METROLOGY PARTNERSHIP | EURAMET

ADMIT
AC & DC High Frequency Instrument Transformers

FUNDACIÓN PARA EL FOMENTO DE LA INNOVACIÓN INDUSTRIAL

Characterization of AC and DC MV Instruments transformers in extended frequency range up to 150 kHz

Work Package 3. Infrastructure for current generation and traceable measurement chain

Partners:

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arteche

ALMA MATER STUDIORUM A.D. 1088

Università degli Studi della Campania Luigi Vanvitelli

Stakeholder workshop, January 2025

The project 22NRM06 ADMIT has received funding from the European Partnership on Metrology, co-financed by the European Union's Horizon Europe Research and Innovation Programme and from by the Participating States

Infrastructure for current generation and traceable measurement chain

Task 3.1: AC and DC current generation systems

To develop generation systems for power frequency 2 kA (DC and 50/60 Hz) + 150 kHz – parallel conductors.

Task 3.2: Current reference measurement systems

Reference measurement system to employ in the accuracy evaluation of AC and DC Current Transformers in the frequency range between 9 kHz and 150 kHz:
0,01% for fundamental component and 1% for f= 9 – 150 kHz (transient and stationary regimes).

Task 3.3: Industry oriented CT test procedures

To develop an industry-oriented CT test procedure, that is a procedure allowing industry laboratories to evaluate the accuracy of Current Transformers through the execution of simplified tests.

Infrastructure for current generation and traceable measurement chain

WP3
Infrastructure for current generation and traceable measurement chain

Task 3.1
AC and DC current generation systems

Activities:
Analysis of generation systems.
Develop a steady-state current generation system:
2kA(50Hz/DC) + 100A(9kHz - 150kHz).
Develop a transient generator:
2kA(50Hz) + 500A(9kHz - 150kHz).

Task 3.2
Current reference measurement systems

Activities:
Analysis of actual current sensors.
Reference current sensors.
Characterization of reference current sensors.
Upgrade of reference comparators.

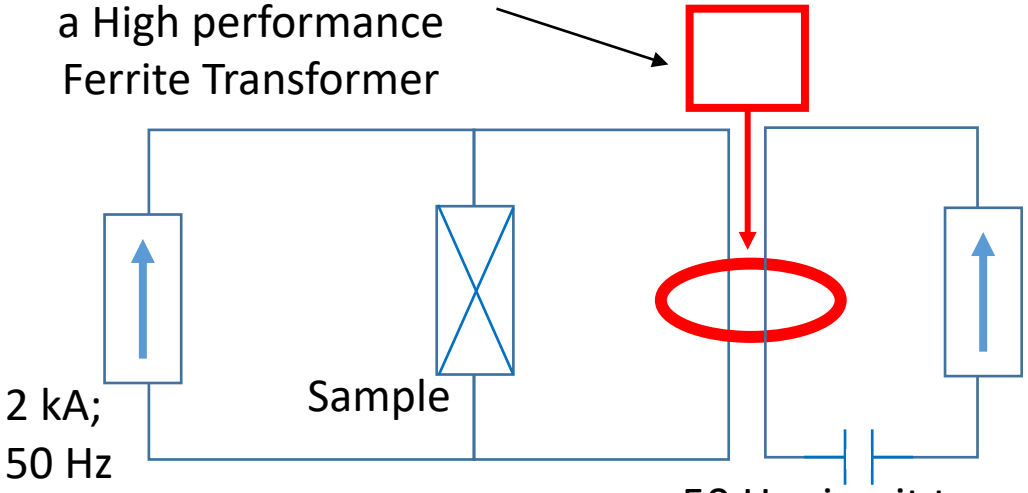
Task 3.3
Industry oriented CT test procedures

Activity:
Develop test procedures for the industry.

Infrastructure for transient current generation

L-C Circuit + Power Electronics injected by a High performance Ferrite Transformer

500 A; 9 - 150 kHz



1. 50 Hz Transformer.
2. High Frequency Transformer.
3. LC Circuit.
4. Test Circuit.
5. Current Probe.
6. Capacitor to compensate the flux from the 50 Hz.

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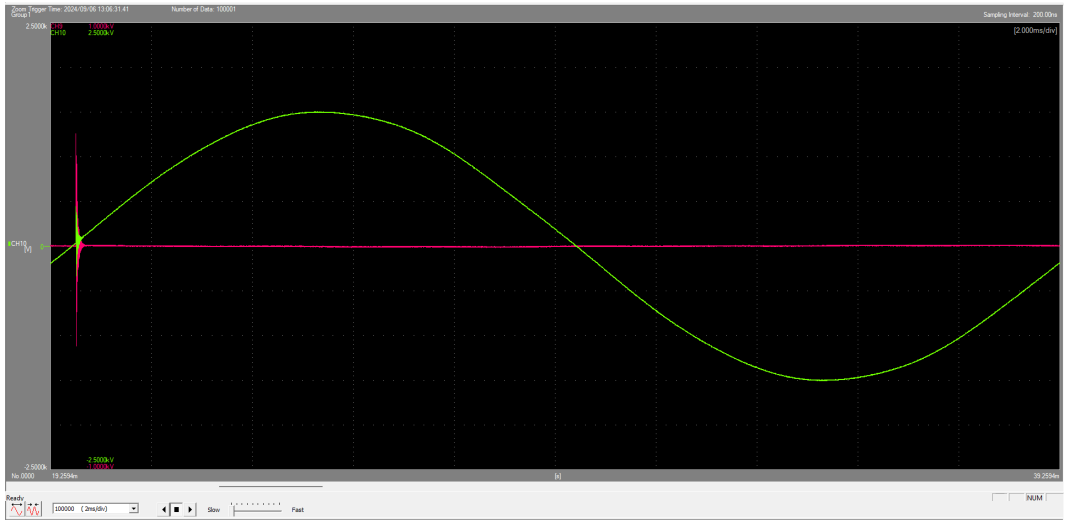
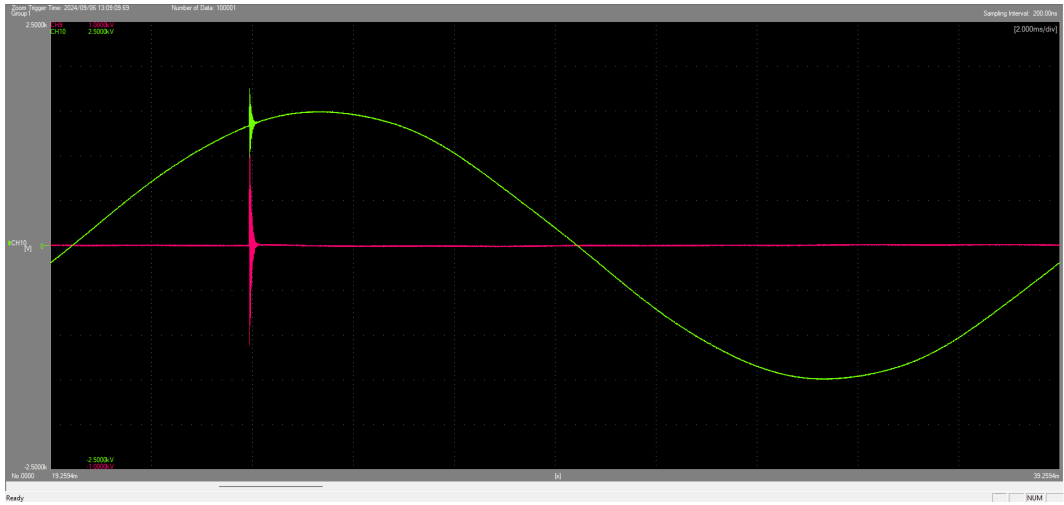
Transient Current Generator

0º



60º



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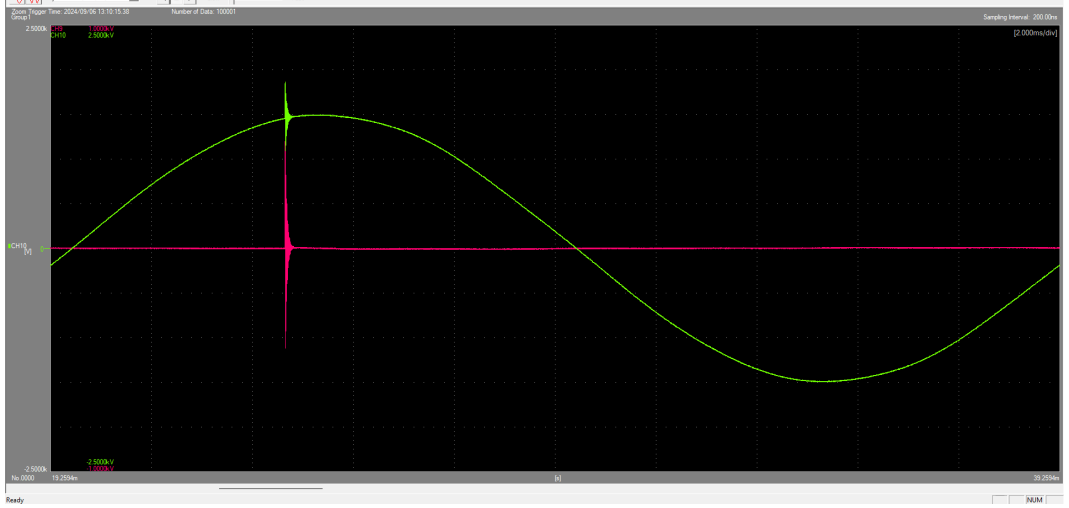
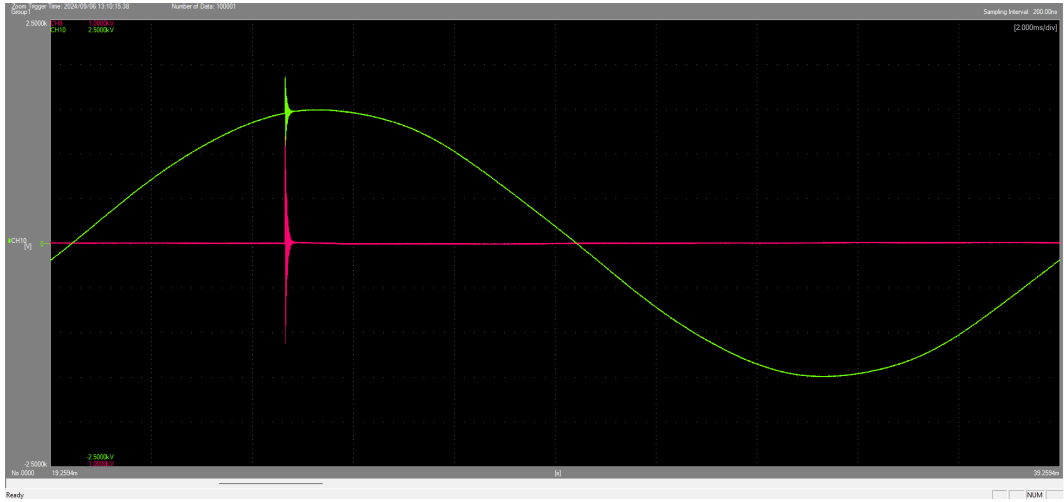


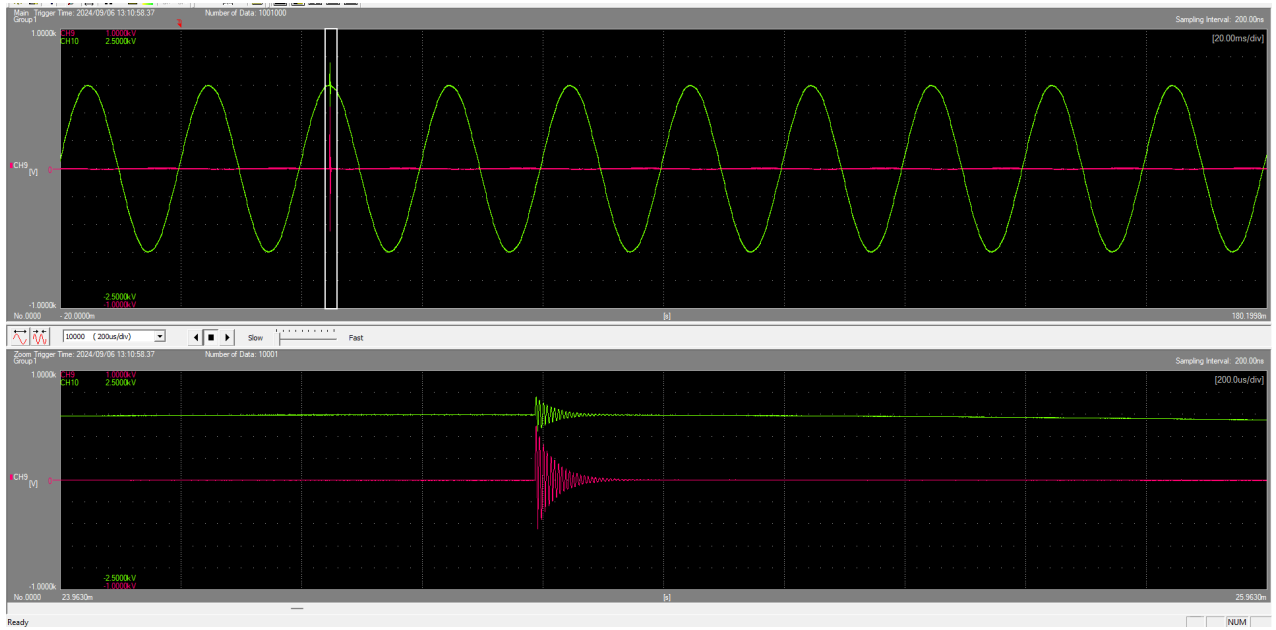
80º



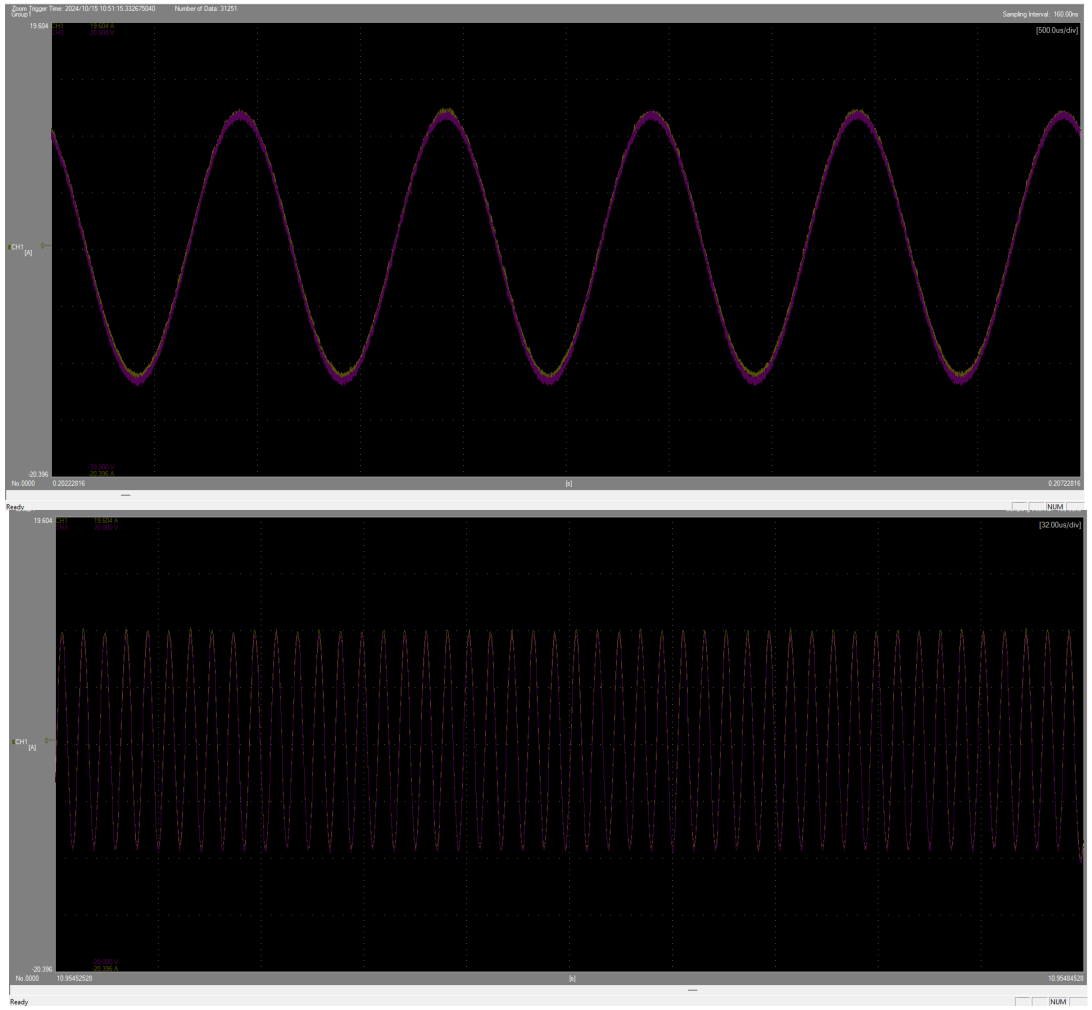
Transient Current Generator

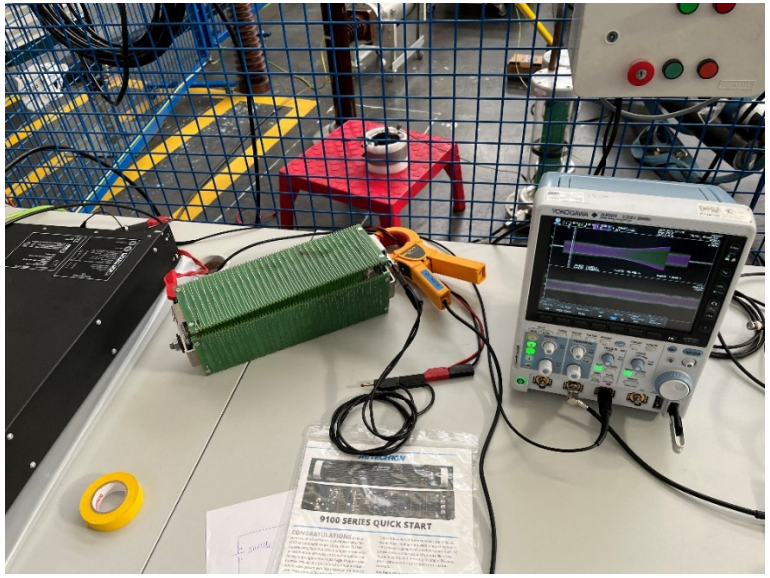
Conclusions:

- Able to generate 1 kA & 0 – 150 kHz up to 500 A.
- 97.6% of performance ratio for the 50Hz Generator. ~ 8 A through the HFT when injecting 2 kA.
- 85% of performance for the HF Generator.
- Modifications of the test circuit to compensate the 50 Hz flux through the HFCT and to prevent core saturation.
- Limitation of 1kA 50Hz due to our HF current probe, but capability of increasing to 2 kA when we install a new probe.



Reference Current Sensor





Frequency sweep characterization from 1 kHz to 150 kHz to Fluke i800s probe – Ferrite core current transformer.
Constant scale factor through all frequencies.

Reference Current Sensor

New reference current sensor for harmonics:
LEM FRS 3000-S

Parameter	Symbol	Unit	Min	Typ	Max	Comm
Primary nominal current	I_{PN}	A		3000		See [1]
Primary current, measuring range	I_{PM}	A	−9000 0		9000 9000	Sx version SUx version
Supply voltage	U_C	V	10	12 or 24	28	
Current consumption	I_C	mA		120 60	140 80	@ U_C = 12 V DC @ U_C = 24 V DC
Output reference voltage Sx version SUx version	U_{ref}	V	2.48 0.48	2.5 0.5	2.52 0.52	Internal reference
U_{ref} output resistance	R_{ref}	Ω	16	25	38	
U_{out} output resistance	R_{out}	Ω		10		
Output voltage range @ $\pm I_{PM}$ Sx version @ 0 ... I_{PM} SUx version	$U_{out} - U_{ref}$	V	−2 0		2 4	$U_{out} - U_{ref}$ = 0 V @ I_P = 0
Load capacitance	C_L	nF		10		
Frequency bandwidth (−3 dB)	BW	kHz		1000		

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THANK YOU

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