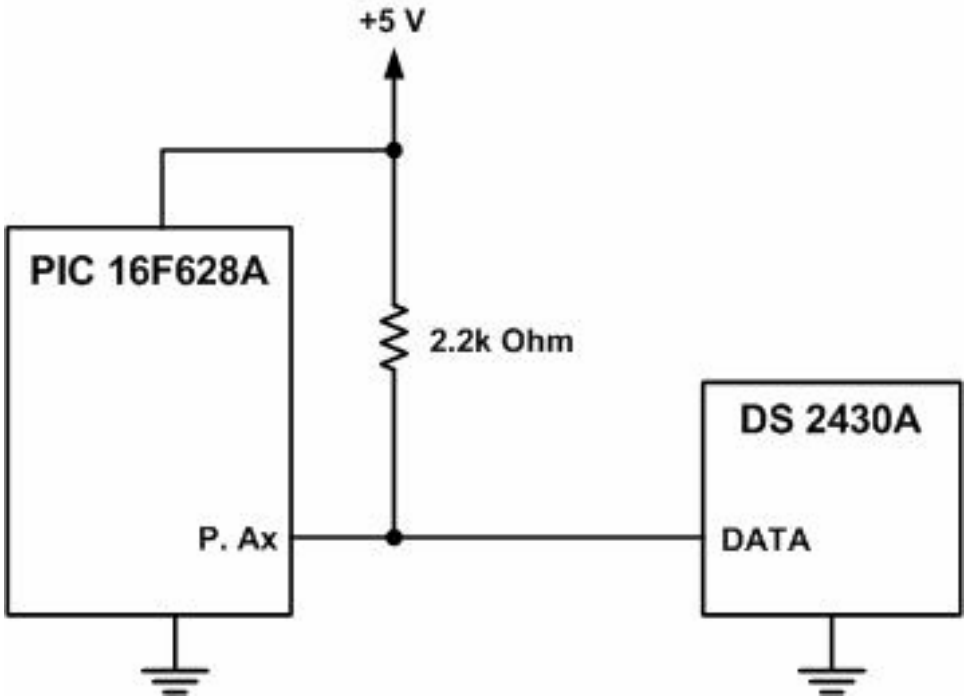


Dot4 standard describes TEDS
but not sensor data (analog) signal

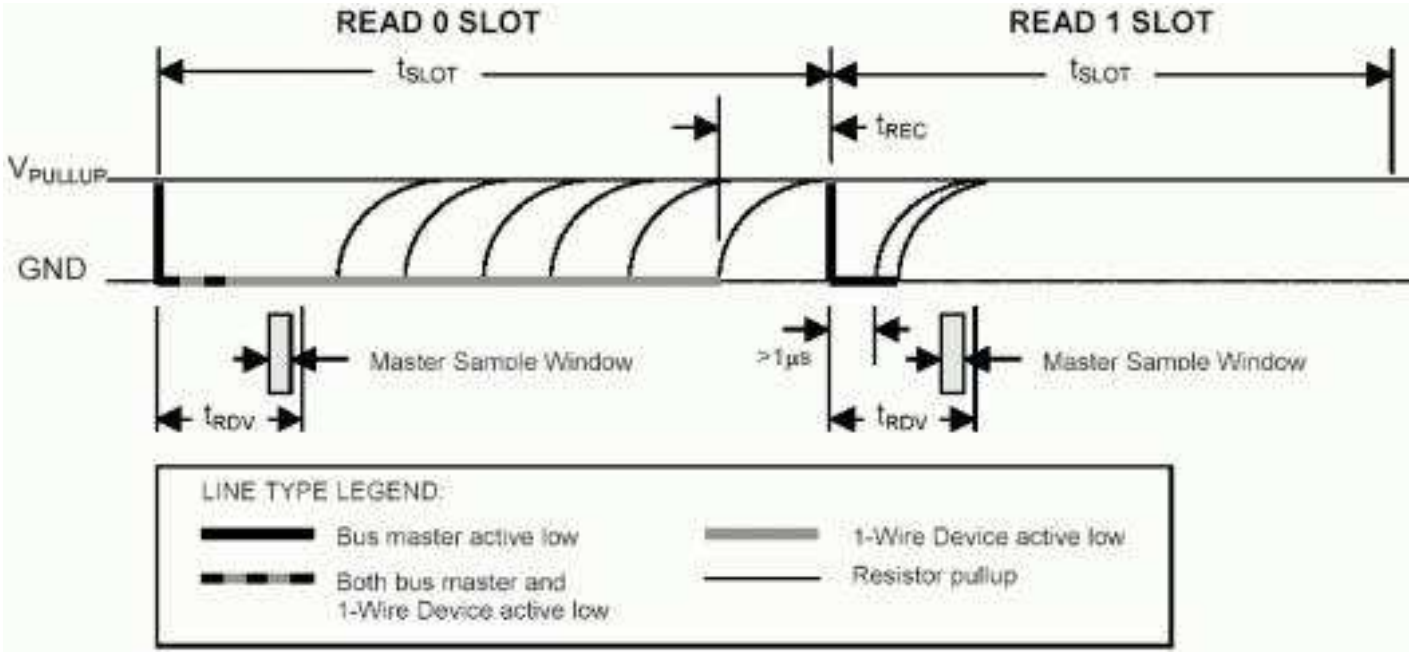
Dot4 System Block Diagram



A 1-Wire Interface to a Microcontroller



1-Wire Interface Timing Diagram



Dot4 TEDS, part 1 -- UUID

- TEDS is divided into three parts
- UUID (Universal Unique Identifier) is used to identify sensor (every sensor of all manufacturers has unique number)
- A 6-byte (48-bit) binary code (plus 1-wire family code and CRC) which is supplied by the EEPROM manufacturer and controlled by the IEEE.

Dot4 TEDS, part 2 -- Basic

- Used for Manufacturers model and serial numbers
- 8 bytes (binary)
- Consists of five parts:
  - Manufacturer ID (14 bits)
  - Model Number (15 bits)
  - Version Letter (5 bits, A-Z)
  - Version Number (6 bits)
  - Serial Number (24 bits)

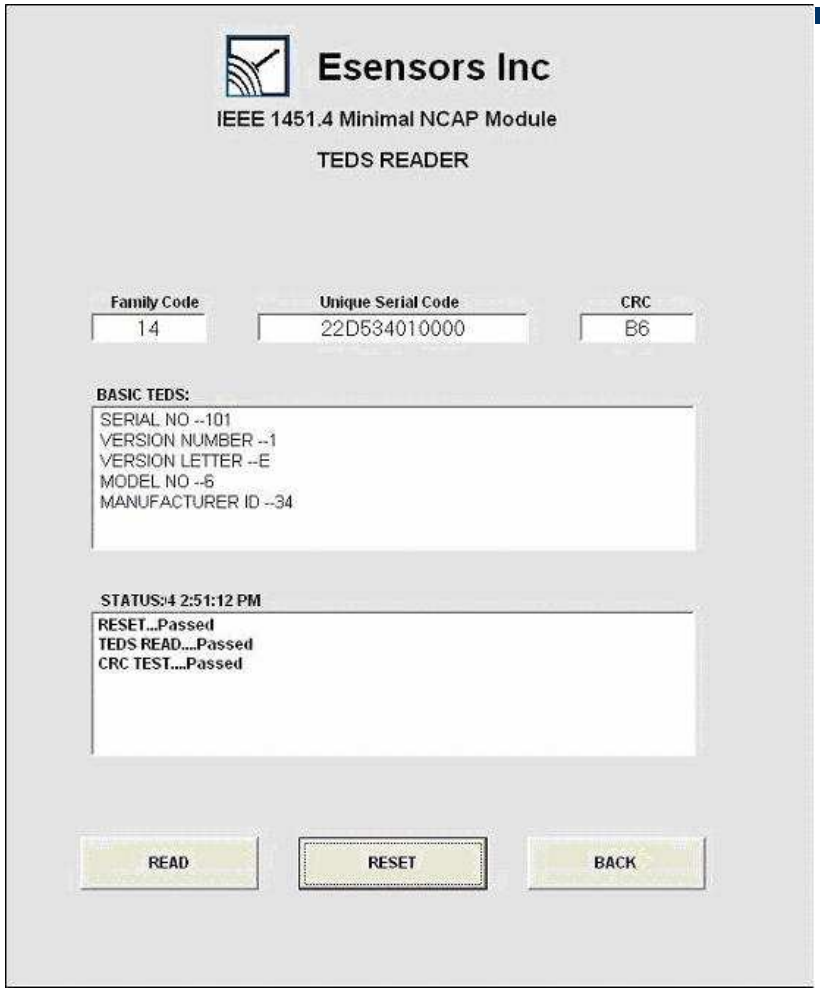
Dot4 TEDS, part 3 – IEEE/Manuf.

- Optional TEDS section for calibration and other information
- Compact binary format (typically <32 bytes but no limit)
- IEEE option has a variety of sensor templates (e.g. bridge)

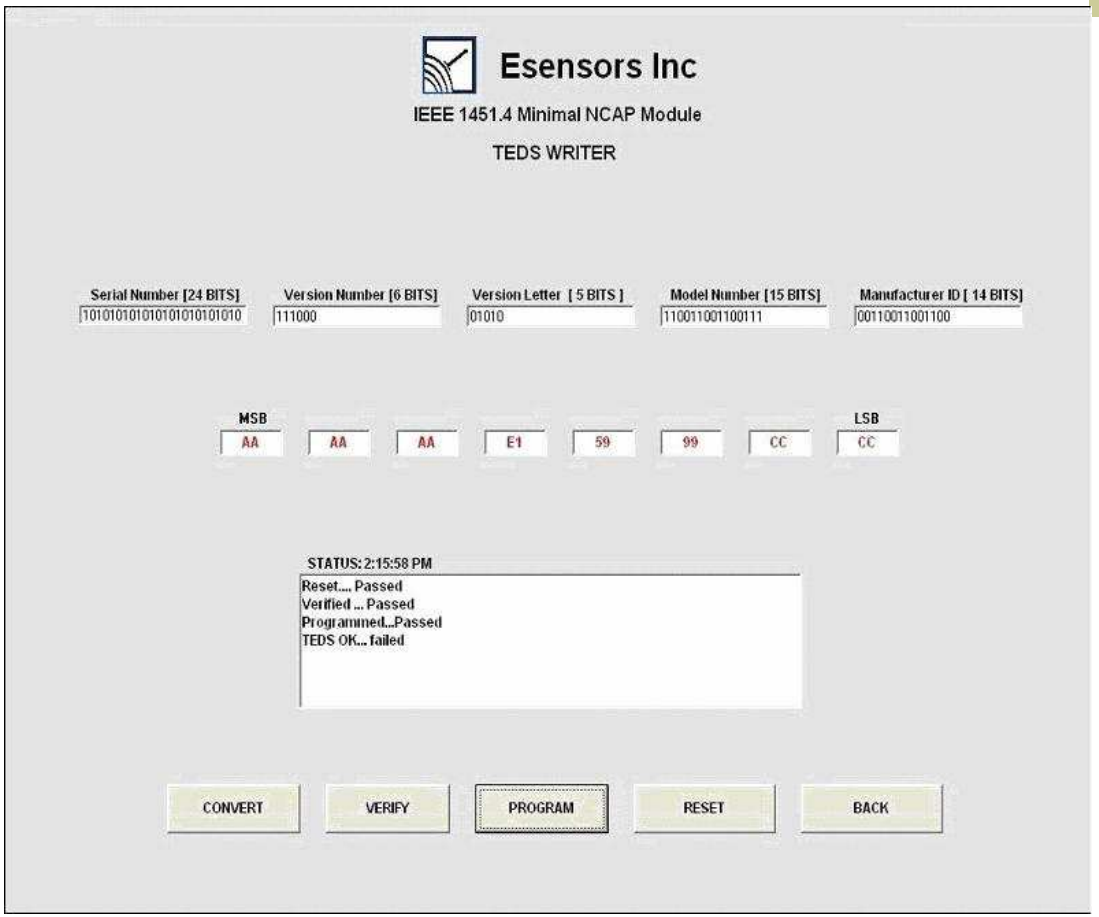
  A specialized program (normally hosted by PC) is needed to parse this TEDS data and expand it into a specification sheet form.
- Manufacturers option is unspecified

  (often used for specialized calibration constants)
- Virtual TEDS at another site (e.g. website) is allowed also

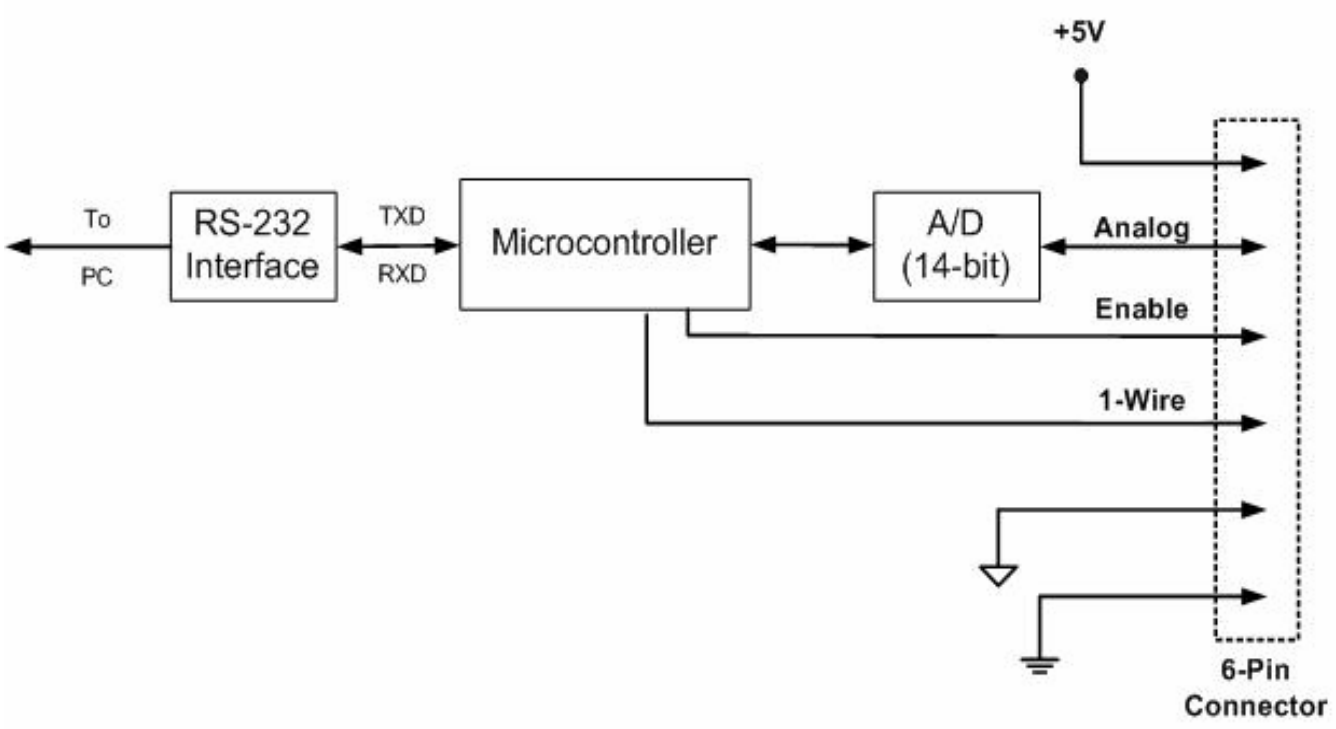
TEDS Data Reader (Screen Display)



TEDS Writer
(PC Screen Display)

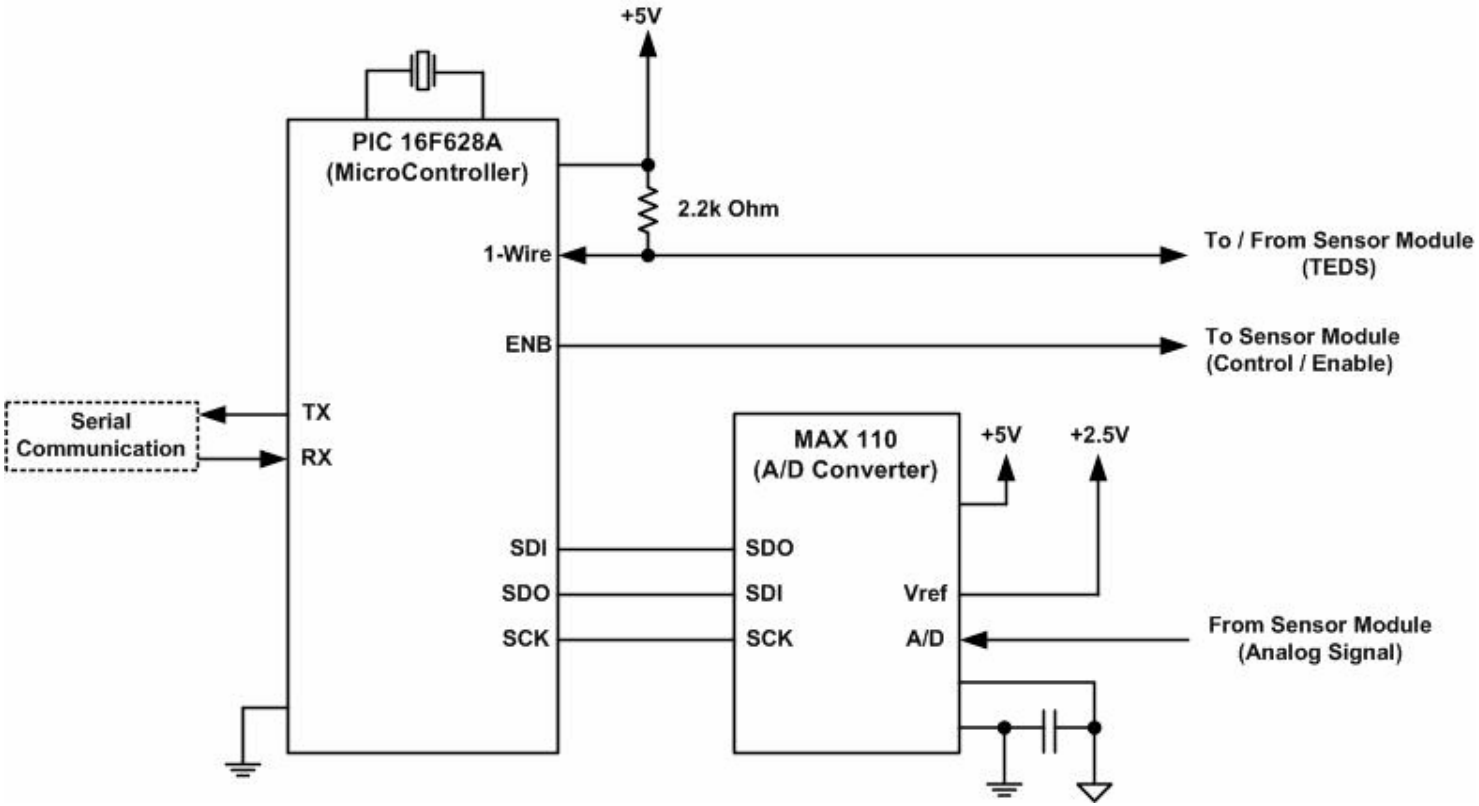


Block Diagram of Minimal (RS232 type) NCAP

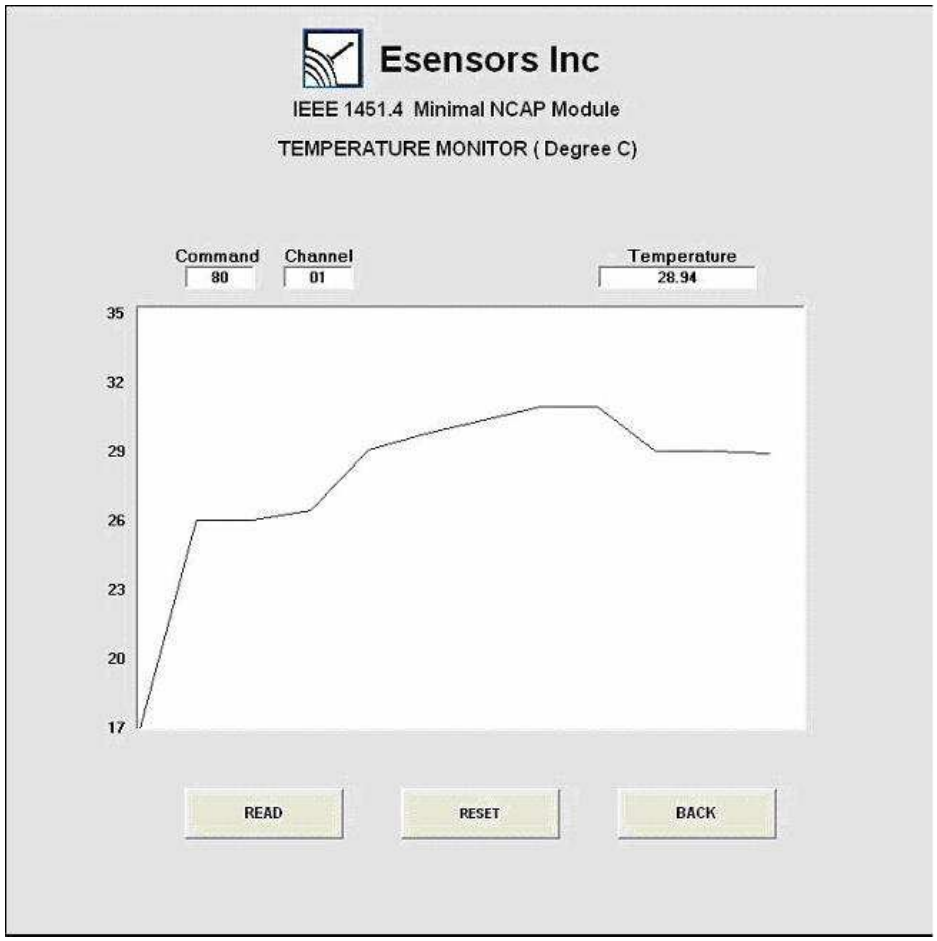


Dot4 Bus

NCAP Circuit Diagram

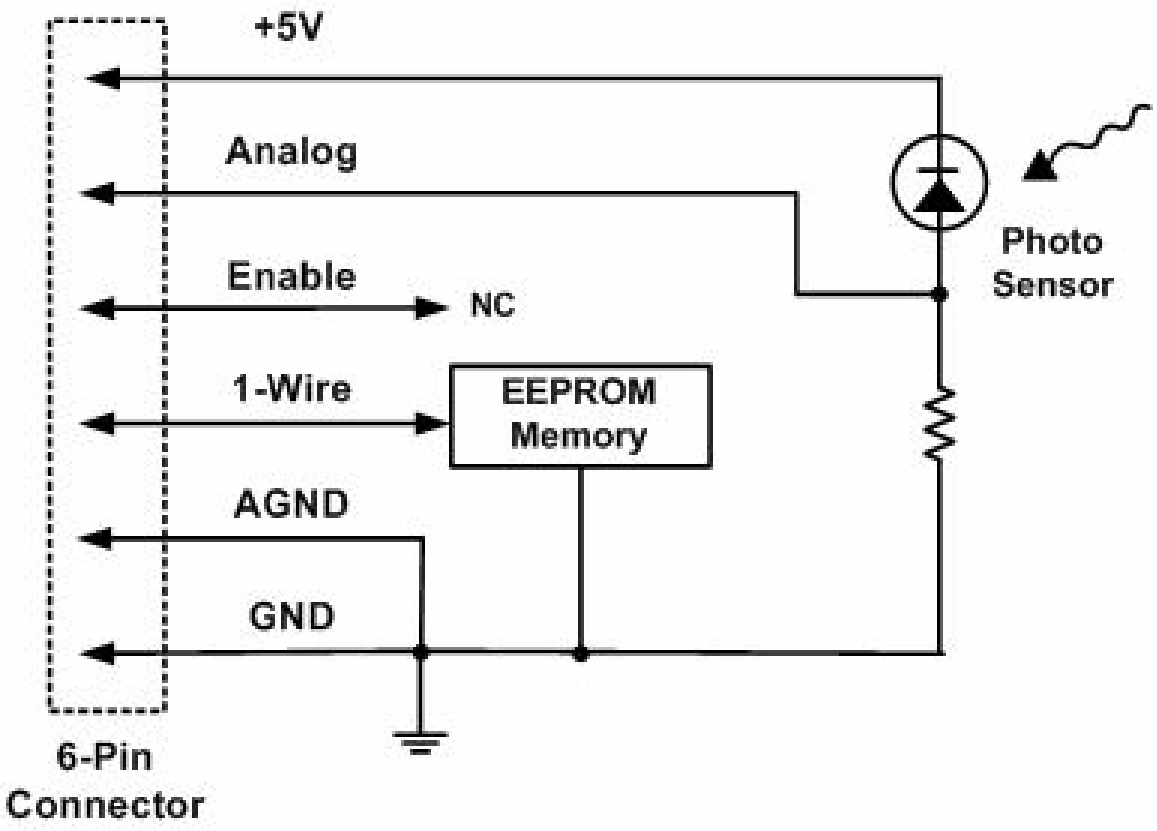


Example of PC Display of Sensor Data



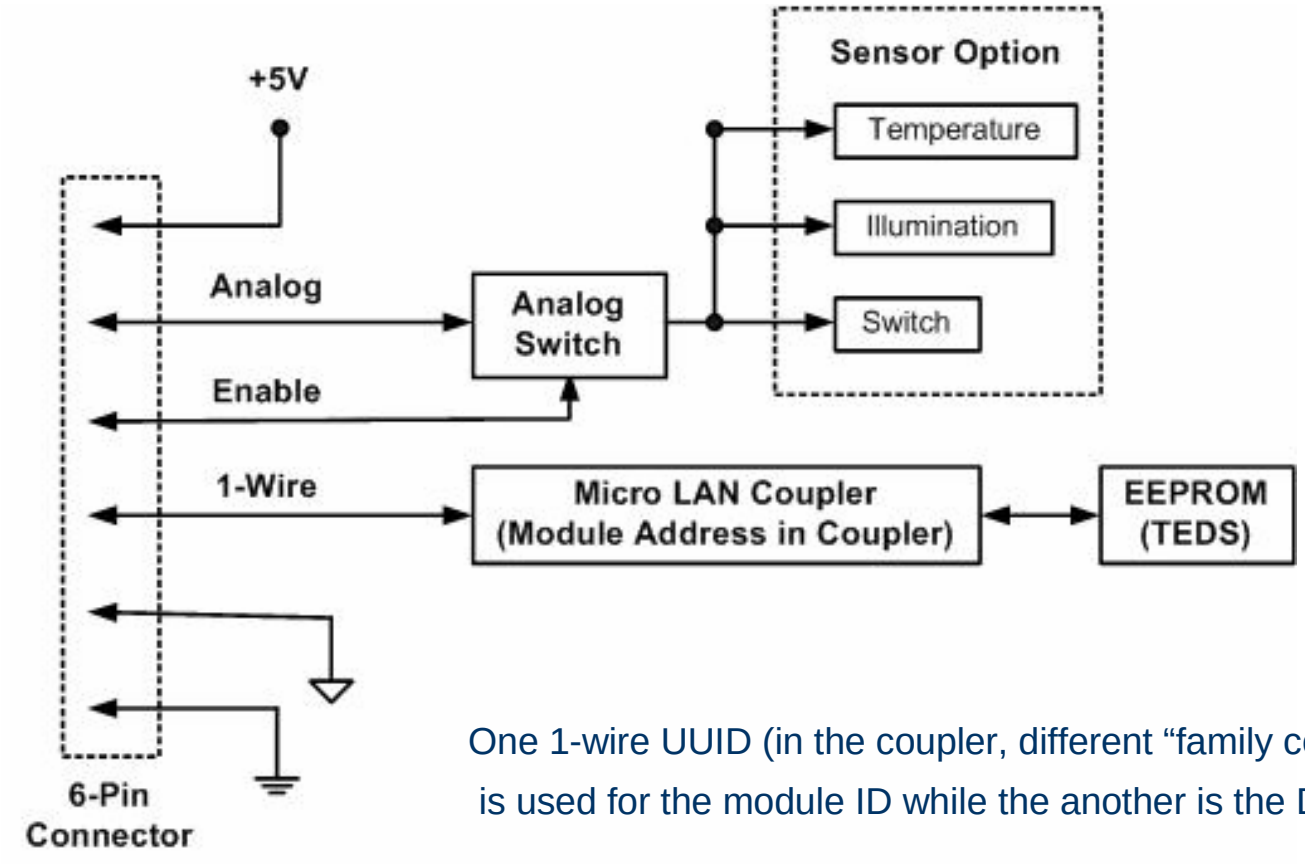
Single Sensor Module

Dot4 Bus



Block Diagram of Multi-drop Sensor Module

Dot4 Bus



One 1-wire UUID (in the coupler, different “family code”) is used for the module ID while the another is the Dot4 TEDS

Circuit Diagram of Multi-drop Sensor Module

Dot4 Bus

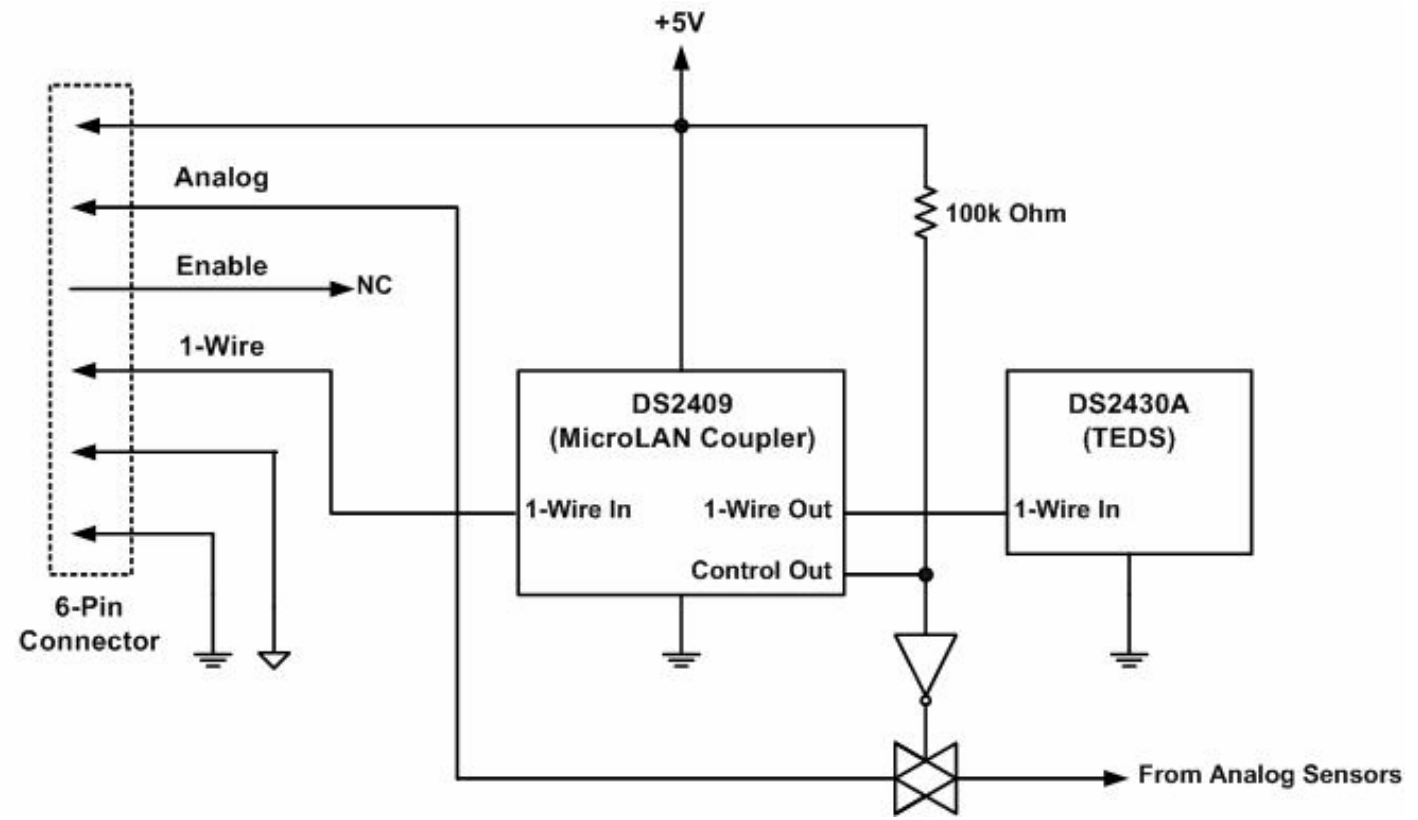
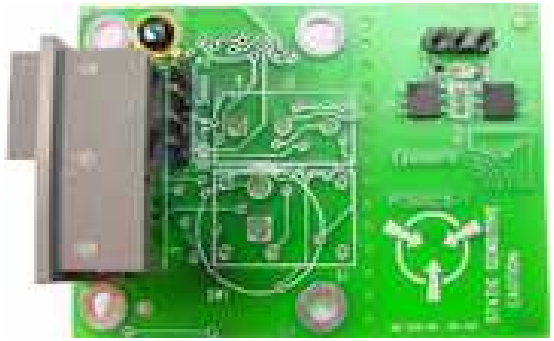


Photo of Printed Circuit Boards

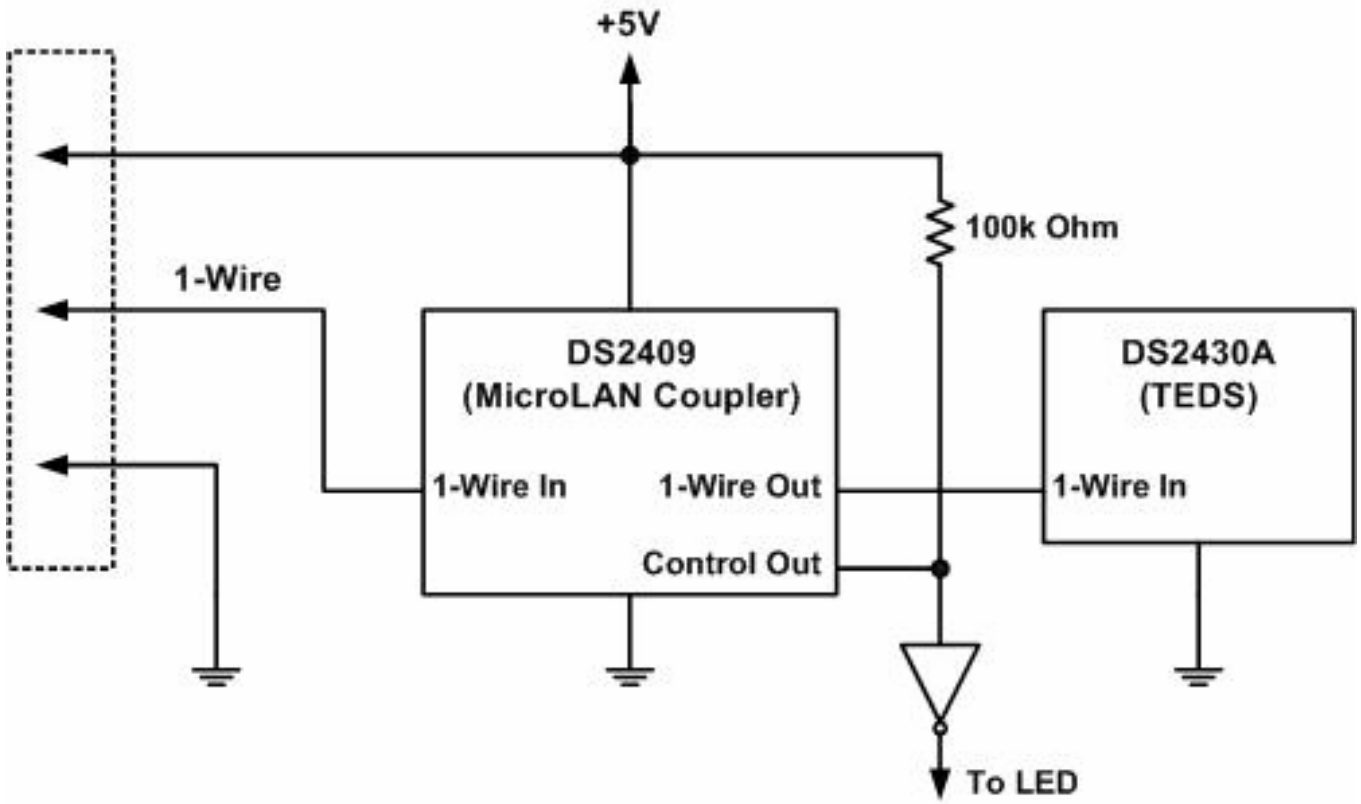
Minimal Dot4 NCAP



Sensor Module

TEDS-only Dot4 Tag

Part of Dot4 Bus

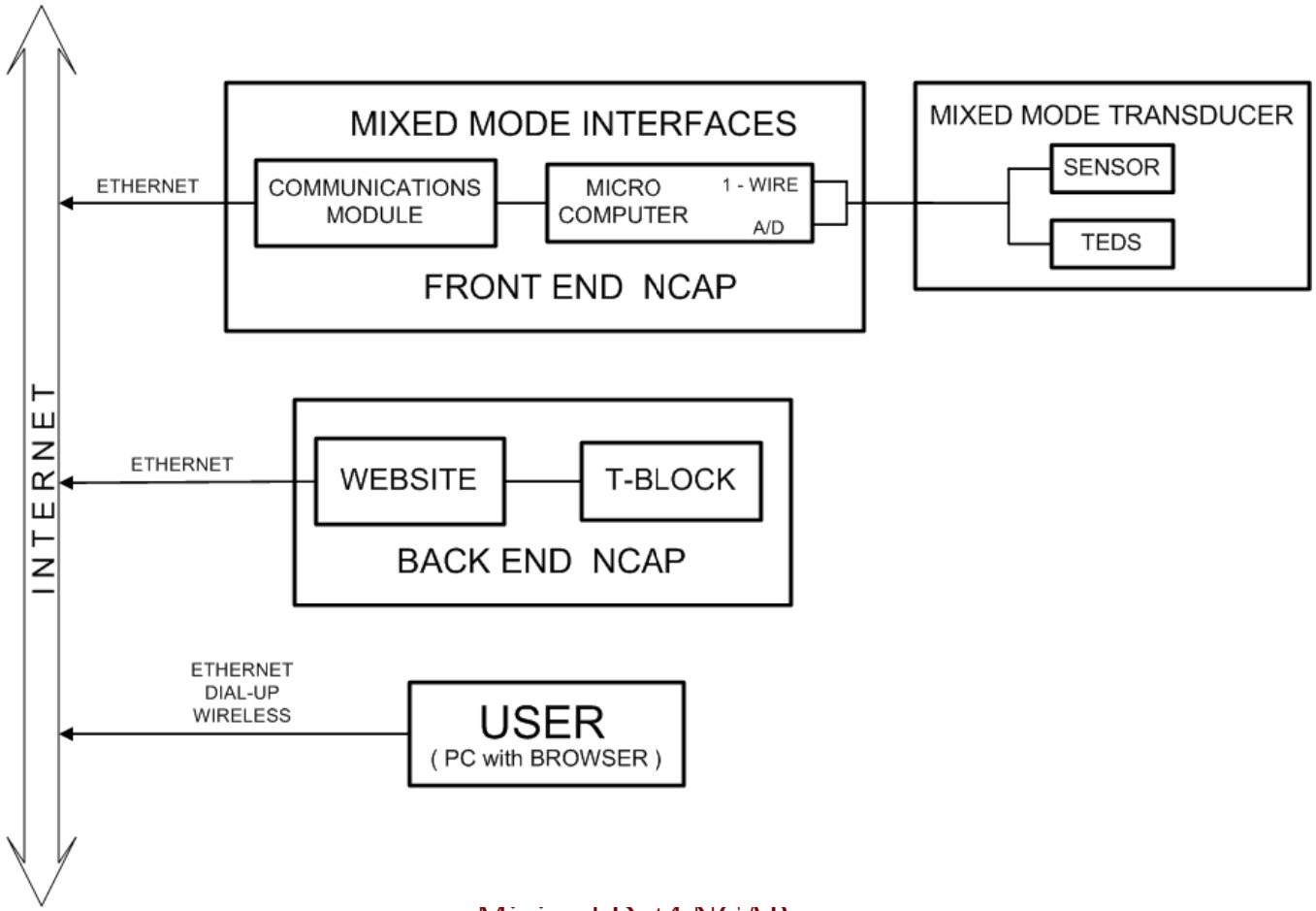


Coupler needed if more than one TEDS on bus

Alternate NCAP
(Split NCAP with Internet/Ethernet Capability)

- Sensor data is transmitted over Internet via Ethernet to Website for further processing
- Needed because full Dot4 Software too complex for a small NCAP at sensor end (Front-end)
- Complex section (T-block) is moved to PC/Website (Back-end)
- Fully processed data is available over Internet from any Internet browser
- System is compatible with appended (virtual) TEDS

Split Dot4 NCAP Block Diagram



References

- R. Johnson, et al “A Standard Smart Transducer Interface” http://ieee1451.nist.gov/Workshop_04Oct01/1451_overview.pdf
- IEEE Std. 1451.2-1907 “IEEE Standard for a Smart Transducer Interface for Sensors and Actuators – Transducer to Microprocessor Communication Protocols and Transducer Electronic Data Sheet (TEDS) Format” http://ihome.ust.hk/~yangrd/pdf/ieee14512.pdf
- R. Frank “Understanding Smart Sensors”, 2nd edition, Artech House (2000)
- D. Wobschall, “Websensor Design – Smart sensors with an Internet Address” Proceeding Sensors Expo (Philadelphia, Oct. 2001)
- www.eesensors.com/IEEE1451

Summary

- An IEEE 1451.4 (Dot4) Minimal NCAP with MMI (analog signal and TEDS) has been described.
- A Dot4 TEDS reader and writer are included.
- Sensors with a TEDS-enabled analog switch were also included.
- A Dot4 compatible multi-drop sensor bus was featured.
- A TEDS-only tag is available.
- An Internet-capable (Split Dot4 NCAP) was briefly described.

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