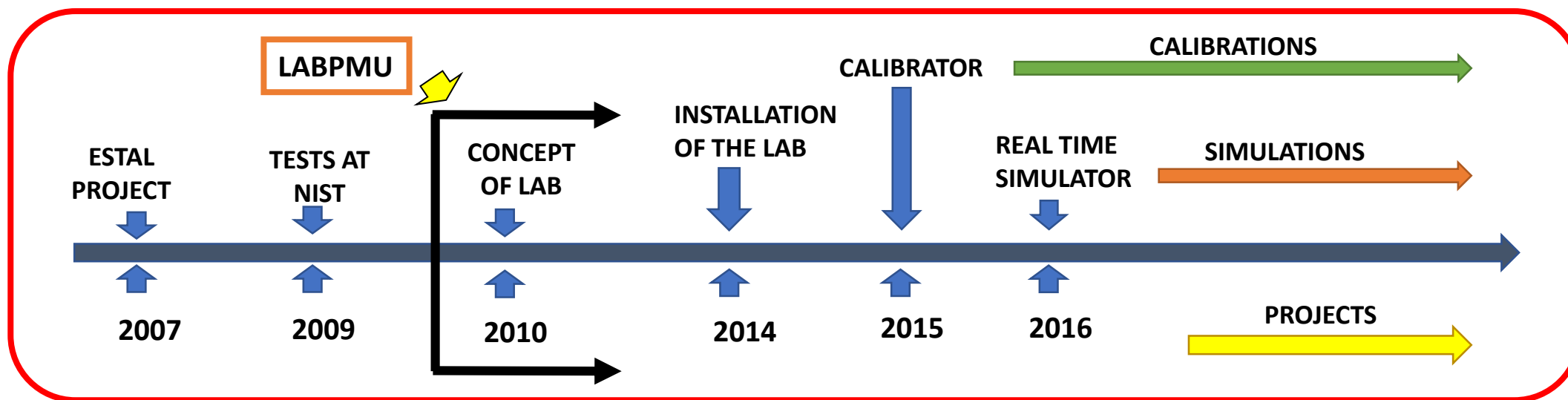
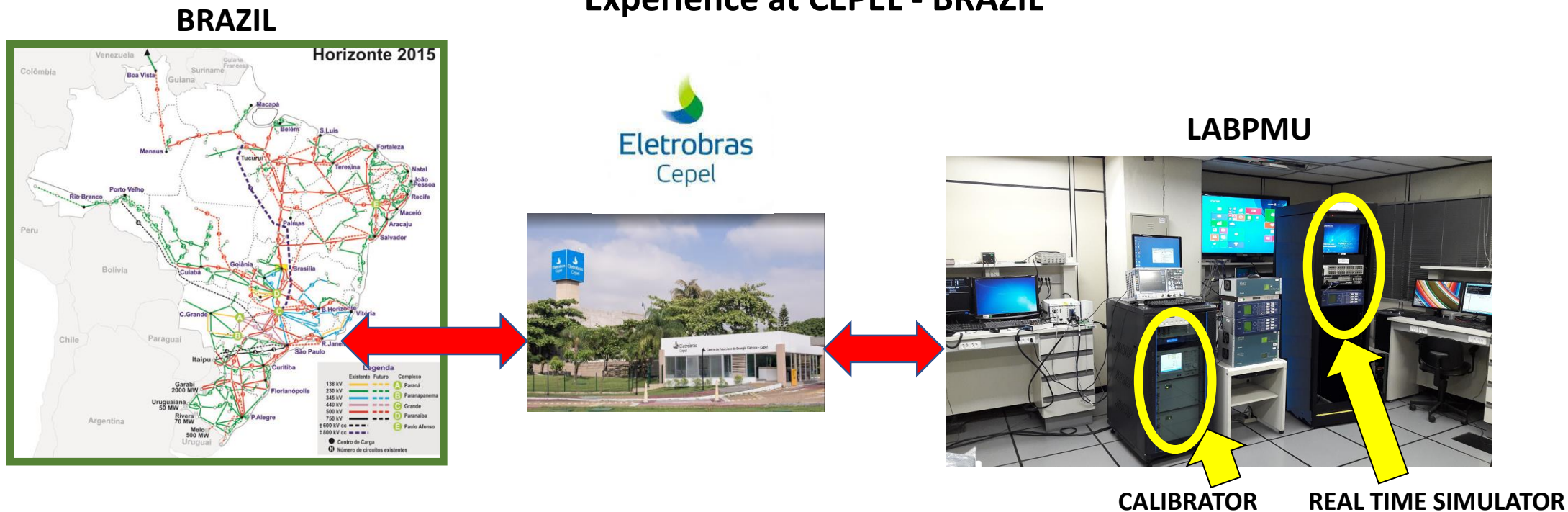


# LabPMU

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**CEPEL** – the Brazilian Electric Energy Research Center

# IEEE 2021 International Conference on Smart Grid Synchronized Measurements and Analytics Experience at CEPEL - BRAZIL



# REFERENCE TESTS



## PMUS USED IN BRAZIL

Vendor	Model	Firmware	Result
1	A	1	N
		2	N
		3	Y
2	A	1	Y
3	A	1	N
	B	1	Y
4	A	1	N
5	A	1	Y



EVOLUTION OF FIRMWARE OF A PMU				
ID	FIRST	SECOND	THIRD	Label
1				SteadyState/FreqResp/TVE
2				SteadyState/FreqResp/Fe
3				SteadyState/FreqResp/RFe
4				SteadyState/Harmonics/TVE
5				SteadyState/Harmonics/Fe
6				SteadyState/Harmonics/RFe
7				SteadyState/InterHarmonics/TVE
8				SteadyState/InterHarmonics/Fe
9				SteadyState/InterHarmonics/RFe
10				SteadyState/Mag/TVE
11				SteadyState/Mag/Fe
12				SteadyState/Mag/RFe
13				Ramp/ramp/TVE
14				Ramp/ramp/Fe
15				Ramp/ramp/RFe
16				Modulation/Phase/TVE
17				Modulation/Phase/Fe
18				Modulation/Phase/RFe
19				Modulation/Amplitude/TVE
20				Modulation/Amplitude/Fe
21				Modulation/Amplitude/RFe
22				Modulation/Combined/TVE
23				Modulation/Combined/Fe
24				Modulation/Combined/RFe
25				Step/Phase/PhasorRespTime
26				Step/Phase/PhasorDelayTime
27				Step/Phase/PhaseOvershoot
28				Step/Phase/FreqRespTime
29				Step/Phase/ROCOFRespTime
30				Step/Phase/FreqOverShoot
31				Step/Phase/ROCOFOvershoot
32				Step/Phase/AmplOvershoot
33				Step/Amplitude/PhasorRespTime
34				Step/Amplitude/PhasorDelayTime
35				Step/Amplitude/PhaseOvershoot
36				Step/Amplitude/FreqRespTime
37				Step/Amplitude/ROCOFRespTime
38				Step/Amplitude/FreqOverShoot
39				Step/Amplitude/ROCOFOvershoot
40				Step/Amplitude/AmplOvershoot
41				Latency

# GOING FROM CALIBRATION TO SIMULATION

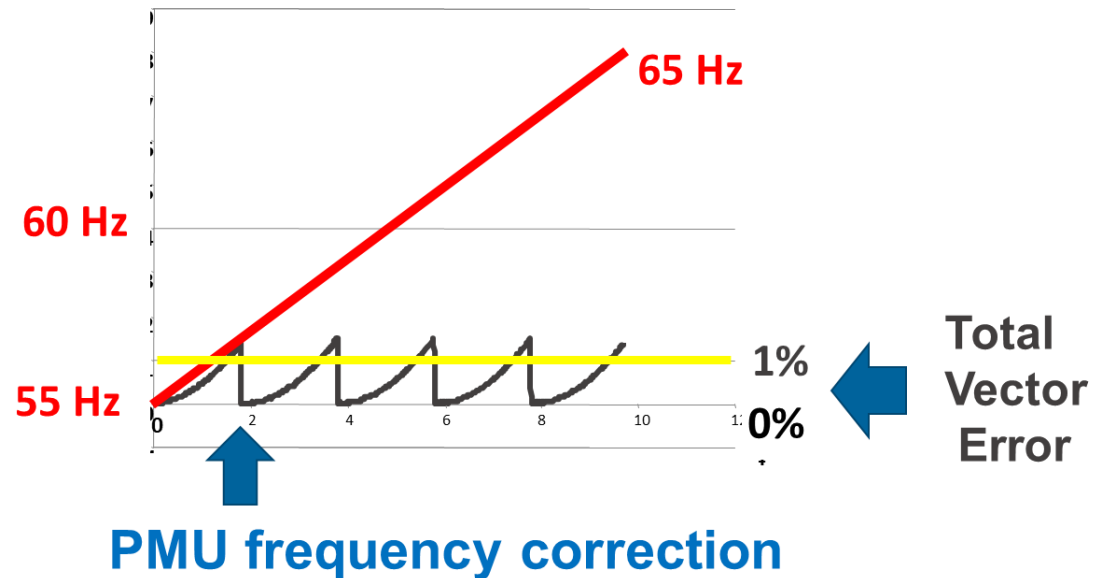
## CALIBRATION



## SIMULATION

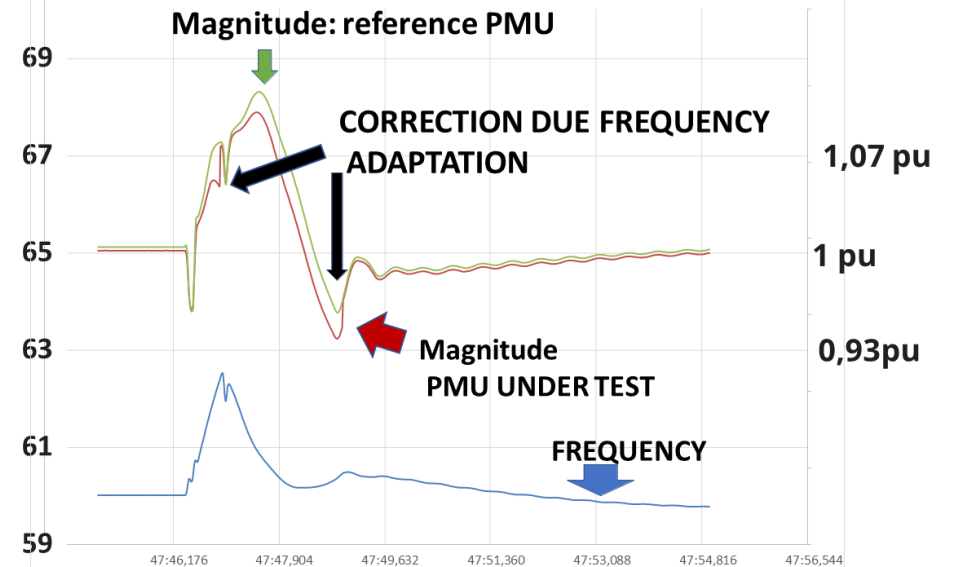


### Frequency Ramp

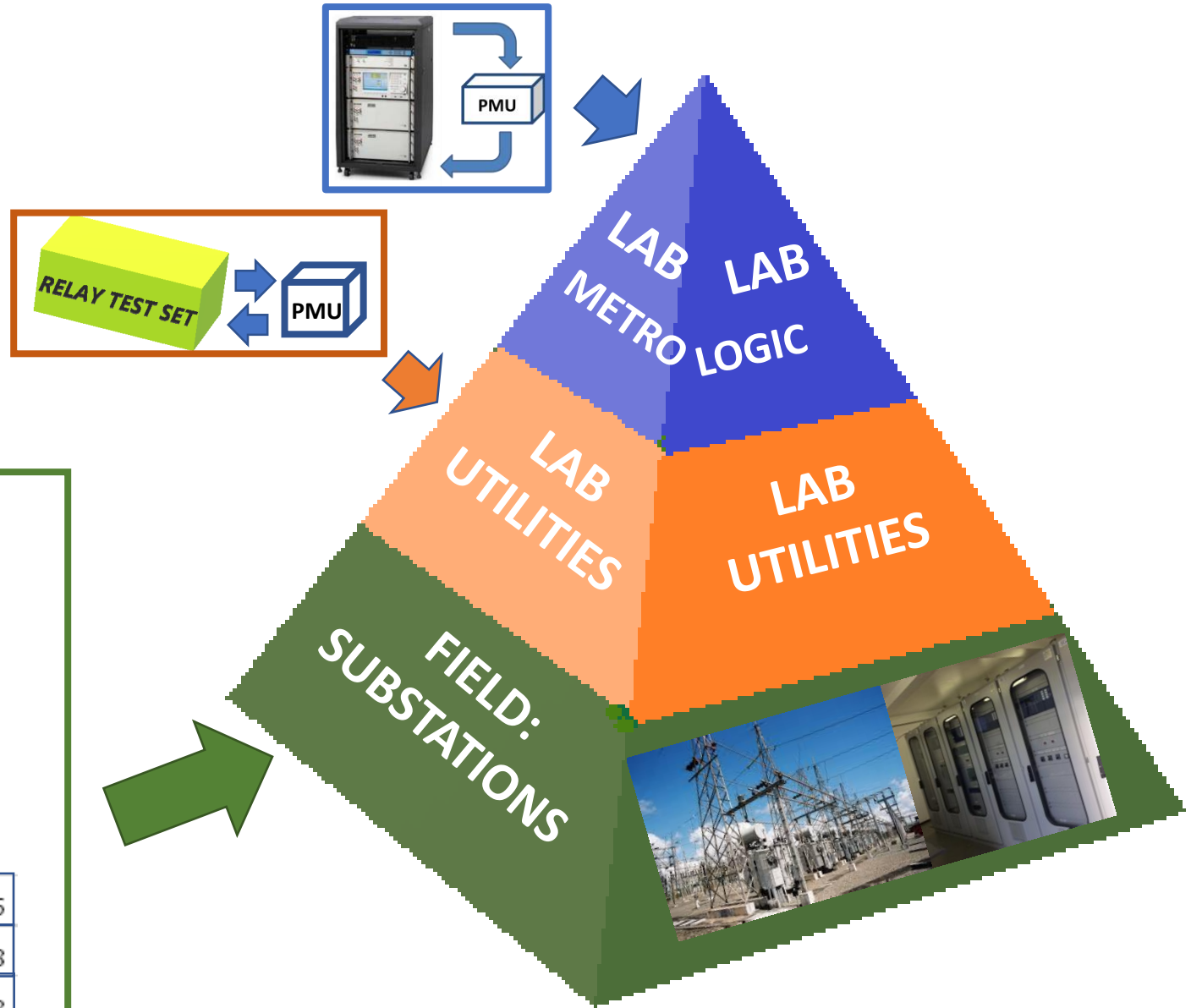


### Frequency Axis

### Magnitude Axis



# CLAMP REFERENCE PMU

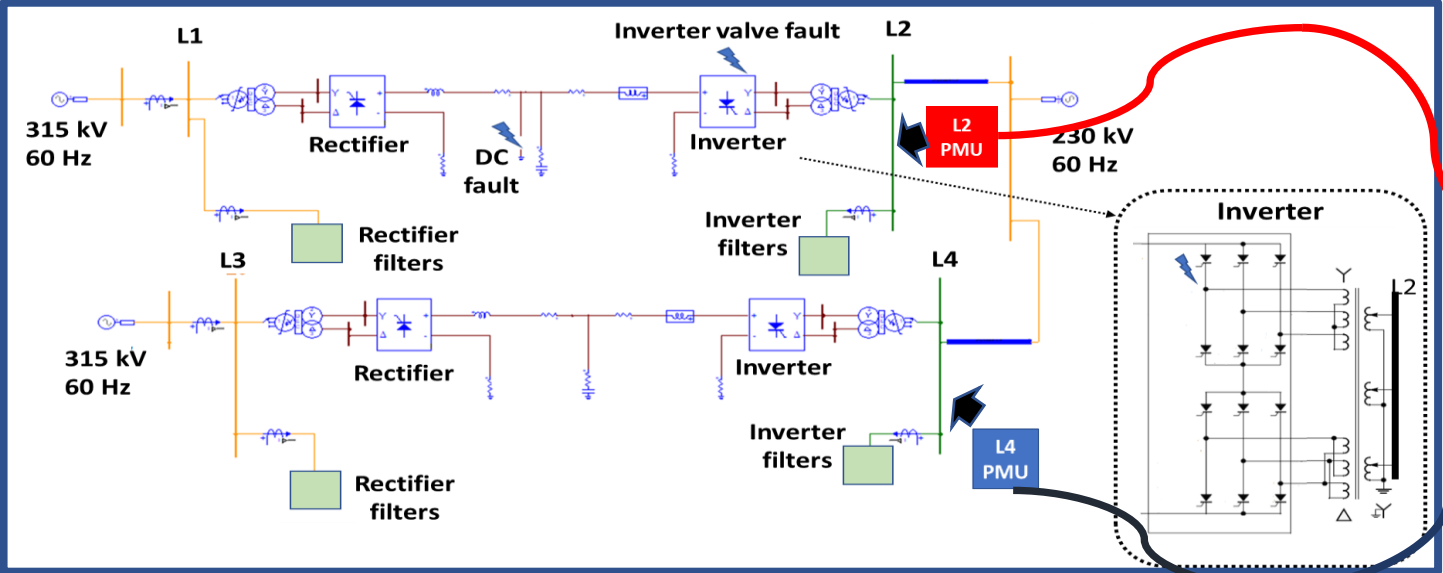
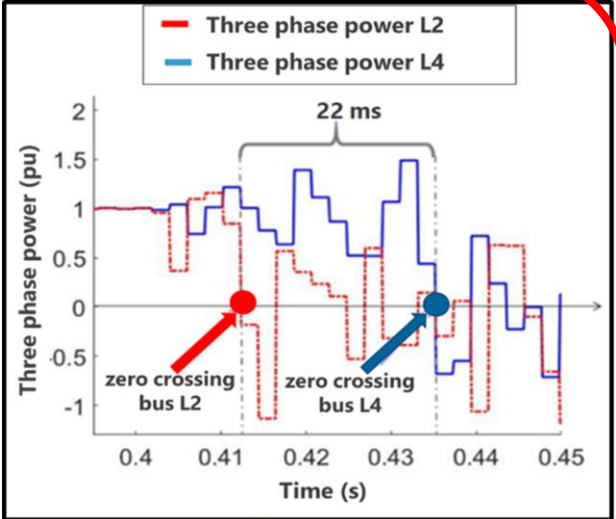
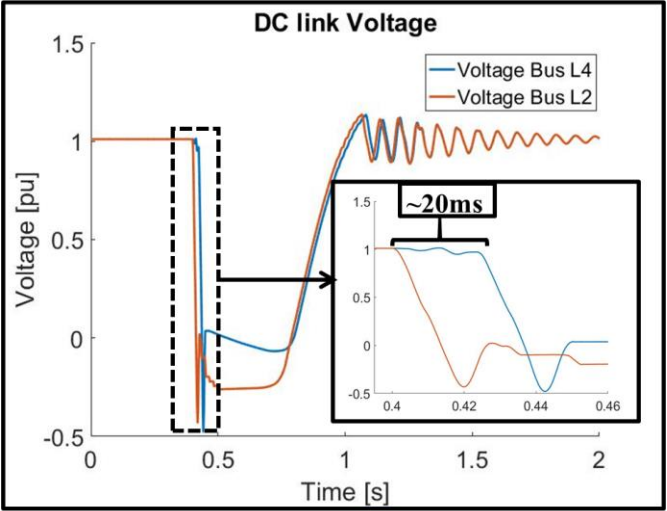
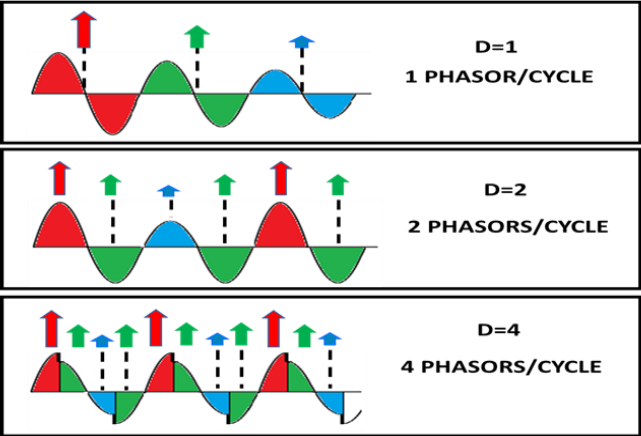


## CLAMP REFERENCE PMU

<b>TVE</b>	0,06376
<b>FE</b>	0,0002098
<b>RFE</b>	0,01778

# FRACTIONAL CYCLE PMU

## FRACTIONAL CYCLE PMU (FC-PMU)



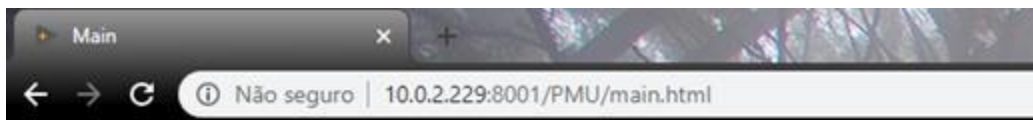
PDC



**CONTROL ROOM**







Configuração do PDC

Informações da PMU Sequência de fase Fasores Erro Servidor

UUT		QualiPMU		TVE (%)		
Mag	Ang	Mag	Ang			
<b>Va</b>	72.012	28.4548	72.0165	28.4537	0.00653534	Pass
<b>Vb</b>	74.0081	-91.547	74.0134	-91.5462	0.00725686	Pass
<b>Vc</b>	76.0095	148.453	76.0126	148.453	0.00415357	Pass
<b>Ia</b>	1.99481	29.6948	2.00329	28.6439	1.88664	Fail
<b>Ib</b>	3.96839	-90.1544	4.00654	-91.5414	2.61548	Fail
<b>Ic</b>	5.95176	149.312	6.01402	148.538	1.71361	Fail

df/dt [Hz/s] UUT	df/dt [Hz/s] Quali	Dif Freq
-0.0015424	0.00029829	-0.0000839
Freq (Hz) UUT	Freq (Hz) Quali	
59.9995	59.9996	

