

SM 53: Final Exam A17

Family Name:

Given Name:

No documents allowed – No calculator allowed

Answer on this document – Answer in English

1. GENERAL QUESTIONS – 6 POINTS

The following questions are all multiple choice questions. There is only one correct answer.

You get +0.5 points for each correct answer, -0.5 points for each wrong answer and 0 points if you do not answer.

1.1 QUESTION 1

What does RCP mean?

- ☐ a. Relative Computer Priorization
- ☐ b. Rapid Control Prototyping
- ☐ c. Recent Controller Programming

1.2 QUESTION 2

What is the difference between RPC and HIL?

- ☐ a. HIL is the PC you do the preparation on, RCP is the programmable controller.
- ☐ b. They are the same.
- ☐ c. In RCP the controller is simulated, in HIL a part of the system is simulated.

1.3 QUESTION 3

Where the RCP is executed?

- ☐ a. On a real-time computer.
- ☐ b. It is not executed at all.
- ☐ c. On your computer.

1.4 QUESTION 4

What is the NI material used during lab sessions?

- ☐ a. PXI
- ☐ b. NI CompactRIO
- ☐ c. NI CompactDAQ

1.5 QUESTION 5

What is the main reason to use NI Hardware and LabView Software?

- ☐ a. Increase knowledge of the system
- ☐ b. Data Acquisition
- ☐ c. System Control

1.6 QUESTION 6

How to react if you have to do something completely new using LabView?

- ☐ a. See if an example for this problem is available in the database.
- ☐ b. Find the elements that might help and try to connect them.
- ☐ c. Start with a new VI

1.7 QUESTION 7

According to Nyquist Sample Theorem, what is the minimum frequency to determine a signal with no frequencies higher than B?

- ☐ a. $2f_s > B$
- ☐ b. $f_s > 2B$
- ☐ c. $f_s < 2B$

1.8 QUESTION 8

How to quickly verify if a material is correctly connected to your system?

- ☐ a. DAQ
- ☐ b. DAQmx
- ☐ c. MAX

1.9 QUESTION 9

How to create a link to the DS1104 card in Simulink?

- ☐ a. RTI Library
- ☐ b. Control Desk
- ☐ c. Configuration Desk

1.10 QUESTION 10

What does "Real Time" mean?

- ☐ a. super rapid execution
- ☐ b. very realistic simulation
- ☐ c. deterministic execution

1.11 QUESTION 11

Where is RCP used?

- ☐ a. On converters
- ☐ b. multiple domains
- ☐ c. Automotive and power engineering

1.12 QUESTION 12

What does the "sample time" in RCP depend on?

- ☐ a. model complexity
- ☐ b. hardware and model complexity
- ☐ c. hardware

2 LABVIEW – 6.5 POINTS

2.1 DATA ACQUISITION

The NI 9263, presented in Figure 1, is an analog output module 4 AO, ± 10 V, 16 Bit, 100 kS/s/ch simultaneous. It is usable for any CompactDAQ and CompactRIO systems. It also features ± 30 V overvoltage protection, short-circuit protection, low crosstalk, fast slew rate, high relative accuracy, and NIST-traceable calibration. The NI 9263 module includes a channel-to-earth ground double isolation barrier for safety and noise immunity.

2.1.1 Question

What is the resolution (or precision) of the writing to a NI 9263 in volt/bit? (Equation and approximate value, knowing that $2^{16}=65\,536$.)

2.1.2 Question

What will be the maximum sampling frequency if we want to use all 4 channels? (Equation and value.)



2.1.3 Question

What will be the maximum sampling frequency if we want to use only 1 channel? (Equation and value.)

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2.1.4 Question

We want to send a periodic signal with a frequency of 50 Hz with maximum sampling frequency of the model 9263 on only one channel. What should be the minimum buffer size to measure at least 5 complete periods? What will be the time required to fill up the buffer?

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2.2 EXAMPLE PROGRAM

Figure 2 presents the example of a Labview Program that has been presented during the guest lecture of Antony Plait.

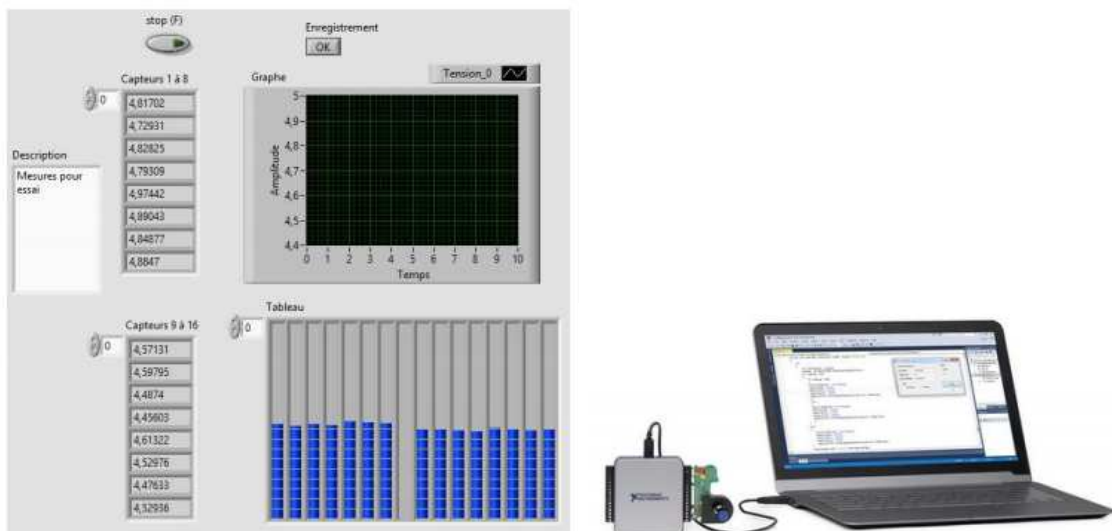
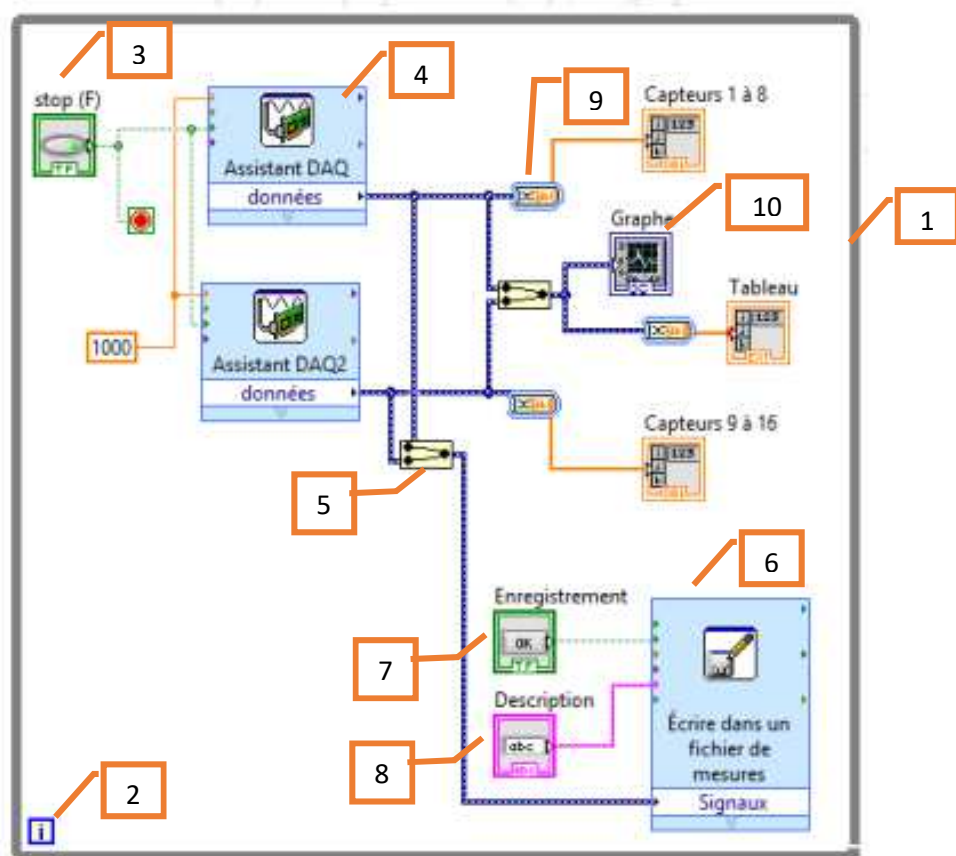


Figure 2 : Labview Program presented by Antony Plait

2.2.1 Based on the diagram, what was the goal of the project?

2.2.2 The program contains two “Assistant DAQ” why are they used? Is this a problem?

2.2.3 Explain the functions realized in the blocks with the numbers

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

3 REALIZATION OF A PROGRAM USING DSPACE— 7.5 POINTS

We want to realize a hysteresis current control (HCC) of the DC/DC converter used during the lab sessions. The program will contain of three parts:

1. Measure system values
2. Hysteresis current control
3. Send PWM value

In the following you have to draw figures of the subprograms as precise as possible.

3.1 MEASURE SYSTEM VALUES

The following values have to be measured:

- DC current
- DC voltage
- Charge current
- Charge voltage

The program to measure the values should contain the following aspects:

- Measurement interface

- Decomposition of measured values
- Data treatment (gains)
- Labels

The Figure 3 will help you determine the gains

Grandeurs mesurées pour 10V sur les sorties BNC

V1: $u-u = 250V$	A1: $I_u = 30A$
V2: $u-w = 250V$	A2: $I_v = 30A$
V3: $w-u = 250V$	A3: $I_w = 30A$
V4: Tension continue = 350V	A4: Courant continu = 30A

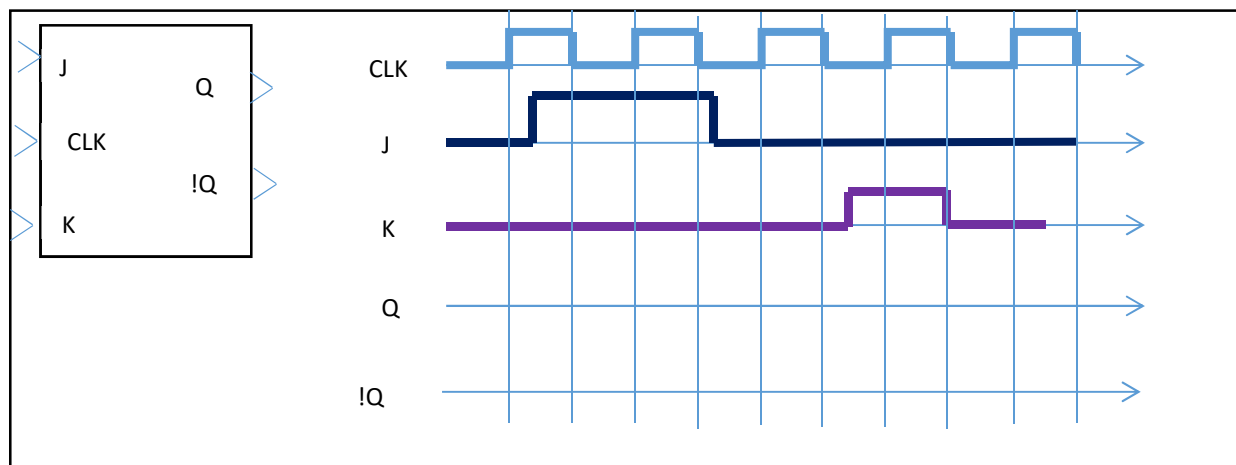
Figure 3 : Converter gains



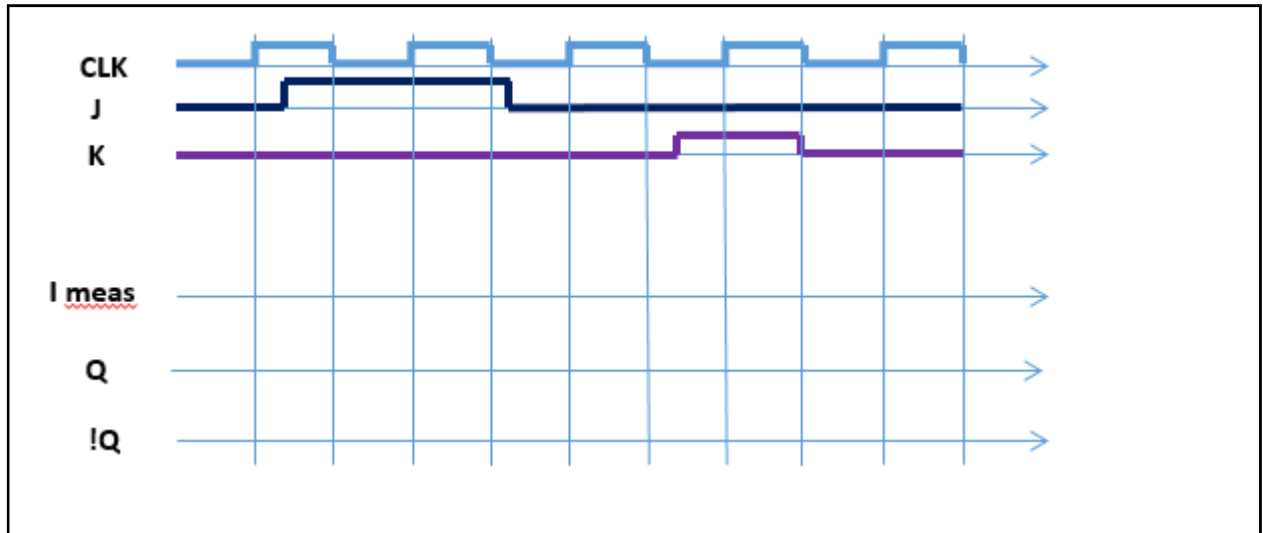
3.2 HYSTERESIS CURRENT CONTROL

The Hysteresis Current Control (HCC) is based on a “J-K Flip-Flop”. The Clock (CLK) signal is the heartbeat of the system. The inputs J and K present the upper and lower current level respectively. The value Q is the output of the block and !Q is the invers of the output.

3.2.1 Draw the outputs Q and !Q of the J-K Flip-Flop in the given figure



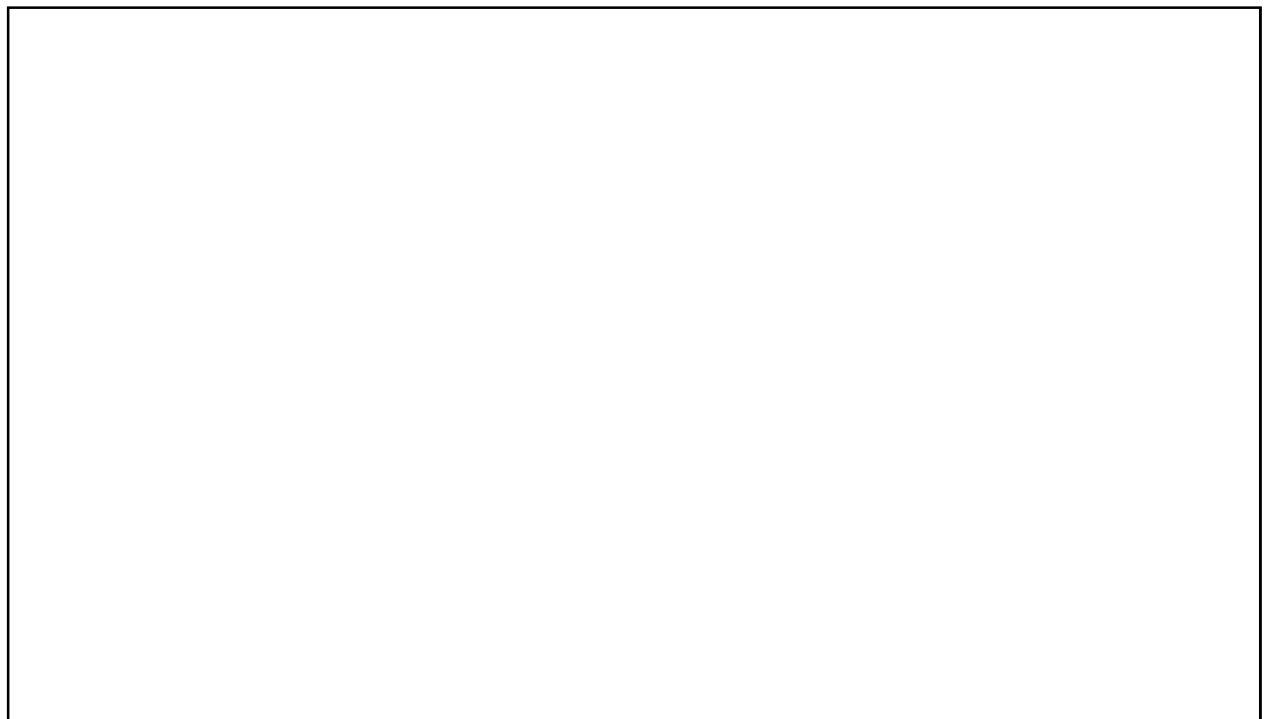
3.2.2 Draw the values of CLK, system current, and Q over time.



3.2.3 Realize HCC program structure

The HCC program has to contain:

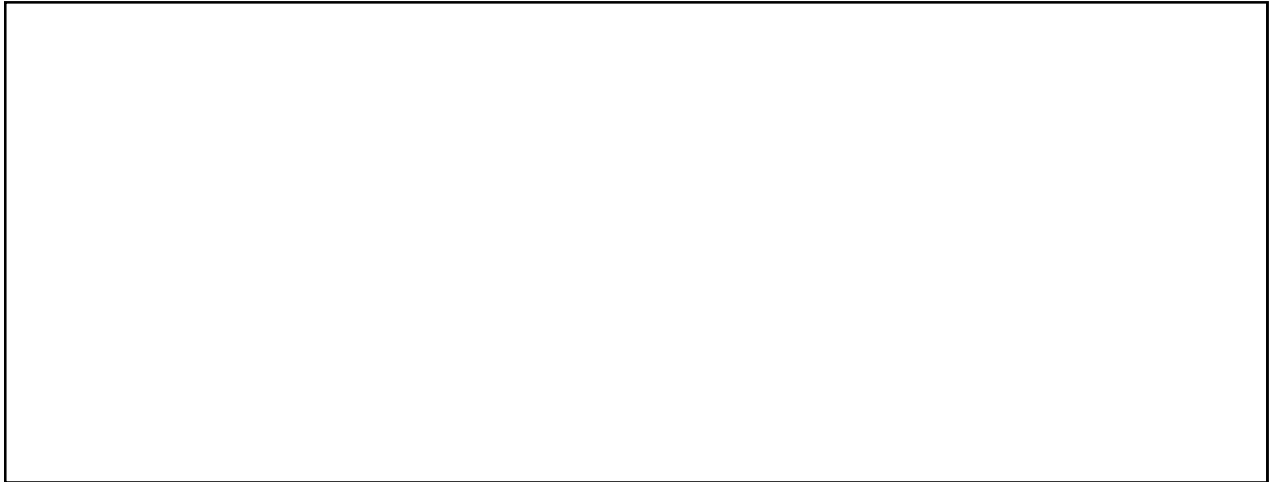
- the clock,
- a calculation of the higher and lower reference value,
- a comparison between the measurement value,
- a J-K Flip-Flop
- a link to the PWM



3.3 SEND PWM VALUE

Finally, the PWM value has to be send. Therefore, three “Slave Bit Out” values have to be reset “RST” and the PWM block (containing duty cycles a, b and c) has to be activated using “Enable”.

3.3.1 Draw the program structure below



3.4 FINAL CONCLUSIONS

The three parts of the dSpace program have to cooperate

3.4.1 What are the values connecting measure system values, hysteresis current control and send PWM value?



3.4.2 Question

Normally, the PWM value varies between 0 and 1. What is special about the PWM value using HCC?
In which cases this can be an advantage?

