ECET 102/CPET 101 Lecture 3

Jan. 18, 2012

Topics Discussed

1. **Real-World Example**
    a. **DC Power supply**
    b. **Total current, Circuit protection fuse**
2. **Using MATLAB Software as a Calculator**
3. **Using Microsoft Excel SpreadSheet as a Calculator**
4. **Calculation Examples**

1. Real-World Calculation Examples

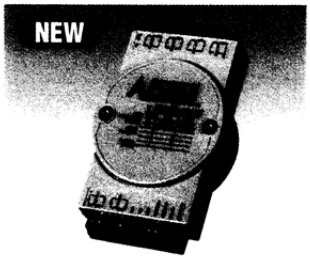
ADAM-4015
ADAM-4015T
ADAM-4016

6-channel RTD Module with Modbus

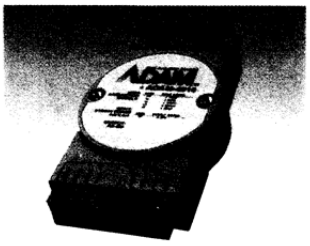
6-channel Thermistor Module with Modbus

Analog Input/Output Module

ADAM-4015



ADAM-4015T



ADAM-4016

Specifications

Analog Input

- **Effective Resolution** 16-bit
- **Channels** 6 differential
- **Input Type** Pt, Balco and Ni RTD
- **RTD Types and Temperature Ranges**

  Pt100 RTD:

  Pt -50° C to 150° C
  Pt 0° C to 100° C
  Pt 0° C to 200° C
  Pt 0° C to 400° C
  Pt -200° C to 200° C
  IEC RTD 100 ohms (a = 0.00385)
  JIS RTD 100 ohms (a = 0.00392)

  Pt 1000 RTD

  Pt -40° C to 160° C

  Balco 500 RTD

  -30° C to 120° C

  Ni 50 RTD

  Ni -80° C to 100° C

  Ni 508 RTD

  Ni 0° C to 100° C
- **Isolation Voltage** 3000 V_{DC}
- **Sampling Rate** 10 samples / sec.
- **Input Impedance** 10 MΩ
- **Bandwidth** 2.62 Hz
- **Input Connections** 2 or 3 wire
- **Accuracy** ± 0.05 % or better
- **Zero Drift** ± 3 µV/° C
- **Span Drift** ± 25 ppm/° C
- **CMR @ 50/60 Hz** 150 dB
- **NMR @ 50/60 Hz** 100 dB

Built-in Watchdog Timer and Individual wire burned-out detection

Power

- **Power Requirements** Unregulated +10 ~ +30 V_{DC}
- **Power Consumption** 1.2 W @ 24 V_{DC}

Ordering Information

- **ADAM-4015** 6-channel RTD Input Module w/Modbus

Specifications

Analog Input

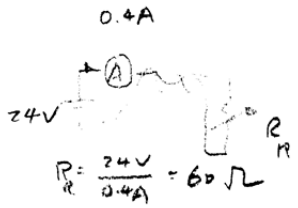
- **Effective Resolution** 16-bit
- **Channels** 6 differential
- **Input Type** Thermistor
- **Thermistor Types and Temperature Ranges**

  Thermistor 3K 0 ~ 100° C
  Thermistor 10K 0 ~ 100° C
- **Isolation Voltage** 3000 V_{DC}
- **Sampling Rate** 10 samples / sec.
- **Input Impedance** 10 MΩ
- **Bandwidth** 2.62 Hz
- **Input Connections** 2 or 3 wires
- **Accuracy** ± 0.05% or better
- **Zero Drift** ± 3 µV/° C
- **Span Drift** ± 25 ppm/° C
- **CMR @ 50/60 Hz** 150 dB
- **NMR @ 50/60 Hz** 100 dB

- **Built-in Watchdog Timer**
- **Individual Wire Burned-out Detection**

Power

- **Power Requirement** Unregulated 10~30 V_{DC}
- **Power Consumption** 1.2 W @ 24 V_{DC}



Ordering Information

- **ADAM-4015T** 6-channel Thermistor Input Module w/Modbus

Specifications

Analog Input

- **Effective Resolution** 16-bit
- **Channels** 1 differential
- **Input Type** mV and mA
- **Input Range** ±15 mV, ±50 mV, ±100 mV, ±500 mV, ±20 mA
- **Isolation Voltage** 3000 V_{DC}
- **Sampling Rate** 10 samples/sec.
- **Input Impedance** 2 MΩ
- **Bandwidth** 2.62 Hz
- **Accuracy** ±0.05% or better
- **Zero Drift** ±6 mV/° C
- **Span Ddrift** ±25 ppm/° C
- **CMR @ 50/60 Hz** 150 dB
- **NMR @ 50/60 Hz** 100 dB

Analog Output

- **Channel** 1
- **Output Type** V
- **Output Range** 0 ~ 10 V
- **Drive Current** 30 mA
- **Isolation Voltage** 3000 V_{DC}
- **Accuracy** 0.05% of FSR
- **Drift** ±50 ppm/° C

Digital Output

- **Channels** 2, open collector to 30 V, 30 mA max. load
- **Built-in Watchdog Timer**
- **Built-in TVS/ESD Protection**

I = 2.2W / 24V = 0.1 A

Power

- **Power Requirements** Unregulated +10 ~ +30 V_{DC}
- **Power Consumption** 2.2 W @ 24 V_{DC}

Ordering Information

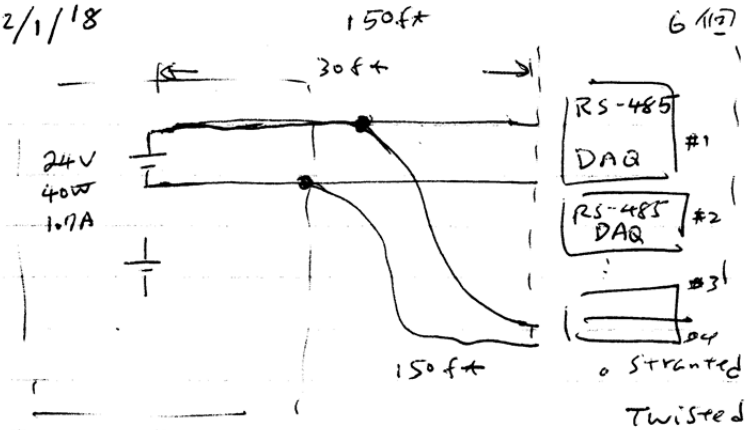
- **ADAM-4016-A2** Analog Input/Output Module

Secure online ordering 24/7/365 from **B&B electronics** MANUFACTURING COMPANY

International Headquarters: 707 Dayton Road - PO Box 1040 - Ottawa, IL 61350 USA
815-433-5100 Fax 815-433-5104 *www.bb-elec.com orders@bb-elec.com support@bb-elec.com*

European Headquarters: Westlink Commercial Park - Oranmore Co. Galway - Ireland
+353 91 792444 Fax +353 91 792445 *www.bb-europe.com orders@bb-europe.com support@bb-europe.com*

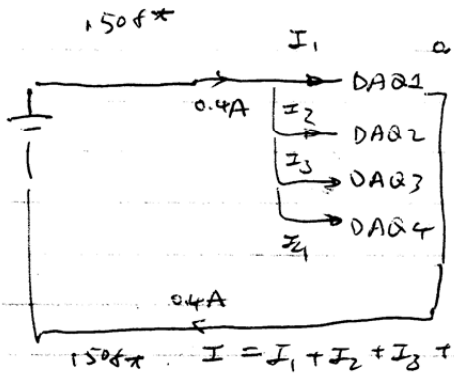
2012/1/18 (1)



Twisted pair

22 AWG

- Audio/Data
- (24V) power line



Rated current

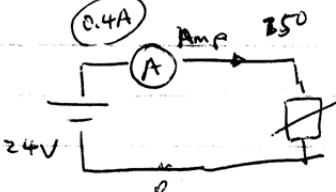
R
30ft

Power supply Testing

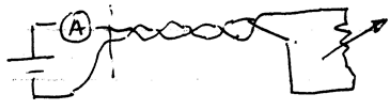
1) Measure R_{150ft} = ____ Ω (RLC meter)

2) $I = 24 / (R_{150} \times 2) =$ ____ Amp

3) (0.4A) Amp 350



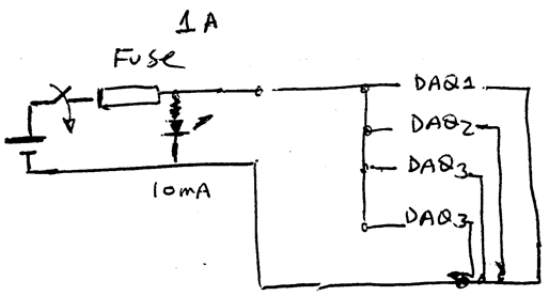
$R_R = R_{line}$

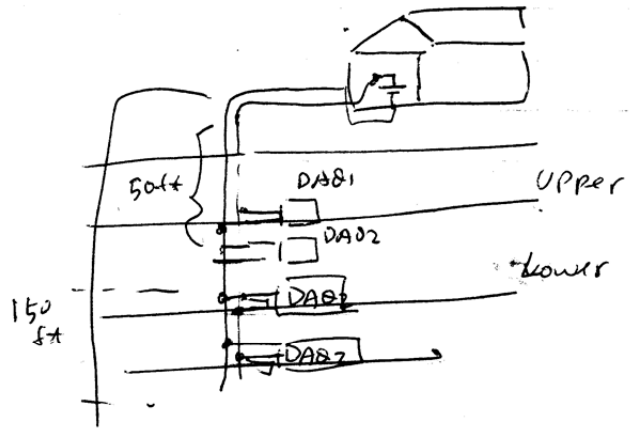


R = 0

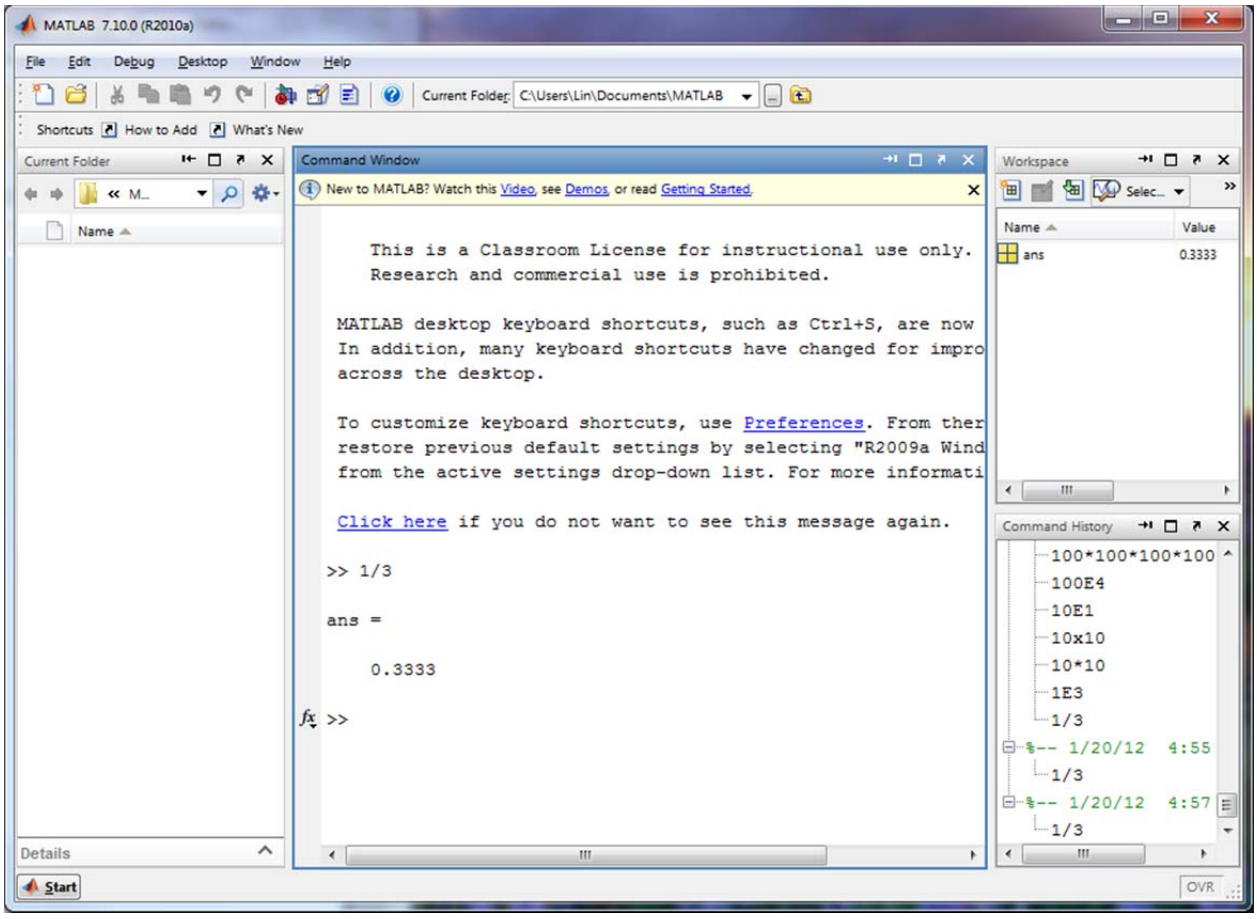
0

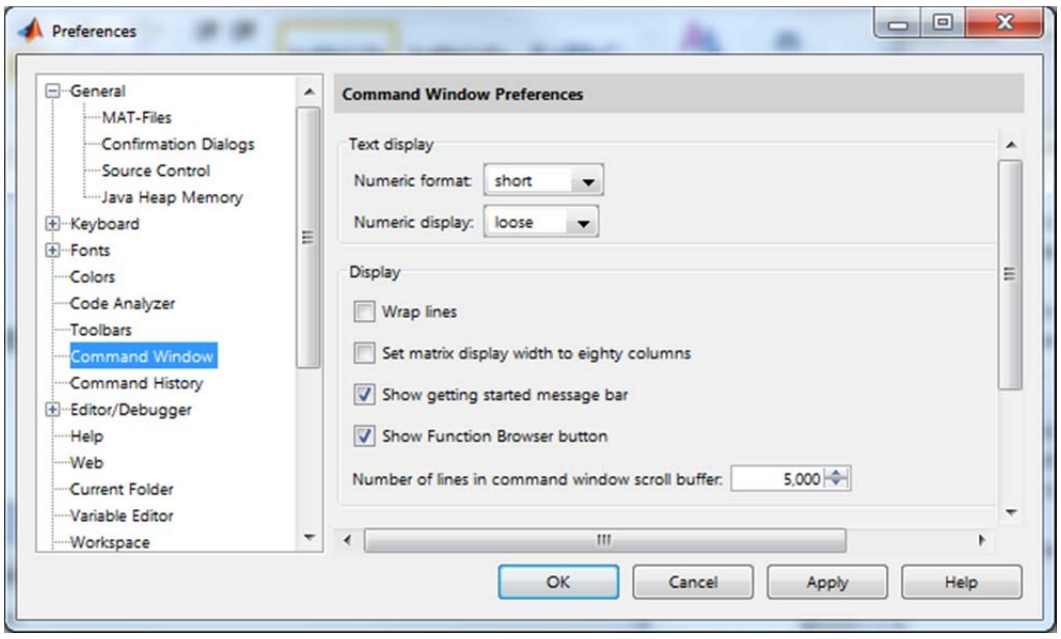
4) $I = \frac{24V}{R_R + R_l}$

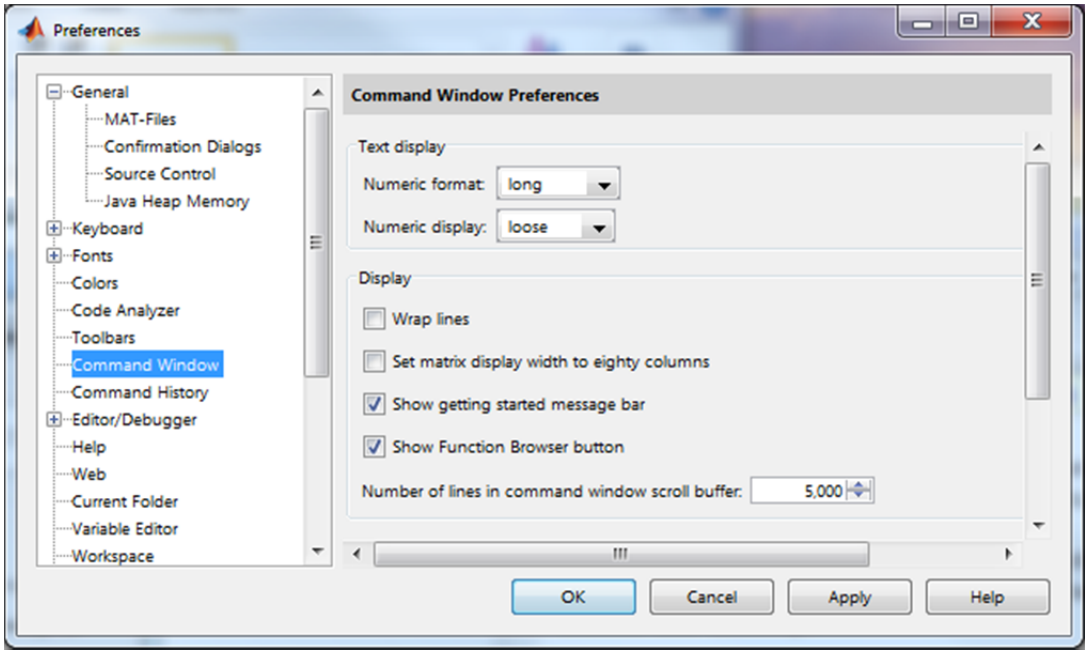

1A
Fuse
10mA
DAQ1
DAQ2
DAQ3
DAQ3

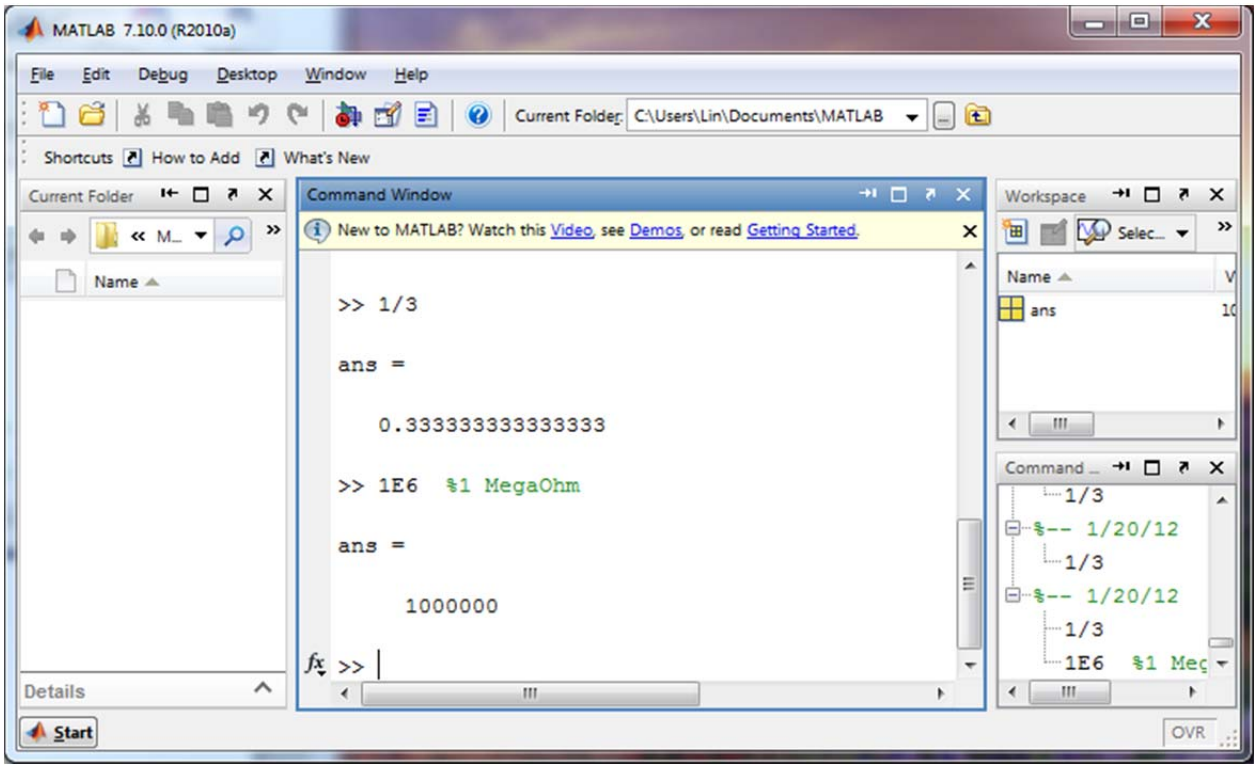

50ft
150 ft
DAQ1
DAQ2
DAQ3
DAQ3
Upper
Lower

2. Using MATLAB Software as a Calculator






Preferences
General
MAT-Files
Confirmation Dialogs
Source Control
Java Heap Memory
Keyboard
Fonts
Colors
Code Analyzer
Toolbars
Command Window
Command History
Editor/Debugger
Help
Web
Current Folder
Variable Editor
Workspace
Command Window Preferences
Text display
Numeric format: long
Numeric display: loose
Display
Wrap lines
Set matrix display width to eighty columns
Show getting started message bar
Show Function Browser button
Number of lines in command window scroll buffer: 5,000
OK
Cancel
Apply
Help


MATLAB 7.10.0 (R2010a)
File Edit Debug Desktop Window Help
Current Folder: C:\Users\Lin\Documents\MATLAB
Shortcuts How to Add What's New
Current Folder
Name
Command Window
New to MATLAB? Watch this Video, see Demos, or read Getting Started.
>> 1/3
ans =
0.333333333333333
>> 1E6 %1 MegaOhm
ans =
1000000
>>
Workspace
Name
ans
Command ...
1/3
%-- 1/20/12
1/3
%-- 1/20/12
1/3
1E6 %1 Meg
Details
Start
OVR

```
>> 1/3

ans =

   0.3333

>> 1/3

ans =

   0.3333

>> 1/3

ans =

  0.333333333333333

>> 1E6  %1 MegaOhm

ans =

    1000000

>> %problem 31a

>> 6E4

ans =

     60000

>> 0.06E6

ans =

     60000

>> %Example 1.6

>> 1E5/1E2

ans =

      1000

>> %Example 1.7

>> 100^4
```

```
ans =

   100000000

>> 1000^-2

ans =

    1.000000000000000e-006
```

4. Calculation Examples

2012/1/18

2) 95 mph = $95 \frac{\text{miles}}{\text{hr}}$ → ft
→ sec

$= 95 \frac{\text{miles}}{60\text{min}}$ ← sec

$= 95 \frac{\text{miles}}{60 \times 60}$ ___ / sec

$= 95 \frac{5280}{3600}$ $\frac{\text{ft}}{\text{sec}}$

$= \frac{95 \times 5280}{3600}$ $\frac{\text{ft}}{\text{sec}}$

ECET 102 / CPET 101

2012/1/18

356 KV = 356,000 V

66 KV = 66,000 V

CPU clock Intel

1.3 GHz — 1.3×10^9 Hz

2.3 GHz

5 MHz = 5×10^6 Hz

Mega

100A
10A
A — Energy conversion

0.001A mA
0.00001A μA — Sensing

1 Hp = 746 watt

120V ≈ 7 A

2012/1/18

2) 95 mph = $95 \frac{\text{miles}}{\text{hr}}$ → ft
→ sec

$= 95 \frac{\text{miles}}{60\text{min}}$ ← sec

$= 95 \frac{\text{miles}}{60 \times 60}$ ___ / sec

$= 95 \frac{5280}{3600}$ $\frac{\text{ft}}{\text{sec}}$

$= \frac{95 \times 5280}{3600}$ $\frac{\text{ft}}{\text{sec}}$