Common PDR Problems

- How do you select an appropriate ADC?
- How do your sensors/transducers work?
- Expected Results (Mission Objectives)
  - Sensor/transducer selection
  - ADC selection
- Test hardware by prototyping.
- Verify software works.
- Calibrations.
- How to get data OUT of on-board storage?
  - How to get data INTO storage?
  - Data volume, format.
- How do you test your payload?
DATAQ system proposed by most PDR’s

- Variations in proposed sensor configuration
  - Multiple sensors connected to an input multiplexer
  - Multiple sensors connected to separate ADC’s
  - Multiple sensors with separate DATAQ systems, i.e., HOBO

- Variations in proposed ADC digital configuration
  - separate Stamp I/O pins for multiple ADC’s.
  - shared data/clock; separate enable lines for multiple ADC’s.
PDR’s indicated some possible misconceptions or lack of understanding of sensor, ADC, Data Acquisition system design.

- There are many kinds of sensors. Thermistors are not the only available temperature sensors.
- Many ADC’s are available. The ADC0831 used as an examples may not always be appropriate.
- Sensors do not usually connect directly to the ADC. Other circuitry may be required.
- Serial ADC’s require appropriate software to generate SCL and write/read SDA lines. Software effort may be underestimated. Also to applies to reading/writing serial EEPROM’s.
Data Acquisition System

Sensor → Signal Conditioning → MUX → ADC → CPU

Storage
Telemetry
Display

Software

Signals:
- SCL
- SDA
- CS
Sensors/Transducers

- Transducers sense some physical phenomena and produce an electrical signal or vary an electrical property that the data acquisition measures.
  - Voltage output
  - Current output
  - Variable resistance (or conductance)
  - Variable capacitance
- ADC inputs typically are voltage sensitive.
- Expected range of electrical output.
- Calibrations.
- Testing of sensor, ADC, software.
Signal Conditioning

Sensor output must be compatible with ADC input over the expected measurement range and optimized as required.

- Conversion of current, resistance, etc. to a suitable voltage range by amplification or attenuation and/or level shifting.
  For highest accuracy the maximum range of the conditioned signal equals the maximum voltage input range of the ADC.

- Filtering (noise, extraneous signals).

- Isolation of sensor from computer system.
Multiplexing of multiple sensor channels.

Excitation - Some transducers will need external voltage or current excitation signals.

Linearization - can also be done in DATAQ software or data analysis software.
Analog-to-Digital Converters (ADC) 
Specifications

- Number of channels
- Conversion time (sampling rate)
- Resolution (8-bit, 12-bit, etc.)
- Input Range and Span (fixed or selectable?)
- Differential Non-linearity (DNL)
  - compared to ideal ADC
  - deviation from ideal response is DNL.
Digital interface to host CPU
- Serial
- Parallel

Reference Voltage
- Internal
- External
What’s wrong with this picture?
...with improvements.
...and another improvement.