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Hybrid Rocket Launch Initiative Test Stand Team

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Hardware Application Overview and Attachment Specifications

I. *NI cDAQ-9172 National Instruments Chassis:*
   A. 120 volt ac power supply to turn the DAQ on and off.
   B. Serial cable for data transfer and communication from chassis to computer running labview.
   C. Input port 1 for Digital I/O module.
   D. Input port 2 for Analog Out module.
   E. Input port 3 for Analog In module.

II. *NI 9401 Digital In and Out Module:*
   A. 5 Volt TTL.
   B. Used for start and stop switch for data acquisition.
   C. Controlled within labview via loops and boolean input values.

III. *NI 9264 Analog Out Module:*
   A. 10 Volt peak to peak output.
   B. Utilized for accelerometer power.
   C. Will NOT be used to power load cell(s) due to current limitation. *
      **External power supply section for load cell(s) powering.*

IV. *NI 9205 Analog In Module:*
   A. 10 Volt peak to peak input reading.
   B. Will be recording data in the millivolt range.
   C. Load Cell(s) will be measured using voltage a differential measurement tool.

V. *PCB Piezotronics 5000 lb max reading Load Cell:*
   A. Input voltage of 12 volts with 26mA of current.
   B. Output voltage between 0 volts and 200mV.
   C. Max reading of 5000 lbs.
   D. Reading for this project not to exceed 1300 lbs of force.
   E. Pin Setup (Analog In):
      1. Pin 4 for data in as a voltage.
      2. Pin 20 for ground as differential to measure voltage.
   F. Voltage multiplier to get data voltage as a force is 8333.33.

VI. *Omegadyne 200 lb max reading Load Cell for Mass Flow Rate:*
   A. Input voltage of 12 volts with 26mA of current.
   B. Output voltage between 0 volts and 200mV.
   C. Max reading of 200 lbs.

D. Voltage in and ground attached to external power supply.
E. Pin Setup (Analog In):
    1. Pin 3 for data in as a voltage
    2. Pin 19 for ground as differential to measure voltage
F. Voltage multiplier to get data voltage as a force is 8333.33.

VII. *Adafruit ADXL377 Accelerometer(s):*

A. Input voltage of 3.3 volts with 1.2mA of current.
B. Output voltage between 0 volts and 200mV.
C. Voltage in and ground attached to Analog Out.
D. Voltage out attached to Analog In.
E. Pin Setup (Analog Out):
    1. Input pin 1 for voltage out
    2. Input pin 2 for voltage out
    3. Input pin 17 and 18 for ground
F. Pin Setup (Analog In):
    1. Input pin 1 for data in
    2. Input pin 2 for data in
    3. Input pin 17 and 18 for ground

VIII. *AC-DC External Power Supply with 12 volt peak output:*

A. Feeds in from AC wall outlet delivering 120 volts ac rms.
B. Delivers 12 volts DC to desired devices (Load Cell(s)).
C. Pinning diagram shown in main wiring diagram below.

IX. *Tyco Digital I/O extension module:*

A. Utilized only for data synchronization and stop / start switch.
B. 12 gauge wire used for wiring between switches and module.
C. Pin Setup:
    1. Input Pin 1 for data out ground
    2. Pin 3 for input ground
    3. Pin 14 for data out
    4. Pin 22 for input data.

X. *12 Gauge Wire*:

A. Utilized for wiring all sensors to DAQ system.
B. Placed inside BX cabling for protection.
C. To be color coordinated for Vin, Vout, Ground, and Data.
D. All wiring to be properly labeled and recorded via tags.

Software Overview

I. *National Instruments Labview 2017 and 2018:*

A. DAQ Assistant to be used as main building block for acquisition within Labview.
B. DAQ Assistant to take data, export it into a waveform, and into excel.
C. Data recording in labview to run as long as the user requests.
D. Writes data to internal RAM of DAQ system, and slowly exports to labview.
E. Timing and acquisition speed in timing overview section.

II. *Microsoft Excel:*

A. Utilized to import raw data after acquisition has been done.
B. Will be utilized to handle post processing with saved and recorded data points.

Timing Overview

I. *Internal Clock:*

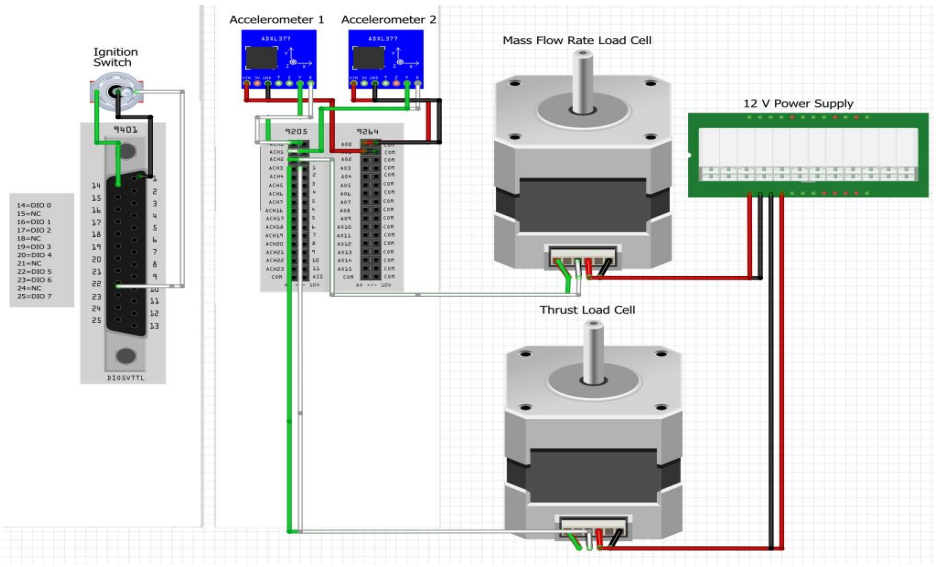
A. Internal clock for computer and labview used to timestamp data.
B. Internal clock will be used for data acquisition time stamping only.

II. *Acquisition Speed:*

A. Acquisition speed to be set at any value deemed necessary by the DAQ engineer.
B. Labview can write at a maximum speed of 1MHz.
C. Mass Flow Rate Sensor to record at 100Hz.
D. Main Load Cell to record at 1kHz.
E. Accelerometers to record at 1kHz.

Wiring Diagram

I. *Main Wiring Diagram:* ***Full Scale Image in Reference B****



Testing

I. *Test Plan Overview:*

A. View test plan documentation on EDGE for in depth testing data and calibration values.
B. Mass flow rate sensor to be tested using arbitrary weight.
C. Main load cell for force to be tested using a weight that shall be dropped at a distance of less than 5mm.
D. Accelerometers to be tested by hand shaking at first, then by utilizing packaging science department vibration simulation machine.
E. Thermocouples to be tested by the use of ice packs, lighters, and the air temperature, to ensure a wide range of data.

II. *Risk Management Overview:*

A. All DAQ hardware to be safely hardened for testing.
B. DAQ Chassis shall be encased in an aluminum bud box.
C. All wiring from DAQ to sensors shall be encased in aluminum BX cabling.
D. Generator to power all devices, and be placed outside the bunker at minimum safe distance to prevent explosions.
E. All wiring to be labeled and color coordinated for easy troubleshooting.

Interfacting

II. *Main Interfacing Overview:*

A. 3 Pressure Transducers, and 4 Thermocouples from Rocket Team
B. Sensors from Rocket Team to be integrated into NI DAQ system.
C. Start switch used for digital input will be used as both handshake and initiation for data acquisition.

References and Important Links

I. *References:*

A. https://edge.rit.edu/edge/P19105/public/Subsystem%20Build%20%26%20Test?rev=0
B. NI - cDAQ 9172 Manual.pdf

II. *Progression Flow Chart:*