Esbus – A sensor bus based on the SPI serial interface

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Overview

• Smart Transducer architecture
• Network Sensor Block diagram
• Esbus Interface
• Monitoring Example
• Summary
Smart sensors without a network have limited applications (and not very smart)

Multiple network standards available and used (each best for specific applications)

**Examples**: Fieldbus, CAN (Device-net & SDS), LonWorks, Modbus, ARCnet, HART

Lack of standards inhibit wider use of smart sensors

No universal standard in spite of efforts to establish one (multiple standards likely for many years)
• Sensor with microcontroller, signal processor and calibration
• Network/Bus Interface
Websensor Block Diagram
Esbus Interface

6 wire sensor bus with modular connector based on modified SPI

- Local Bus Options considered
  - RS232, RS485, I2C and SPI Serial Buses
  - SPI was selected because of wide availability, simplicity, low cost, and variable clock rate
  - Optical Isolators provide networking capability
**Esbus Description**

- Based on SPI serial interface
- Byte of date is exchanged between the master and slave
- Optical isolators provide ground isolation for safety and noise reduction
- Data is transmitted from master along EDI lines
- The signal is connected to the data input to SPI serial bus on microcontroller
- Sensor information from slave are transmitted on EDO line to output of remote sensor
- Data line is connected to SDO in sensor end.
- Isolated DC to DC supply is used to retain ground isolation (optional)
Esbus Circuit Diagram

16F873 Micro Controller

ATTN
SCK
SDO
SDI
GND
ISO GND

remote (slave)

Isolator Section

* Signal Inverted

master interface

Local power

+9 V

ES BUS

To other remotes

+9 V

+5 V

ATTNE

10 K

16F873 Micro Controller

+5 V

GND

1/25/2008

IEEE Sensors conference 2002
Esbus Circuit Showing Open collector multiplexing on EDO

To S D O

Local Ground # 1

SENSOR # 1

To S D O

Local Ground # 2

SENSOR # 2

EDO

2.2 k Ω

GND

Isolation Ground

To S D I
Esbus Waveform

ECK

EDI

EDO

Note: EDO is inverted
Waveform Details – Simulated

Amplitude : 2 V / div
Time base : 0.02 ms/div

Clock Frequency : 10 KHz
Line Length : 30 meter (1 µf)
Data format transmitted to/from sensor over the Esbus and Internet

Command from Website to Sensor

http://localhost/index.php?action=chart&group=2&Sensor=0&%date=1&cdate=2001.06.01

General header: Eiiicfw
- E = 1st byte (ASCII)
- iii = sensor model (4 char)
- c = channel # (1 char, hex)
- f = format [1 for standard Esbus format]
- w=status/attention byte

Data: ssddd.dd (3 of these)
- ss is sensor parameter type (e.g. temperature)
- d is sensor data; 6 digits
- . is decimal point, placed anywhere
Example: HVAC Monitor

Measures temperature, Illumination and Relative humidity of Commercial Buildings

EM01a010 Header
TC123.78 Temperature
I1142.57 Illumination
H046.87 Humidity
Sensor Monitoring Website

![Web Sensor Chart Image]

Database Connection Established

version: Web Sensor | login

Main menu

WebSensor Chart

Chart of Group ID = 2

Previous day | 06/02/2001 | Submit | Next day
Photos of Websensor

Digital Power Meter

HVAC Monitor
Summary

• Smart Sensor with a digital network have been developed

• Sensor data is transmitted through the Internal in an Email format (TCP/IP)

• A local bus (Esbus) based on SPI facilitates interconnection of groups of sensors at the measurement site.
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