

Backward hCal: **DAQ for tile testing**

May 19 2025



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CAMAC crate : (Computer Aided Measurement And Control) provides power & backplane for modules

Controller: CC-USB, WleNeR Communication with modules inside the crate

DOCUMENTATION



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Modules:

ADC: Analog - Digital Converter

LaCory 2249A

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DOCUMENTATION

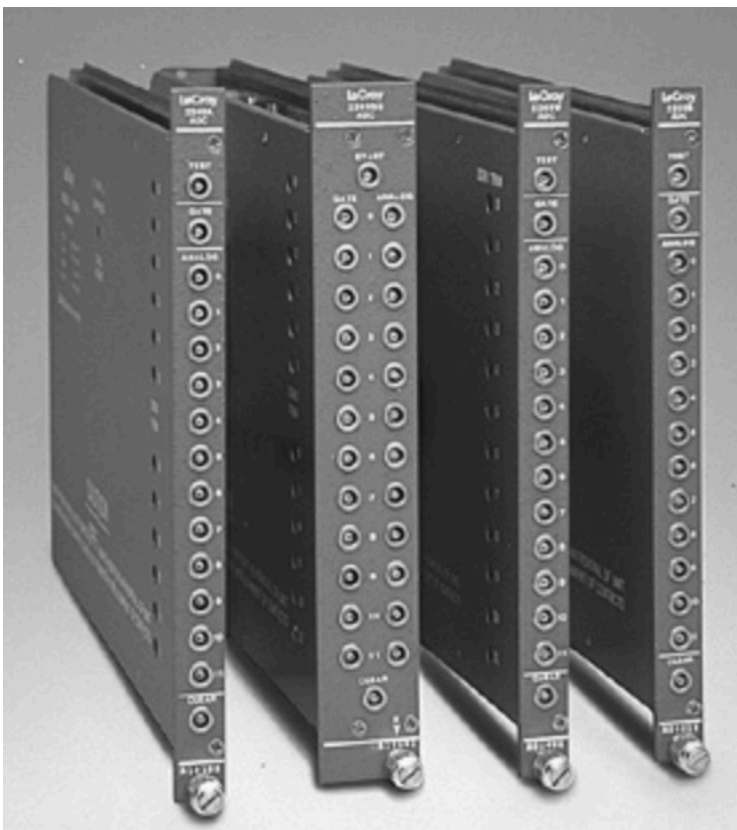


Modules:

ADC: Analog - Digital Converter

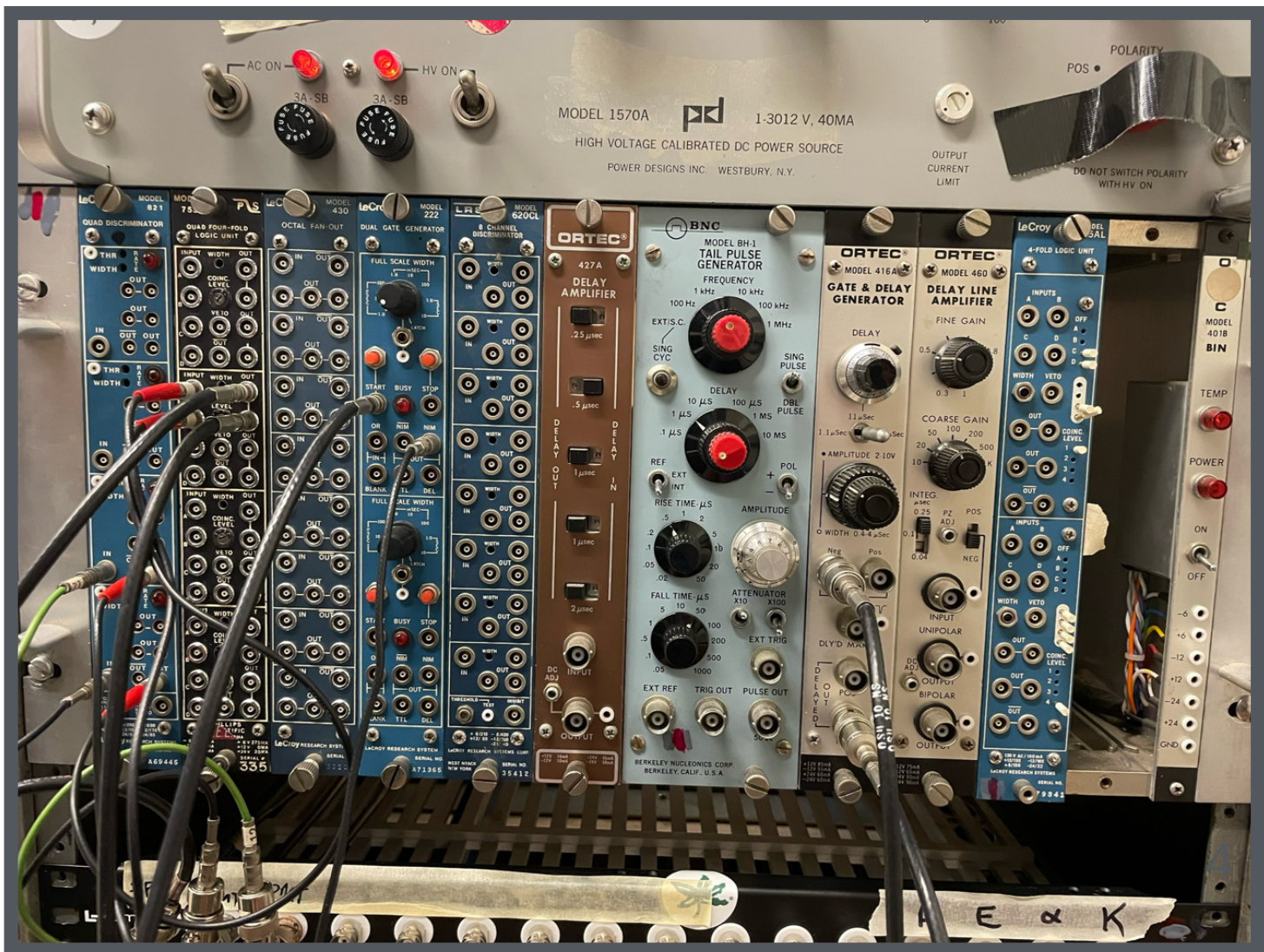
LaCory 2249A

DOCUMENTATION

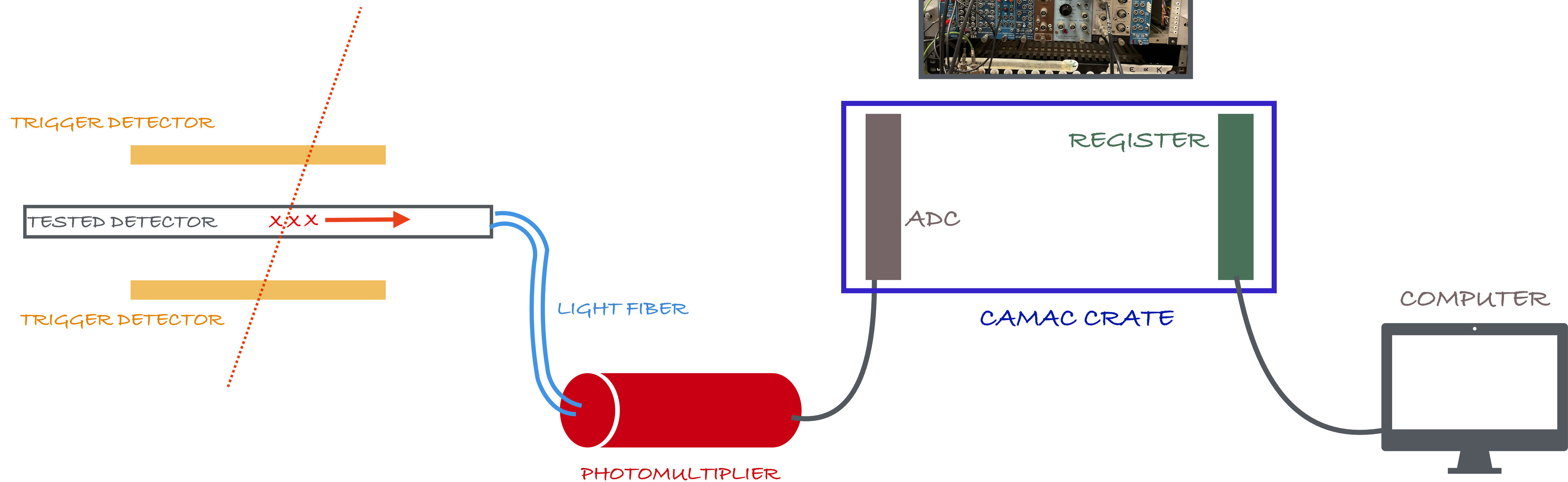
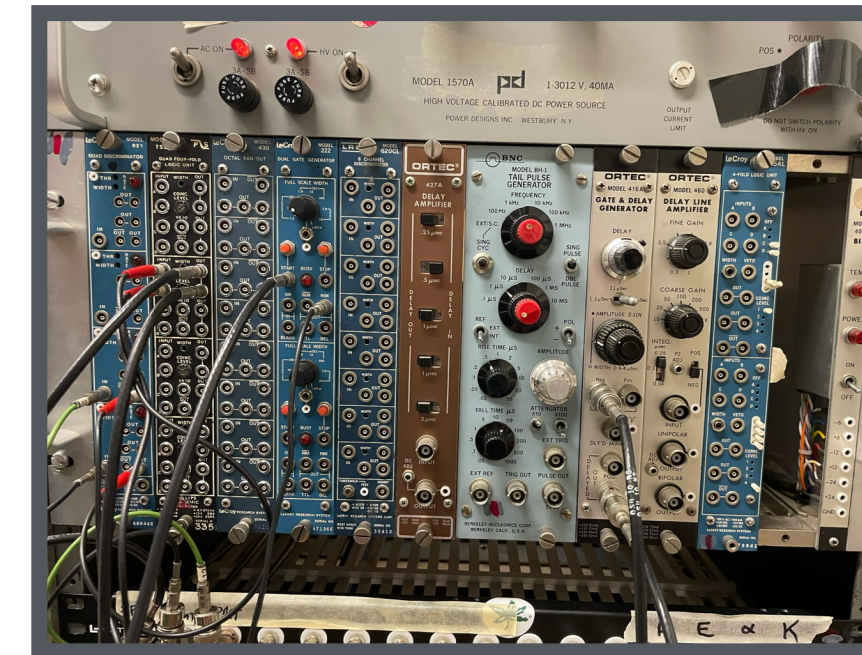


+

Voltage generator
Gate generator
etc...



VOLTAGE/ GATE GENERATORS, AND MANY OTHERS



1. Load & execute Stack Commands

STACK COMMANDS

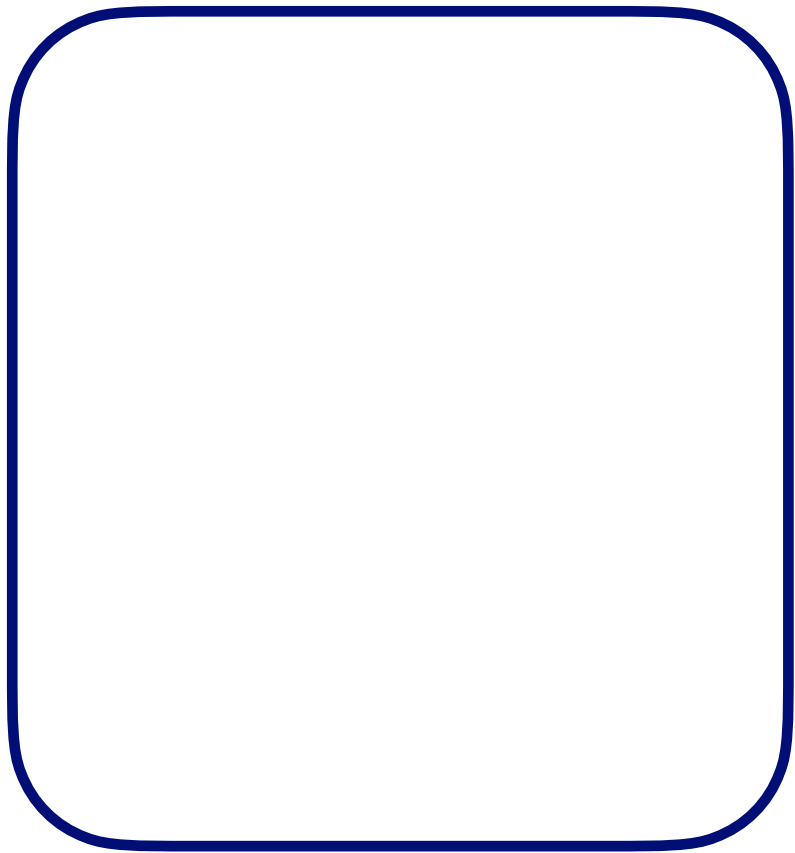
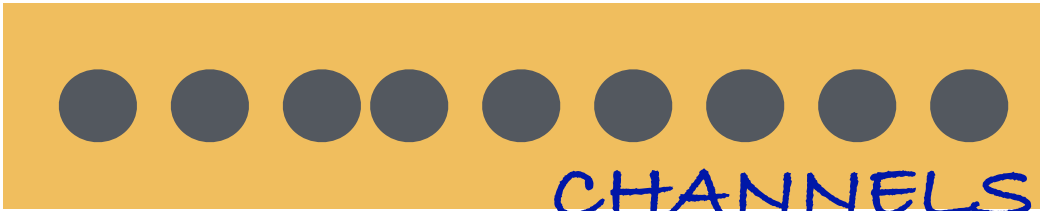
1. Read module

2. Clear module



TRIGGER

ADC



BUFFER



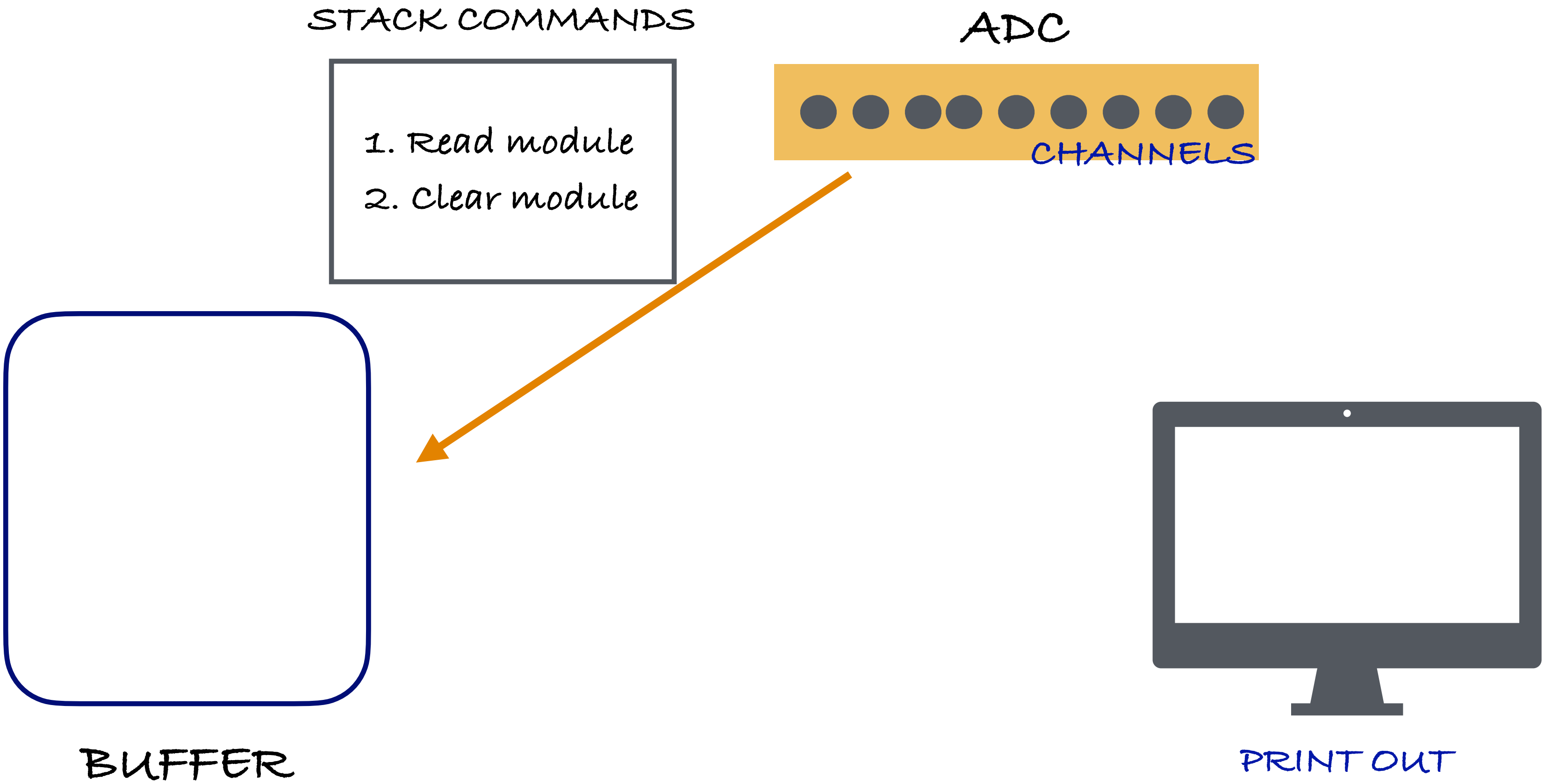
PRINT OUT

1. Load & execute Stack Commands

2. Trigger the stack



Hey CAMAC! Ask Module (ADC) to execute STACK!



1. Load & execute Stack Commands

2. Trigger the stack

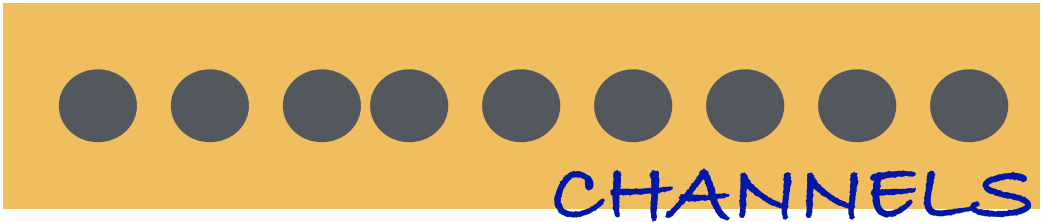


Hey CAMAC! Ask Module (ADC) to execute STACK!

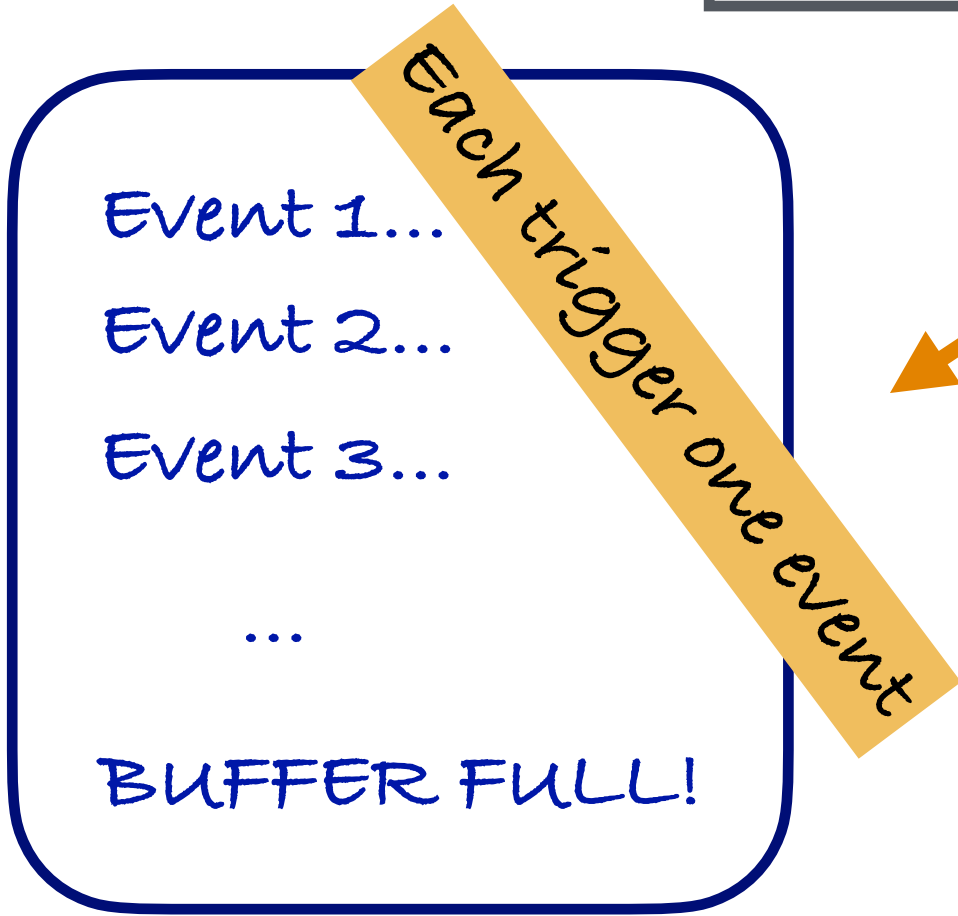
STACK COMMANDS

- 1. Read module
- 2. Clear module

ADC



3. Filling the buffer



BUFFER



PRINT OUT

1. Load & execute Stack Commands

2. Trigger the stack

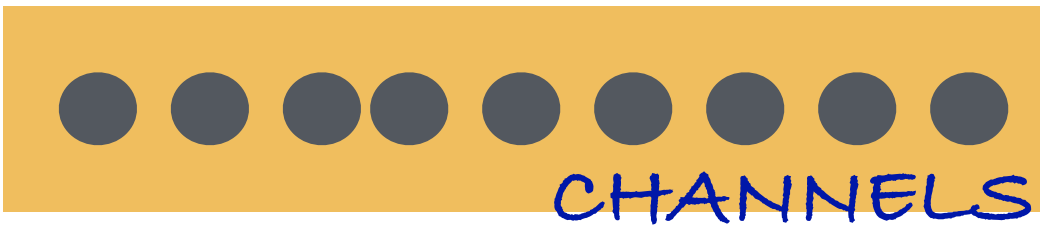


Hey CAMAC! Ask Module (ADC) to execute STACK!

STACK COMMANDS

- 1. Read module
- 2. Clear module

ADC



3. Filling the buffer



BUFFER

4. Acquisition mode - read buffer



PRINT OUT

1. Load & execute Stack Commands

2. Trigger the stack

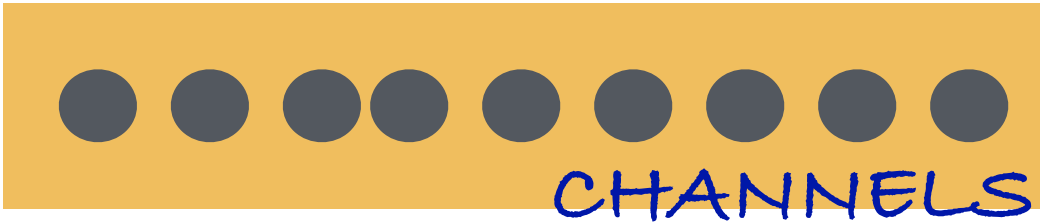


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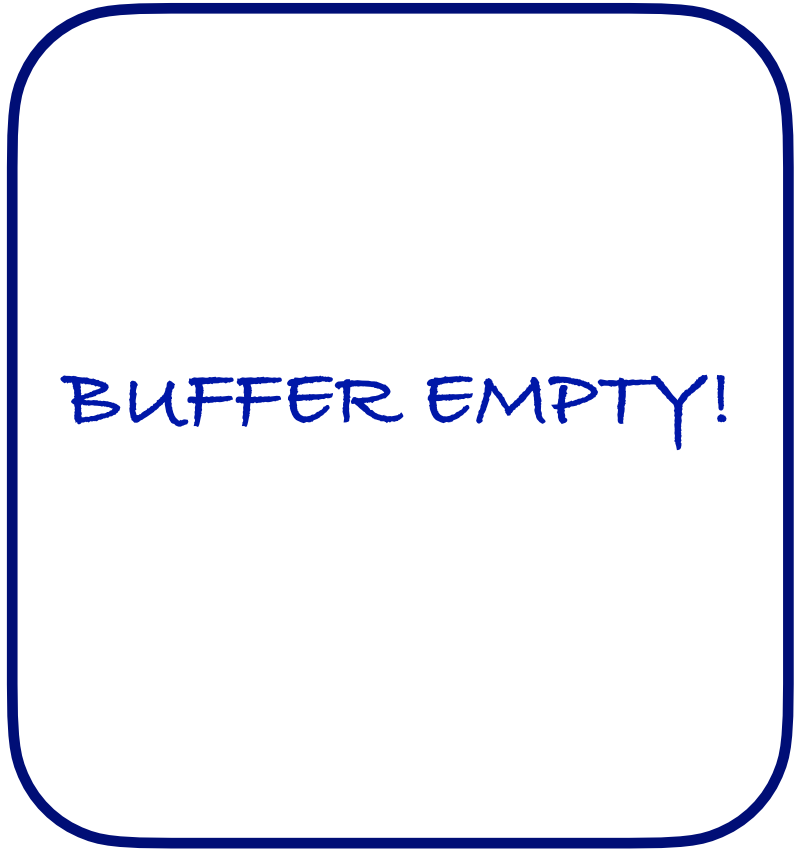
STACK COMMANDS

- 1. Read module
- 2. Clear module

ADC



3. Filling the buffer



BUFFER

4. Acquisition mode - read buffer

5. Drain the buffer

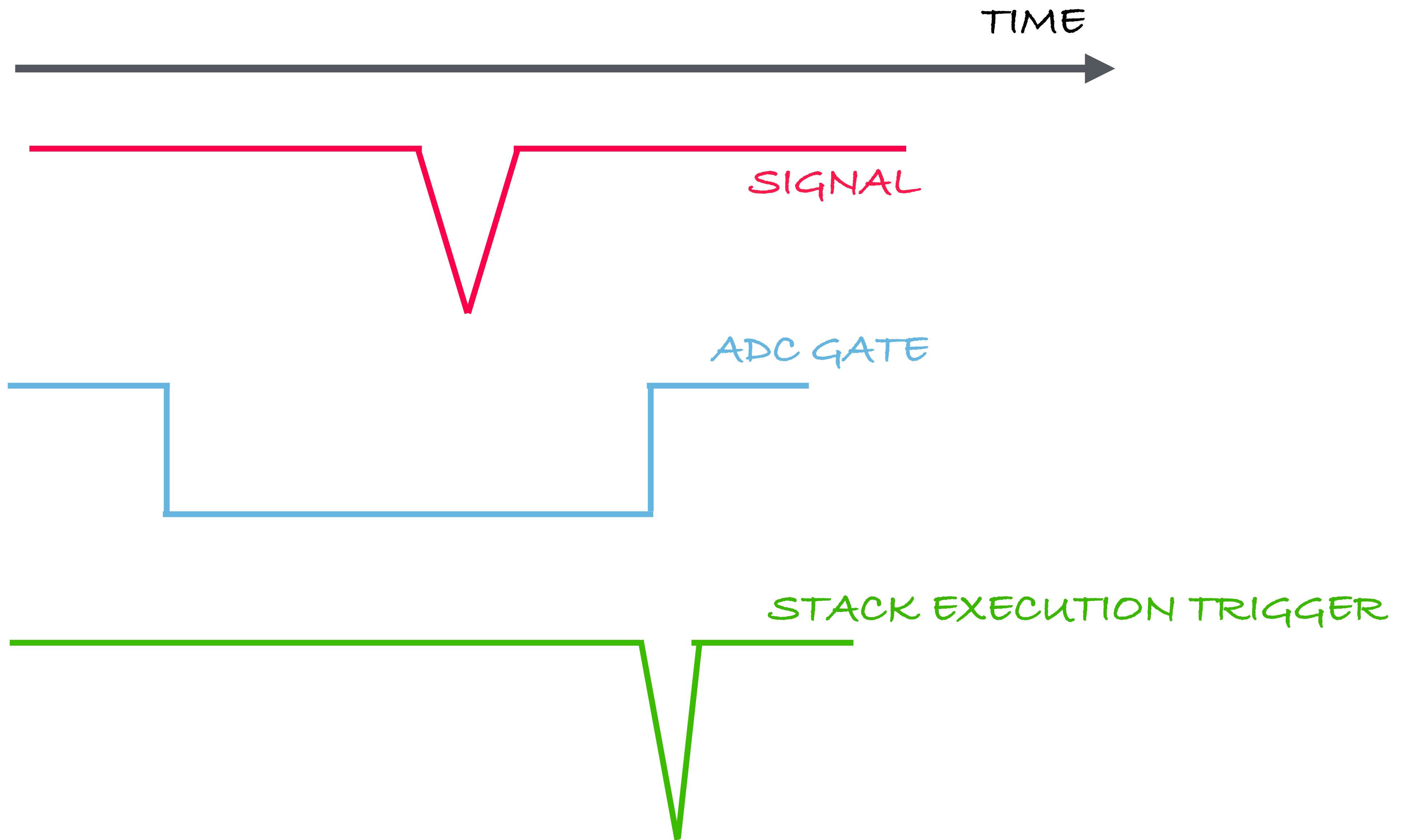


PRINT OUT

Code available on my [GitHub](#)

1. CAMAC INITIALIZATION:
 - check if device is connected
 - creates object which handles controller
 - test basic functions
 - set LAM mask (we want to read everything, so we don't set anything special)
LAM → Look At Me
 - set the trigger delay?
 - set Buffer size in Global Mode register
(I made several options for buffer size: {4096, 2048 ... 64, 1})
2. PRINT MODULES
 - prints info about devices, connected modules
3. PREPARE & LOAD STACK
 - list of commands
 - writing stack commands (adds reading commands to all channels
→ clear module)
 - loading all the commands to controller
 - execute the stack
4. INITIALIZE MODULE OUTPUT
5. CREATE SOME HISTO TO STORE THE OUTPUT (CREATE OUTPUT TREE)
6. DATA TAKING: [IN THREADS]
 - INITIALIZE DAQ → START ACQUISITION
 - TAKE DATA: → NEXT PAGE
~~read bytes~~
7. TURN OFF → STOPS DATA TAKING
8. FINALIZE

- TAKE - DATA
- Read bulk (reading 128 bytes)
200 milliseconds
 - dataStream[] → all read ^{data} stuff
 - nBytes → nr of read bytes
 - dataStream[0] → number of events
[1] → nr of ^{words} data in event
(if it is 14: 12 channels + Q_STOP_BIT + (-1) trailer)
[2] → Q_STOP_BIT
 - nr Words expected per event
→ nr channels + 2
one for 1st word
one for negative in the end
- NOW MOVE TO EVENTS
- a) verification if it is good:
- if structure of event is OK!
- 1. ~~nr events~~ = nr of words = nr channels + 1 (negative in the end) (it does not count itself)
 - 2. ~~nr of words~~ + last in the event = -1 (this is the "closure" for event)
 - 3. After [2] = Q_STOP_BIT
- b) Going over MODULES:
- Read Data - saves to histogram in tree (filling only for channel 4)
 - Prints sum of taken data?
- LEAVE DAQ MODE
- CLEAN UP! → drain all data from FIFO → first in first out MEMORY

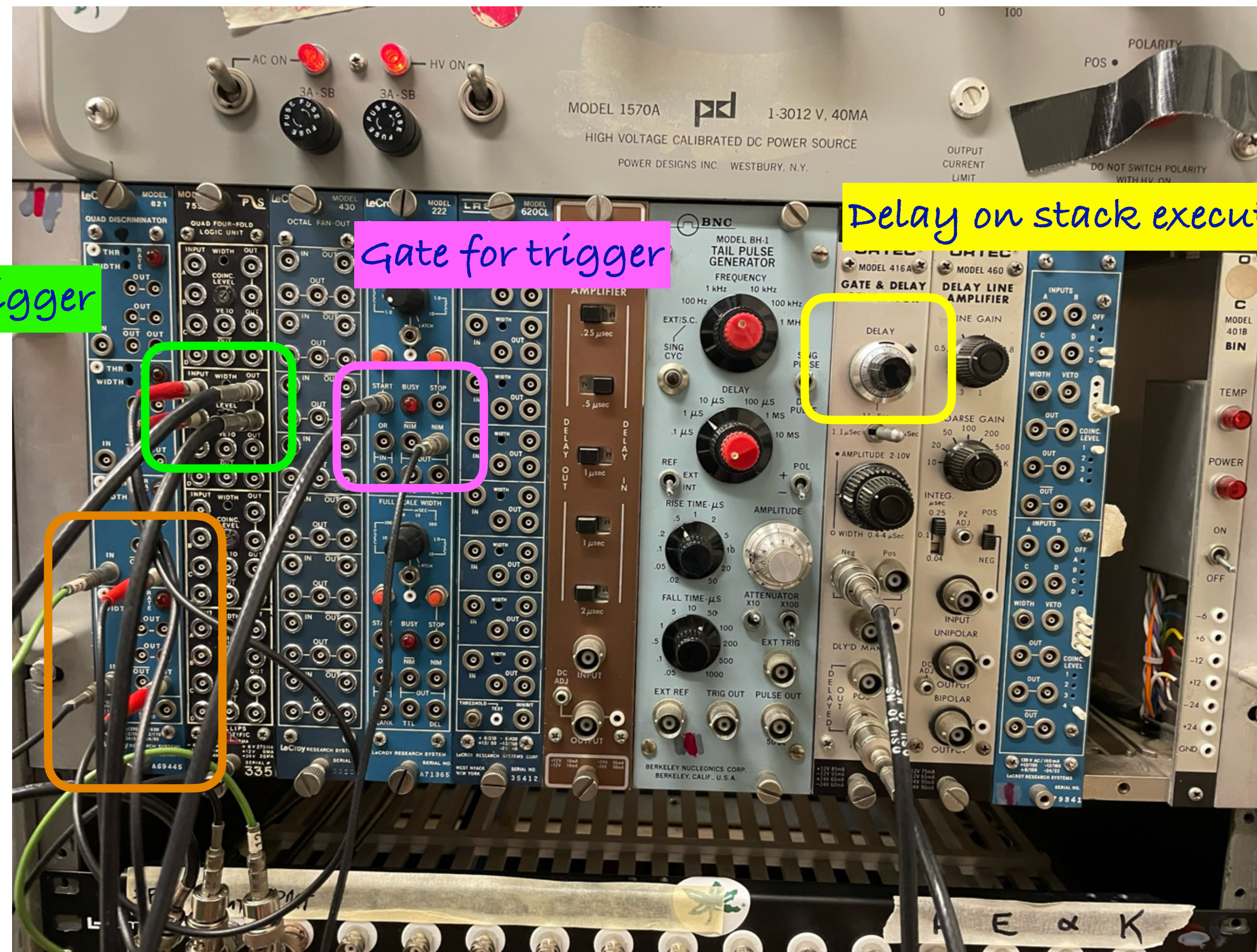


Coincidence for trigger

Gate for trigger

Delay on stack execution from trigger

Conversion





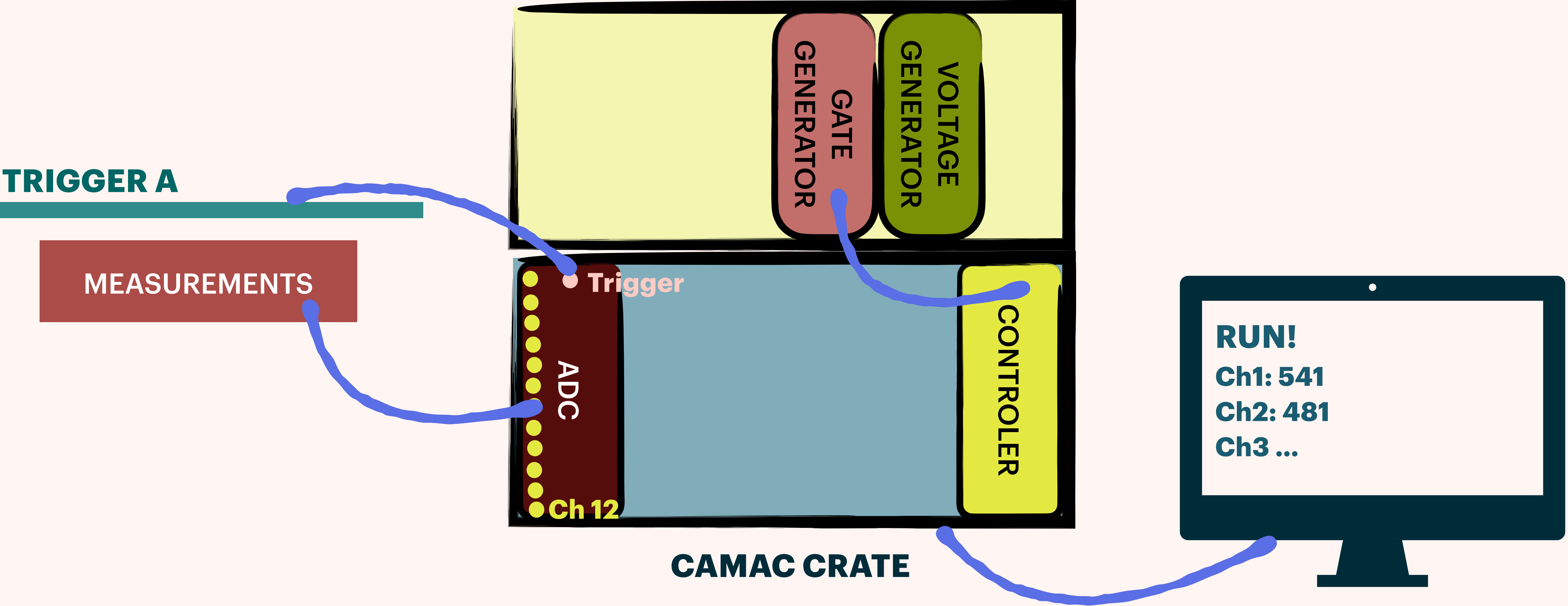
THANKS!

Wednesday November 29

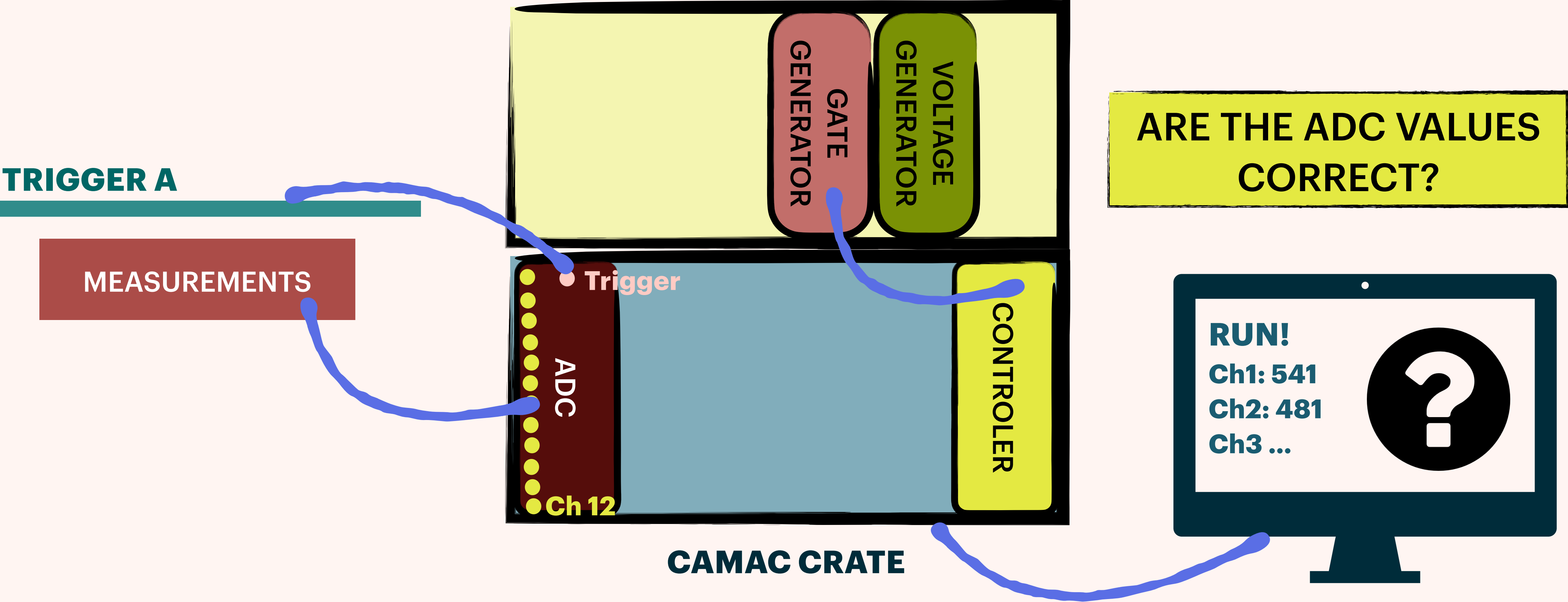
DATA ACQUISITION

Maria Stefaniak

SET-UP

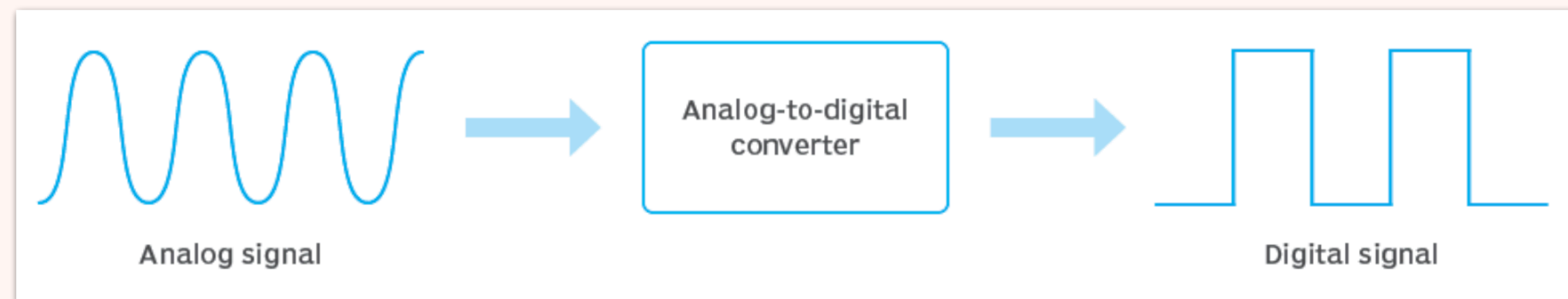


SET-UP

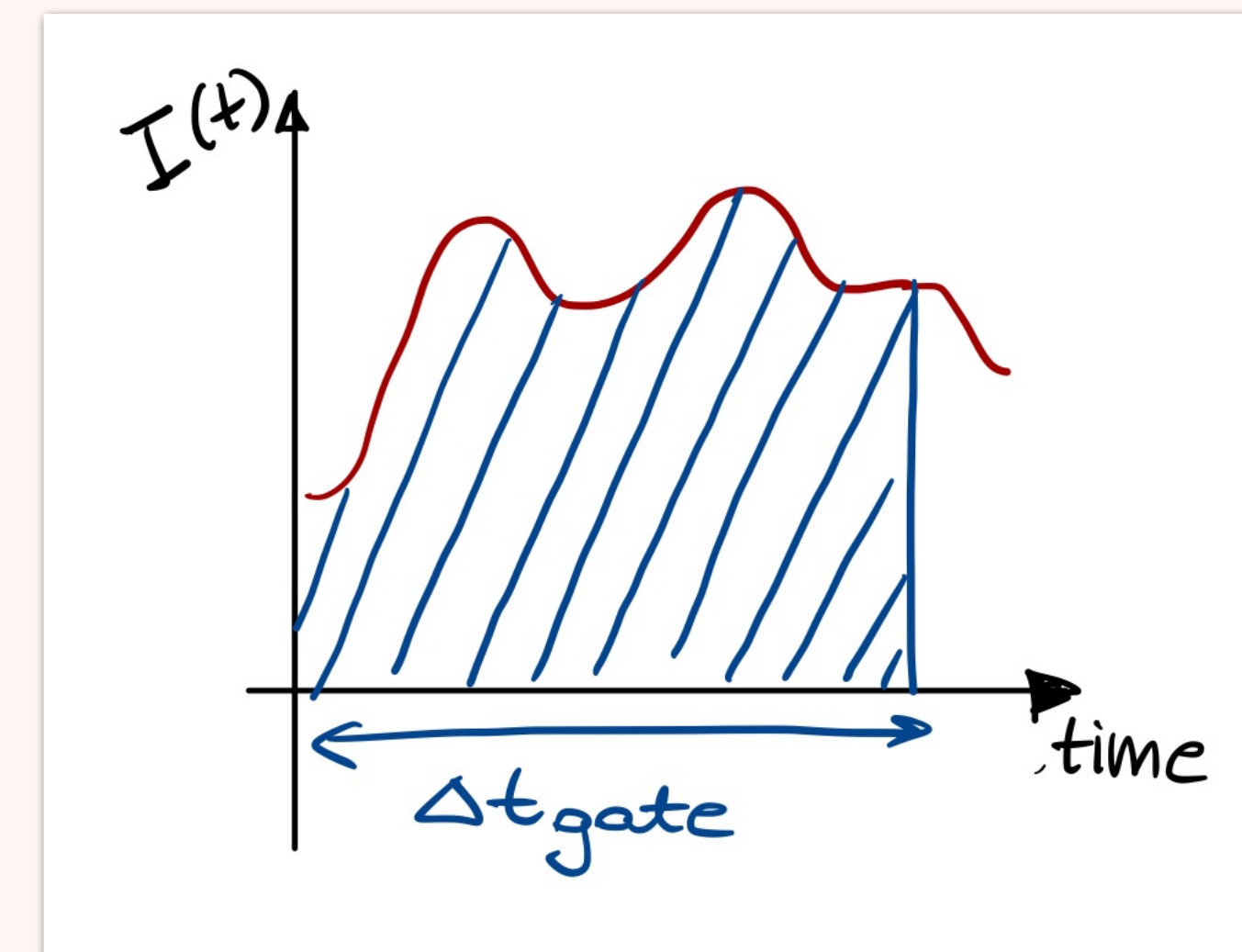
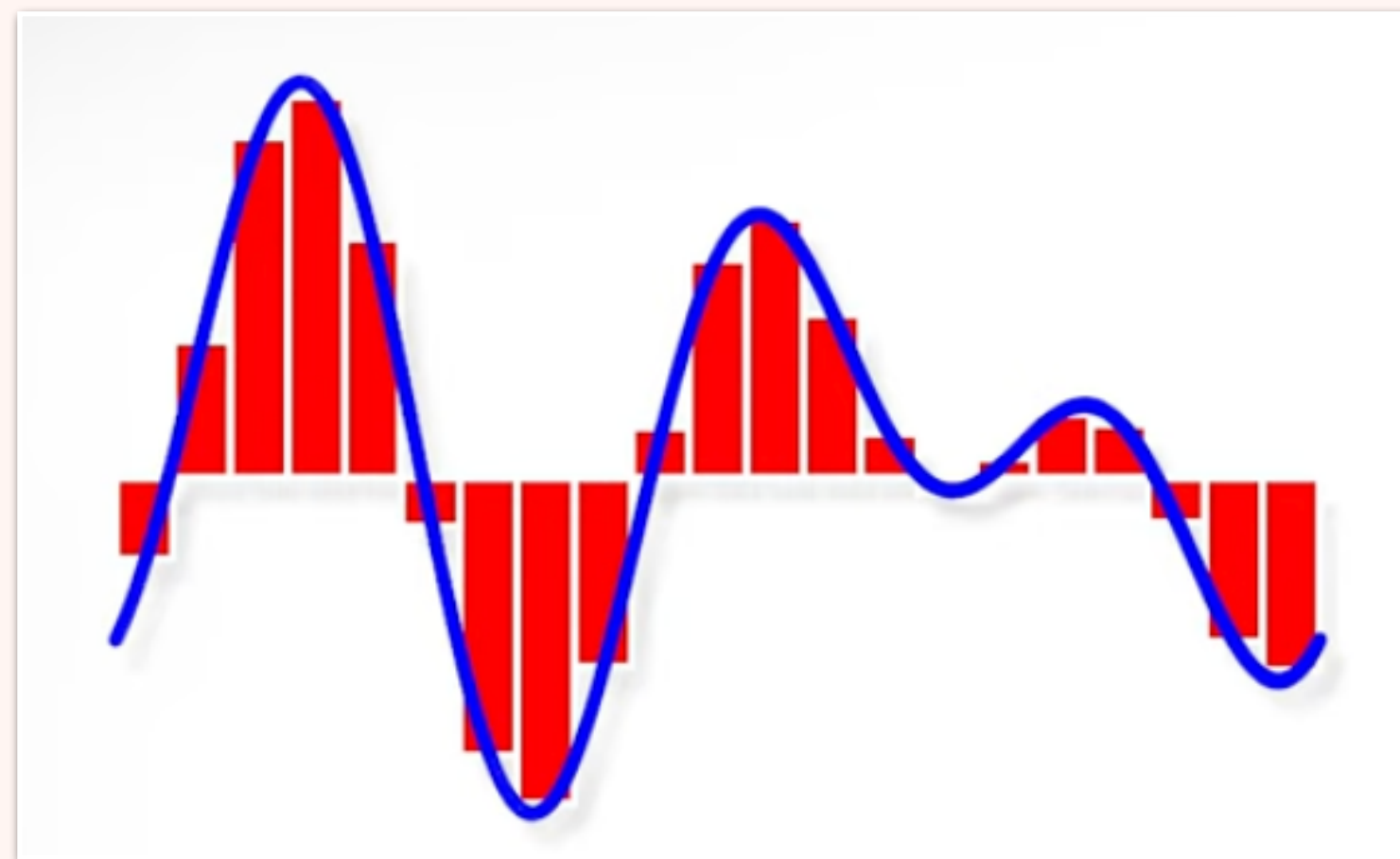


ADC

Analog to Digital Conversion



continuous variable $\longrightarrow$ **multilevel digital signal**
both in time and amplitude

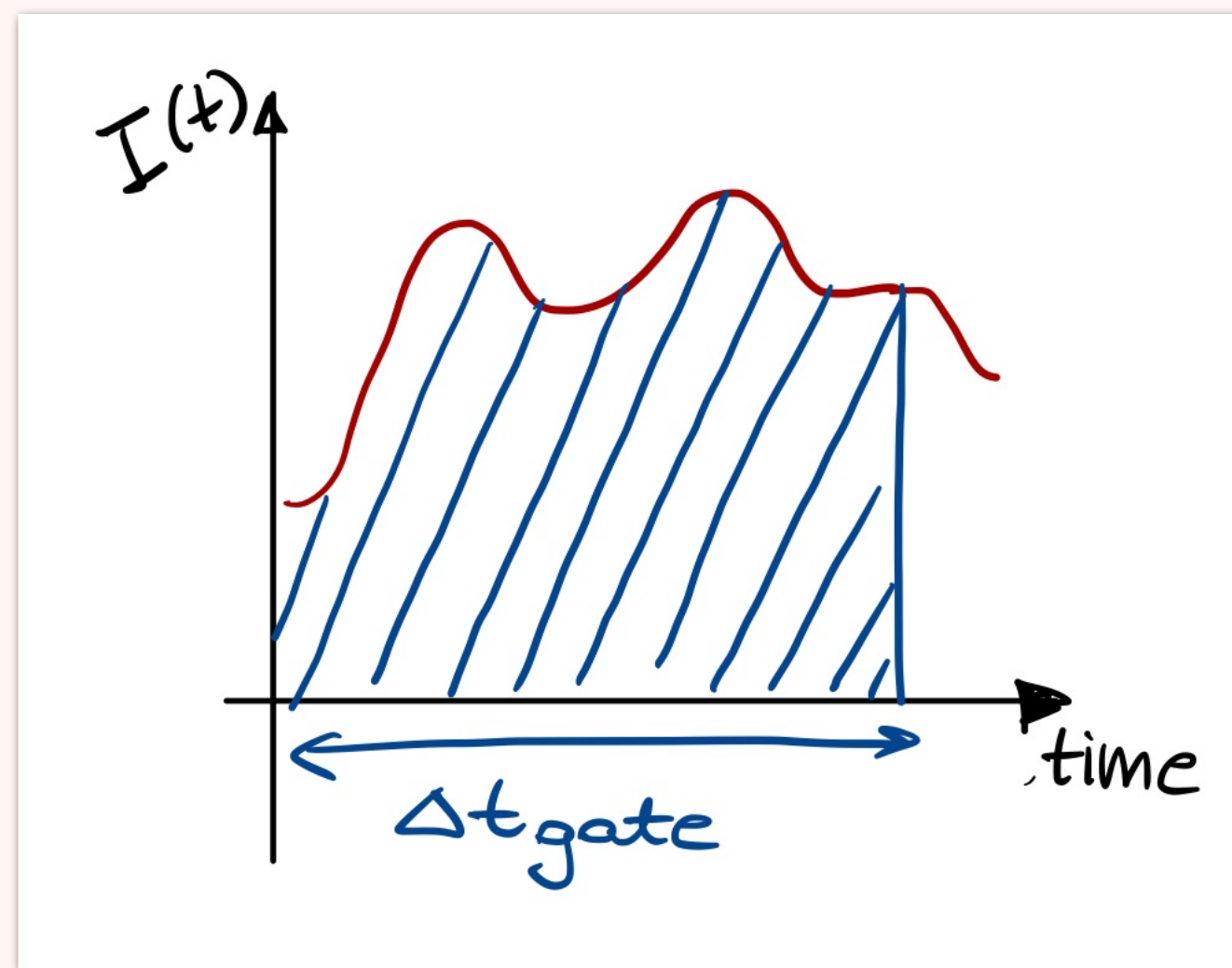


$$q = \int I(t) dt$$

Q proportional to "adc" (plus pedestals)

ADC

Analog to Digital Conversion



$$q = \int I(t) dt$$

$$q = \int_{\Delta t_g} I(t) dt = \int_{\Delta t_g} \frac{U(t)}{R_{\text{imp}}} dt = \frac{U}{R_{\text{imp}}} \Delta t_{\text{gate}}$$

$$R_{\text{imp}} = 50 \Omega \rightarrow \text{property of ADC module}$$

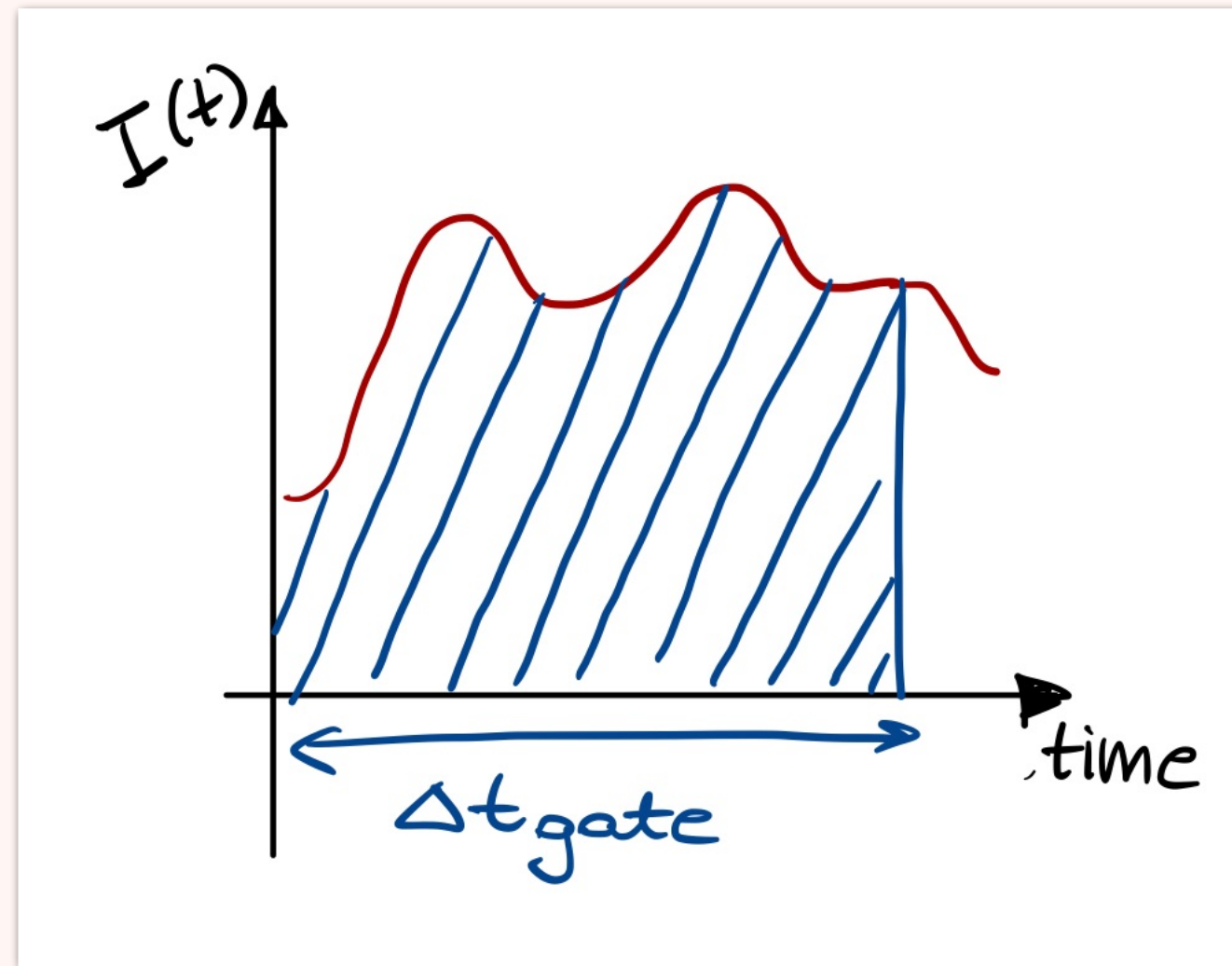
$$\Delta t_{\text{gate}} = 100 \text{ ns}$$

$$\text{full: } 256 \text{ pC}$$

Q proportional to "adc"

ADC

Analog to Digital Conversion



$$q = \int I(t) dt$$

Q proportional to "adc"

$$q = \int_{\Delta t_g} I(t) dt = \int_{\Delta t_g} \frac{U(t)}{R_{imp}} dt = \frac{U}{R_{imp}} \Delta t_{gate}$$

$R_{imp} = 50 \Omega$ → property of ADC module

$\Delta t_{gate} = 100 \mu s$

full: $256 \mu C$

I can set voltage supply

ADC

Analog to Digital Conversion

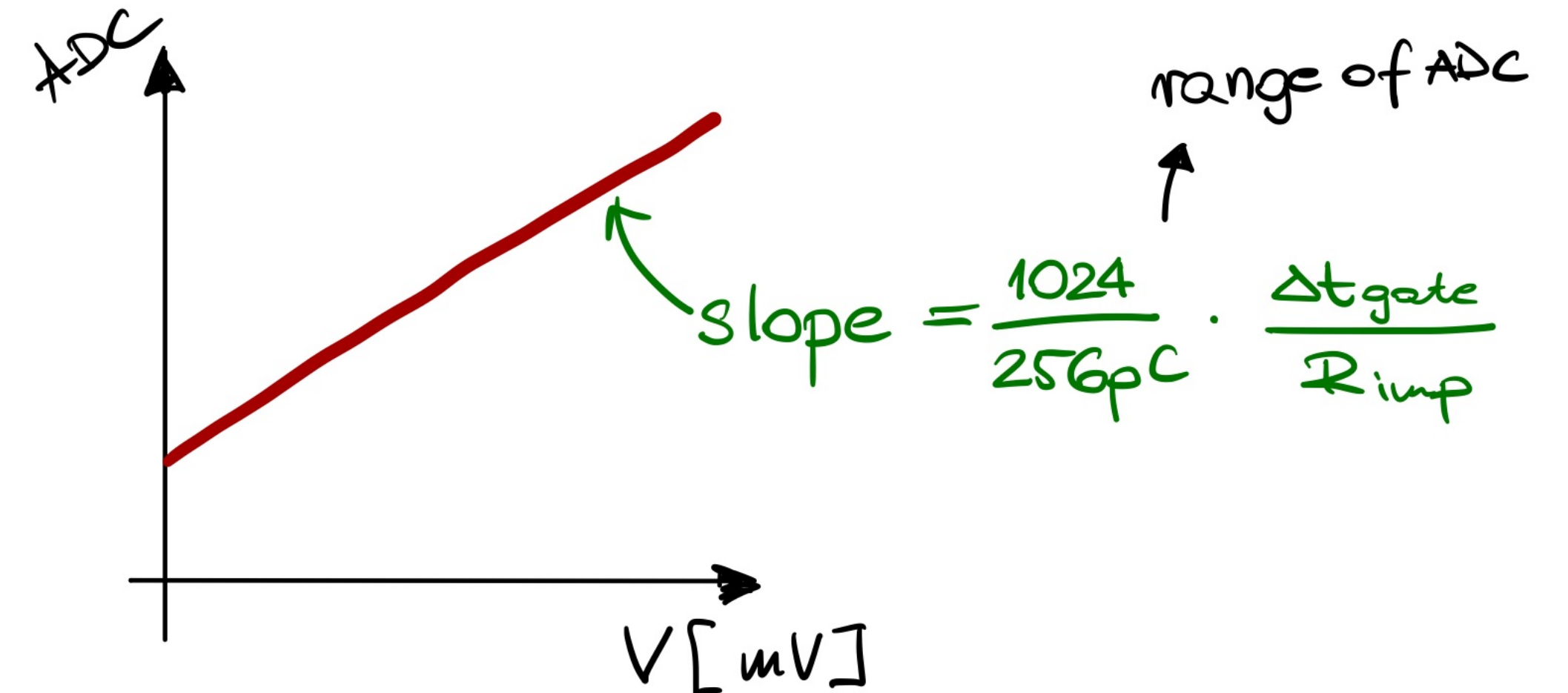
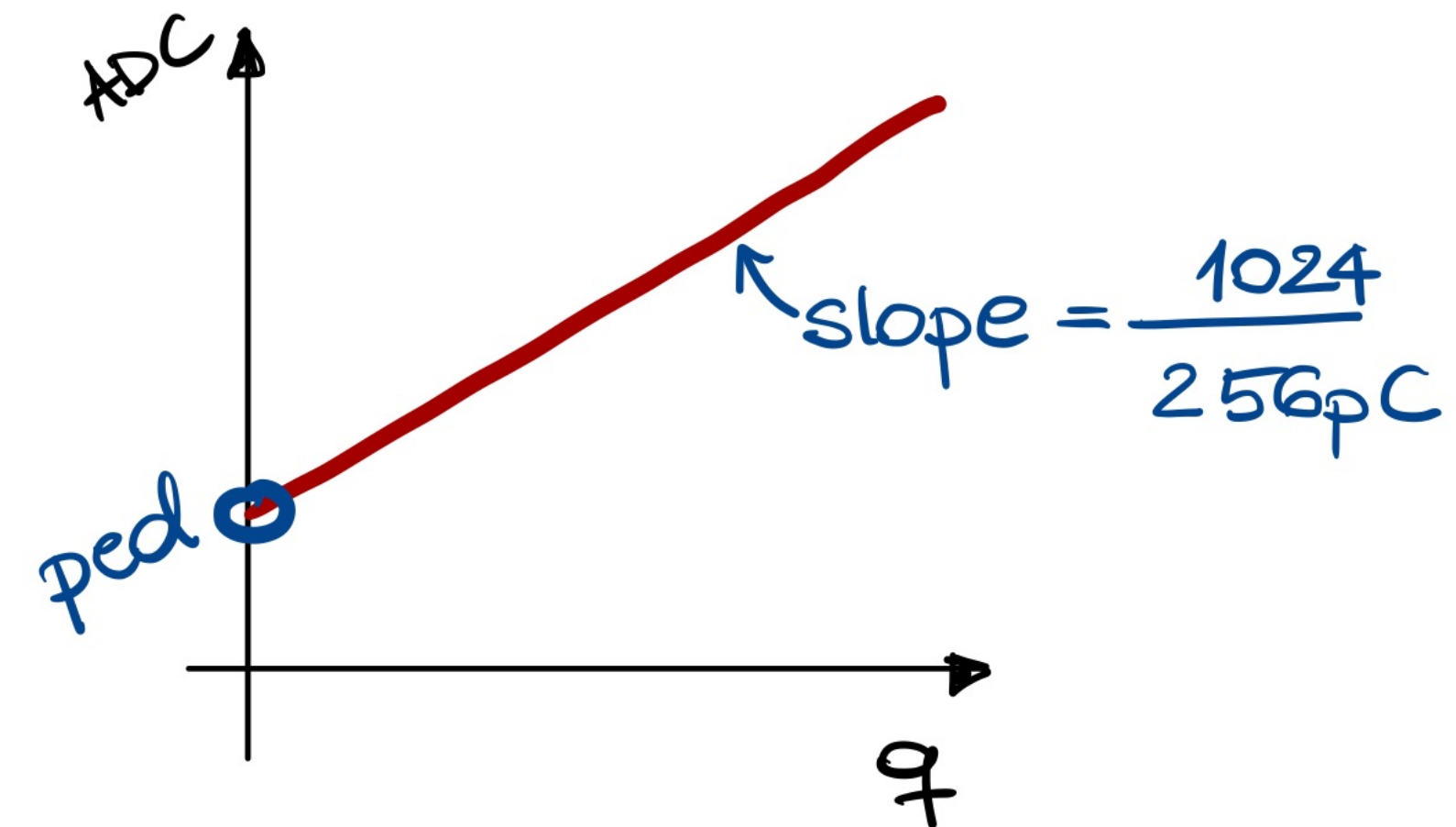
$$q = \int I(t) dt = \int \frac{U(t)}{R_{imp}} dt = \frac{U}{R_{imp}} \Delta t_{gate}$$

$R_{imp} = 50 \Omega$ → property of ADC module

$\Delta t_{gate} = 100 \text{ ns}$

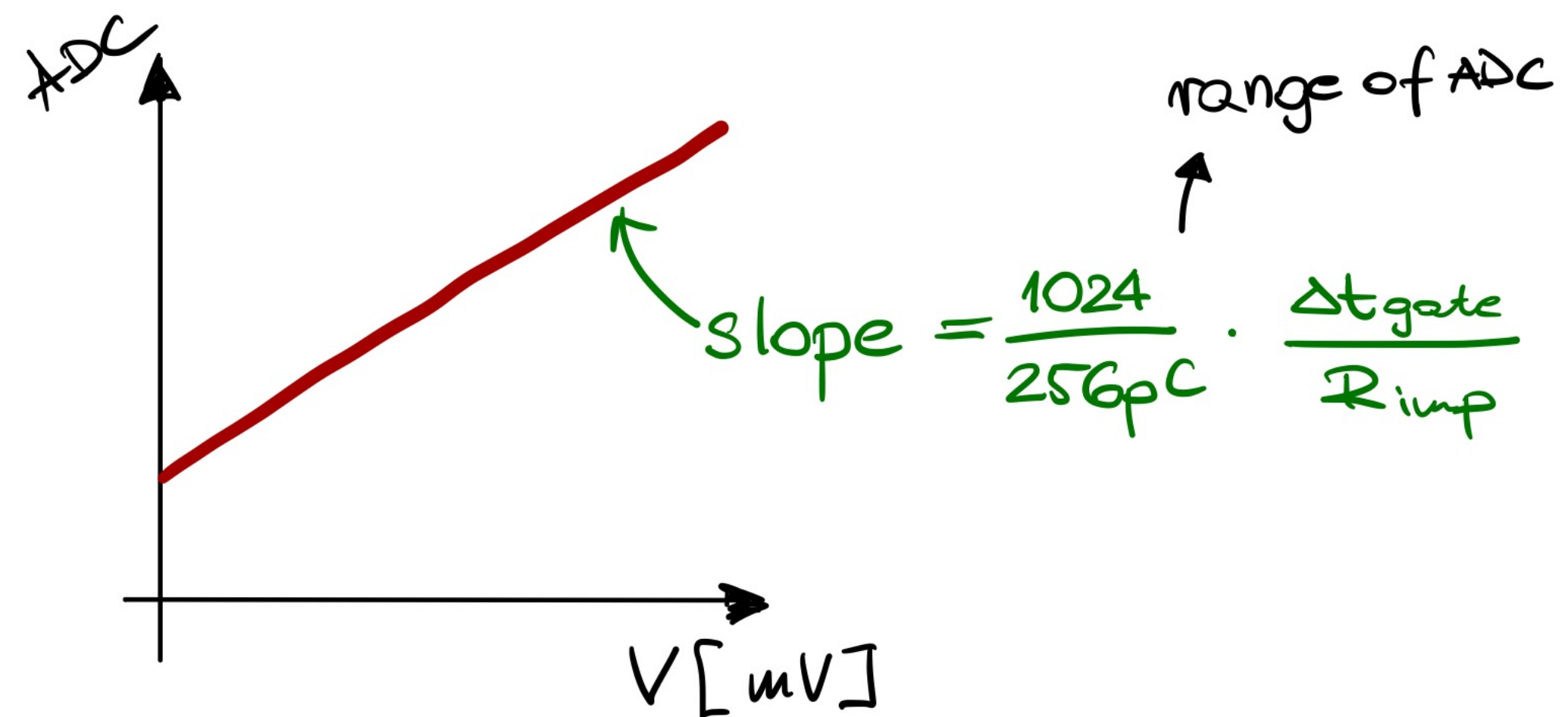
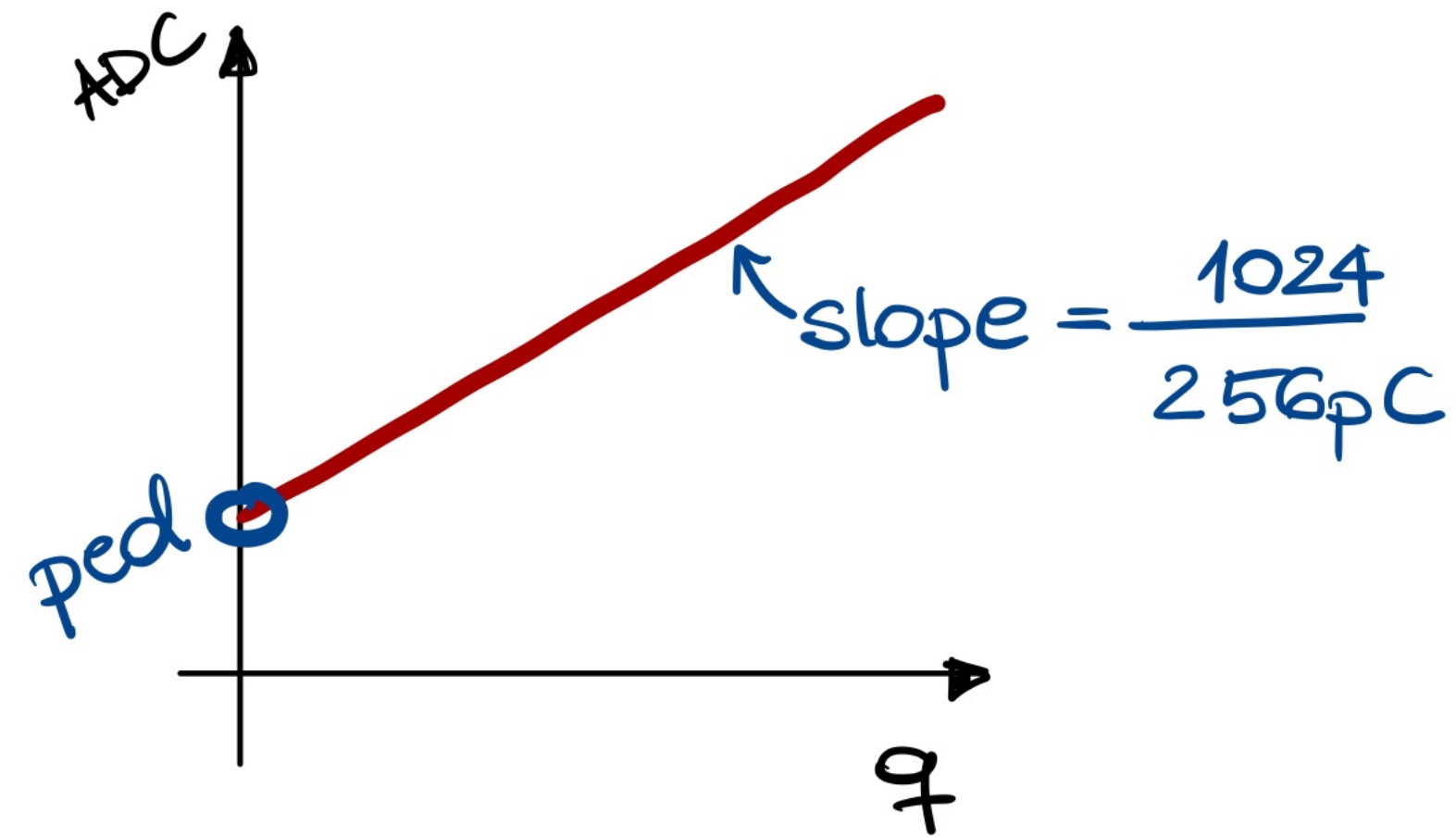
full: 256 pC

→ I can set voltage supply



ADC

Analog to Digital Conversion



$$ADC = ped + \frac{1024}{256pC} \cdot Q$$

$\hookrightarrow I \Delta t = \frac{V}{R} \Delta t = \frac{\Delta t}{R} V$

SET-UP

TRIGGER A

MEASUREMENTS

Trigger

ADC

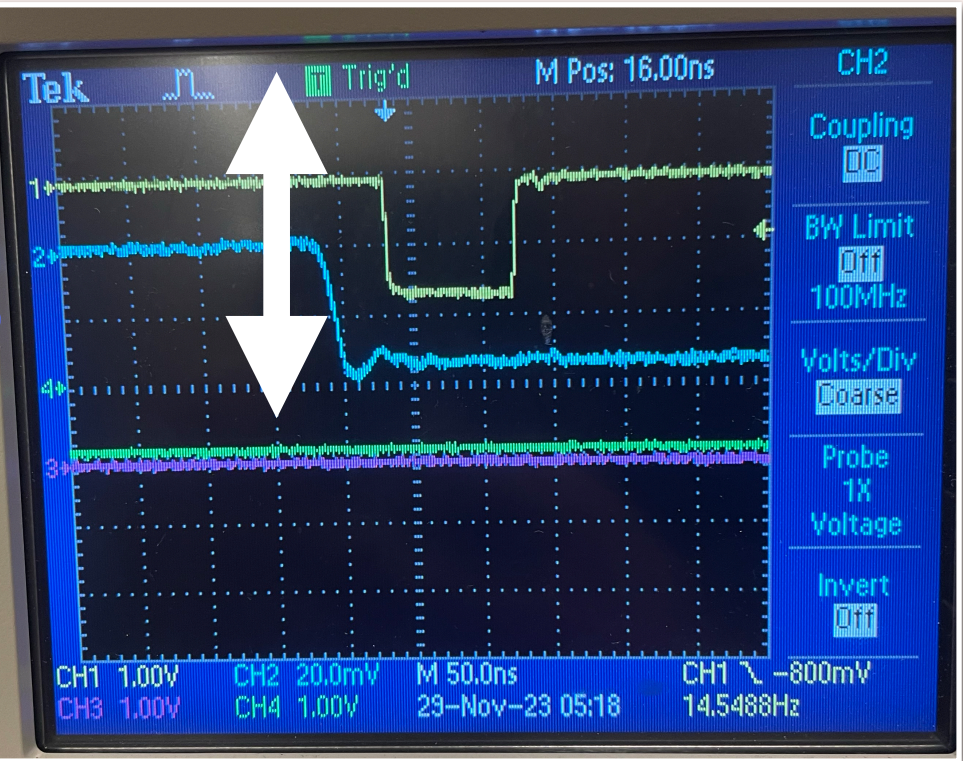
Ch 12

CONTROLLER

CAMAC CRATE



Amplitude -> Voltage



Scope

RUN!

Ch1: 541
Ch2: 481
Ch3 ...



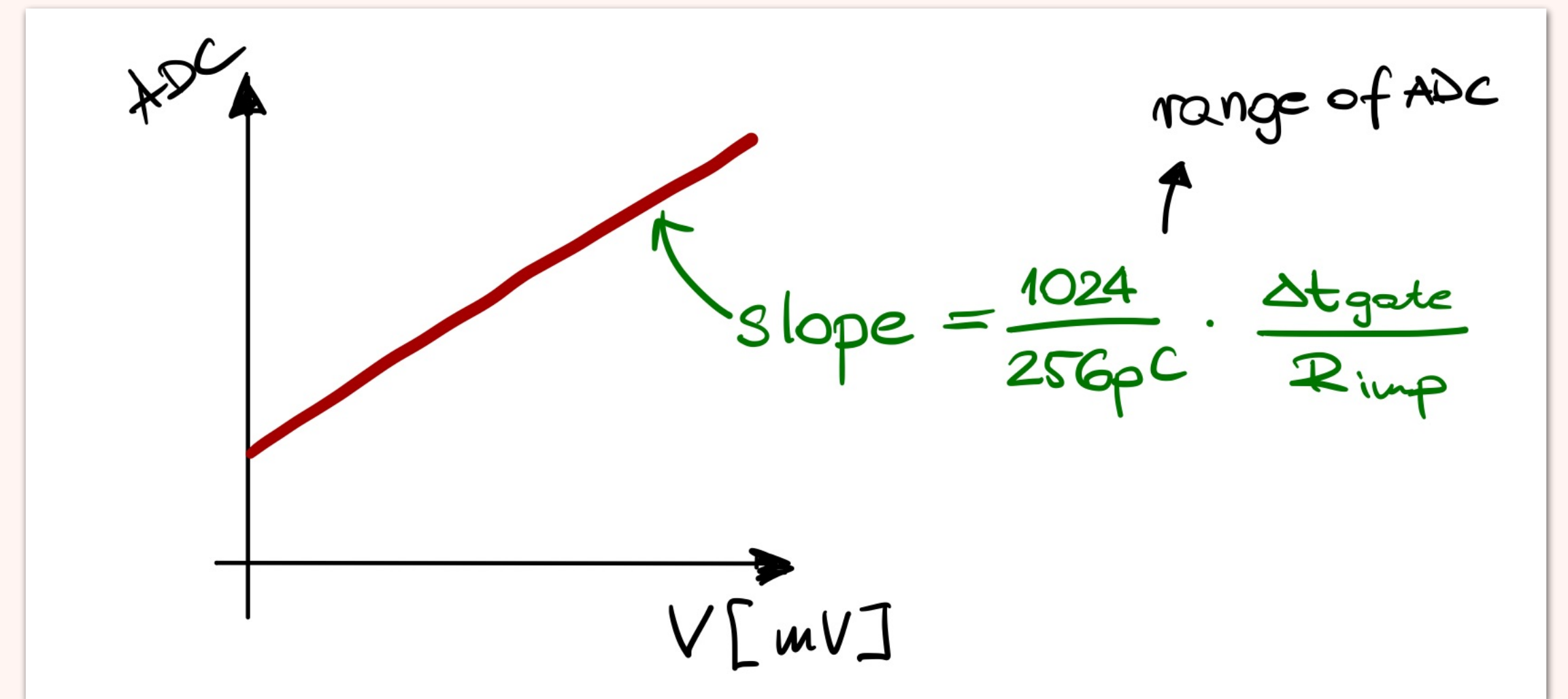
ADC

Analog to Digital Conversion

$$\text{ADC} = \text{ped} + \frac{1024}{256\text{pC}} \cdot Q$$

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$$\text{ADC} = \text{ped} + \underbrace{\frac{1024}{256\text{pC}} \cdot \frac{100 \cdot 10^{-9}\text{s}}{50\Omega}}_{\text{slope}} \cdot V$$



ADC

Analog to Digital Conversion

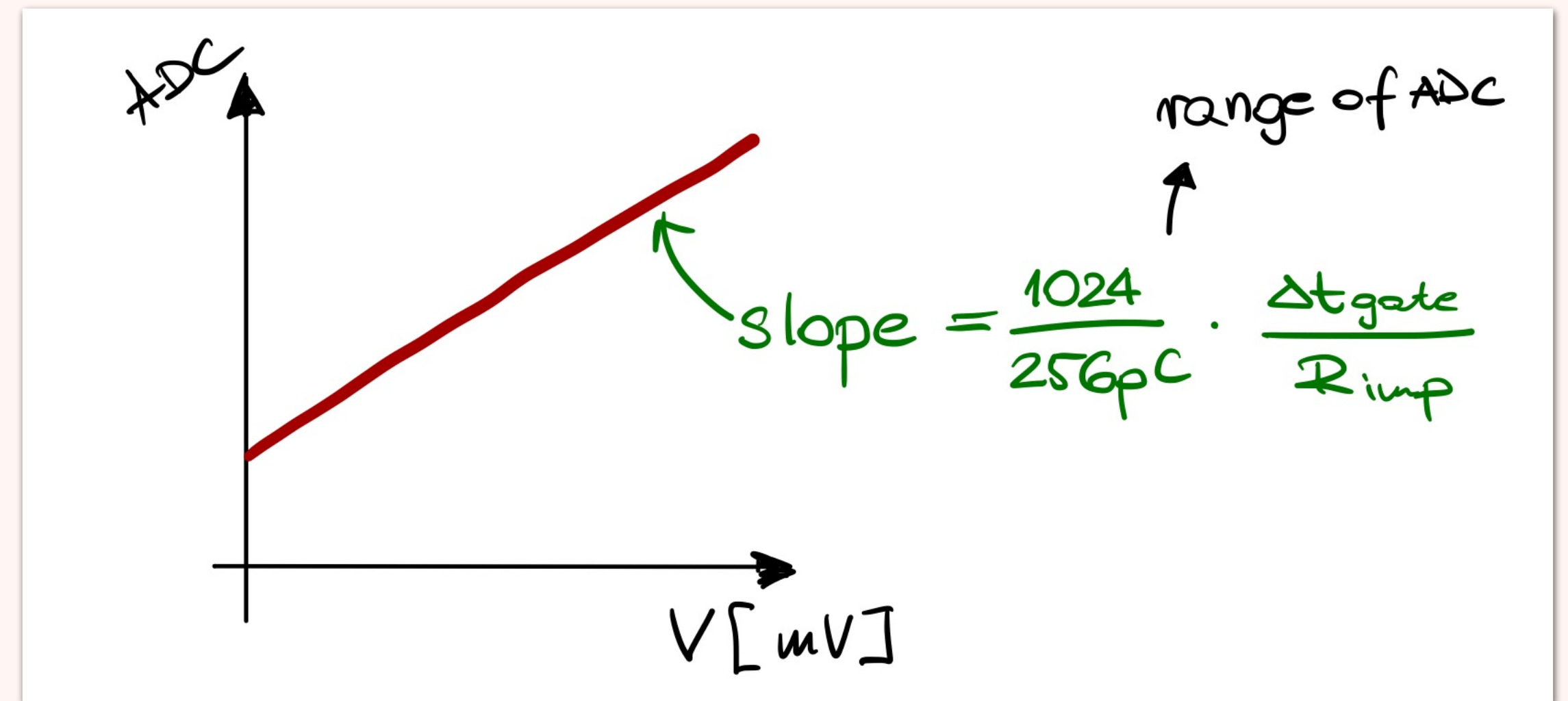
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Read from DAQ via Cotroler

Set on the generator
(checked on Scope!)



ADC

Analog to Digital Conversion

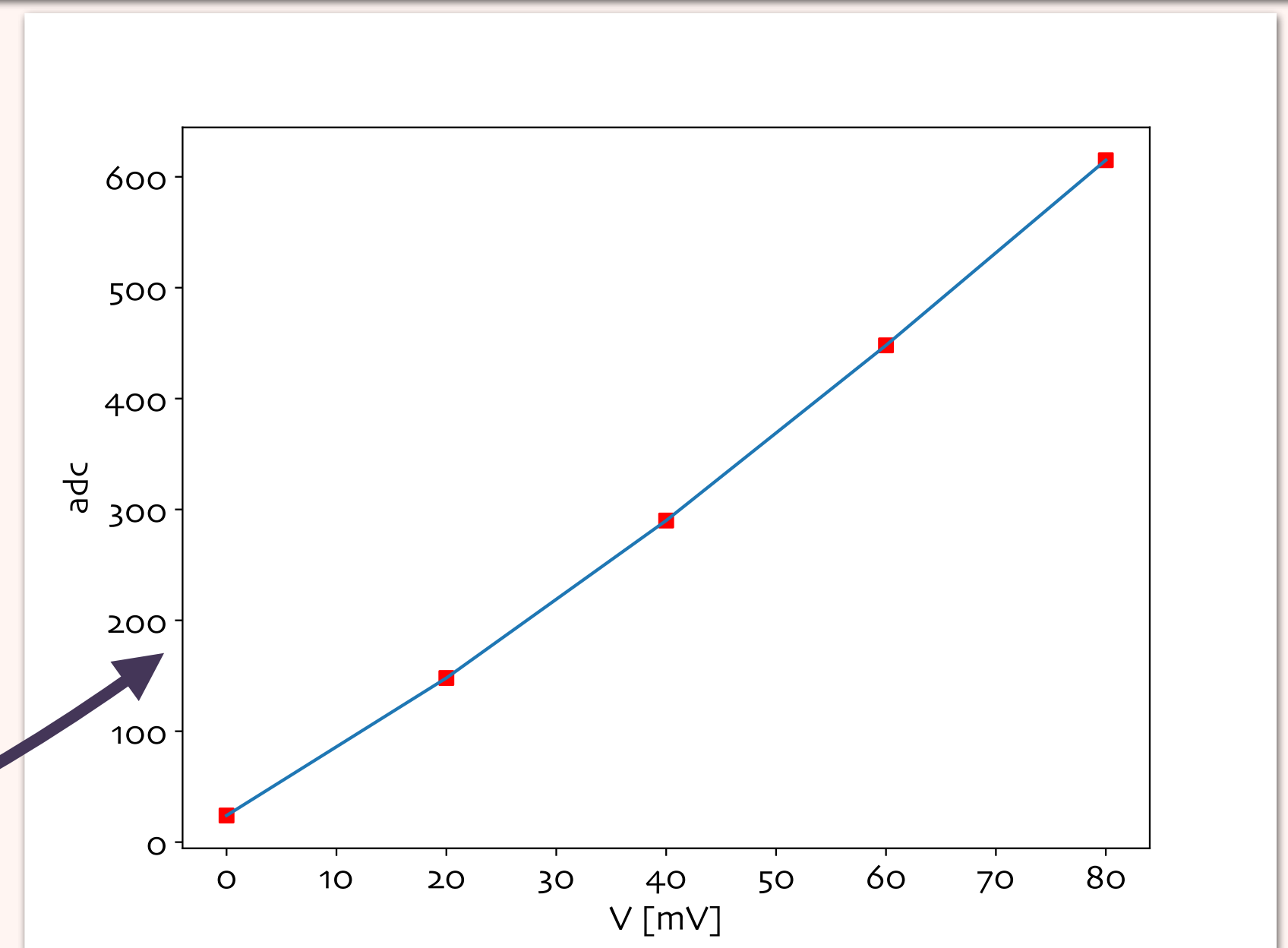
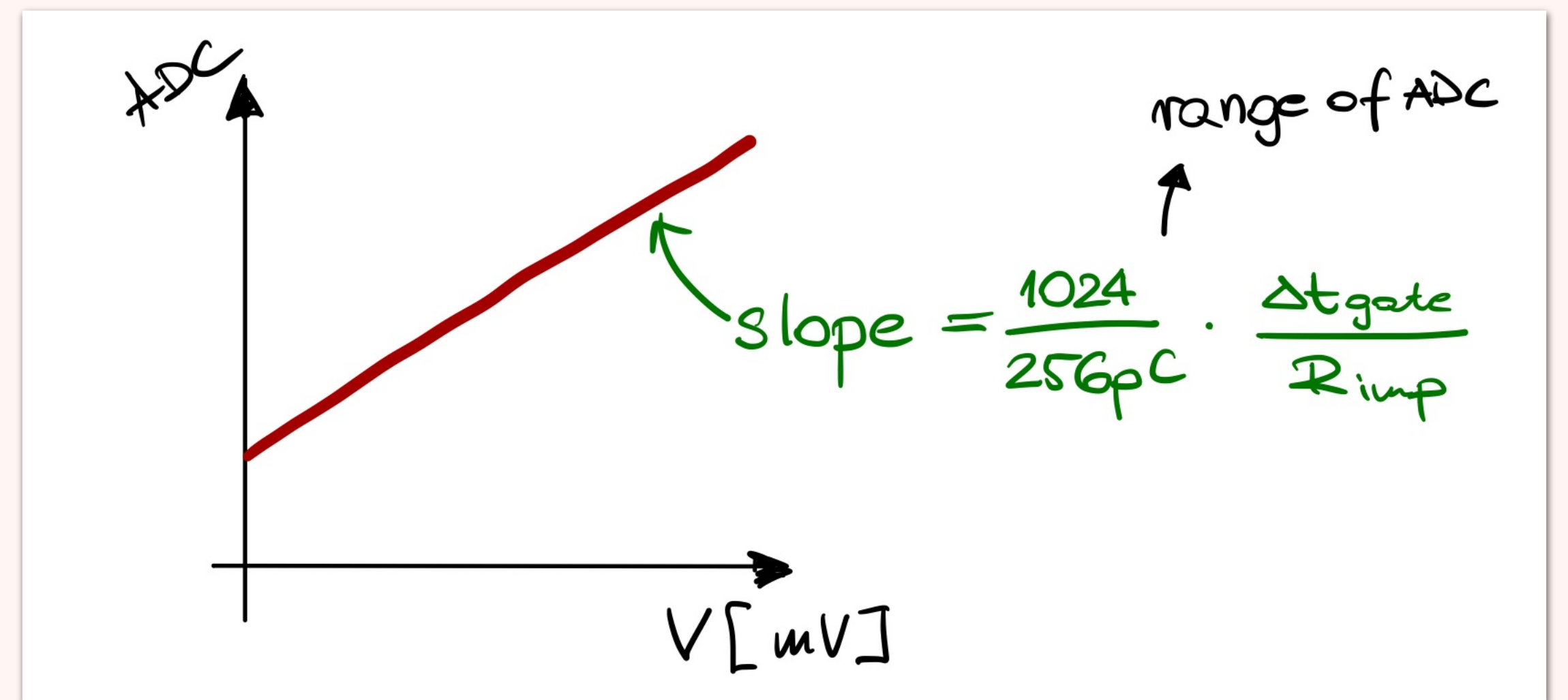
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Read from DAQ via Cotroler

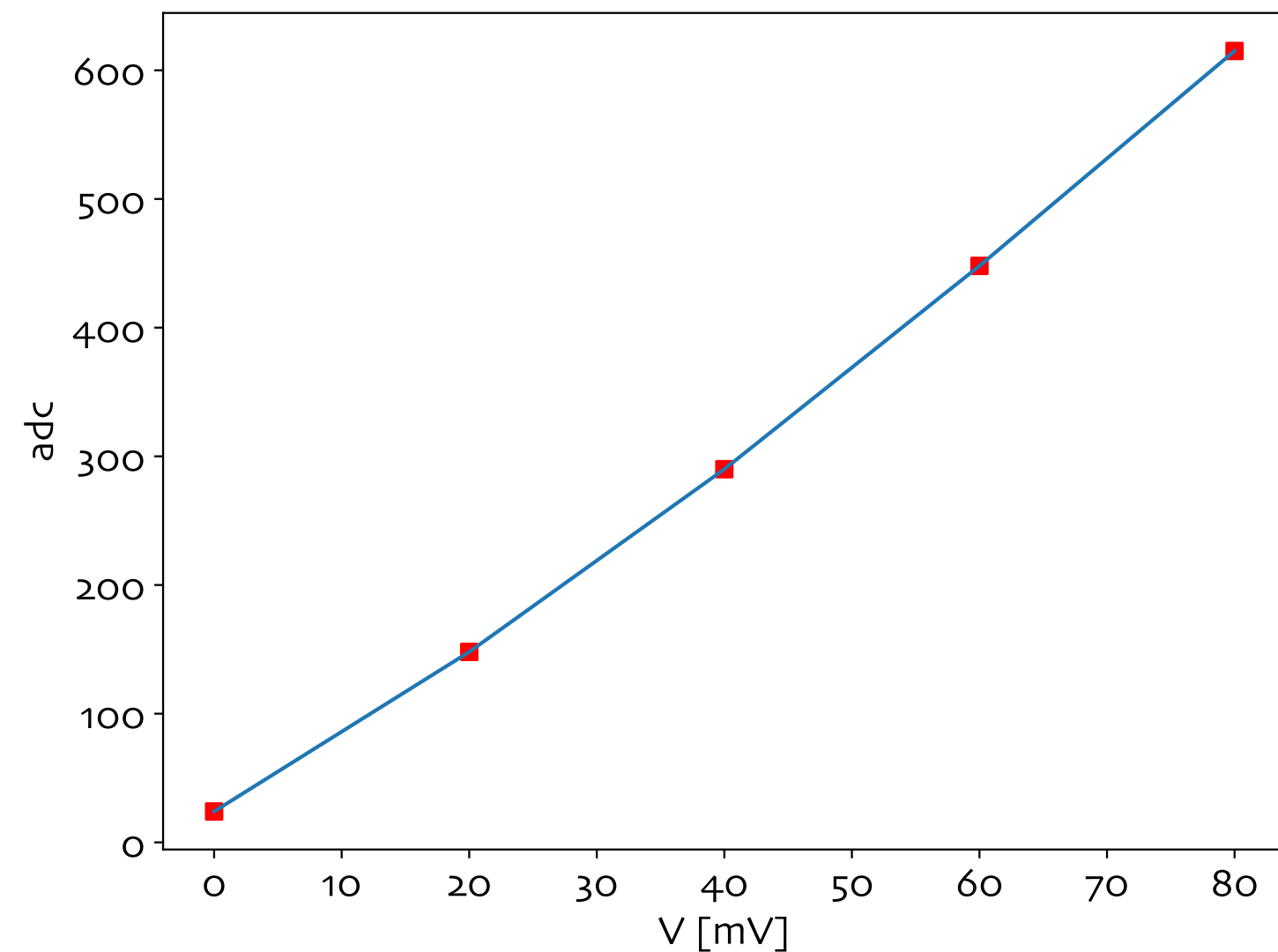
Set on the generator
(checked on Scope!)

	V [mV]	adc
0	0	24
1	20	148
2	40	290
3	60	448
4	80	615



ADC

Analog to Digital Conversion



	V [mV]	adc
0	0	24
1	20	148
2	40	290
3	60	448
4	80	615

$$\text{slope}_{\text{Measured}} = \frac{615 - 148}{0.08\text{V} - 0.02\text{V}} = 7783.3 \frac{1}{\text{V}}$$

$$\text{slope}_{\text{Expected}} = \frac{1024}{256 \cdot 10^{-12} \text{C}} \cdot \frac{10^{-4} \text{s}}{50 \Omega} \approx 8000 \frac{1}{\text{V}}$$

GOOD :)