Mesures électriques rapides et synchronisation

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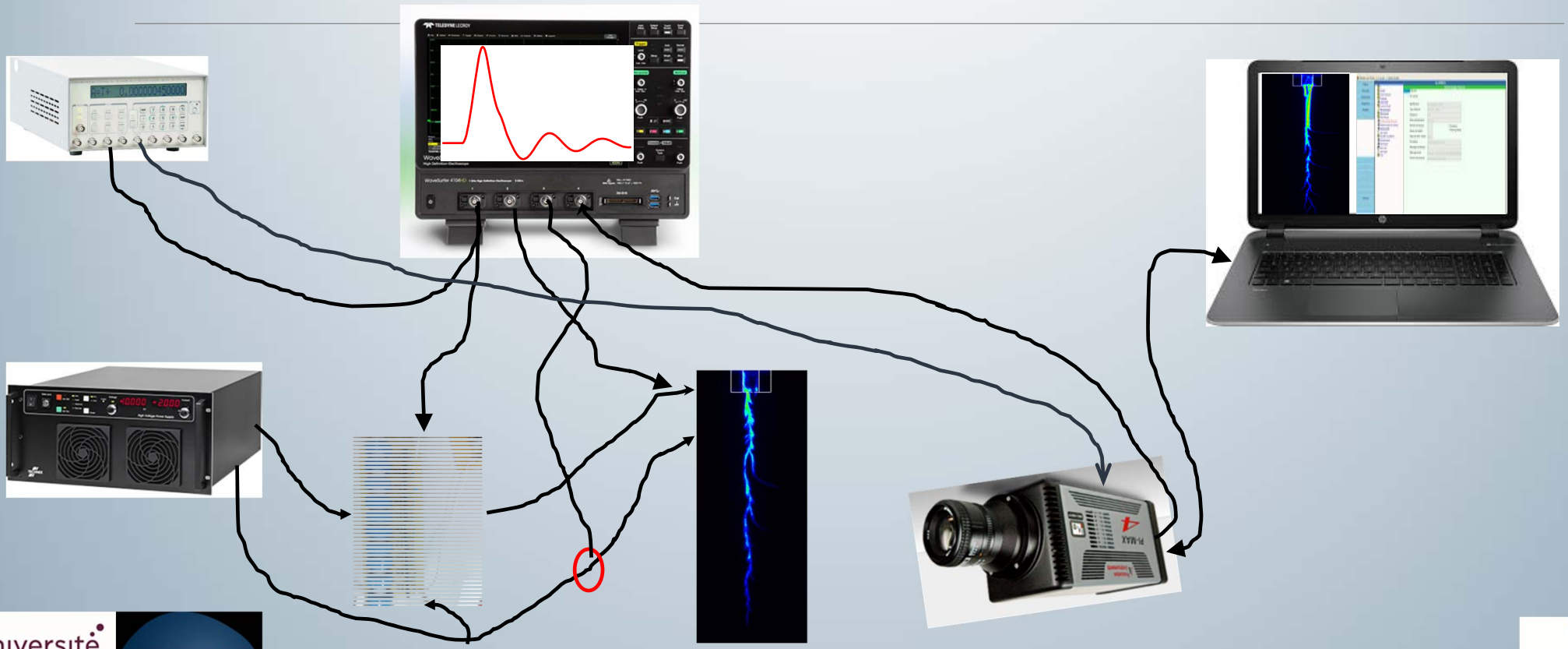
Problématiques

- Synchronisation
- Haute tension
- Forts courants

Synchronisation : exemple de manip

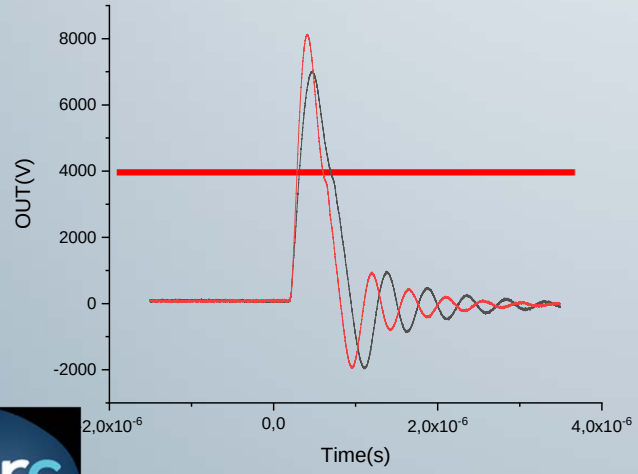


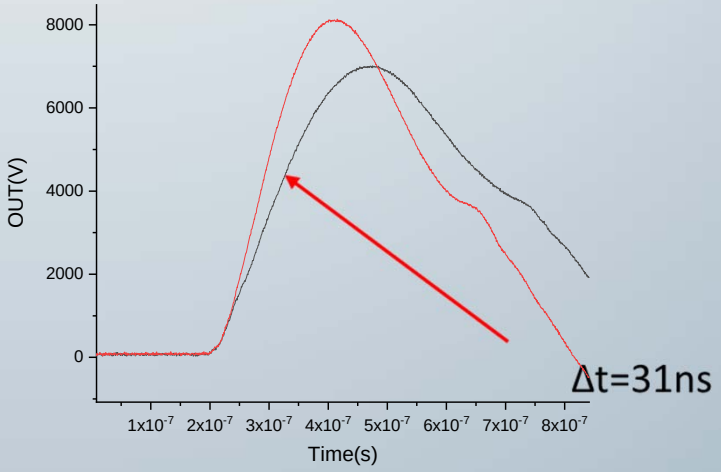
Synchronisation

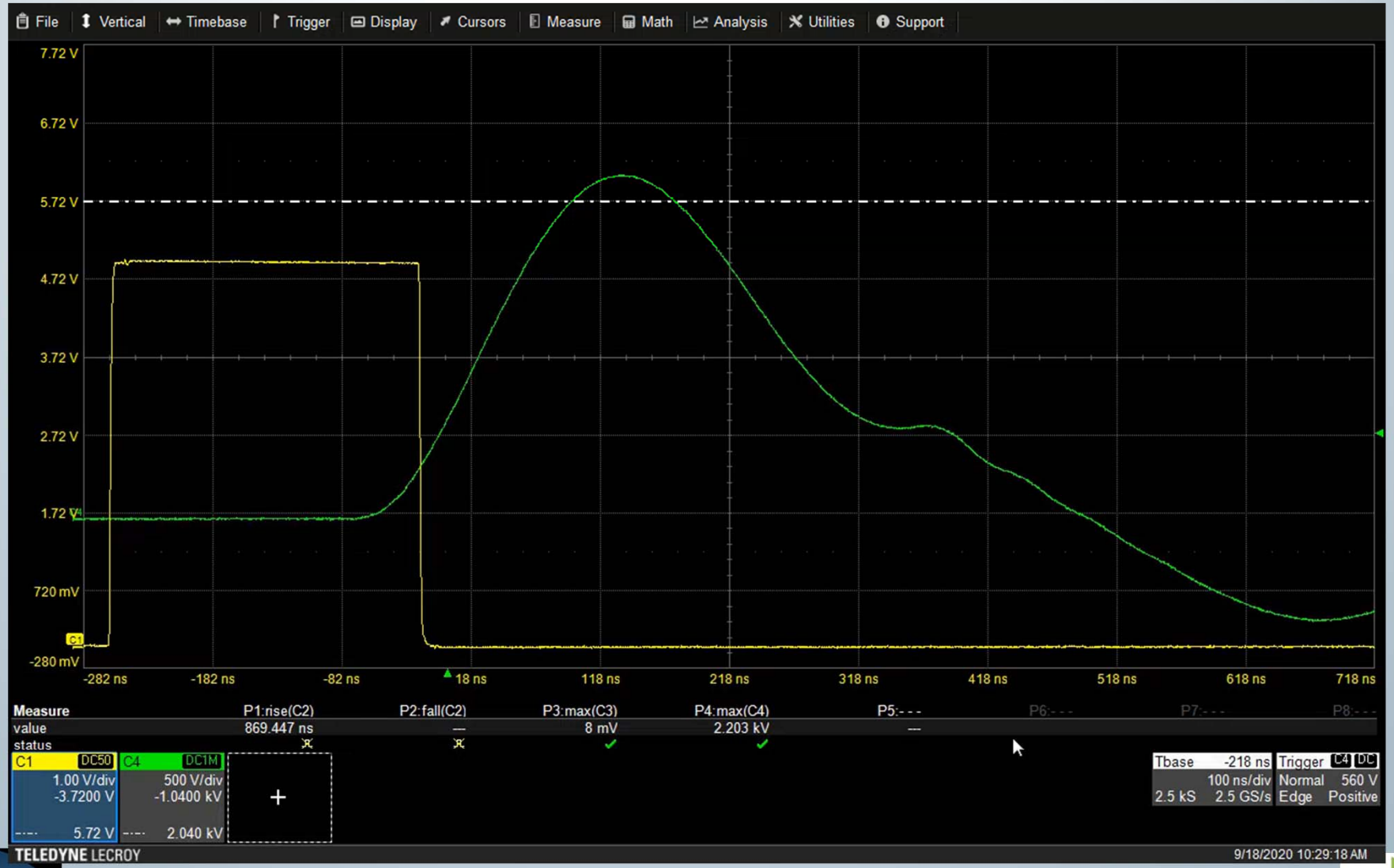
Règle de base

- On se synchronise sur un système stable

  Par exemple sur le générateur d'impulsion et non sur le signal HT






File
Vertical
Timebase
Trigger
Display
Cursors
Measure
Math
Analysis
Utilities
Support
7.72 V
6.72 V
5.72 V
4.72 V
3.72 V
2.72 V
1.72 V
720 mV
-280 mV
C1
-282 ns
-182 ns
-82 ns
18 ns
118 ns
218 ns
318 ns
418 ns
518 ns
618 ns
718 ns
Measure
P1:rise(C2)
P2:fall(C2)
P3:max(C3)
P4:max(C4)
P5:- - -
P6:- - -
P7:- - -
P8:- - -
value
869.447 ns
---
8 mV
2.203 kV
---
status
C1 DC50
1.00 V/div
-3.7200 V
5.72 V
C4 DC1M
500 V/div
-1.0400 kV
2.040 kV
Tbase -218 ns
100 ns/div
2.5 kS 2.5 GS/s
Trigger C4 DC
Normal 560 V
Edge Positive
TELEDYNE LECROY
9/18/2020 10:29:18 AM

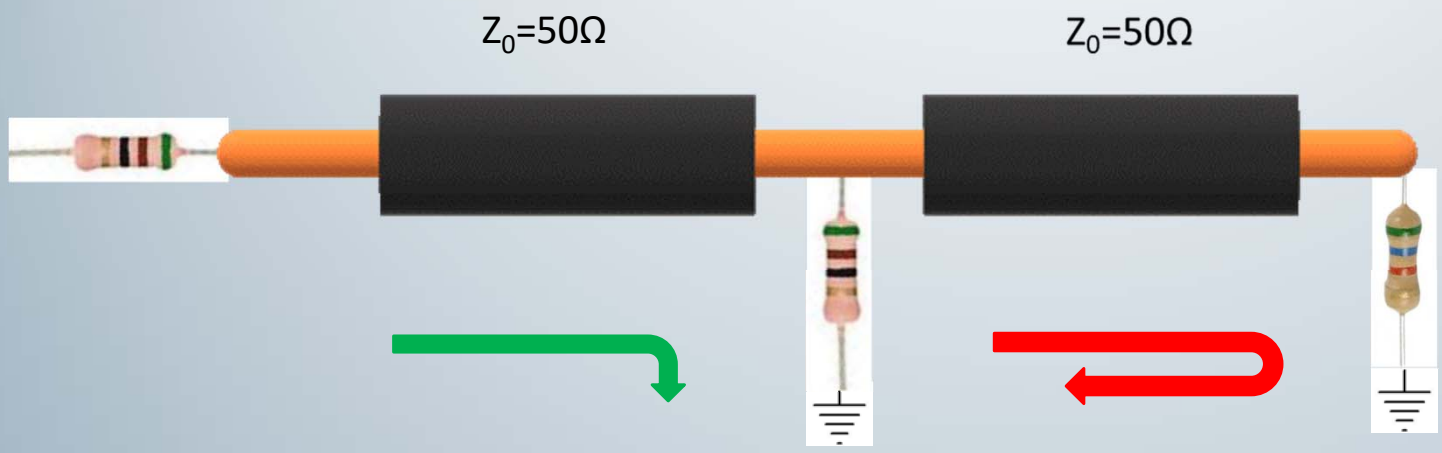
Synchronisation (NON)

Sortie 50Ω

DC 1MΩ

Entrée 50Ω

Synchronisation (NON)



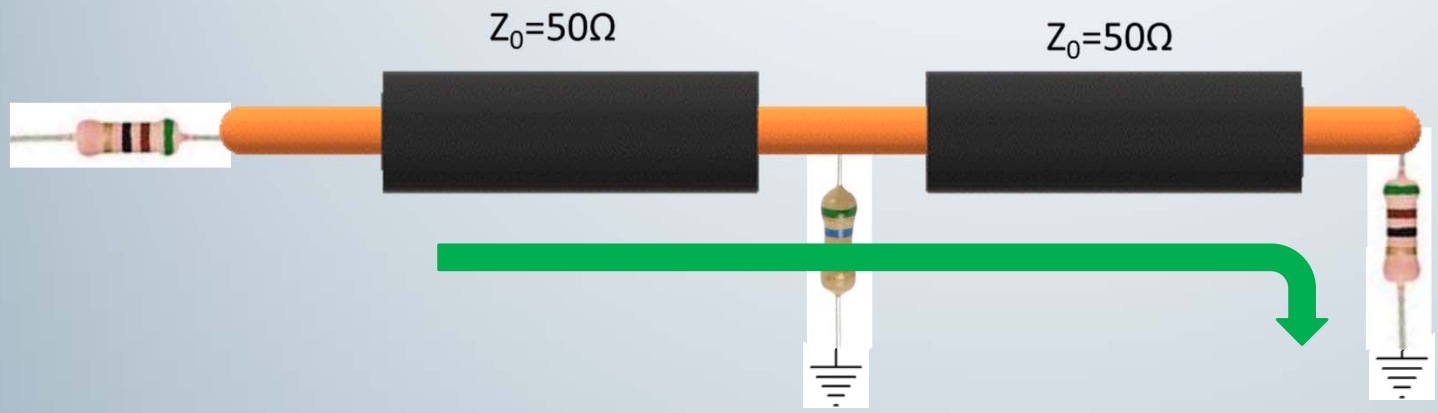
Synchronisation (OUI)

Sortie 50Ω

DC 1MΩ

Entrée 50Ω

Synchronisation (OUI)

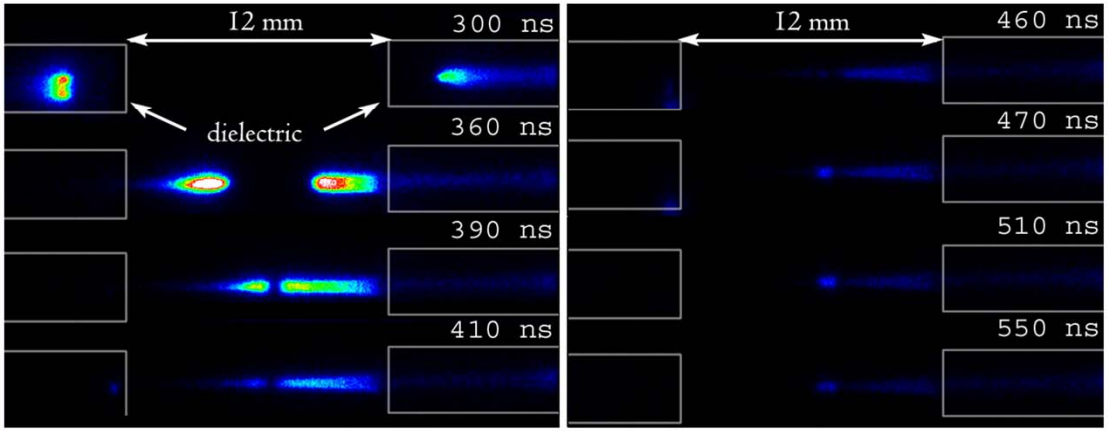


Synchronisation

Imaging of the pink glow

■ If we turn off one discharge, the plasma jet is able to reach the other device. On the contrary, if the two discharges are turned on, the two bullets interact. Their relative velocity decreases.

■ But they never merged, leaving between them a region empty of plasma. At 460 ns the two bullets vanished. But a few nanoseconds after, a pink glow suddenly appears in the previous empty zone and remains active during 100 ns.

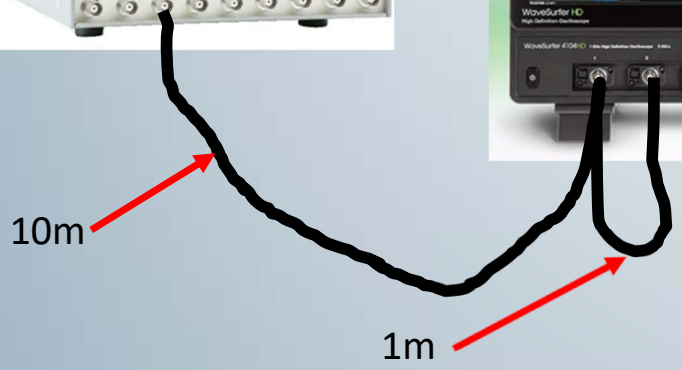


He_5kV on-on_1000sccm off-on_12mm

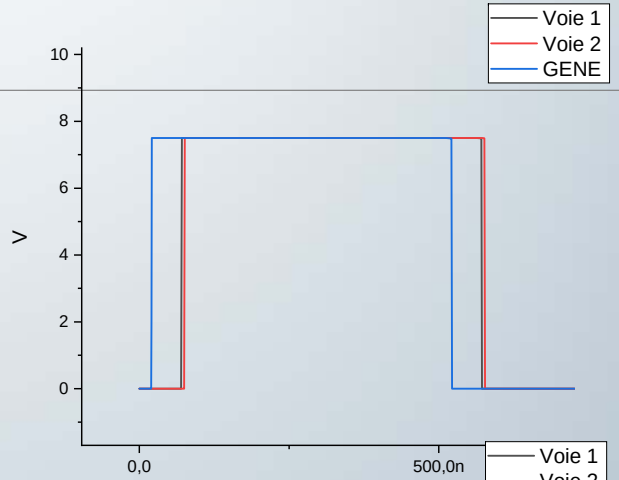
Study of the interaction between two counter-propagating plasma bullets

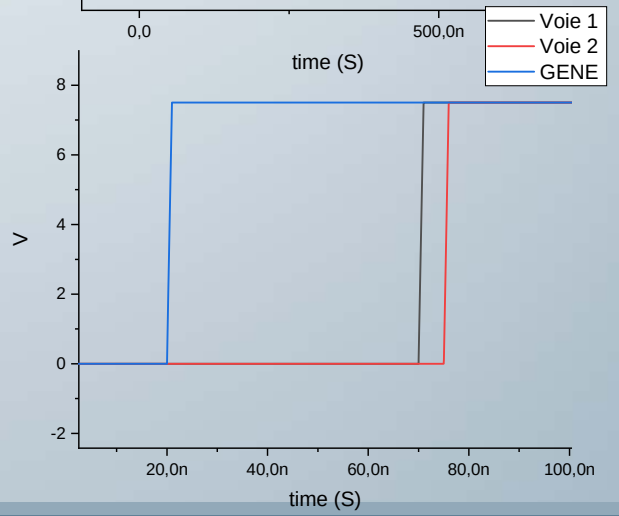
C.Douat, M.Fleury, M.Laroussi, V.Puech

Synchronisation

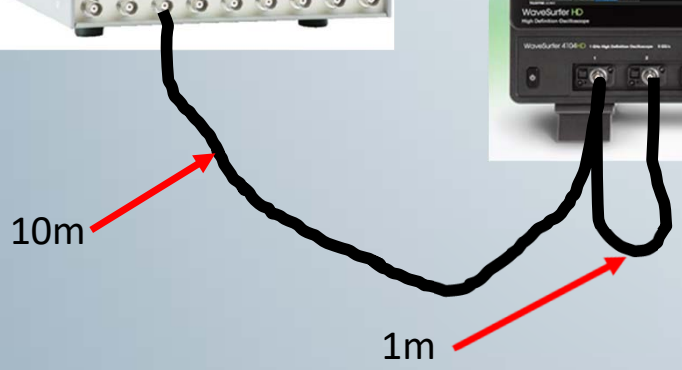


Voie1 DC 1Meg
Voie2 DC 50Ω

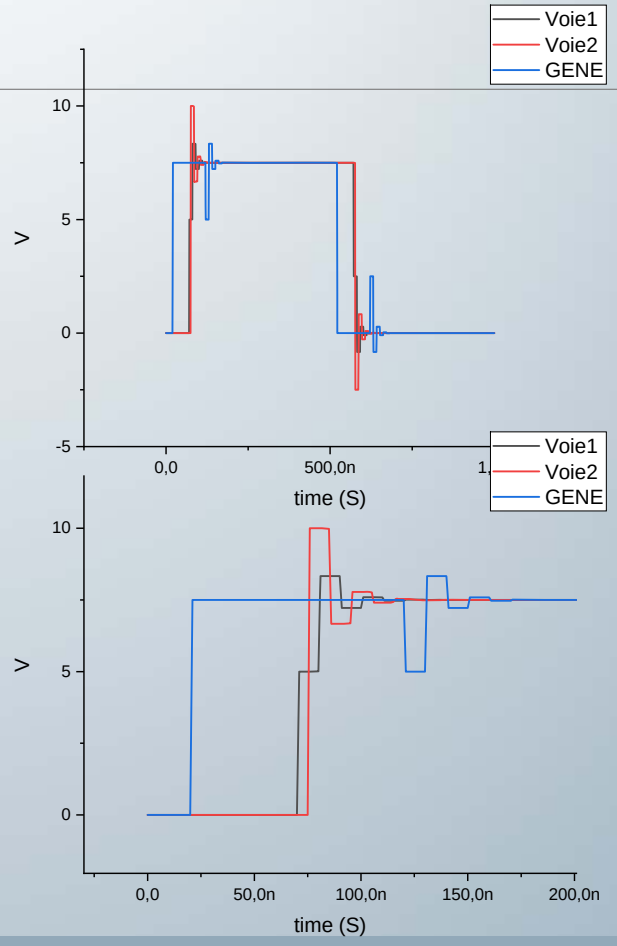




Synchronisation



Voie1 DC 50Ω
Voie2 DC 1Meg



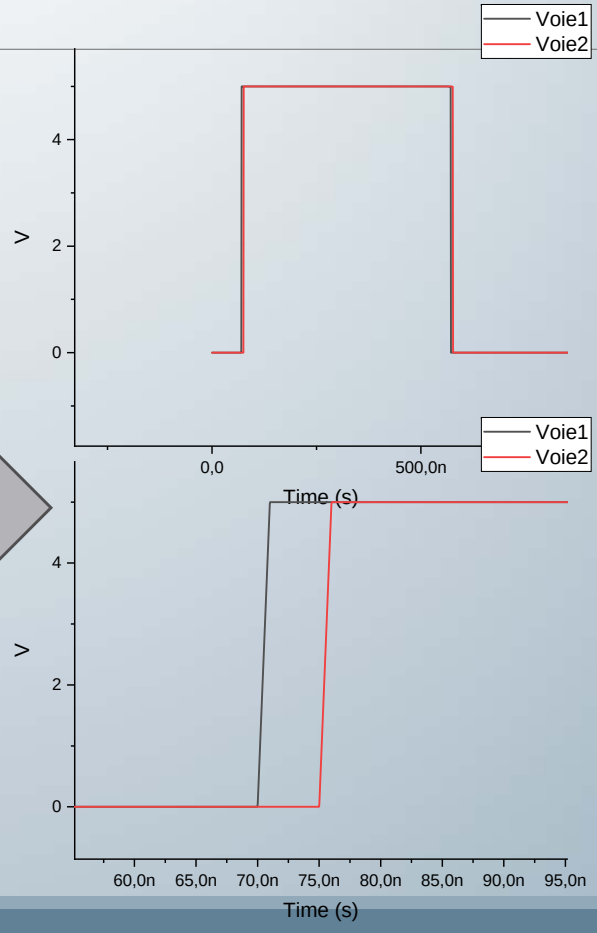
Synchronisation

10m

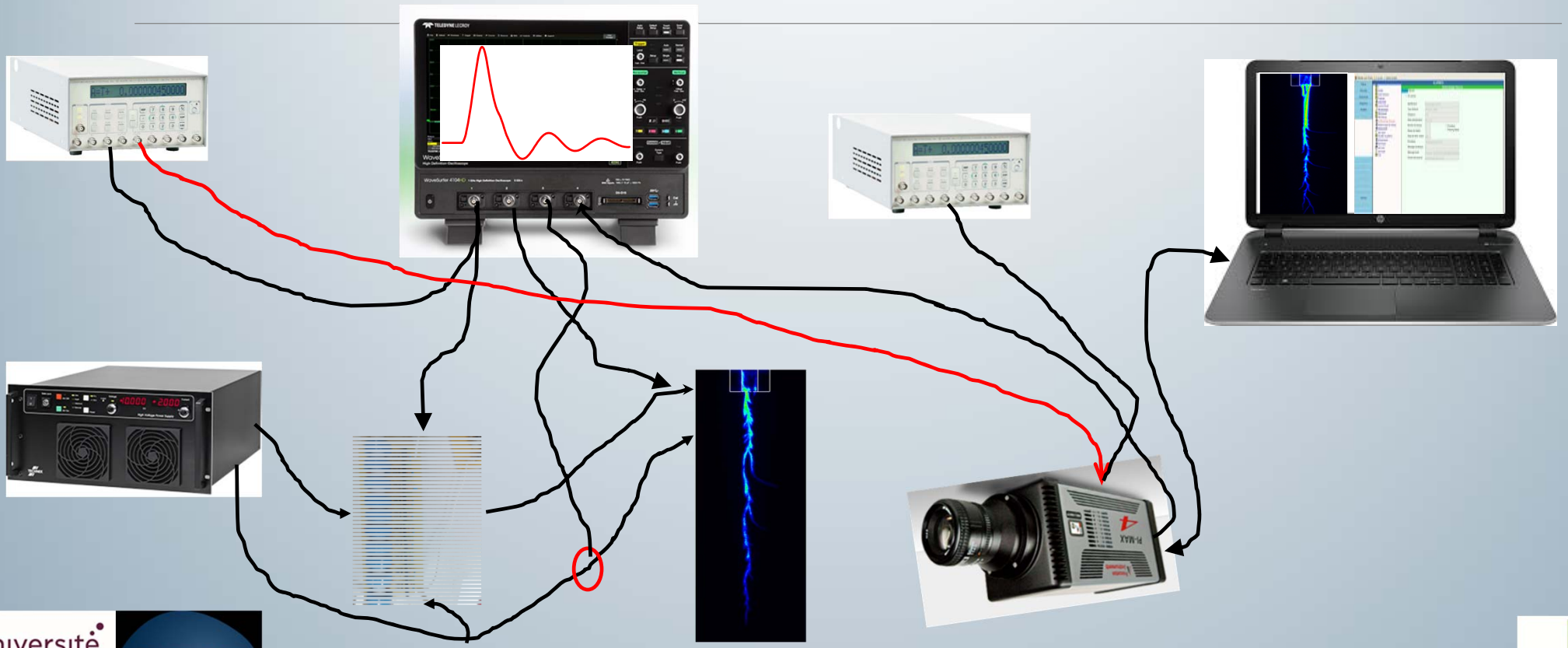
1m

Voie1 DC 50Ω
Voie2 DC 50Ω

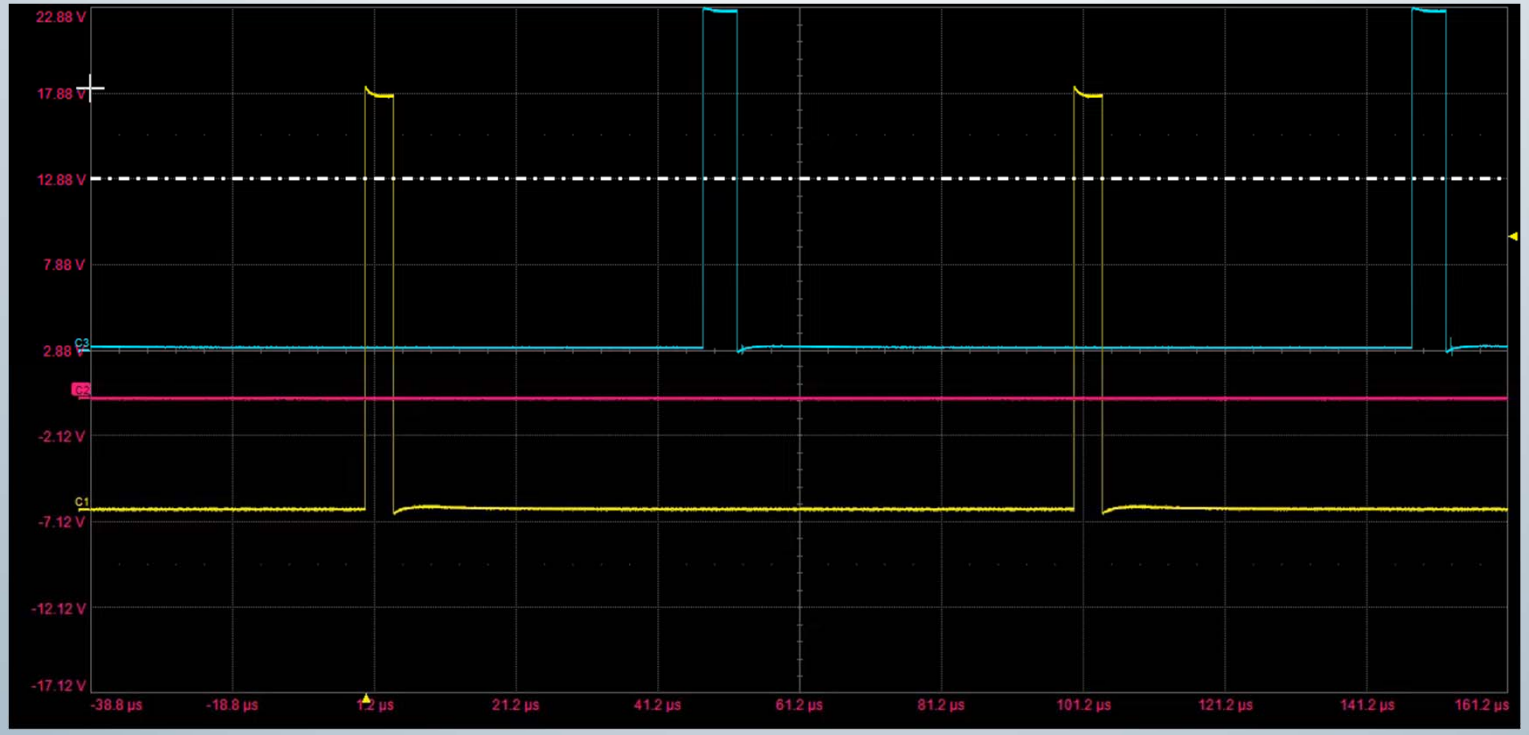
5V



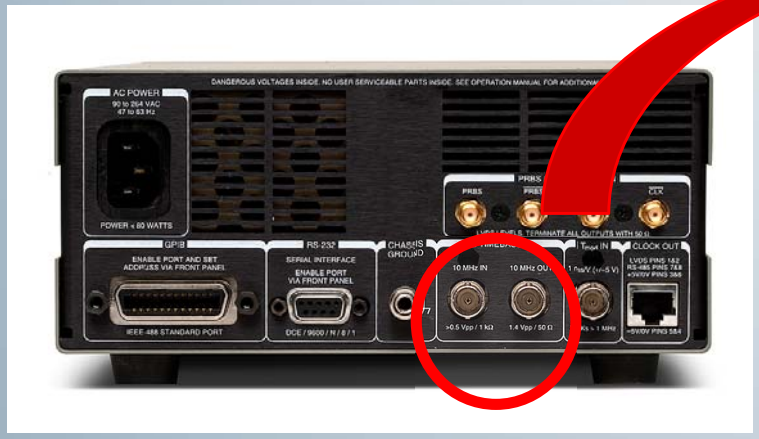
Synchronisation : exemple de manip



Synchronisation des 2 générateurs



Synchronisation des 2 générateurs

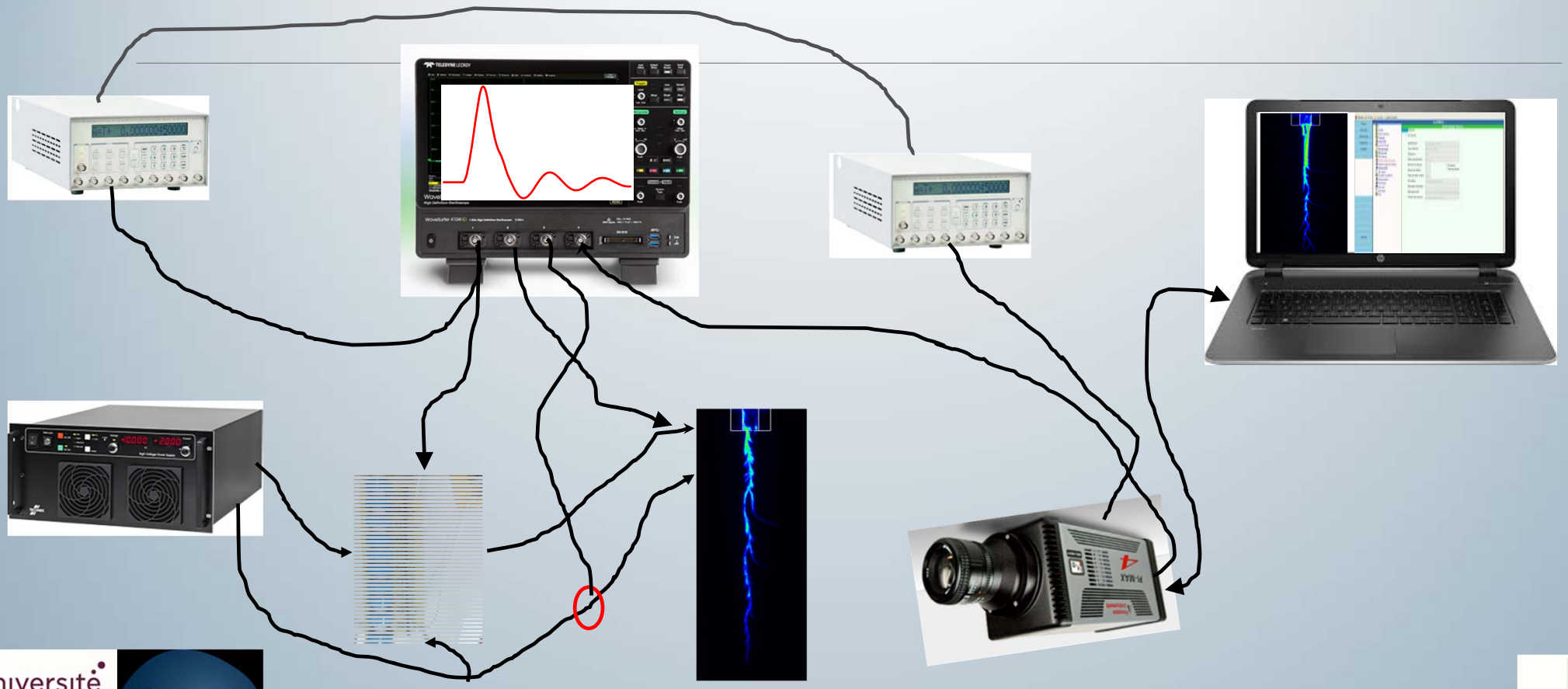


Synchronisation

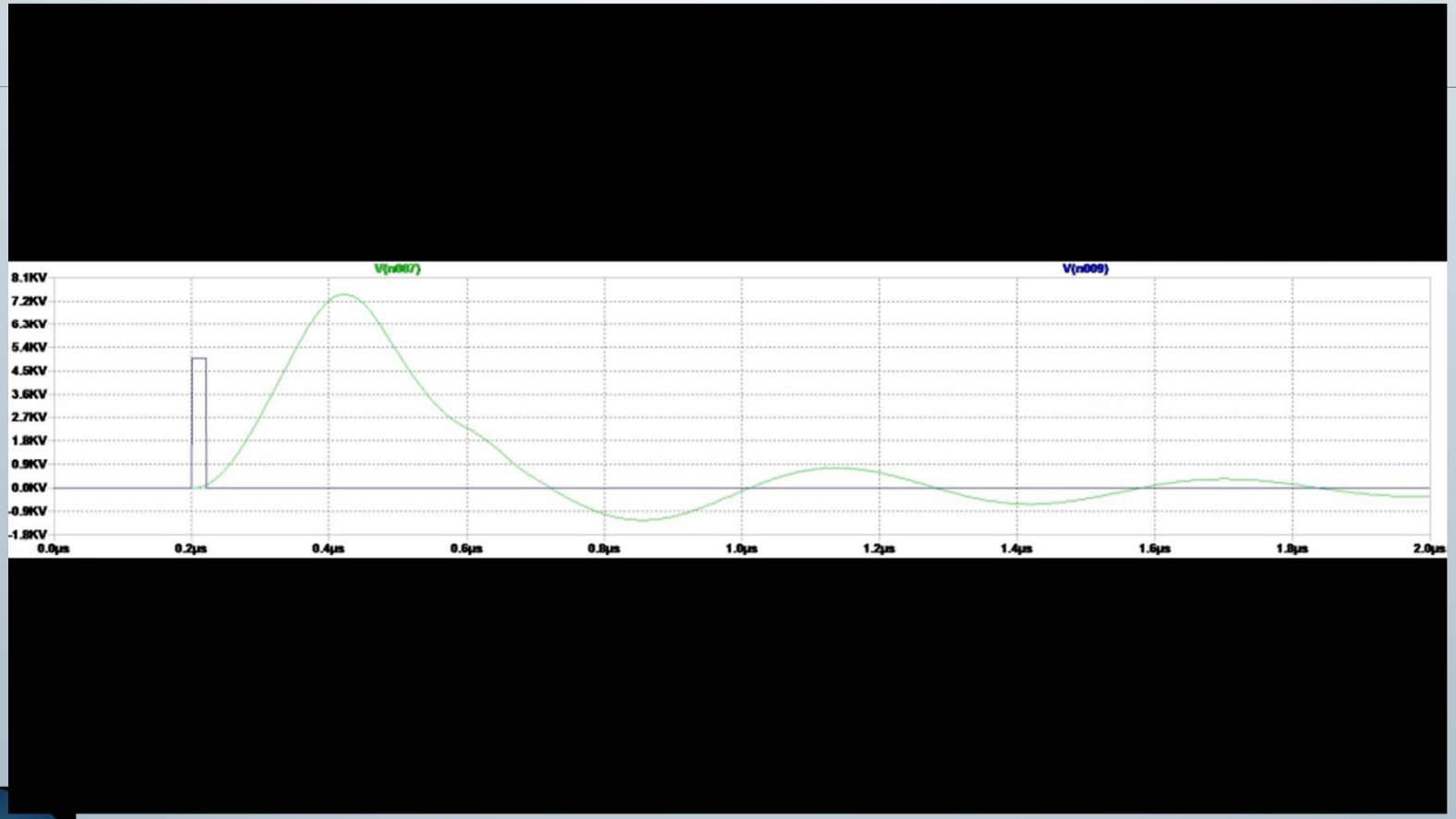
- On se synchronise sur le phénomène le moins rapide ou le plus rapide ?

  Grande question

Synchronisation : exemple de manip



Synchronisation



Mesures de tension

Mesures de tension

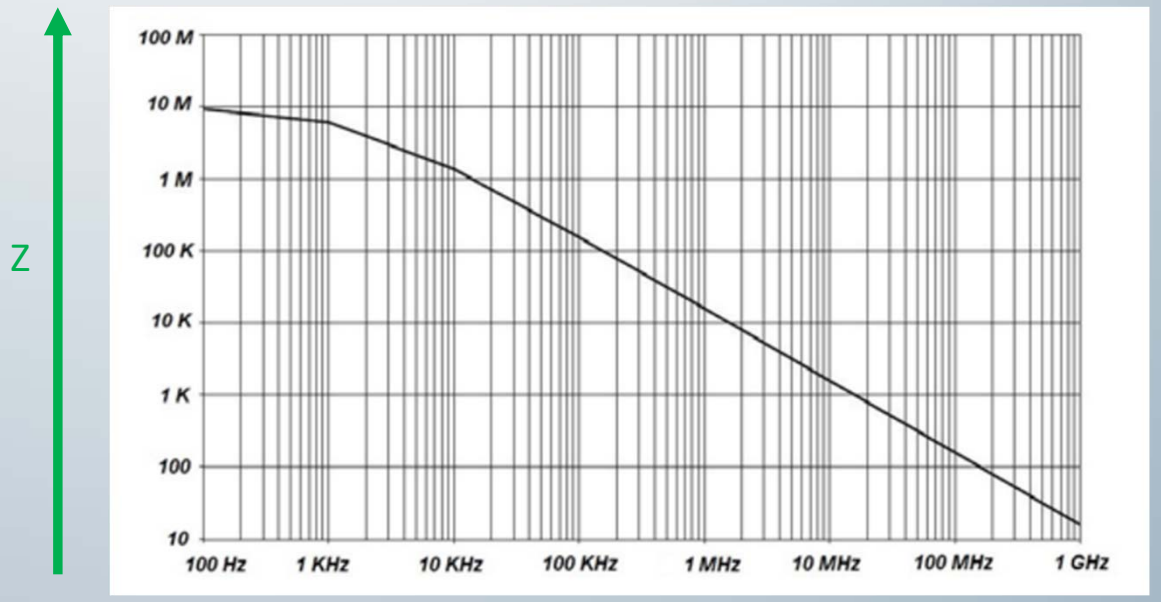
Minimiser les longueurs de câble entre le « pulseur » et le réacteur.

Toujours faire la prise de référence (masse) au plus près du réacteur ainsi que la prise de tension (point chaud).

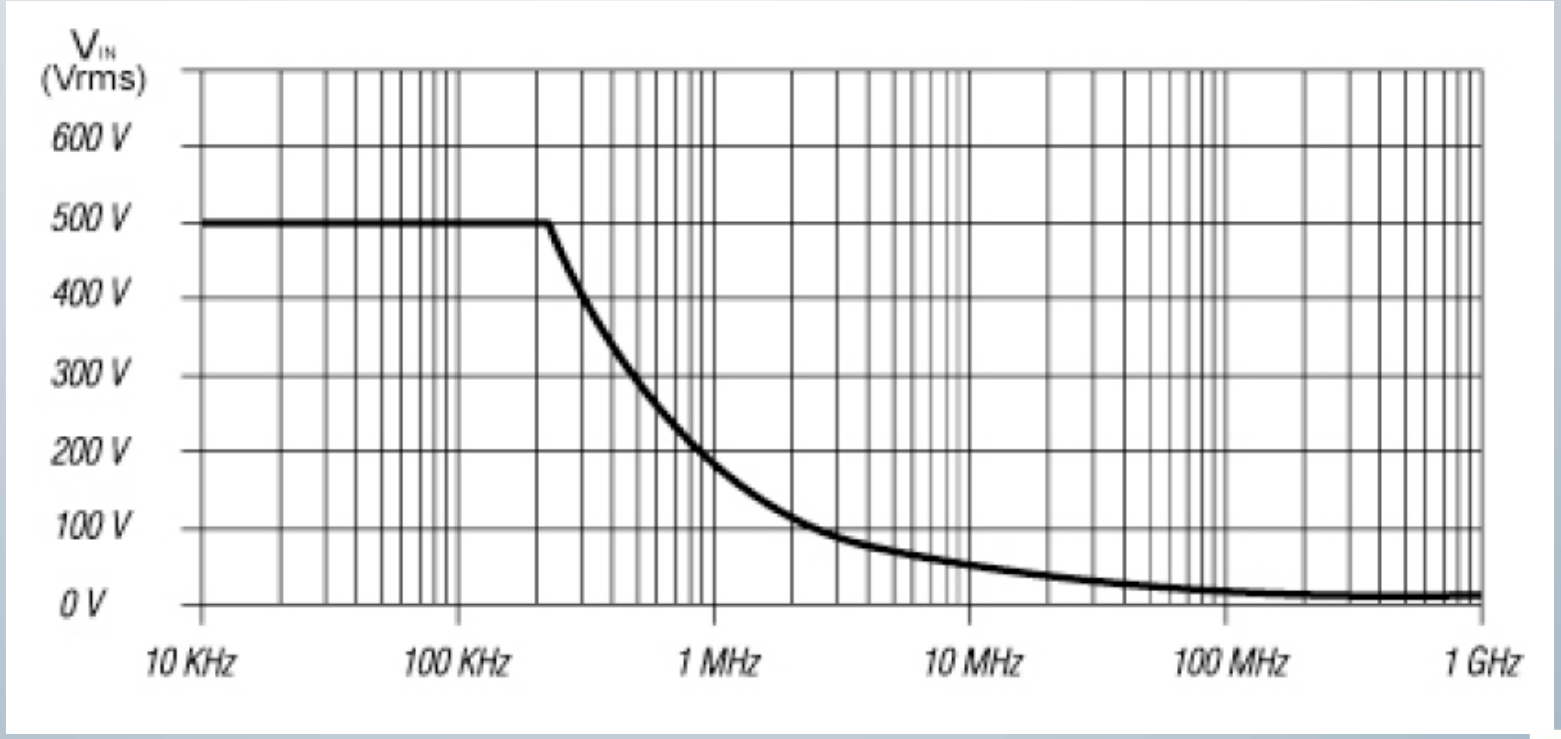
On utilise des sondes de tension et il en existe plusieurs sortes

Sondes de tension

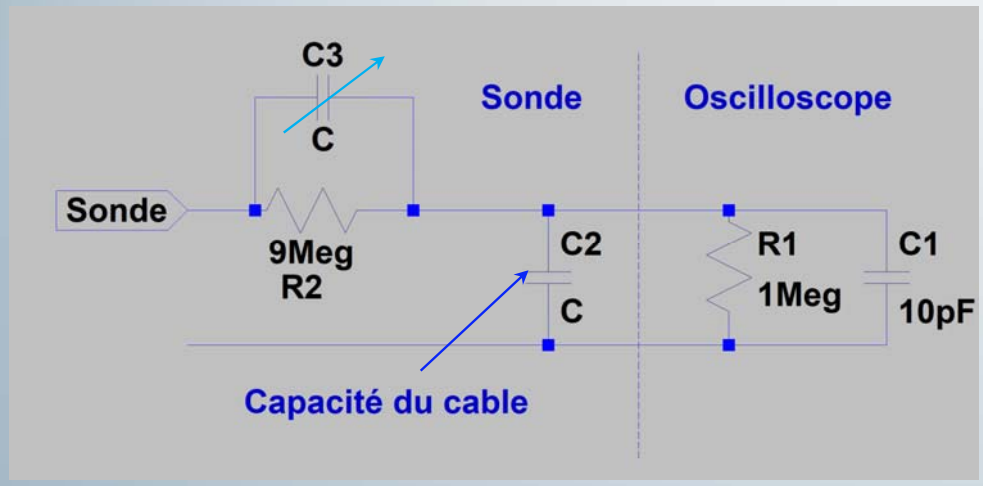
V<=500V Atténuation 10x Zi= 10MΩ et 10pF

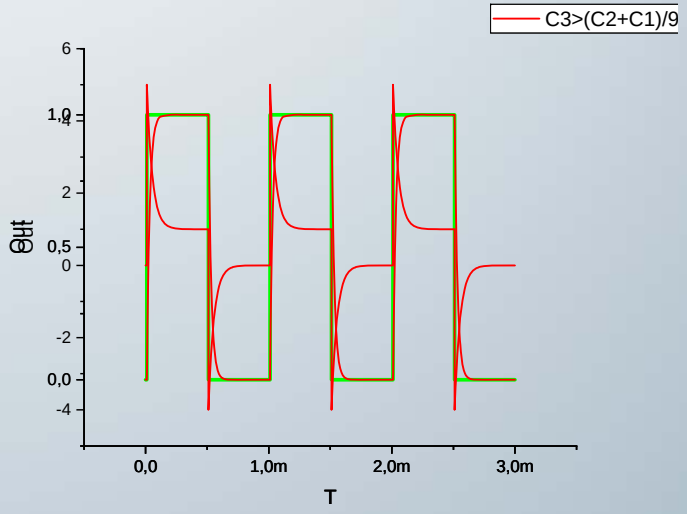


Mesures de tension



Sondes de tension

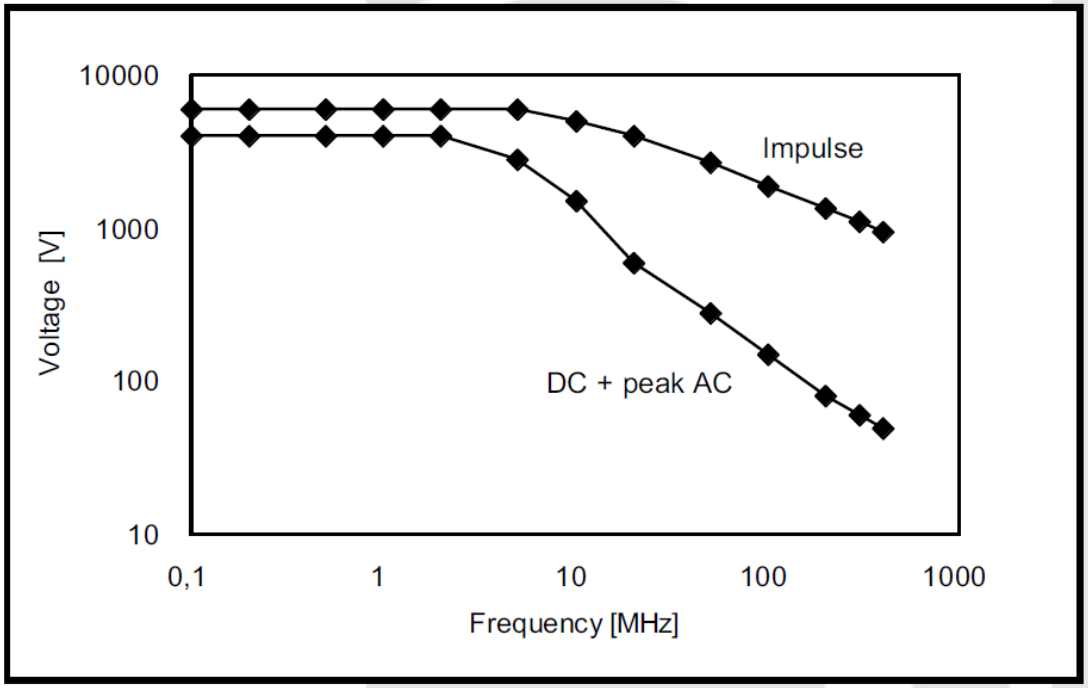




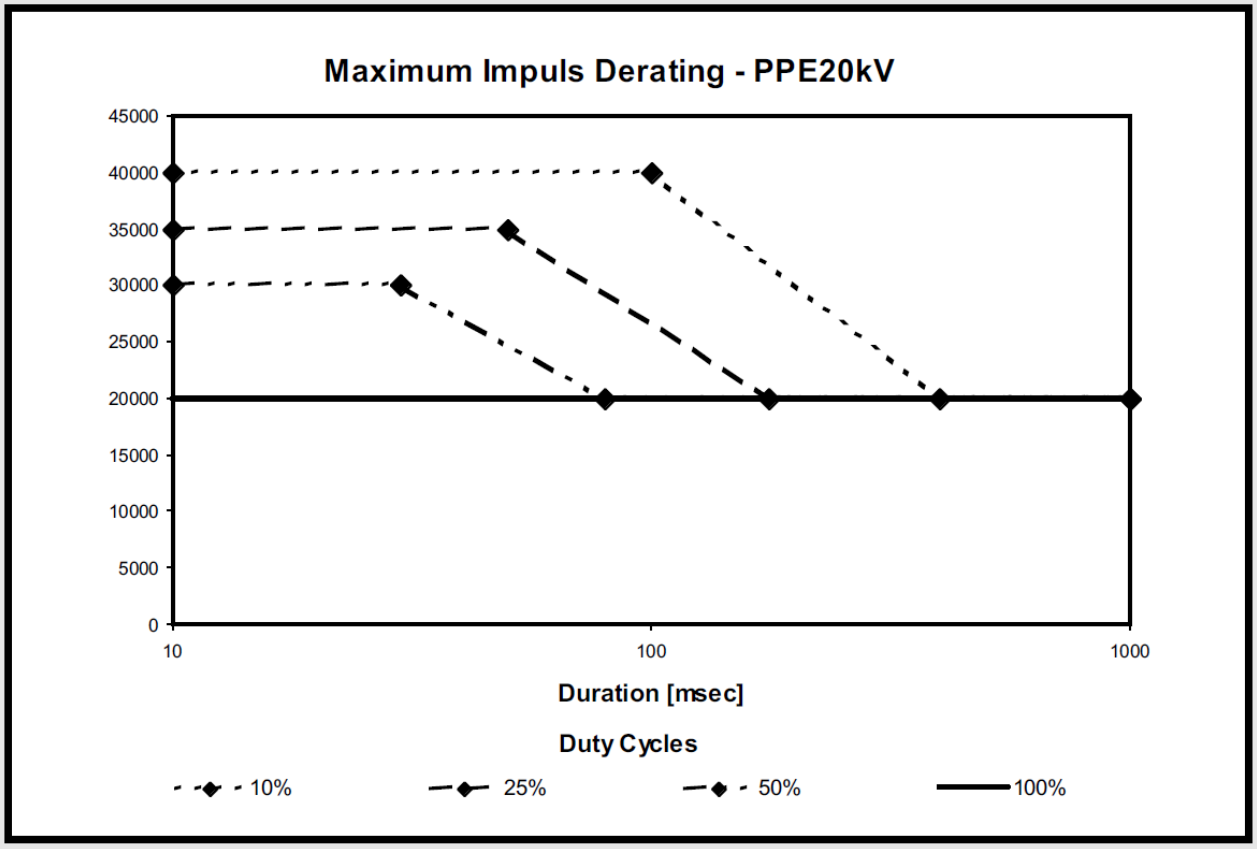
Ian Hickman Oscilloscopes fifth edition
https://fr.wikipedia.org/wiki/C%C3%A2ble_coaxial

Sondes de tension

<=6kV
Atténuation 100/1000
Zi= 50MΩ et ~6pF



Sondes de tension



Sondes de tension

>=20kV DC ou 40kV Pulse

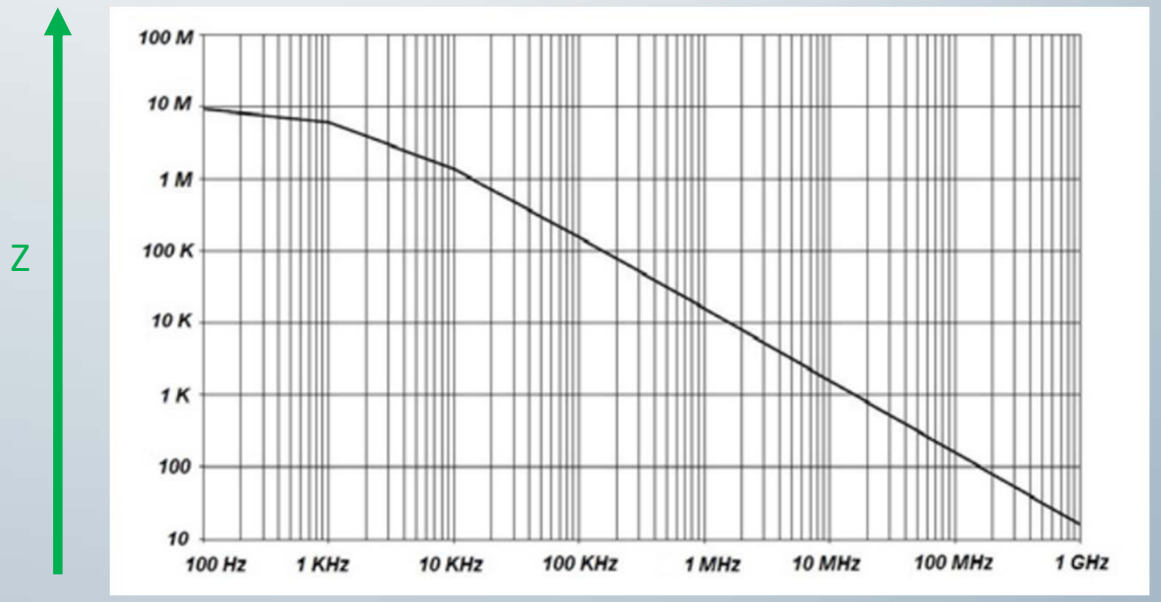
Atténuation 1000x
Z=100MΩ

De 40 à 300kV DC ou 60 à 550kV Pulse

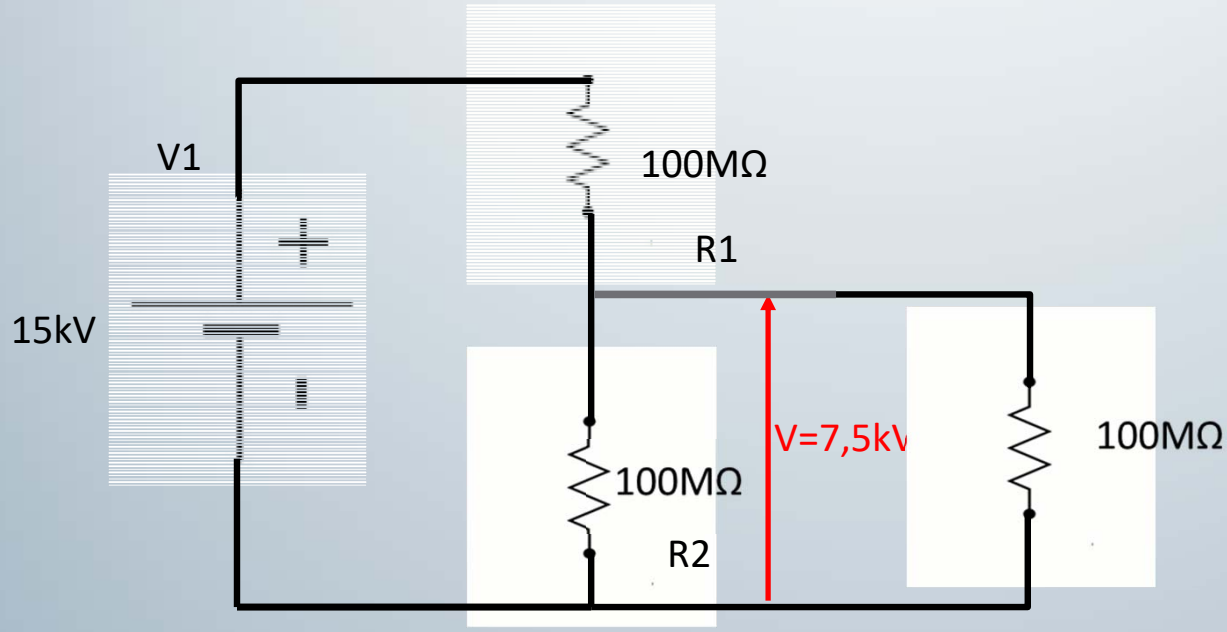
Atténuation 1000x
Z=100MΩ ou plus

Sondes de tension

V<=500V Atténuation 10x Zi= 10MΩ et 10pF



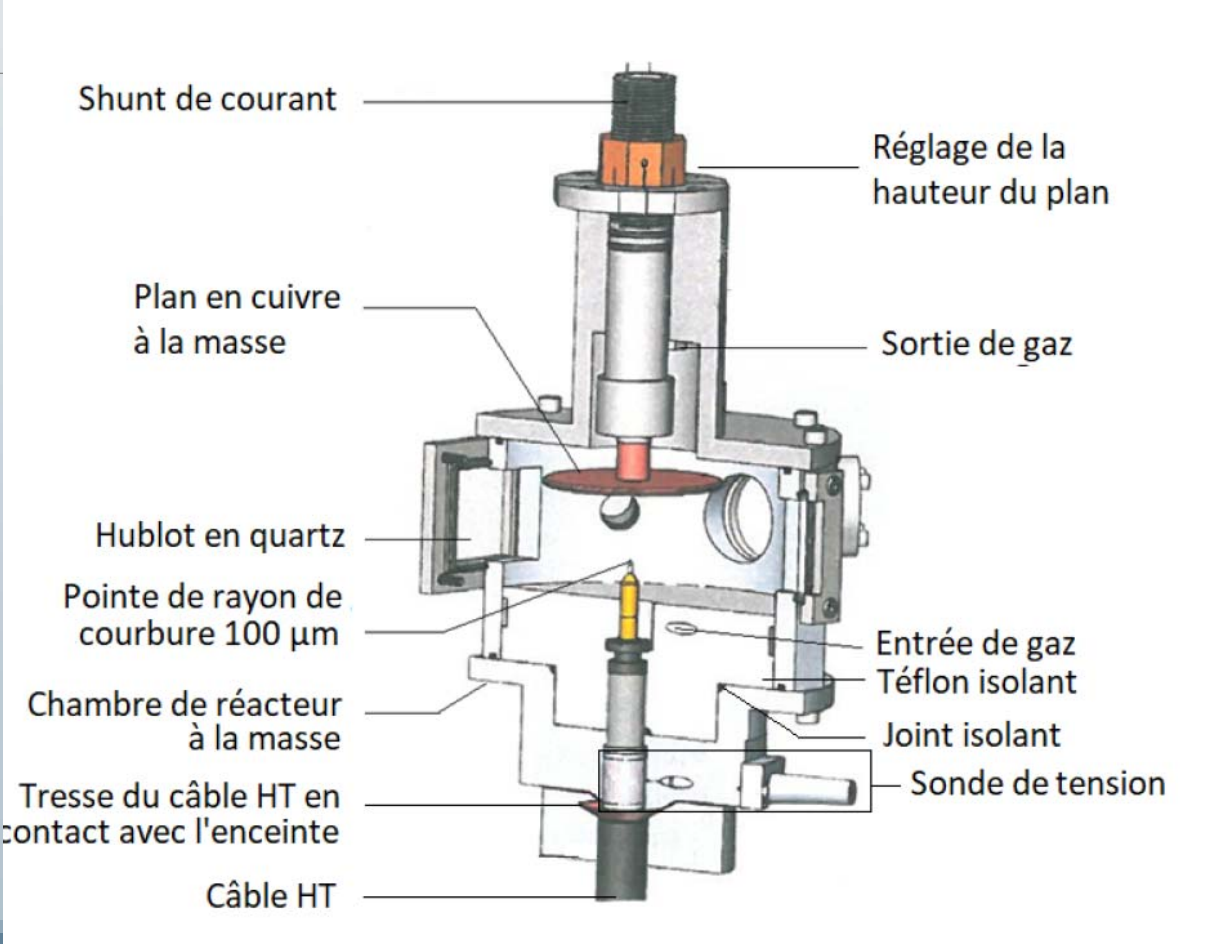
Attention à la mesure



5kV

V(R2)=(V1*50MΩ)/150MΩ

Exemple de réacteur



ANR EXFIDIS

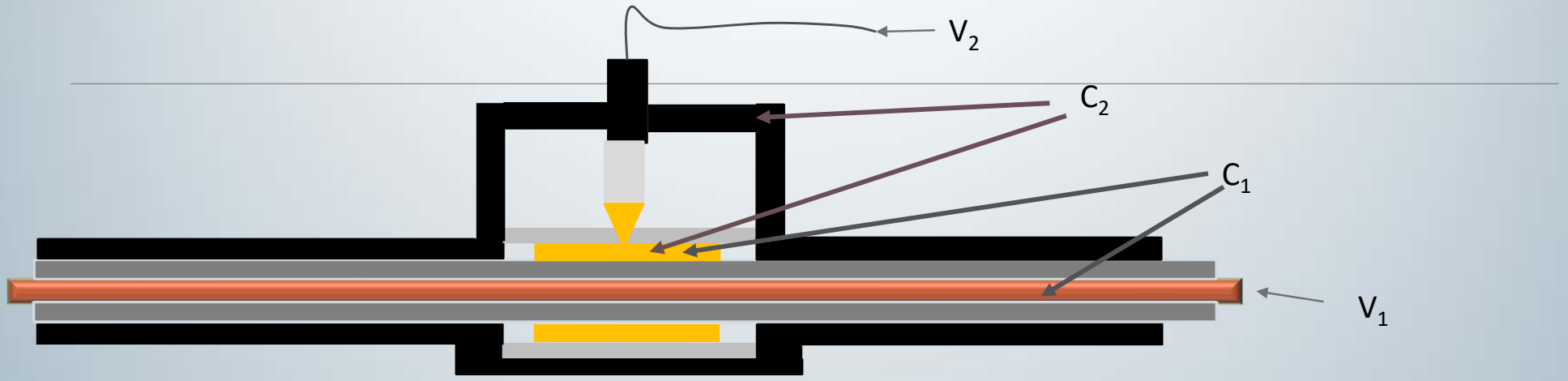
Thèse Alexandra Brisset

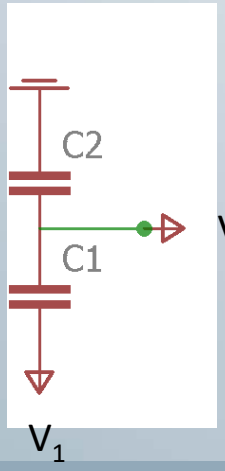
Physique des décharges nanosecondes diffuses générées sous champs électriques extrêmes

5 décembre 2019

HAL Id: tel-02466313

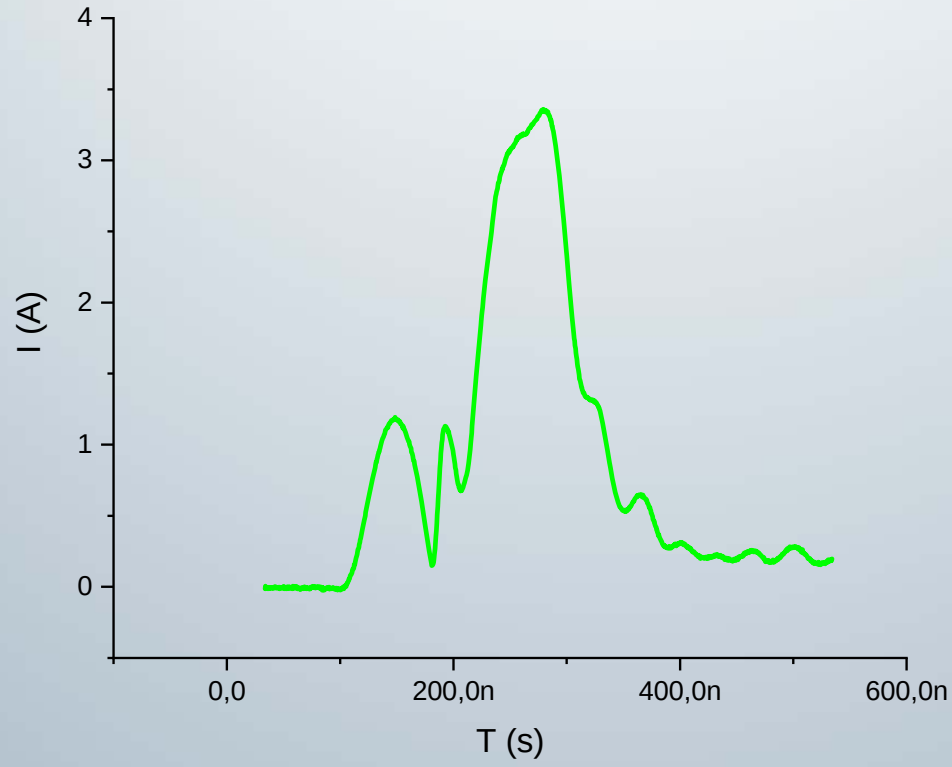
Sonde capacitive



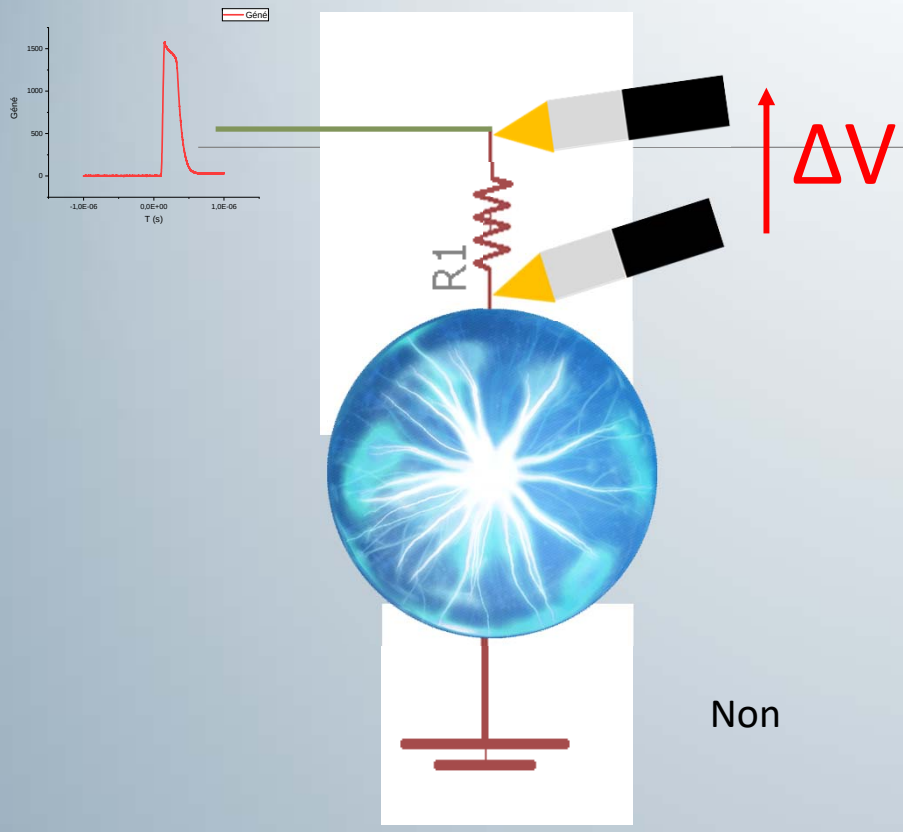


$$V_2 = \frac{1}{Att_{sonde}} \frac{C_1}{C_1 + C_2} V_1$$

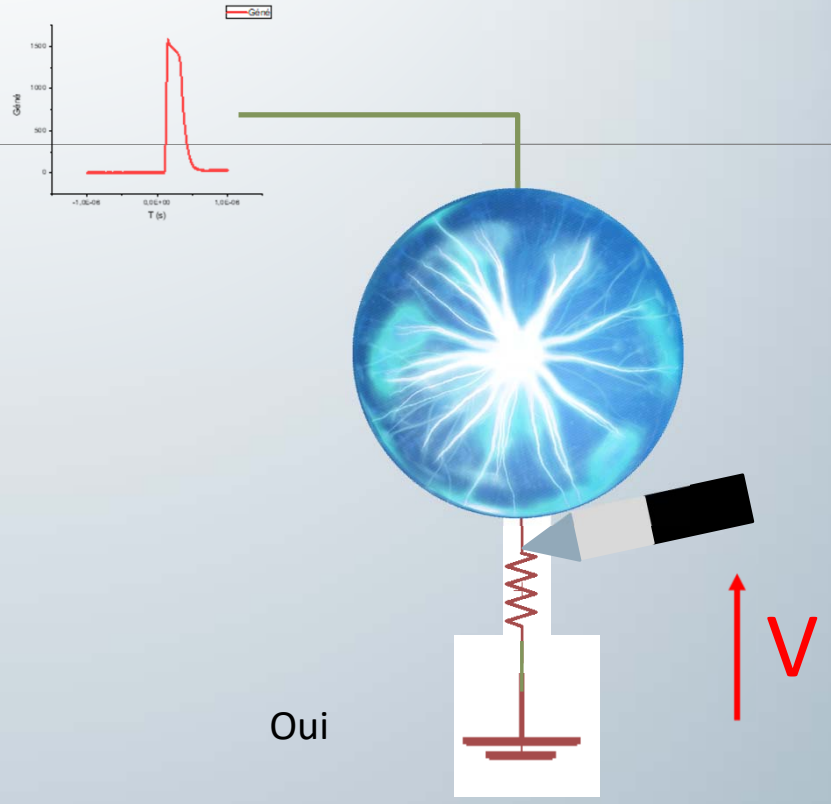
Mesures de courant



Mesures de courant

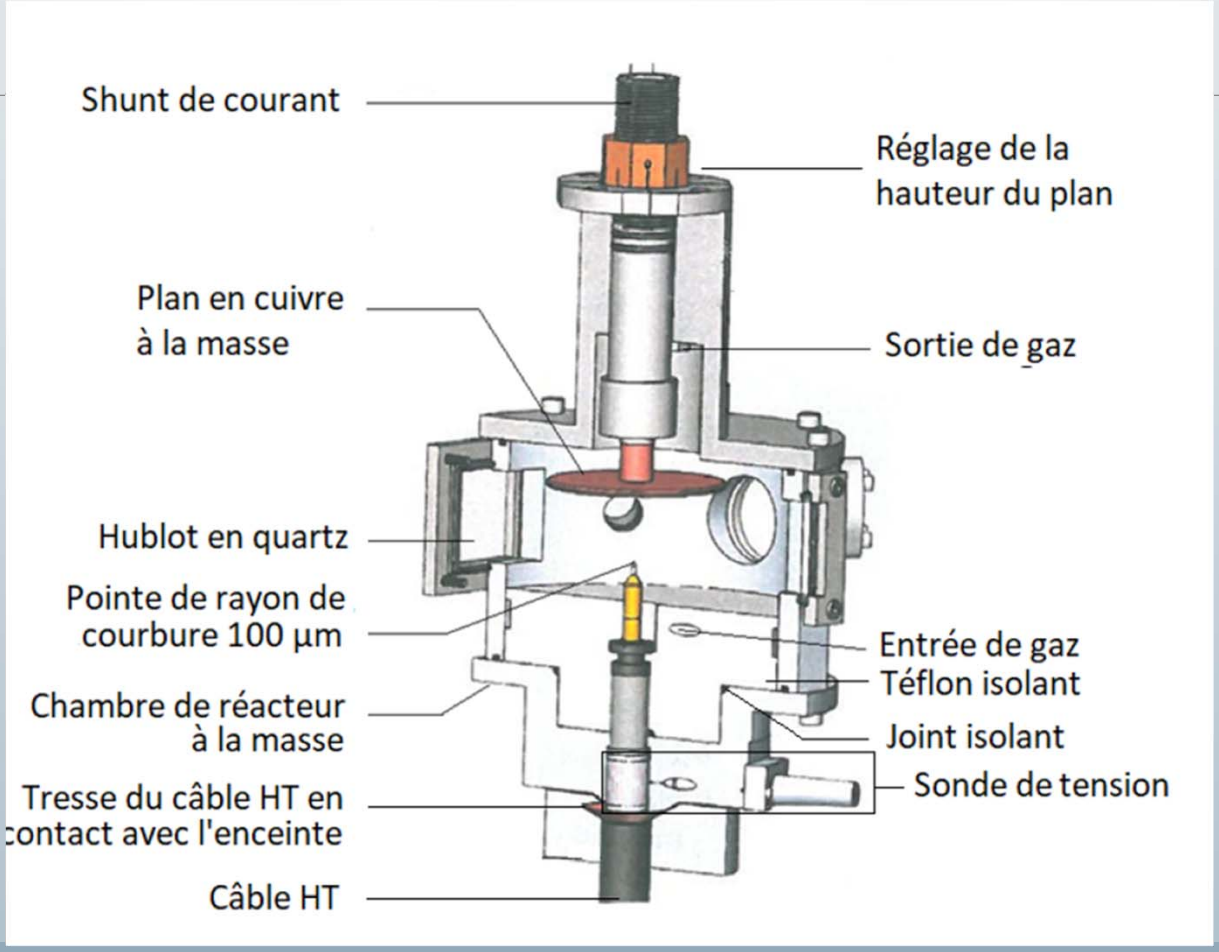


Non



Oui

Réacteur EXIFIDIS



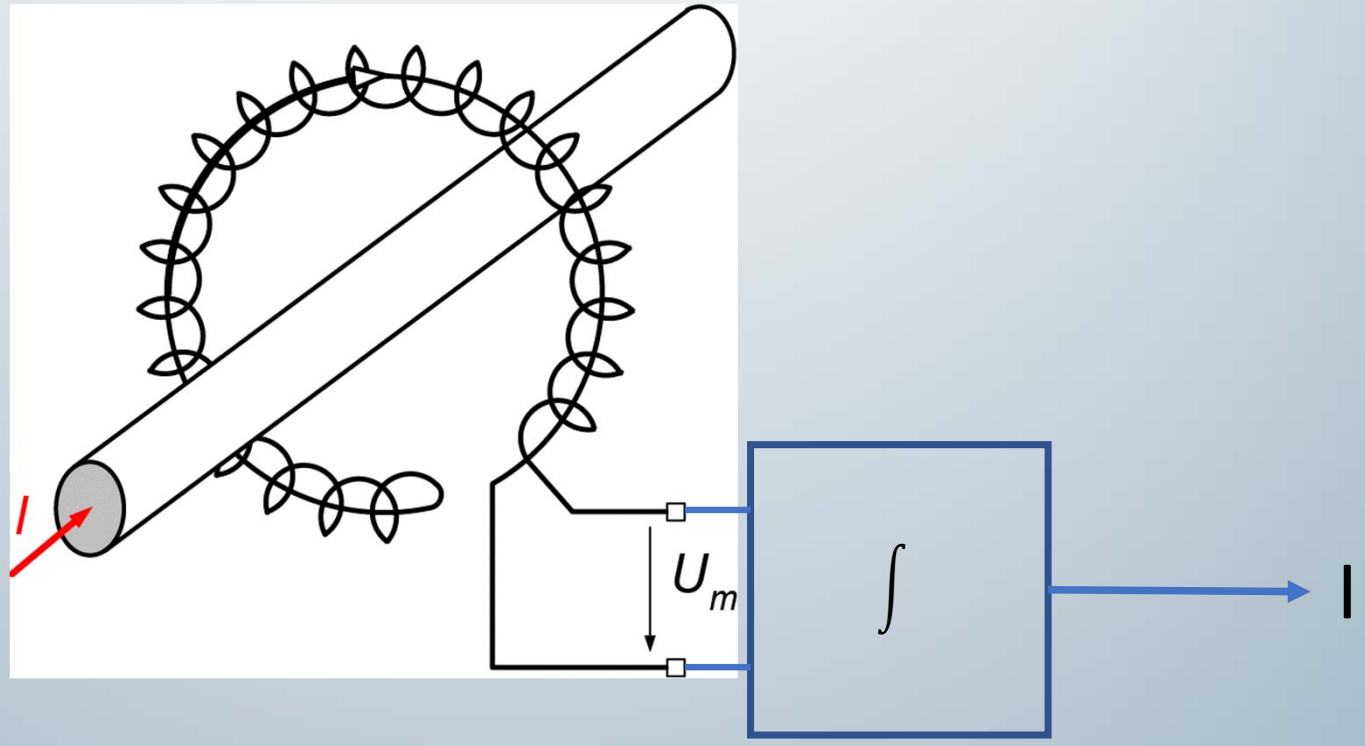
Mesures de courant

SBNC with locking nut and busbar isolator

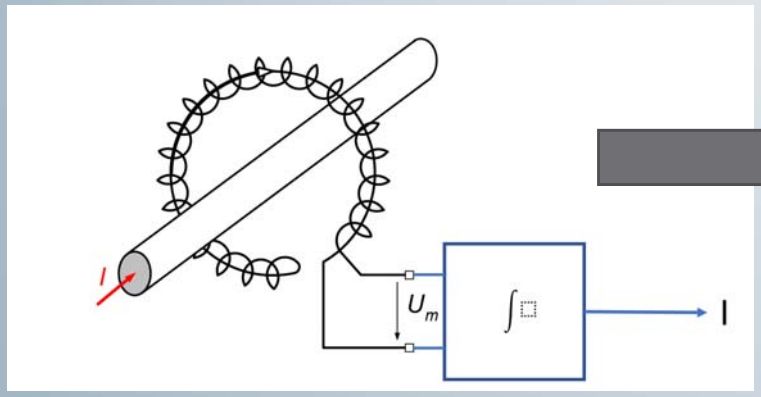
Coaxial Shunts T&M

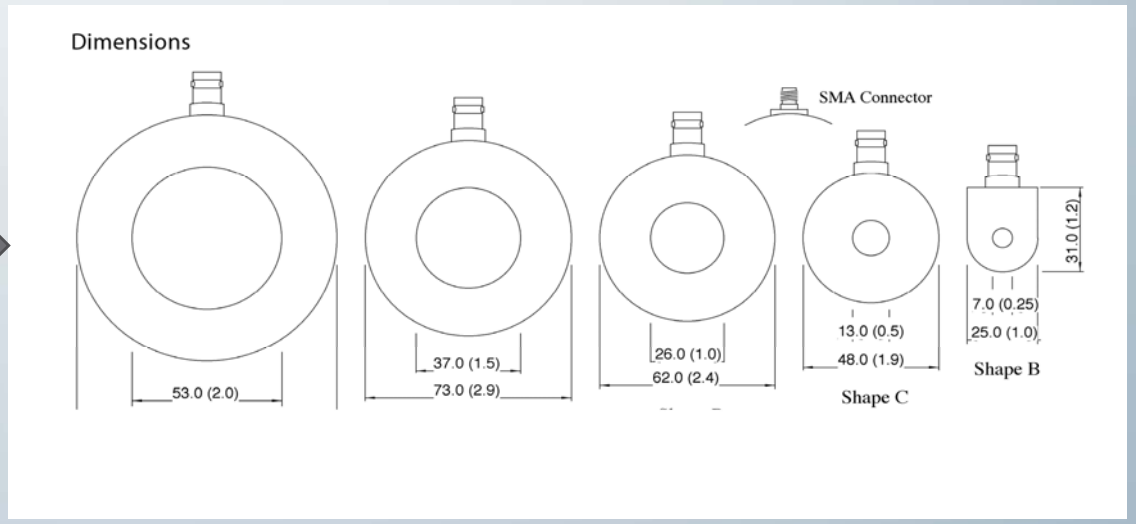
Model	Resistance ohms	Bandpass MHz.	Risetime nsec.	Emax joules
SDN-414-01	.01	400	1	6
SSDN-414-01	.01	400	1	6
SPT-414-01	.01	400	1	6
SDN-414-025	.025	1200	0.3	3
SSDN-414-025	.025	1200	0.3	3
SPT-414-025	.025	1200	0.3	3

Mesures de courant
Enroulement de Rogowski

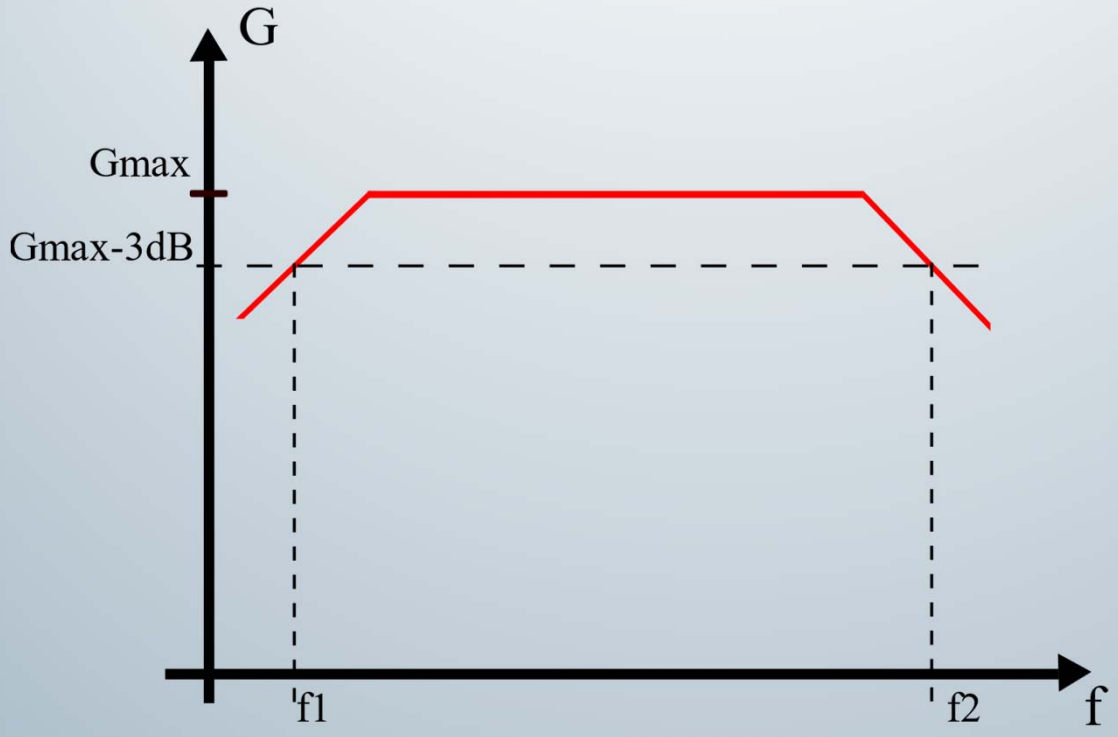


Mesures de courant
Enroulement de Rogowski





Un peu d'électronique : La bande passante



$$1dB = 10\ log_{10}(\frac{P_1}{P_2})$$

$$1dB = 20\ log_{10}(\frac{V_1}{V_2})$$

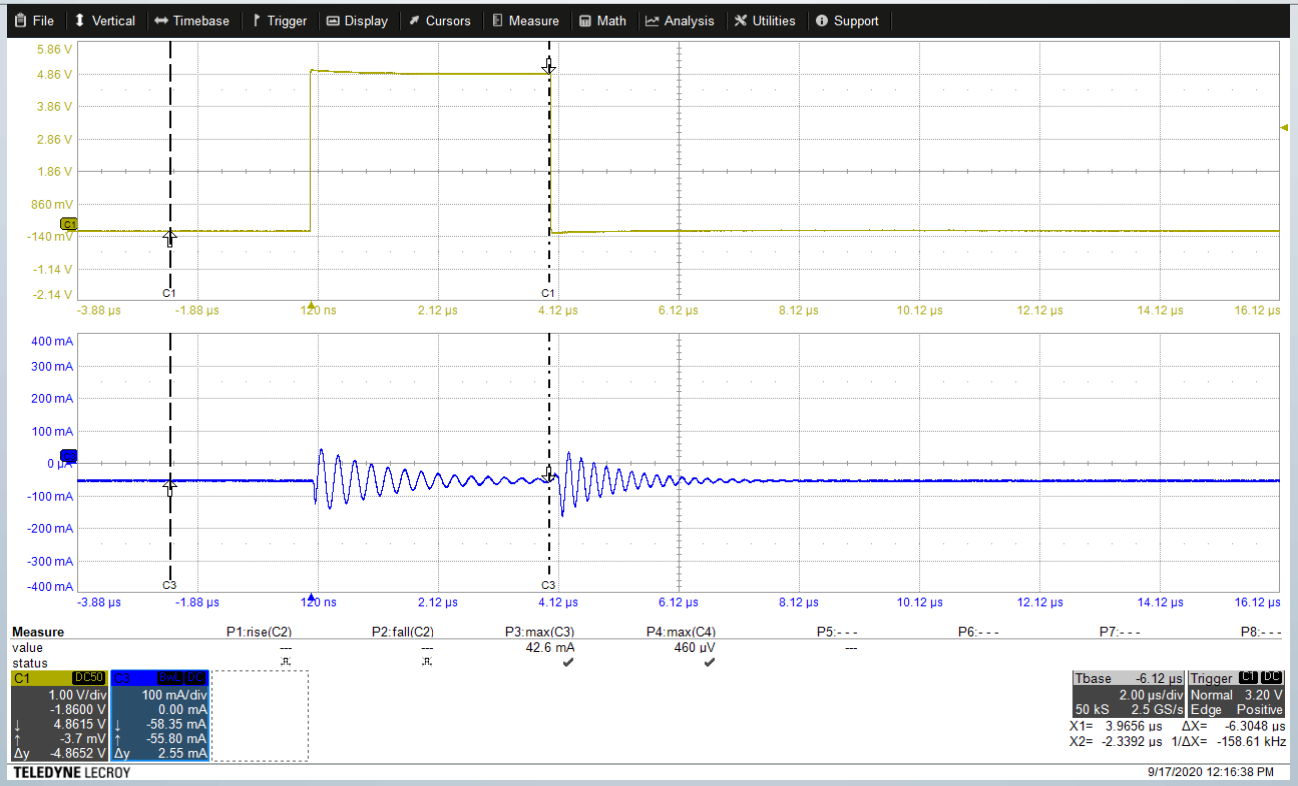
Mesures de courant
Enroulement de Rogowski

Unit height : 17mm (0.67"), models C,D,E & F, 15mm (0.60") model B — Dimensions in mm (inches)

Model	Output (V/A) in 1MΩ	Output (V/A) in 50Ω	Max rms (A)	Max Peak (A)	Droop (%/us)	Rise (ns)	Max I.t * (As) in 50Ω	-3db low (Hz)	-3db high (MHz)
CT-B5.0	5.0	2.5	2	200	3	0.875	0.0001	4800	400
CT-B2.5	2.5	1.25	5	400	0.75	0.7	0.0004	1200	500
CT-B1.0	1.0	0.5	8	1000	0.13	0.7	0.0025	200	500
CT-B0.5	0.5	0.25	11	2000	0.03	1.75	0.01	48	200
CT-B0.25	0.25	0.125	16	4000	0.015	3.5	0.04	24	100
CT-B0.1	0.1	0.05	25	10000	0.006	7	0.25	10	50
CT-B0.05	0.05	0.025	35	20000	0.003	17.5	1	5	20
CT-C5.0	5.0	2.5	2	200	3	0.875	0.0002	4800	400
CT-C2.5	2.5	1.25	5	400	0.75	0.7	0.0008	1200	500
CT-C1.0	1.0	0.5	11	1000	0.13	0.7	0.005	200	500
CT-C0.5	0.5	0.25	16	2000	0.03	1.75	0.02	48	200
CT-C0.25	0.25	0.125	22	4000	0.01	3.5	0.08	12	100
CT-C0.1	0.1	0.05	35	10000	0.004	7	0.5	6	50
CT-C0.05	0.05	0.025	50	20000	0.002	17.5	2	3	20
CT-D5.0	5.0	2.5	2	200	3	0.875	0.0002	4800	400
CT-D2.5	2.5	1.25	5	400	0.75	0.7	0.0008	1200	500
CT-D1.0	1.0	0.5	11	1000	0.13	0.7	0.005	200	500
CT-D0.5	0.5	0.25	16	2000	0.03	1.75	0.02	48	200
CT-D0.25	0.25	0.125	22	4000	0.01	3.5	0.08	12	100
CT-D0.1	0.1	0.05	35	10000	0.002	7	0.5	2	50
CT-D0.05	0.05	0.025	50	20000	0.001	17.5	2	1	20

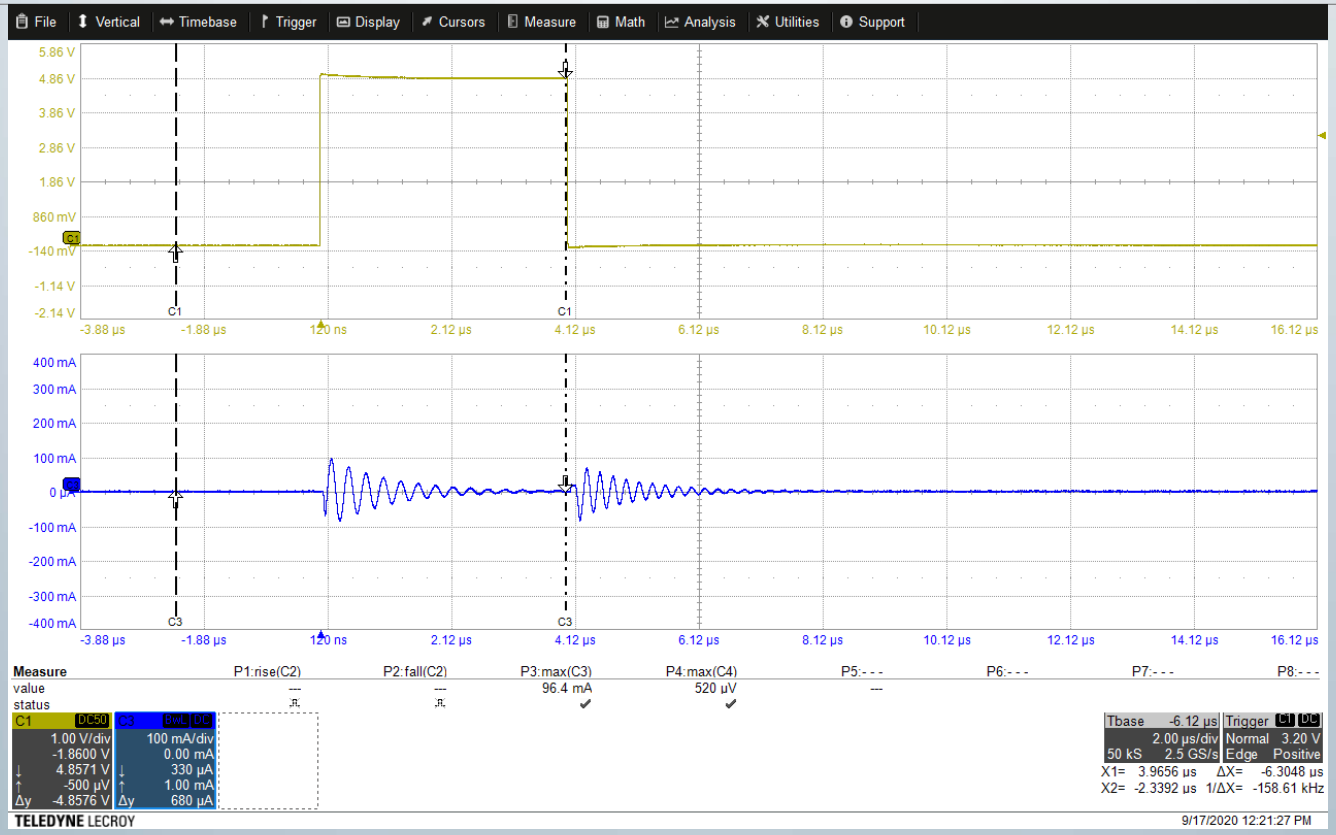
Sondes de courant

Sondes de courant



Sondes de courant

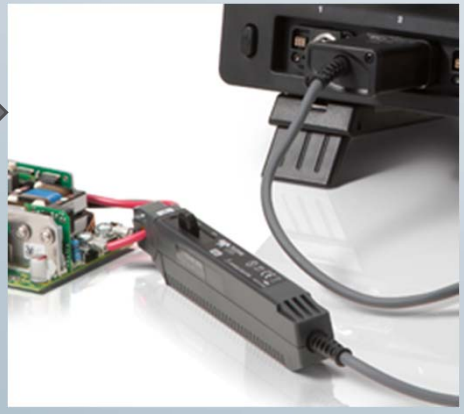
Sondes de courant

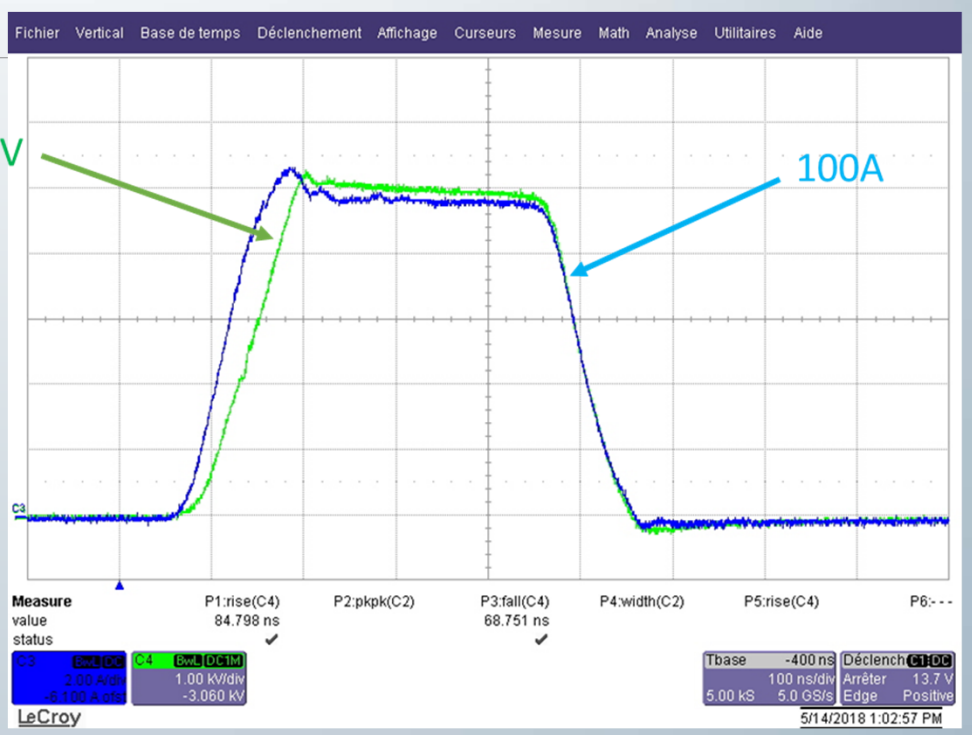


Mesures de courant

Par exemple : 10 tours sur une résistance de 1Ω
La réponse est de 10 A/V

Mesures de courant





Merci