ATLAS Movement System DAQ Procedure

Jim Grudzinski
ANL
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Abstract: This document describes the procedure for taking movement data using the Detector Movement control system PLC and extracting the data into a PC. The data file produced is described as well.

1 Overview to taking data from the PLC.

a) Connect PC to PLC through serial connection.
b) Start terminal program (such as HyperTerminal) on PC
c) Open file on PC and start capturing data.
d) Start/ Stop DAQ (Data acquisition) function in PLC
e) Stop terminal data capture.
f) To view data: Data is written in HEX (4-bit) format. A conversion utility is used to convert it into signed integer format (16 bit).

2. Connect PC to PLC

Connect serial cable to CP340 module in PLC rack and to PC serial port. A null modem cable or null modem adapter is necessary in the line. When done properly, the there should not be a red indicator light illuminated on the CP340 card.

3. Start terminal program on PLC

A terminal software program is needed to receive the text file sent through the serial port. HyperTerminal is an application that has been proven to work acceptably. The settings for communication to the PLC are, 9600 Baud, 8 data bits, no parity, 1 stop bit, Xon, Xoff flow control. If the terminal is not already connected, select CALL from the CALL pull down menu. When the terminal is connected properly, the words "Connected" will appear in the lower left corner of the HyperTerminal window.

4. Open file and begin capturing data

In HyperTerminal, select CAPTURE TEXT from the TRANSFER pull down menu and open a file with any desired name such as "input.txt". Choose a file name that does not already exist in the directory chosen or the data will be appended to the existing file. Then select start. When properly done, the word "Capture" at the bottom center of the screen will display bold.

5. Start DAQ in the PLC

Refer to the screen diagram below. Using the Siemens HMI (Human Machine Interface),

a) Verify that "Data Ready" is displayed on the "Data Ready" indicator. If it instead displays "Data Done", press the **<Reset Data>** button.

b) Set the DAQ trigger by pressing the **<Set Trigger>** button. When properly set, the <**Set Trigger>** as wellas the **<DAQ Start>** buttons will display green.
c) Start/ Stop taking data. Press the <**DAQ Start>** button and the data collection begins and continues until the <**DAQ Stop>** button is pressed.
d) When data is being properly collected, the <**DAQ Stop>** button will flash BLUE. If this is not the case, the DAQ may not have been properly reset (a) or the trigger (b) is not set. The data is sent to the PC every 30 seconds. Numbers should begin appearing in the HyperTerminal Display after 30 seconds and all data should be saved into the file identified in step 4 above.

6. STOP DATA CAPTURE IN THE PC

After stopping the data in the PLC, in HyperTerminal, from the TRANSFER pull down menu, select CAPTURE TEXT and then STOP.

7. CONVERTING THE DATA TO SIGNED 16-bit INTEGER

The data file needs to be converted to a convenient readable form. A utility program was created to convert the ASCII Hex files into a signed integer file. The utility is called "casetest.exe". The following details it's use. It is recommended to make a back-up of the original unconverted data.

Execute the CASETEST.EXE program. A command window should come up with the prompt: " Enter File Name". Type in the full file name and press <ENTER>. Be sure to include the full directory path of the file if it is located in a directory different than that contain the CASETEST.EXE program. It may be necessary to place the input file in the same directory as the CASETEST.EXE program. Type "c" and again press <ENTER> to start the conversion process. It may take 10-15s for the conversion depending on the file size. After the conversion is complete, the message "Press any key to continue" will appear. Pressing any key will then close the window. A new file will be created with the same name as the input file except that it will be preceded by the letters and symbol "OUT_". For example, if the input file was named "input.txt", the output file would be named "OUT_input.txt". This file will be created if one does not exist and will overwrite an existing file of the same name.

Note that in some cases, a few initial entries may be made into the file before the actually data is written. This can cause incorrect results when converting the data. To check for this, simply open the original input file written from the terminal program. Examine the first data line. This line should contain eight (8) 4 byte HEX words. If this first line is something different, simply delete this line and save the modified file. It should now be correct when converting the data as described above.

8. DETAILS OF THE RAW DATA FILE

The DAQ routine stores the data every 200ms plus an undetermined scan time ranging between 2-7ms which is believed to remain constant during each individual mode (a variation between jog and leveling mode might be expected). The data consists of 21 signed integer values (16 bit in representation) for each time step. Table 1 details the values that are written into the raw data file. Table 2 shows the make up of the two status bits. Table 3 describes the converted data file.

The raw data file is created by the PLC and transferred to the PC in the form of 4 byte HEX characters transmitted serially as ASCII text. The values are written with a space between each value and with a linefeed and carriage return character after each 21 values. The conversion program described in step 7 above converts the data into signed integers scaled to the proper engineering units. The integer values are raw in the sense that they are in units that are convenient for working within the PLC. Table one lists the scale factor that is necessary to change these integer values into real units.

DATA COLUMN	VARIABLE	DESCRIPTION	Multiply raw data value by this scale factor to get data in engineering units	Units
1	velocity(z4)	Z direction velocity [mm/s] taken from the draw wire sensor.	100	mm/s
2	z4**	Z direction position [mm] from draw wire sensor.	10	mm/s
3	y1*	Raw height sensor data with offset subtracted (in analog data units).	0.001838	mm
4	y2*	Raw height sensor data with offset subtracted.	0.001838	mm
5	y3*	Raw height sensor data with offset subtracted.	0.001838	mm
6	y4*	Raw height sensor data with offset subtracted.	0.001838	mm
7	P1A	Raw pressure sensor data in PLC analog data units.	0.0217	Bar
8	P2A	Raw pressure sensor data in PLC analog data units.	0.0217	Bar
9	P3A	Raw pressure sensor data in PLC analog data units.	0.0217	Bar
10	P AirPadPump	Raw pressure sensor data in PLC analog data units.	0.0217	Bar
11	P5B	Raw pressure sensor data in PLC analog data units.	0.0217	Bar
12	P5A	Raw pressure sensor data in PLC analog data units.	0.0217	Bar
13	P4B	Raw pressure sensor data in PLC analog data units.	0.0217	Bar
14	P4A	Raw pressure sensor data in PLC analog data units.	0.0217	Bar
15	P Traction Pump	Raw pressure sensor data in PLC analog data units.	0.0217	Bar
16	Status 2	Status word	--	--
17	Valve 1	Valve command signal in PLC analog data units.	1/2764.8	VDC
18	Valve 2	Valve command signal in PLC analog data units.	1/2764.8	VDC
19	Valve 3	Valve command signal in PLC analog data units.	1/2764.8	VDC
20	Valve 4	Valve command signal in PLC analog data units.	1/2764.8	VDC
21	Status 1	Status word	--	--
Notes:				
1. All raw data (except for status words) is 16 bit signed integers stored in a 4-byte hex representation. Status words are 16-bit words also stored as hex.				

Table 1. Description of the raw data file data produced in the DAQ cycle.

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Status Word 1	G13	ISO Tract	CYL 5 En	CYL 4 En	Airpad Mode	Cyl 3 En	Cyl 2 En	Cyl 1 En	Alarm bit	G35	G41	DeadBand On	Hydrosta	Enable OK	Stop	E-Stop OK
Status Word 2	Group 2 Small Error D	Group 2 Small error	Group 1 Small Error D	Group 1 Small error	Traction Mode Enabled	Blocking Jack Mode Enabled	Leveling Mode Enabled	Low Limit Group 3	Low Limit Group 2	Low Limit Group 1	Leveling ON	Lowering	Raising	Group 3 Small Error D	Group 3 Small error	Raise/Lowering

Table 2. Bits that form the two status words.

DATA COLUMN	VARIABLE	DESCRIPTION	Units
1	time	elapsed time from start if data taking.	s
2	z4**	Z direction position [mm] from draw wire sensor.	mm
3	velocity	Z direction velocity [mm/s] taken from the draw wire sensor.	mm/s
4	F4	Force on cylinder 4	Ton
5	F5	Force on cylinder 5	Ton
6	y1*	Raw height sensor data with offset subtracted (in analog data units).	mm
7	y2*	Raw height sensor data with offset subtracted.	mm
8	y3*	Raw height sensor data with offset subtracted.	mm
9	P4A	Raw pressure sensor data in PLC analog data units.	Bar
10	P4B	Raw pressure sensor data in PLC analog data units.	Bar
11	P5A	Raw pressure sensor data in PLC analog data units.	Bar
12	P5B	Raw pressure sensor data in PLC analog data units.	Bar
13	P1A	Raw pressure sensor data in PLC analog data units.	Bar
14	P2A	Raw pressure sensor data in PLC analog data units.	Bar
15	P3A	Raw pressure sensor data in PLC analog data units.	Bar
16	Valve 1	Valve command signal in PLC analog data units.	VDC
17	Valve 2	Valve command signal in PLC analog data units.	VDC
18	Valve 3	Valve command signal in PLC analog data units.	VDC
19	Valve 4	Valve command signal in PLC analog data units.	VDC
20	Status 2	Status word	--
21	Status 1	Status word	--
Notes:			
1. Area used in force calculation for EB cylinder: Area (extened) = 22698mm^2, Area (retract)= 11388 mm^2.			

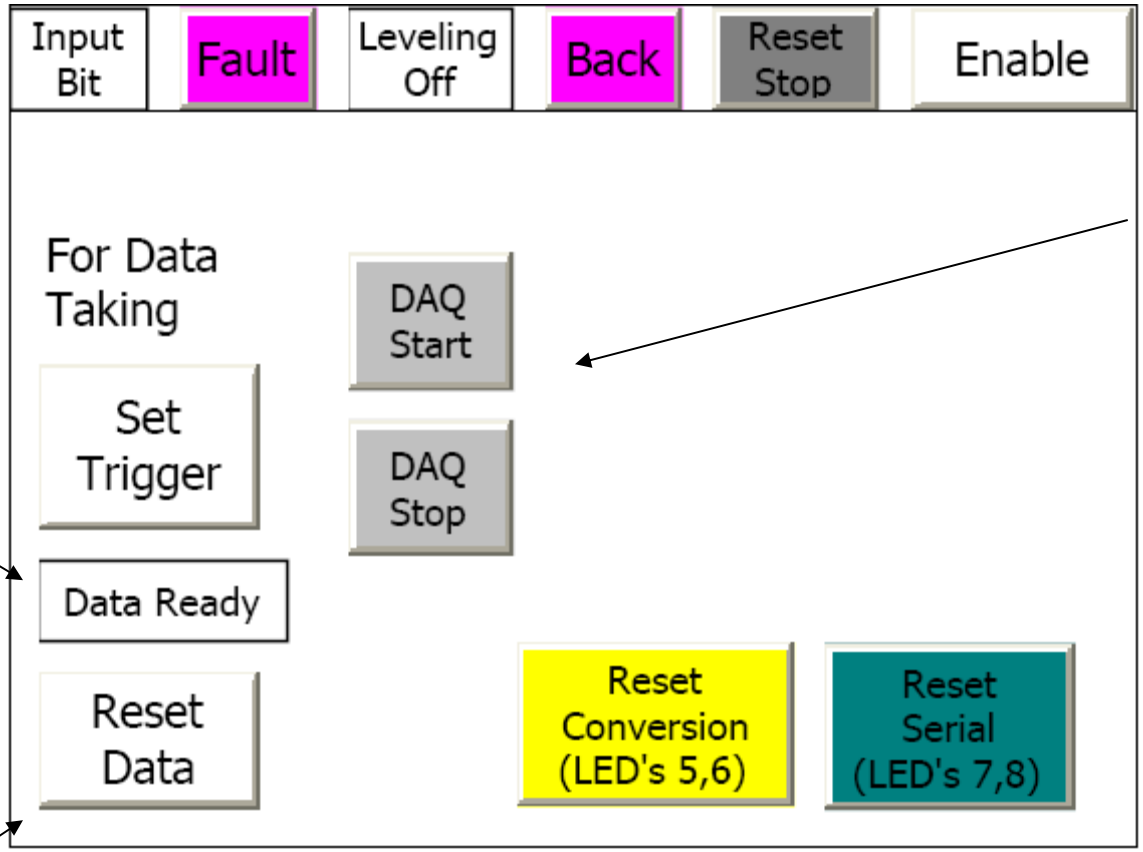
Table 3. Data contained in columns of the converted output file after running the CASETEST.EXE program.

DATA AQUISITION (DAQ) SCREEN

Press the **<Set Trigger>** button to prepare for data taking. The button will be green when the trigger is properly set and ready to take data. Trigger will not set if the Data needs to be reset (see below).

"Data Ready " indicator should display **"Data Ready"**. If it displays **"Data Done"** and with yellow background, the data must be reset before more

Press the **<Reset Data>** button to reset data.



Press the **<DAQ Start>** and **<DAQ Stop>** buttons to Start and Stop data taking. The **<DAQ Start>** button turns green when ready to take data. The **<DAQ Stop>** button will flash blue while data is being taken.