

Examples of Sensors with IEEE 1451 Protocol (Dot 2 and Dot 4)

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*Goal: Demonstrate reference implementation of smart sensors
and actuators with IEEE 1451 protocol*

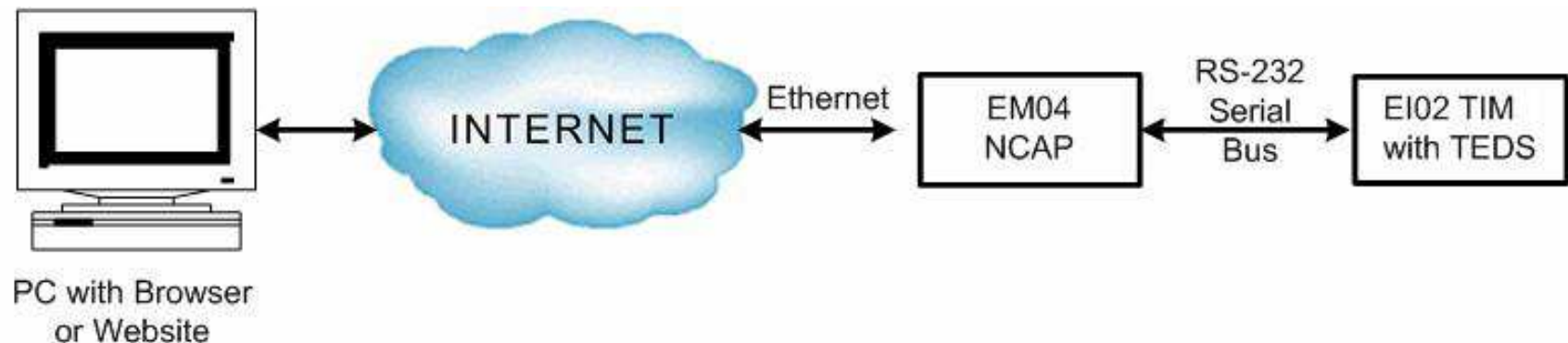
Dot 0 TEDS Compiler Features

- Dot 0 TEDS (and protocol) is comprehensive (282 pages) and thus complex
- A TEDS compiler is a practical necessity for widespread deployment
- Draft version of TEDS reader/writer is available (UB grad student)
- Includes simplified Channel & Calibration TEDS preparation for linear sensors
- Automatic UUID calculation, insertion of default values into required (but often obscure) fields and other features
- Internet-based TIM (and some NCAP) IEEE 1451 conformance test procedures available

Dot 0 TEDS Compiler Screen

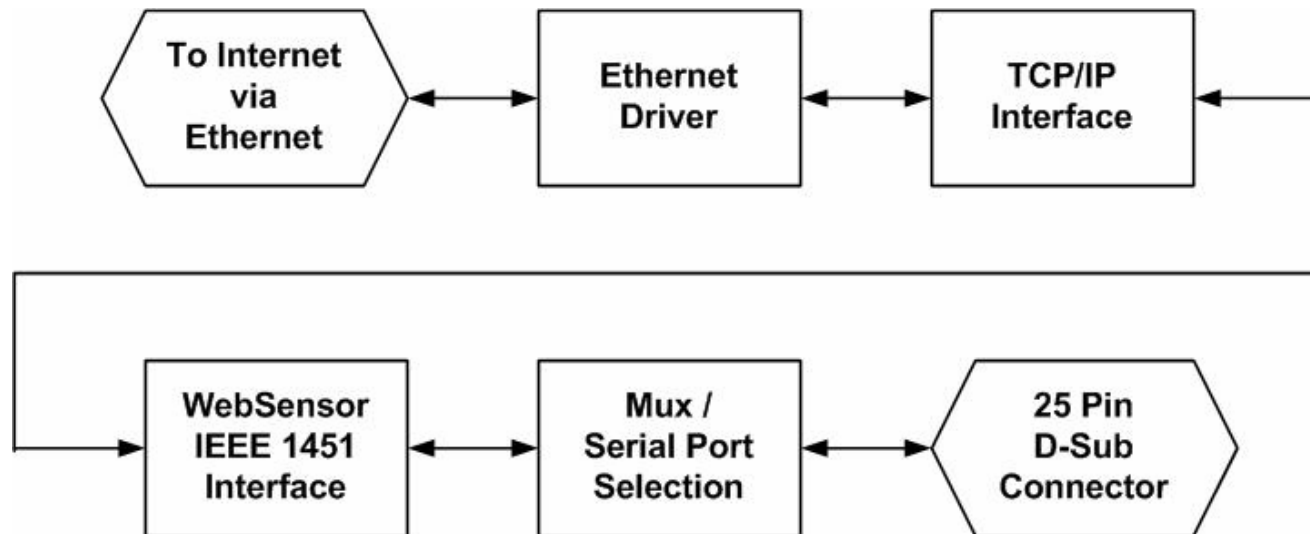
IEEE p1451.2 (Dot 2) NCAP and TIM

- Uses RS232 (and other serial buses)
- Point-to-point (one TIM per NCAP)
- Proposed revision of Dot 2 (original was TII or augmented SPI)
- TEDS and protocol being revised to conform to Dot 0
- Internet via Ethernet on Network side



Dot 2 NCAP Example

- Uses RS232 (and other serial buses)



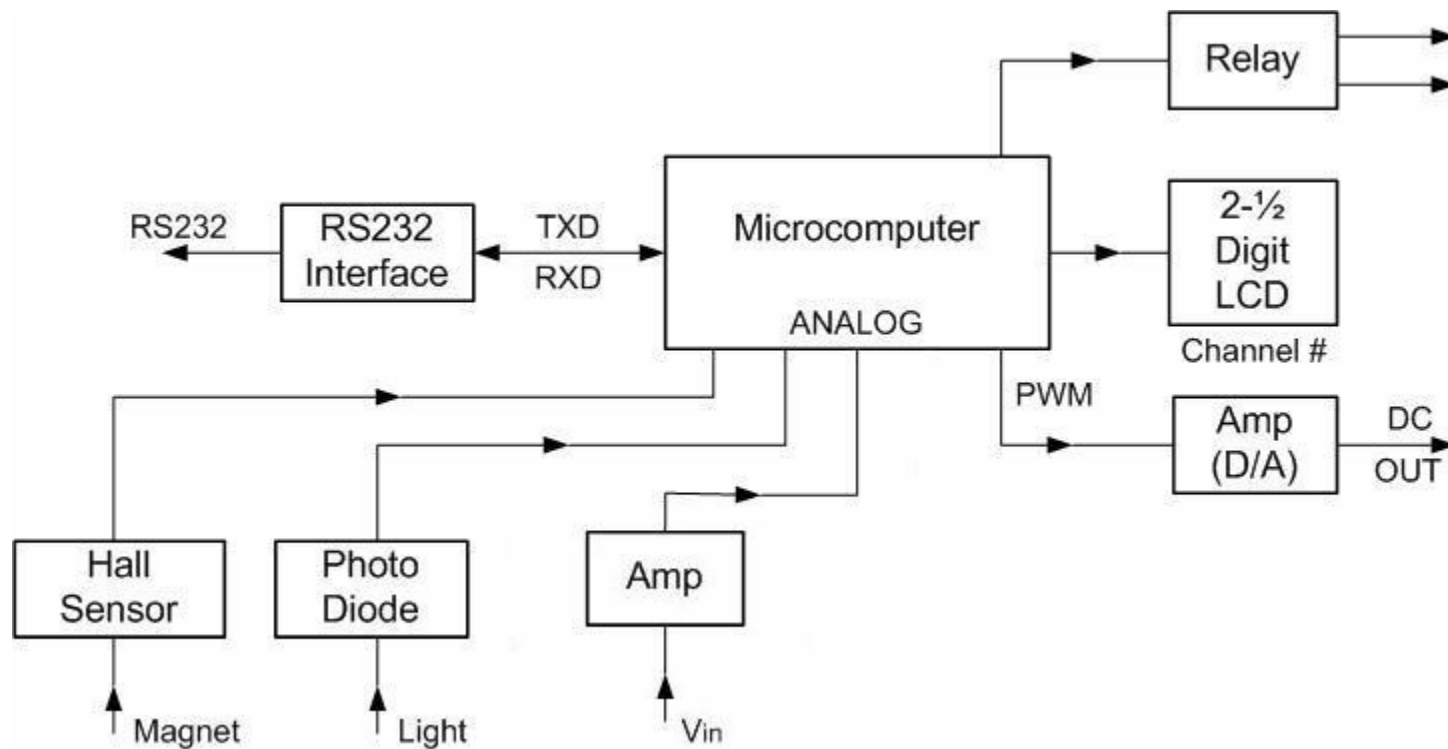
NCAP



TIM

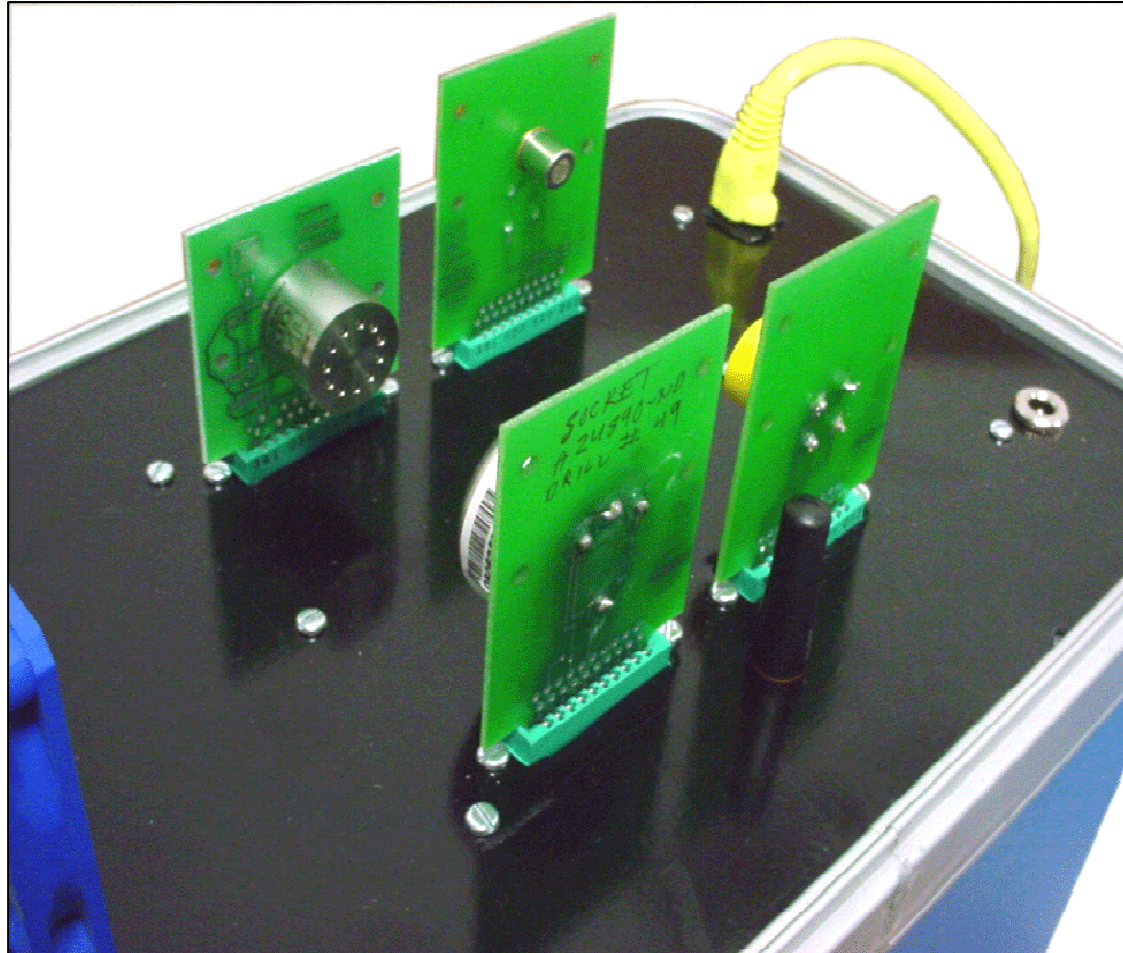
Dot 2 TIM Example

(3 sensors, 2 actuators)



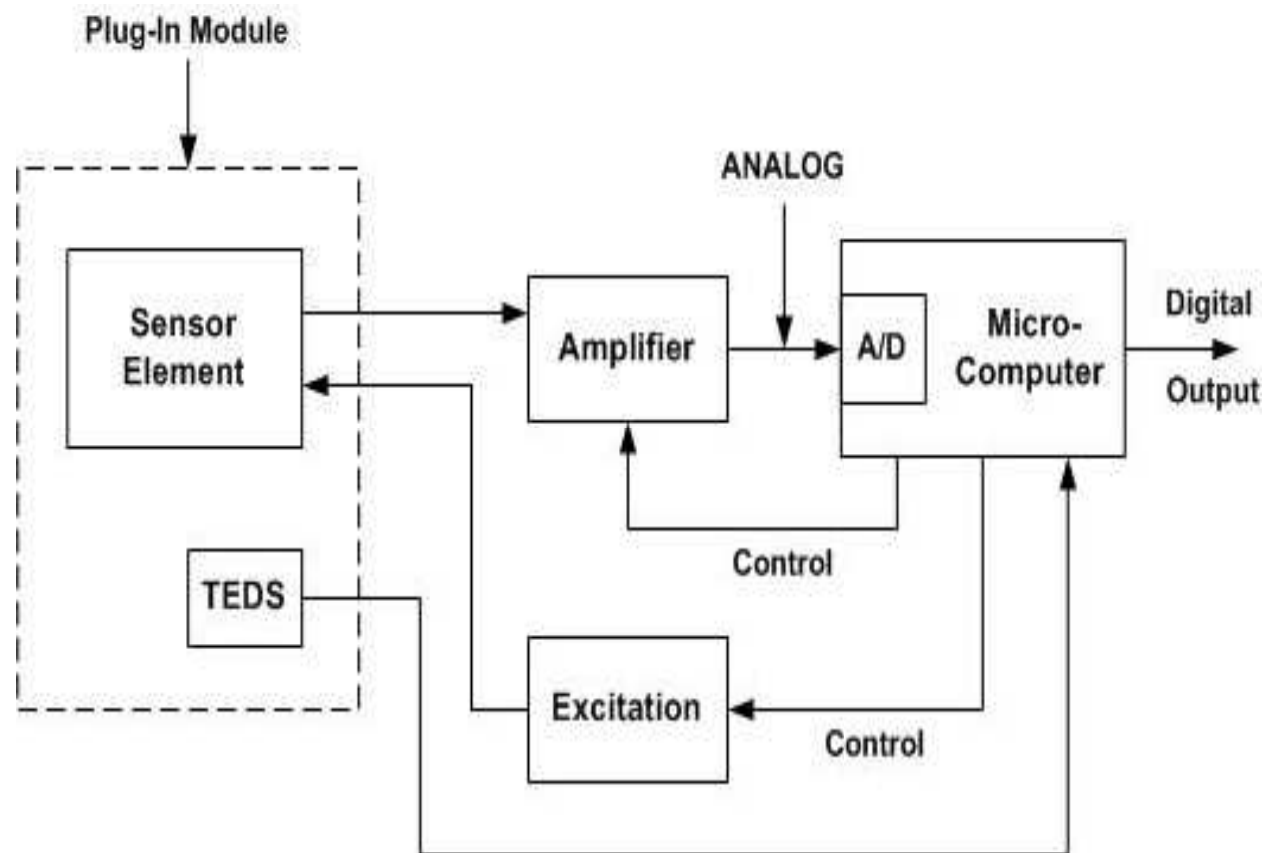
Environmental Monitor

-- a Dot 4 TEDS example with plug-in gas sensors--

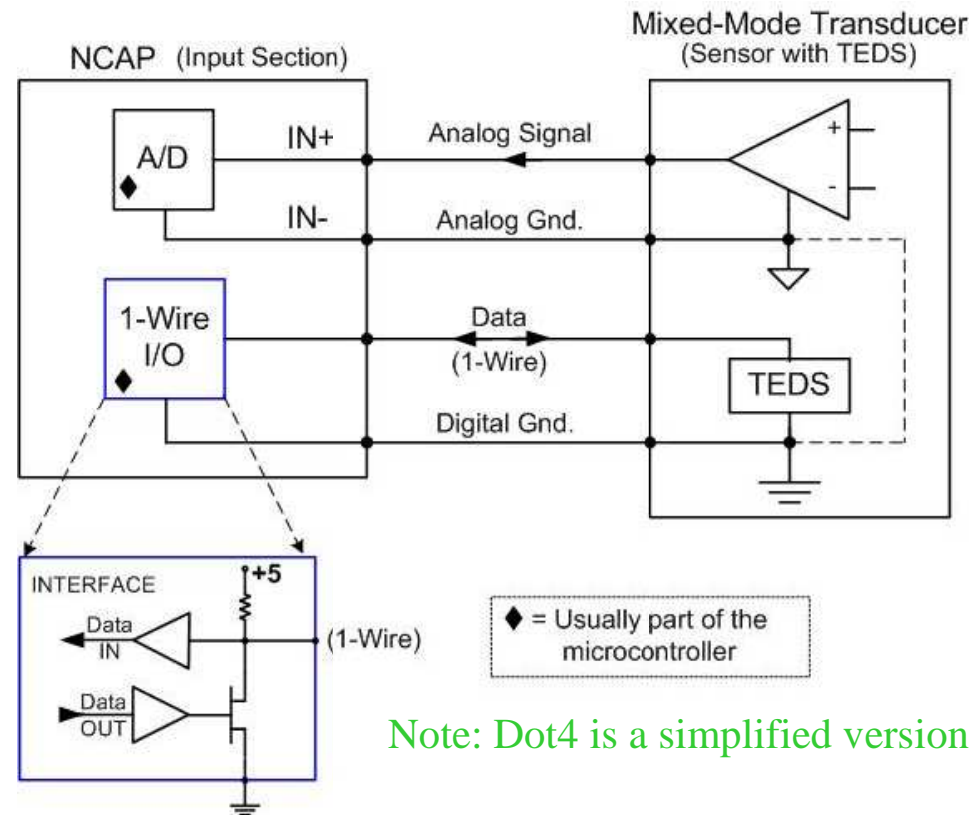


Start of Dot 4 slide section

Block Diagram of Plug-in Sensor Module (Dot 4 style TEDS)



IEEE 1451.4 Interface (featuring the Dot 4 style TEDS)




Note: Dot4 is a simplified version of IEEE 1451

Transducer Electronic Data Sheet (Dot 4 TEDS)

- UUID (Universal **Unique** Identifier)
Supplied by EEPROM (DS2433) manufacturer (6 bytes)
- Basic TEDS (8 bytes)
 - ☐ Model Number (15 bits)
 - ☐ Version Letter (5 bits, A-Z)
 - ☐ Version Number (6 bits)
 - ☐ Manufacturer ID (14 bits)
 - ☐ Serial Number (6 bits)
- Manufacturer's TEDS
Sensor type and calibration parameters (16 bytes)
[used instead of standard IEEE sensor template]

Dot 4 TEDS Reader/Writer (PC Screen Display)

**Esensors Inc**
IEEE 1451.4 Minimal NCAP Module
TEDS READER

Family Code
14

Unique Serial Code
22D534010000

CRC
B6

BASIC TEDS:
SERIAL NO --101
VERSION NUMBER --1
VERSION LETTER --E
MODEL NO --6
MANUFACTURER ID --34

STATUS: 4 2:51:12 PM
RESET...Passed
TEDS READ...Passed
CRC TEST...Passed

READ

RESET

BACK

Writer

**Esensors Inc**
IEEE 1451.4 Minimal NCAP Module
TEDS WRITER

Serial Number [24 BITS]
101010101010101010101010101010

Version Number [6 BITS]
111000

Version Letter [5 BITS]
01010

Model Number [15 BITS]
110011001100111

Manufacturer ID [14 BITS]
00110011001100

MSB
AA

AA

AA

E1

59

99

CC

LSB
CC

STATUS: 2:15:58 PM
Reset... Passed
Verified ... Passed
Programmed...Passed
TEDS OK... failed

CONVERT

VERIFY

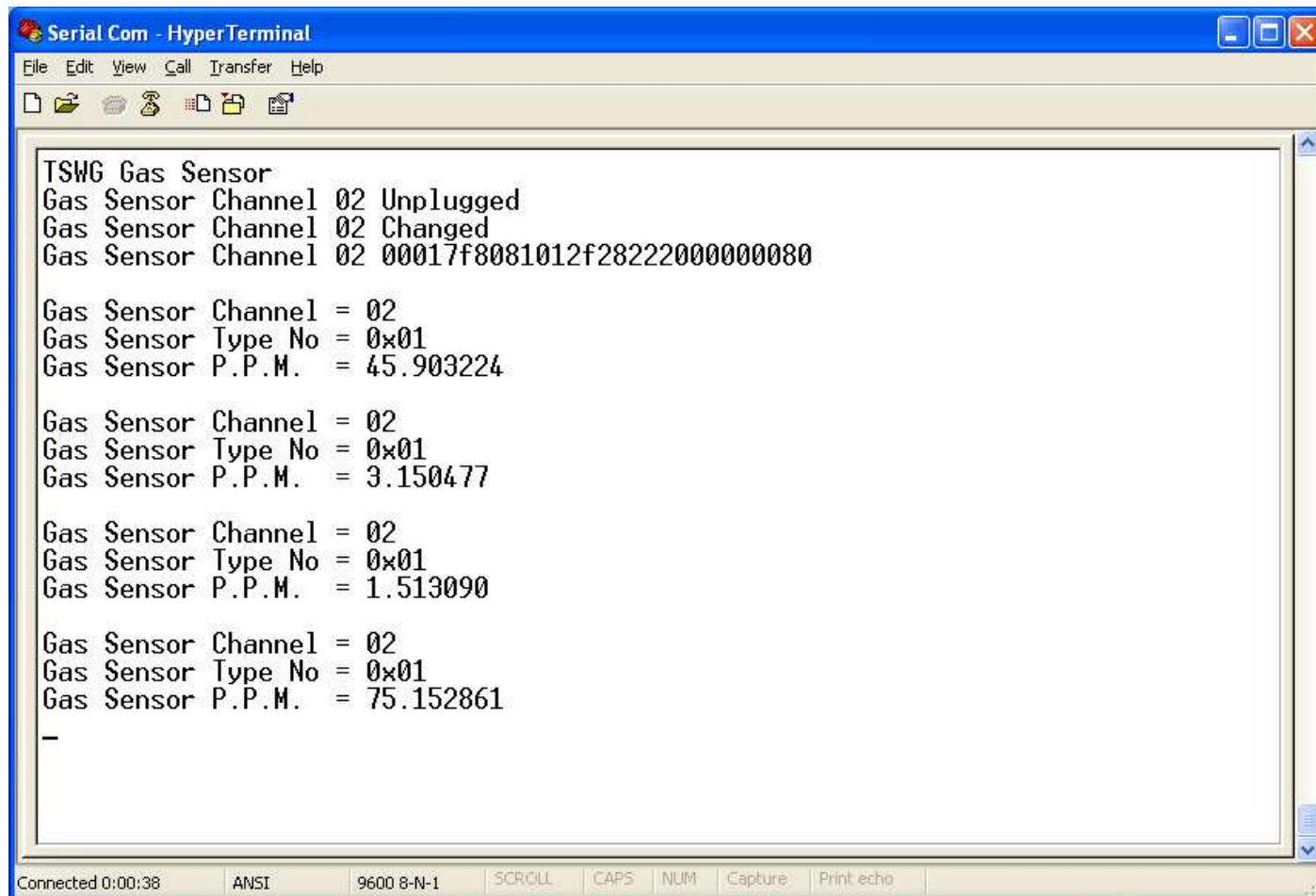
PROGRAM

RESET

BACK

Reader

Gas Sensor Plug and Play Testing (Screen Capture)



The screenshot shows a HyperTerminal window titled "Serial Com - HyperTerminal". The window has a menu bar with "File", "Edit", "View", "Call", "Transfer", and "Help". Below the menu bar is a toolbar with icons for file operations and communication. The main text area displays the following data:

```
TSWG Gas Sensor
Gas Sensor Channel 02 Unplugged
Gas Sensor Channel 02 Changed
Gas Sensor Channel 02 00017f8081012f28222000000080

Gas Sensor Channel = 02
Gas Sensor Type No = 0x01
Gas Sensor P.P.M. = 45.903224

Gas Sensor Channel = 02
Gas Sensor Type No = 0x01
Gas Sensor P.P.M. = 3.150477


Gas Sensor Channel = 02
Gas Sensor Type No = 0x01
Gas Sensor P.P.M. = 1.513090

Gas Sensor Channel = 02
Gas Sensor Type No = 0x01
Gas Sensor P.P.M. = 75.152861
-
```

At the bottom of the window, a status bar shows the connection status: "Connected 0:00:38". To the right of the status bar are several checkboxes: "ANSI", "9600 8-N-1", "SCROLL", "CAPS", "NUM", "Capture", and "Print echo".

Display of Gas Concentration in Engineering Units

WebSensor V2 Management Tool

 [Logout](#)

Home

Sensor's Readings

TCP/IP Settings

SMTP Settings

SNMP Settings


Timer Settings

Firmware Upgrade

Wireless

Security

Sensor's Readings

 [Help](#)

This page contains sensor's data reading from POD. You can look up the sensor type table to map the correct sensors that POD connected to.

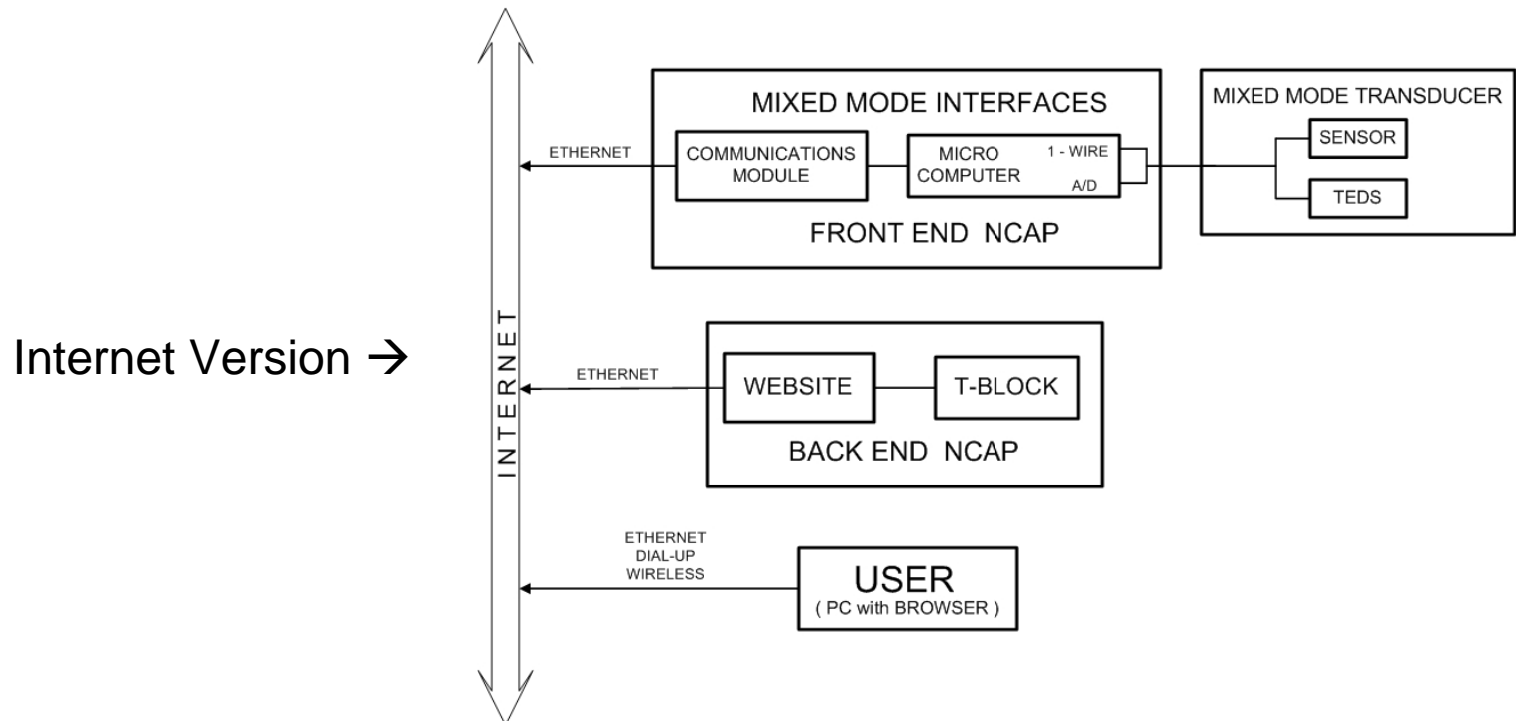
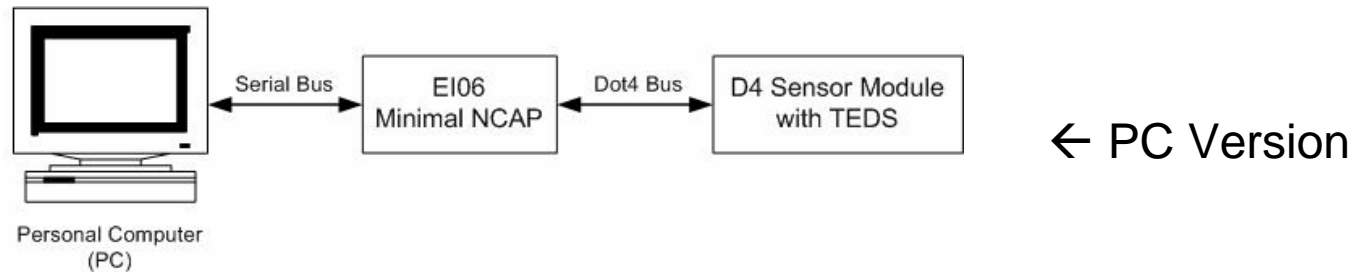
Chan#	Type	Current Data	Unit	W/N/C
1	VOC	54	PPM	Normal
2	CO2	804	PPM	Normal
3	H2	122	PPM	Normal
4	CO2	805	PPM	Normal

Dot 4 to Dot 0 Format Conversion

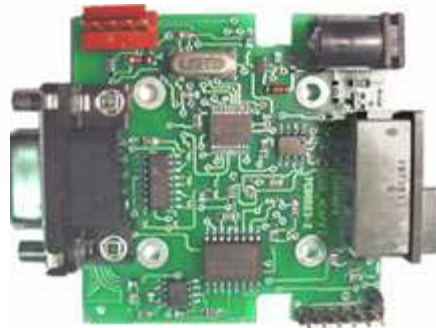
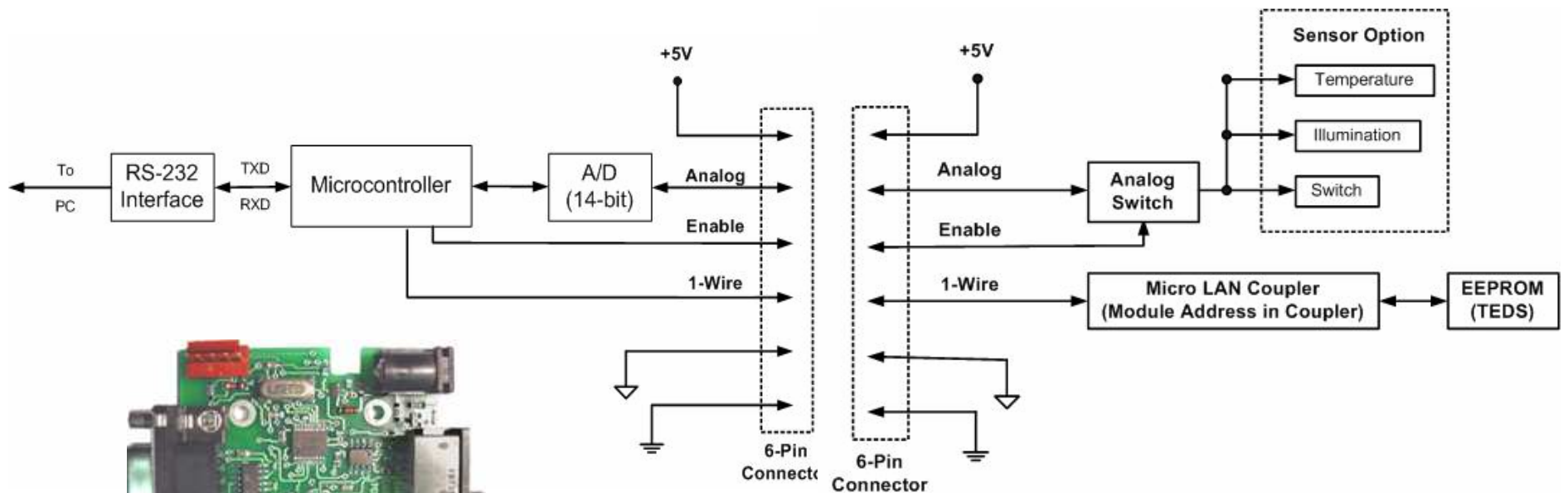
for environmental monitor

- Monitor is TIM, except that units with gateway function are NCAPs
- No standard method of Dot 0 to Dot 4 conversion
- For the UUID (10 bytes), the least significant bits are Dot4 UUID (6 bytes, chan 1)
- Dot 0 channel # is (gas) sensor number
- No calibration TEDS (this model) since linearization and calibration done in TIM and not NCAP
- Dot 4 basic TEDS transferred to Dot 0 Channel-ID TEDS

Minimal Dot 4 NCAP and Sensors



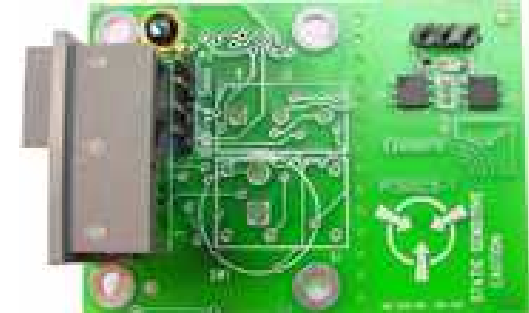
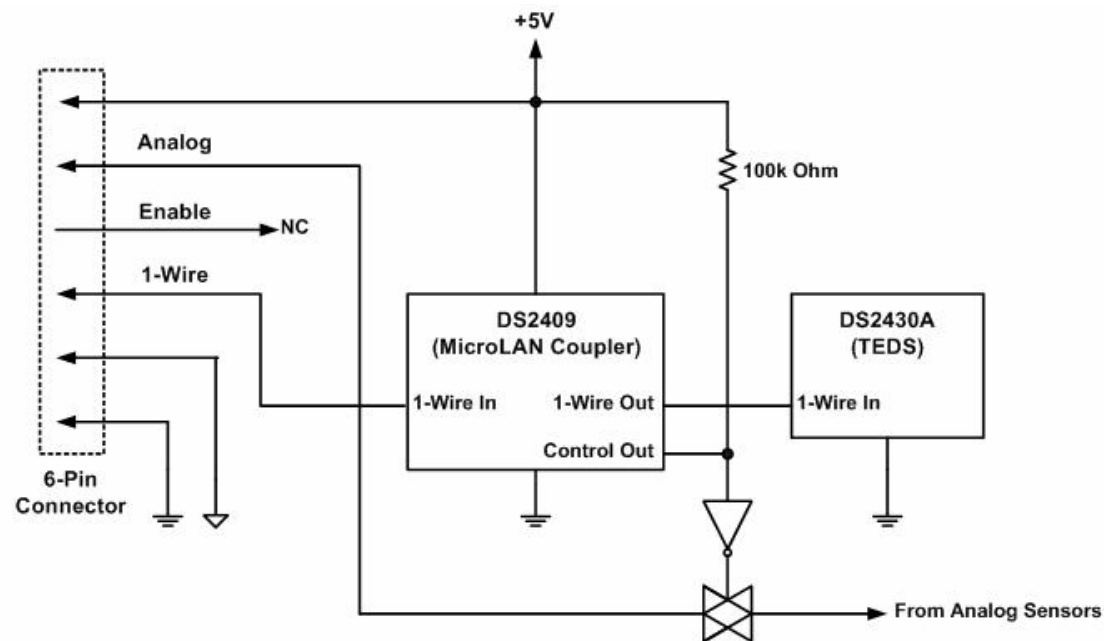
Block Diagram of Minimal NCAP with Dot4 Bus and Sensors



Minimal Dot4 NCAP

Dot4 Bus

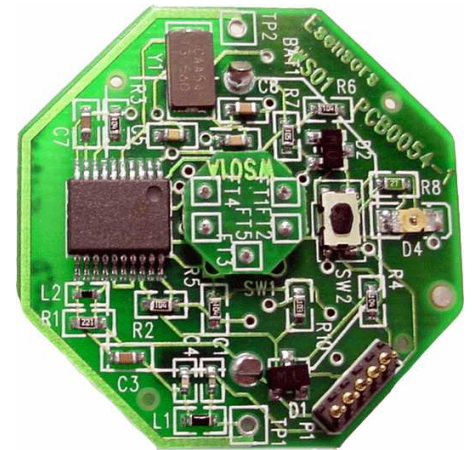
Circuit Diagram of Multi-drop Sensor Module



Dot4 Bus

Low-cost, Transmit-only Wireless Sensors

- Format: Preamble, Sync(1), Header(3), Address/channel(3), Data or TEDS (2+), CRC(2)
- Manchester encoded, 9600 Baud, SNAP protocol
- TEDS is Dot 4 type
- Transmission is short (few bytes)
- Converted to Dot 5 or Dot 0 (more bytes) by transceiver or NCAP

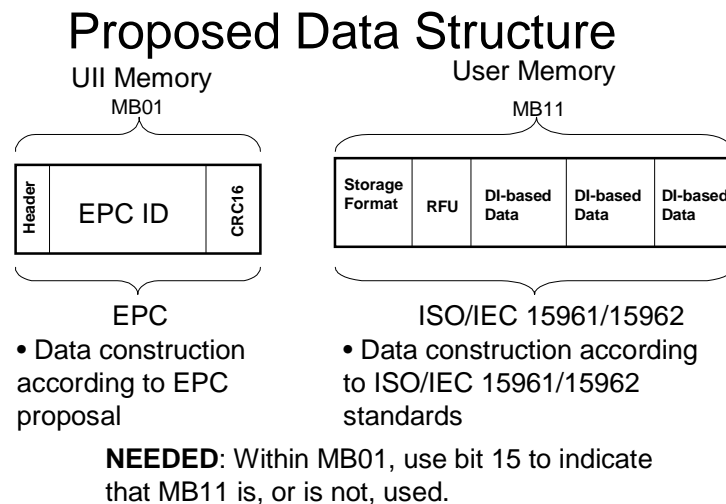


End of Dot 4 slide section

RFID with IEEE 1451

(suggested Dot 4 type format)

- Augmented RFID tag memory has additional user memory (flag set)
- User memory has Dot4 TEDS section
- Optional data pointer to “Virtual TEDS” (external file)
- User memory has section for block of sensor data



- End D. Wobschall section