INSTRUCTIONS for DEMO201.py SAMPLE SOFTWARE

Lawson Labs, Inc.   www.lawsonlabs.com

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1) Getting Started

One serial port, or one USB port with a USB-to-RS232 converter is required.
The sample code is tested on a PC running Windows.

You need either a Lawson Labs Model 201 or an EMF16 for precision data acquisition.
If you have a Model 202, only minor modifications to the sample code are needed. Contact the factory for more information.

If you are using a USB to RS232 converter, you must use the correct system driver. *Simply allowing Windows to pick the default driver is rarely successful.* These protocol converters come with disks and installation instructions. Almost always, you will be instructed to install the driver before plugging in the protocol converter. In all cases, you will need to download and install the free application software from the Lawson Labs website -   www.lawsonlabs.com

2) Hardware Installation

The EMF16 and Model 201 are both supplied with wall-mount power supplies. If the power supply is of the interchangeable plug variety, install the appropriate mains plug first. *Be certain it snaps all the way into place, or a shock hazard will result when the removable plug stays behind in the outlet.*

Plug in the power supply at both ends.

Note: Make certain that the power jack is plugged all the way into the instrument. Failure to do so can short-circuit the power supply, resulting in subsequent failure. The power supplies have an internal thermal fuse. If it blows, the power supply will not be repairable.

The serial cable plugs into both the EMF16 or Model 201 and the host. If a USB converter is used, remember that each physical USB connector is treated individually, so it is best to always use the same location. The COM port assigned will change when you change physical USB connectors.

You will need to know the COM port number for your connection. Find it in Windows by locating the Device Manager and selecting Ports. If the COM port to be used is assigned a

number higher than 8, reassign a lower number by right-clicking on the port and selecting Properties. Click the Port Settings tab and click the Advanced button. Select the desired COM number from the drop-down list. Click OK and exit back out of the Device Manager.
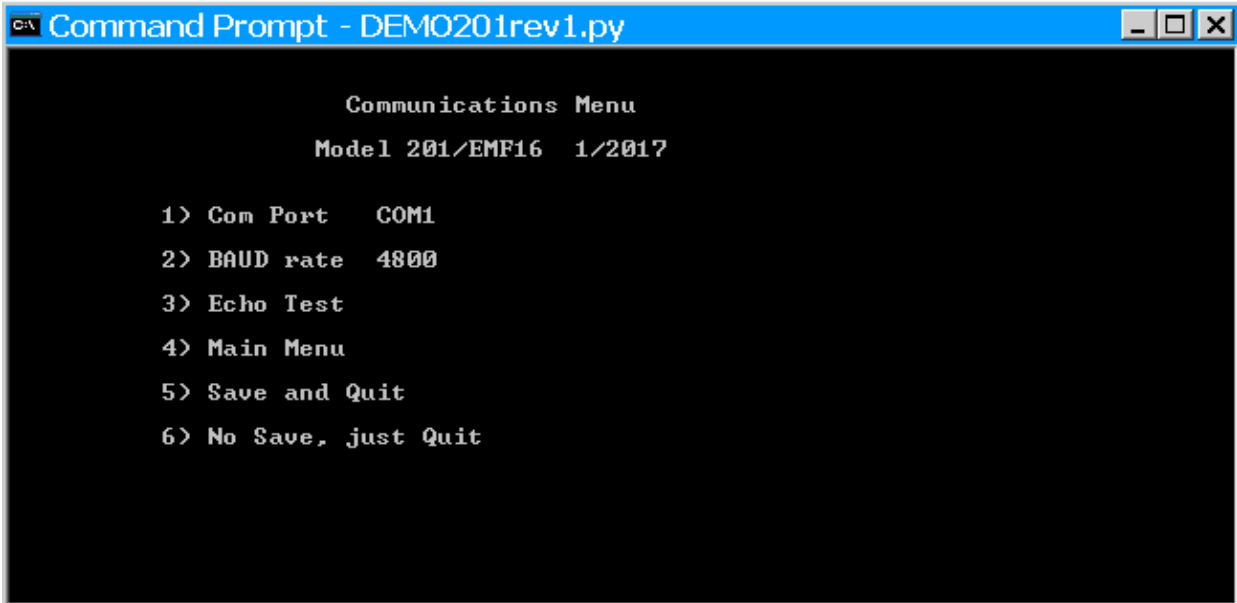
3) Software Installation

The sample code is tested with Python 2.7. Libraries required are serial, time, msvcrt and curses. You will need to set up your own environment with some sort of terminal for the user interface. We assume a 24 line, 80 column, or larger, text screen.

Make a folder for your project and place the .py code and the drivr201.cfg file there. Your data output files will be written to the same folder. The configuration file is compatible with files written by Drivr201.bas and NT_m201.exe. The NT_m201 code reads a different configuration file when starting.

4) Operation

A. Communications Menu

You should see the first menu on your screen.

1. Cycles through COM1 through COM 8. You must select the correct port for operation.

2. 4800 BAUD is the maximum reliable rate on many systems. You can select between 300 and 9600 BAUD.

3. Starts an echo test to validate communications. You would normally only need echo test for initial set-up and/or troubleshooting. Press any key to return to the Communications Menu.

4. Progress to the Main Menu. All the programmable features are supported from there.

5. Save and Quit writes a new drivr201.cfg file, replacing the old one. All the new settings are preserved while the old ones are lost.

6. No save, just quit. The original drivr201.cfg file remains.

B. Main Menu

```
Command Prompt - DEMO201rev1.py                          _ □ ×
                           Main Menu
                                                 Version  11
    C> A/D input Channel      0        D> Digital input
    E> External sub-channel   1        U> digital oUtput
    A> remote Averaging       32       K> checKsum
    L> Local averaging        3        S> System calibration
    T> filTer                 40Hz     O> Offset calibration
    G> Gain                   1        W> Word length         24 bits
    R> internal data Rate     59.91    P> Polarity            Bipolar
    B> StandBy                OFF      Z> Sleep

    N> to scaN                         Q> to Quit


    Count 11094885   Volts  +1.613067  Avged  +1.613065
    Count 11094877   Volts  +1.613062  Avged  +1.613061    Effective
    Count 11094881   Volts  +1.613064  Avged  +1.613062    Resolution
    Count 11094879   Volts  +1.613063  Avged  +1.613063    22.0 in Bits
    Count 11094879   Volts  +1.613063  Avged  +1.613063
    Count 11094882   Volts  +1.613065  Avged  +1.613064
```

The microcode version number is displayed in the upper right corner of the Main Menu. Extra features or modified operation may be available with versions other than Version 11.

The six most recent polled A/D conversion results are shown below. If Local averaging is greater than 1, averaged data is shown, as well. The effective resolution for DC input voltages is displayed in Bits. The effective resolution calculation uses the readings after any local averaging. The effective resolution acts on blocks of 40 readings, so it may take a while for it to update.

C) Enter analog input channel, 0 - 7.

NOTE: The Model 201 uses 0-based labeling while the EMF16 uses 1-based labels. Channel 0 selects the first channel, which is labeled "1" on the EMF16.

E) Enter analog sub-channel, 0 -15. The EMF16 includes the multiplexer. A Model 201

requires an external multiplexer (Model 17B or Model 35B, for example).

A) Enter power of 2 for remote averaging, 0 - 9. Entering 0 causes no averaging. 1 averages 2 readings, 2 averages 4, 3 averages 8, etc. This averaging is block averaging done in the hardware. It will slow down your data rate. Extreme averaging can make your system appear to be unresponsive. At a 10 Hz conversion rate, it takes 51.2 seconds for a single conversion with averaging set to 512. *Be prepared to wait.*

L) Local averaging is a running average, performed in the host . You can enter any number between 1 and 254. A running average does not affect your scanning rate, but it will slow your settling times. Both unaveraged and averaged data are shown when Local average is greater that 1. Unaveraged data are written to the data file. Local averaging can always be applied as a post-acquisition step.

T) Toggle between the three filter settings. More filtration slows down channel changes because it lengthens settling times.

G) The gain is entered as a power of two, like the remote averaging, 0 -7. The maximum gain is 2 ^7, or 128. You can't use Calibration Scanning mode if the gain is greater than 1. A gain change is always automatically followed by a recalibration, indicated by a "recal" message. The indicated voltage is the voltage after the gain. If you want to display the voltage as seen at the input, divide the reading by the gain.

Note: There are other ways to perform active offset and gain correction for gains greater than 1. Contact the factory for more information.

R) The Internal Data Rate setting is crucial for noise reduction. Normally, it should be set to line frequency, or an integer division of line frequency. Lowering the rate lowers the maximum frequency that you can digitize. For best effective resolution, run at 10 Hz. That is an integer division for both a 50 and a 60 Hertz line frequency.

B) Pressing B, for standBy, toggles the Model 201 low power standby mode. The I/O state is unchanged, and some commands will function in Standby, but the analog input section is powered down. Any commands referring to the analog input section will be ignored in Standby. The available commands in standby are Channel and External control code settings, Averaging and Filter settings, checKsum and Digital input and outpUt commands.

N) Pressing N for scaN brings up the Scanning Menu. See Section C for details.

D) D returns the Digital input state. It is displayed as an 8 bit binary byte with the most significant bit to the left. Because the digital inputs have pull-up resistors, open inputs show as 1. If pulled down, an input will show as 0.

U) Prompts for the Digital output word, 0 to 255. It is displayed as an 8 bit binary byte with the most significant bit to the left. Active outputs are at 5 volts, shown as 1 and inactive outputs are at zero volts, shown as 0. If the outputs and inputs were tied together, the D and U words would match.

K) Enter K for checKsum, to perform a checksum command. If the two checksums match, an "OK" message is displayed.

S) System calibration readjusts the Model 201 for any offset or gain drift. A "cal" message appears during calibration. Note that at stronger filter settings, calibration takes longer.

O) Offset calibration readjusts the Model 201 to read 0 volts on the currently selected channel. There is limited range for the offset calibration. Typically, the selected channel should be within 1 volt of zero for proper offset calibration behavior. Again, a "cal" message appears during calibration.

NOTE: An unintended offset calibration will cause incorrect readings. If there is any doubt regarding the voltage displayed, perform a system calibration to restore normal voltage readings.

W) Word length toggles between 16 and 24 bits. In 16 bit mode with stable voltage inputs, the readings will be so steady that you might think the voltage was not being updated at all.

P) Toggles between uniPolar and biPolar operation.

Z) Puts the Model 201 to sleep and returns to the Communications Menu. A Sign On is required to continue operation after sleep. The current requirement for power during sleep is under 2 ma.

Q) Returns to the Communications Menu. The Model 201 remains awake.

C. Scanning Configuration Menu

```
Command Prompt - python DEMO201rev1.py                    _ □ ×
                    SCANNING   CONFIGURATION

        CHANNEL           EXTERNAL CONTROL CODE        DATA POINTS
                            FROM           TO          THIS CHANNEL

            0>               0             1               2
            1>               1             0               0
            2>               3             3               1
            3>               1             0               0
            4>               1             0               0
            5>               1             0               0

        6> Scan Interval        4.9997

        7> Scan type       Self-Calibration

     Enter> Perform the SCAN

     X> eXit SCAN menu       data points per scan:    5
```

Up to 64 channels can be scanned sequentially with external multiplexers or EMF16 instruments, which contain multiplexers. Sub-channels 0-15 can be selected for each of the six main channels, numbered here 0 to 5. Sub-channels must be consecutive.

Enter a channel number, 0 - 5, to change sub-channel settings. You are then prompted for the starting sub-channel, followed by the ending sub-channel for that main channel. The number of active sub-channels will be shown in the "DATA POINTS THIS CHANNEL" column. The total number of channels selected is shown below as "data points per scan". Enter a starting sub-channel greater than the ending sub-channel to skip an A/D channel entirely. Control codes on skipped channels show as "external control code from 1 to 0".

6) Enter 6 to set the scan interval. The minimum and maximum interval, in seconds, is displayed in the prompt. A number entered outside that range will be reset to the appropriate limit. Your scan interval may be slightly adjusted to the nearest available interval.

7) Entering "7" cycles the scan type. Single Channel scanning sets the number of data points to 1, and replaces the channel selection block with the single channel and sub-channel.

If Single channel scanning is selected, only one channel and sub-channel are displayed. There are two keys to set the single channel active channel (C) and sub-channel (E). The single channel scan information is stored separately, so you will still have your original settings in place if you switch back to a multi-channel scan.
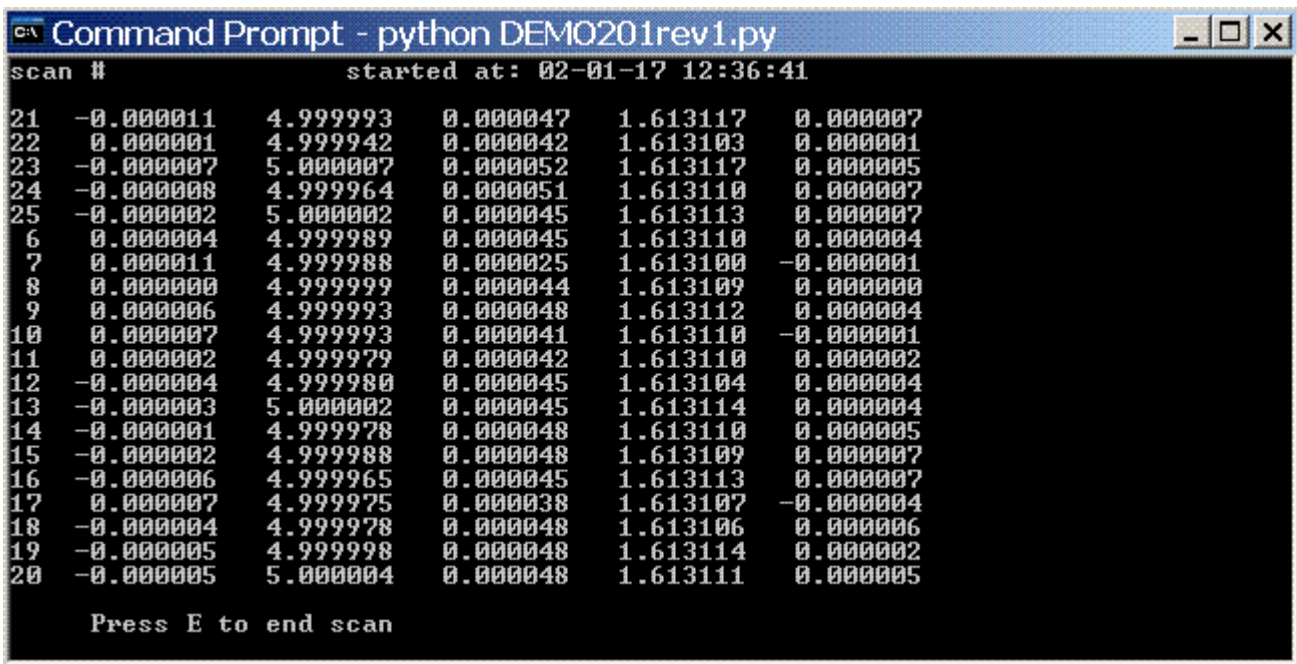
The total number of active channels is displayed in the lower right. Normal scanning includes all the selected channels and sub-channels. Calibration scanning adds two channels for calibration.

After changing channel selections or scan types, you may need to revise the scan interval because the range of available intervals may change.

Pressing "Enter" begins a scan. See the Scanning screen description below.

X) Returns to the Main Menu.

D. Scanning Screen


```
C:\  Command Prompt - python DEMO201rev1.py                          _ □ ×
scan #                 started at: 02-01-17 12:36:41

21    -0.000011    4.999993    0.000047    1.613117    0.000007
22     0.000001    4.999942    0.000042    1.613103    0.000001
23    -0.000007    5.000007    0.000052    1.613117    0.000005
24    -0.000008    4.999964    0.000051    1.613110    0.000007
25    -0.000002    5.000002    0.000045    1.613113    0.000007
 6     0.000004    4.999989    0.000045    1.613110    0.000004
 7     0.000011    4.999988    0.000025    1.613100   -0.000001
 8     0.000000    4.999999    0.000044    1.613109    0.000000
 9     0.000006    4.999993    0.000048    1.613112    0.000004
10     0.000007    4.999993    0.000041    1.613110   -0.000001
11     0.000002    4.999979    0.000042    1.613110    0.000002
12    -0.000004    4.999980    0.000045    1.613104    0.000004
13    -0.000003    5.000002    0.000045    1.613114    0.000004
14    -0.000001    4.999978    0.000048    1.613110    0.000005
15    -0.000002    4.999988    0.000048    1.613109    0.000007
16    -0.000006    4.999965    0.000045    1.613113    0.000007
17     0.000007    4.999975    0.000038    1.613107   -0.000004
18    -0.000004    4.999978    0.000048    1.613106    0.000006
19    -0.000005    4.999998    0.000048    1.613114    0.000002
20    -0.000005    5.000004    0.000048    1.613111    0.000005

       Press E to end scan
```

The 20 most recent scans will cycle on the scanning screen. Each is identified with its scan number. The local average in not applied to the data.

The same data is saved in a file having a name matching the starting time and date. There is a flag passed into the scan function that can be set to zero in the source code if

data files are not desired.

The scan will continue until stopped with a keypress, E. The data file, if enabled, will be closed at that time. At the end of the data file a brief summary will be appended:

```
Averaging: 32
Internal Data Rate: 59.91
Number of Scans: 23
Started: 02-01-17 12:34:13
Finished: 02-01-17 12:36:08
End scan OK
```

The final entry is a confirmation that the scan ended without errors, or, the appropriate error message.

justScanrev1.py is a minimalist version of the same code that loads the configuration and starts a predefined scan without keyboard input.

Please contact Lawson Labs at lawsnlab@lawsonlabs.com or 610 725-8800 with questions or comments.

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