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Transición energética en la 4ta revolución industrial

A low-cost lightning electric field measurement device for tropical zone. A preliminary result.

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How expensive is a lightning location system?

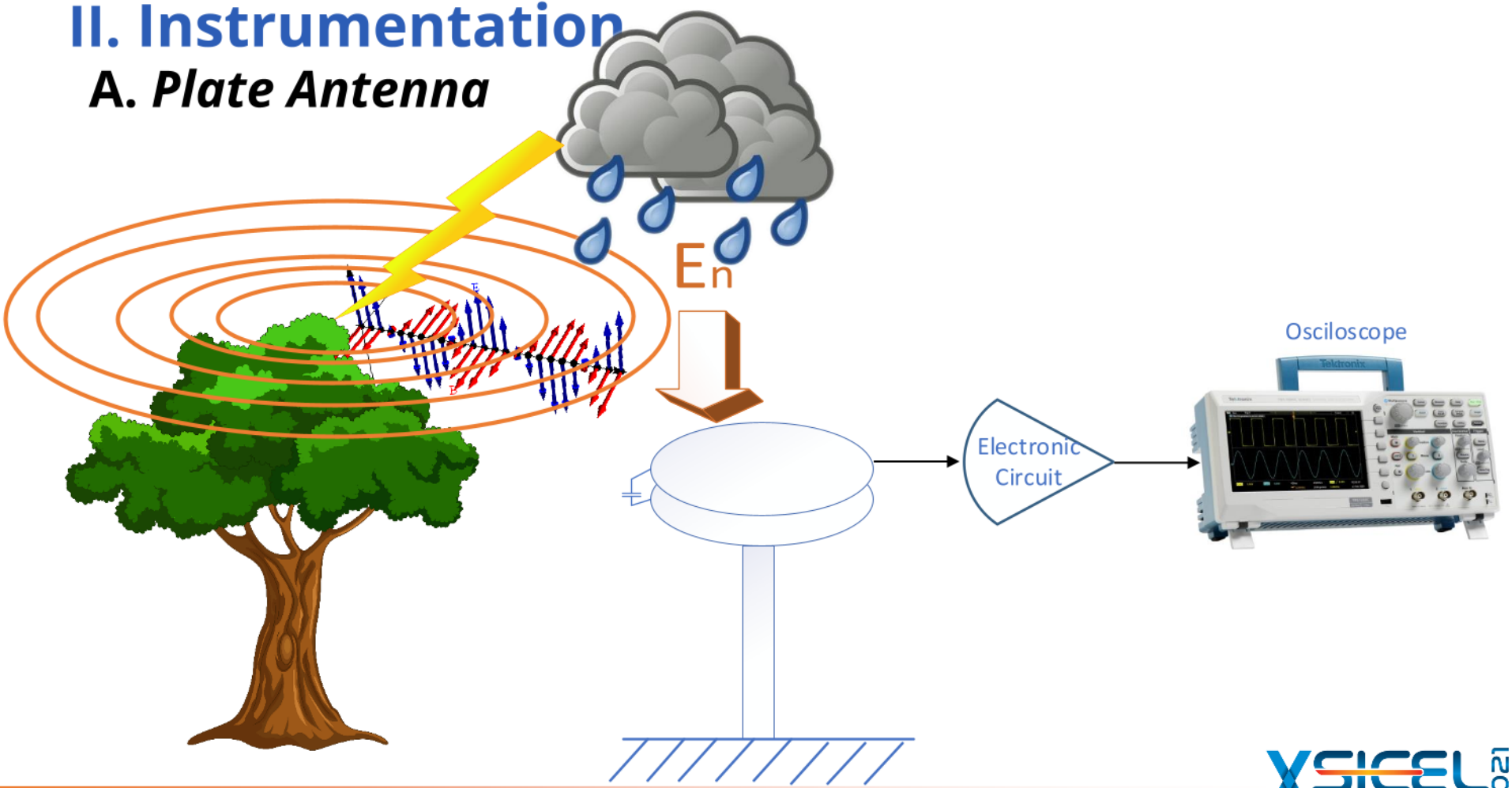
https://www.lapatria.com/manizales/temporada-de-lluvias-trae-tormentas-electricas-indicaron-expertos-2109

I. Introduction

How expensive is a lightning location system?

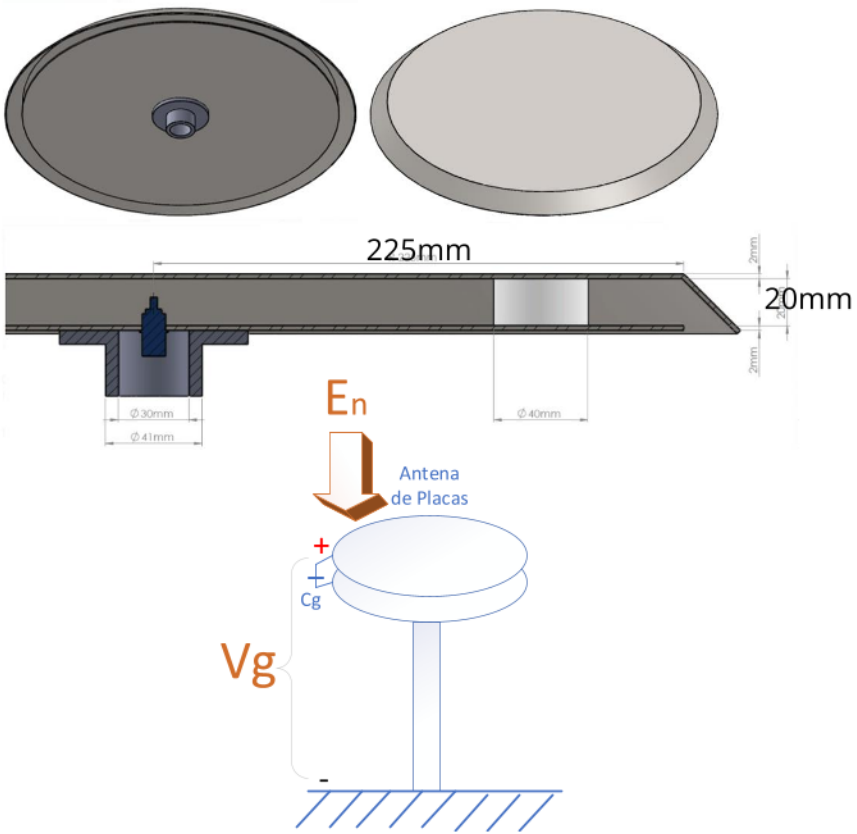
II. Instrumentation

A. *Plate Antenna*



II. Instrumentation

A. *Plate Antenna*



$$E_n = \frac{Q}{\varepsilon_0 \varepsilon_r S} \text{ [V/m]} \qquad (4)$$

E: Electric field
ε_0 : Absolute permittivity
ε_r: Relative permittivity
S: The surface area (45cm diameter)

$$V_g = -\int_0^d E_n . dx = \frac{Q.d}{\varepsilon_0 \varepsilon_r S}$$

$$V_g = E_n . d \text{ [V]} \qquad (5)$$

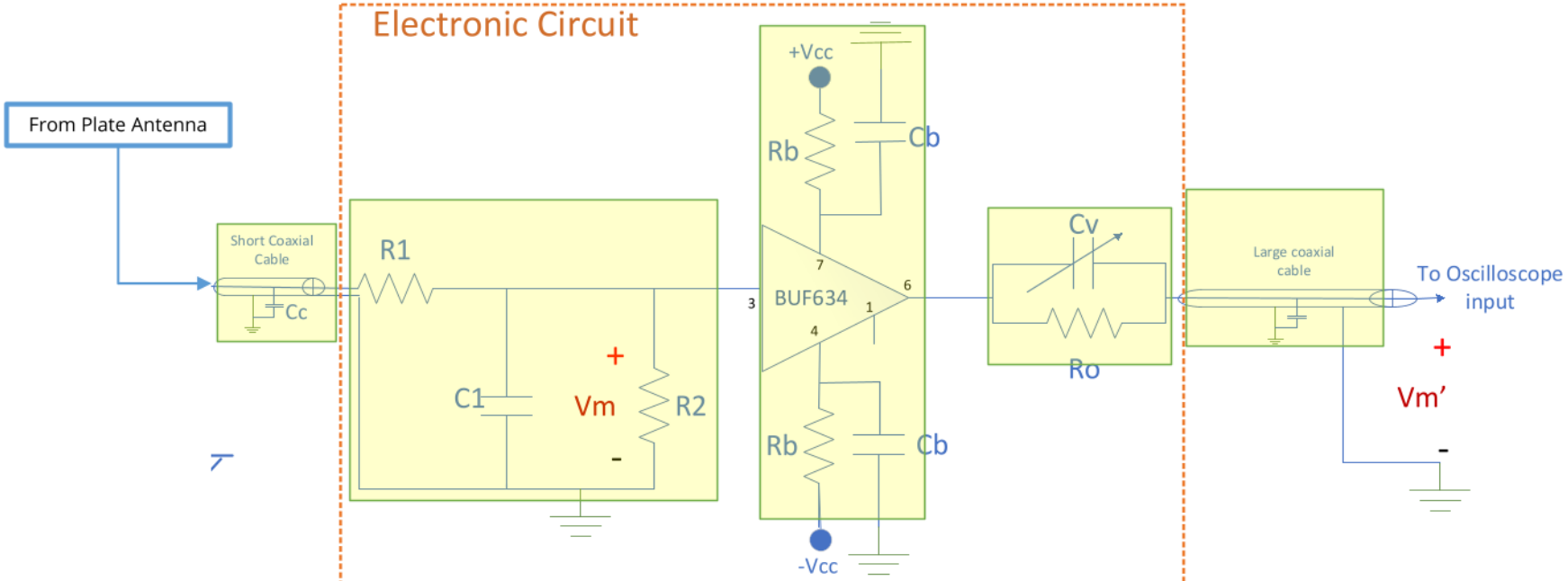
Vg: Voltage between the plate and ground
d: Gap between the plates (2cm)

$$C = \frac{\varepsilon A}{d} \text{ [F]} \qquad (9)$$

C: Capacitance=70.4pF

II. Instrumentation

B. *Electronic Circuit*



Tested integrated circuits

Integrated Circuit	BUF602	BUF634	OP633	LT1815	LMH6559	OPA354
Bandwidth	1000MHz	210 MHz	260Mhz	220MHz	1750MHz	1000MHz
Rin	1M	180M	1.5M	5M	200k	1.00E+13
Rout	1.4	7	5	0.2	1.2	0.05
Max Vs+	12	18	12	5	5	5.5
Min Vs-	-12	-18	-12	-5	-5	-2.5

II. Instrumentation

B. *Electronic Circuit*

Using the Thevenin equivalent circuit analysis, a relation between Vm y Vg can be obtained by:

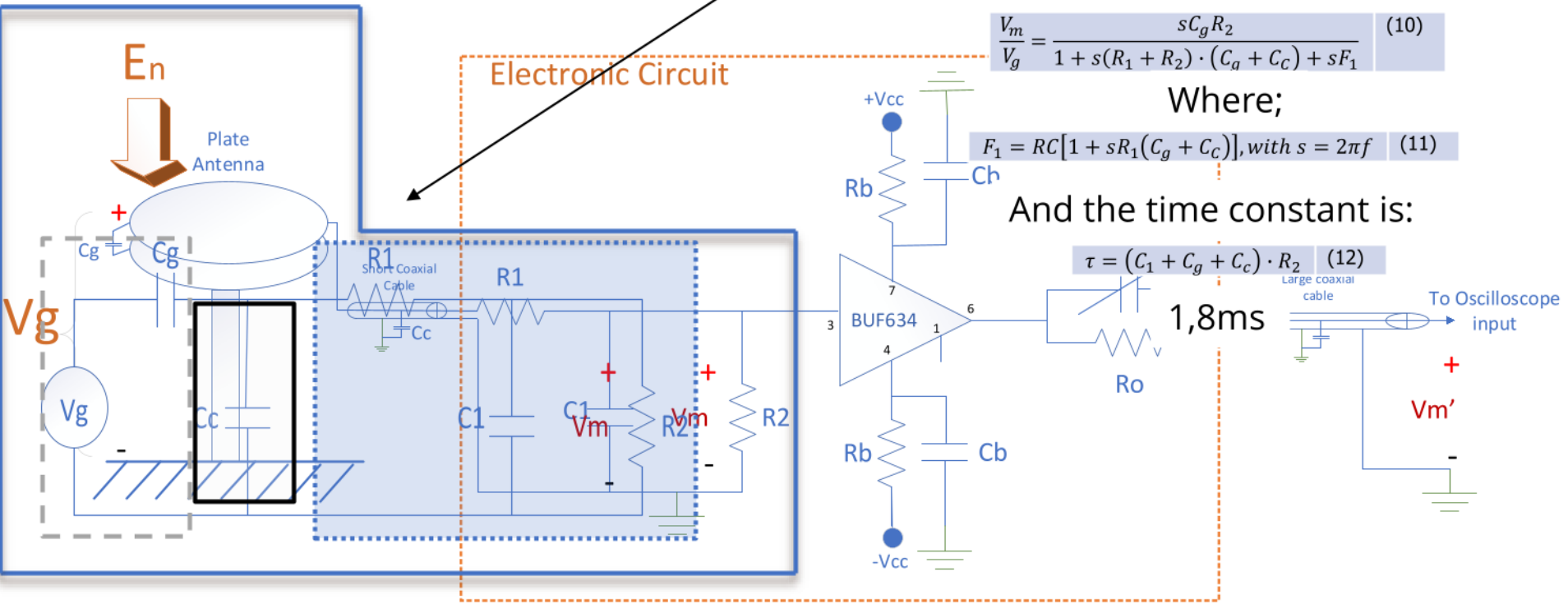
$$\frac{V_m}{V_g} = \frac{sC_gR_2}{1 + s(R_1 + R_2)\cdot(C_a + C_c) + sF_1} \quad (10)$$

Where;

$$F_1 = RC[1 + sR_1(C_g + C_c)], with\ s = 2\pi f \quad (11)$$

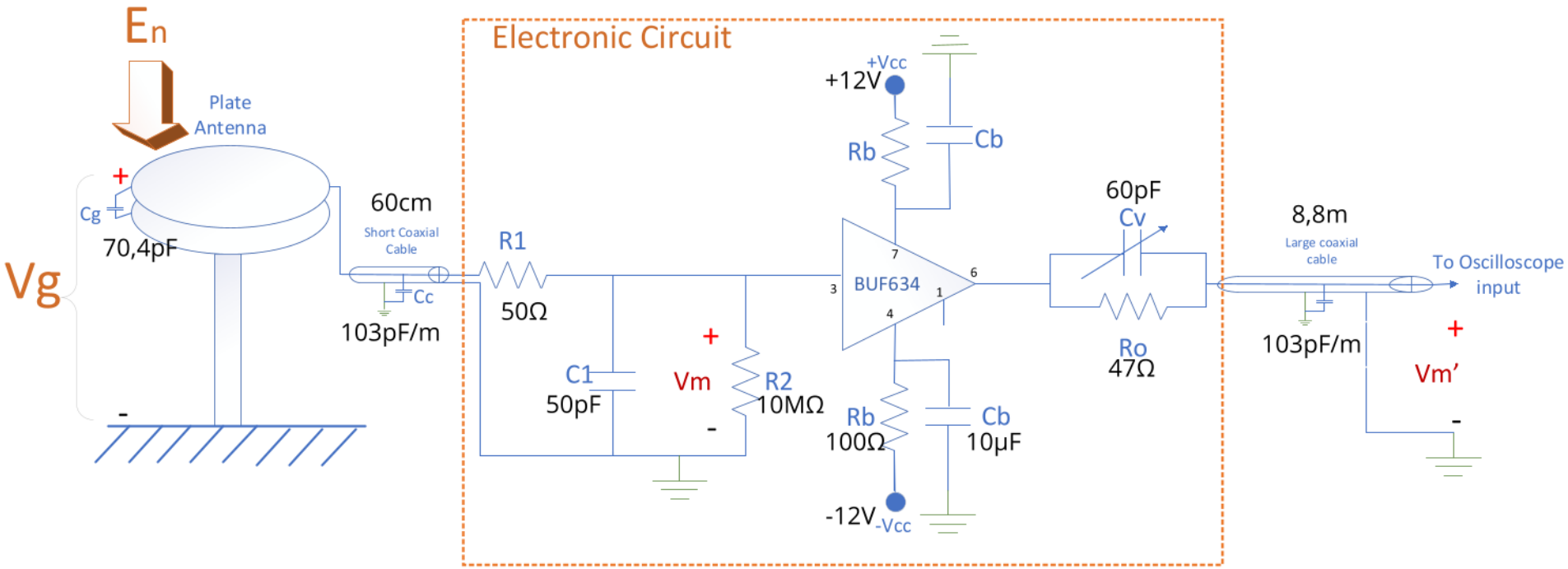
And the time constant is:

$$\tau = (C_1 + C_g + C_c)\cdot R_2 \quad (12)$$



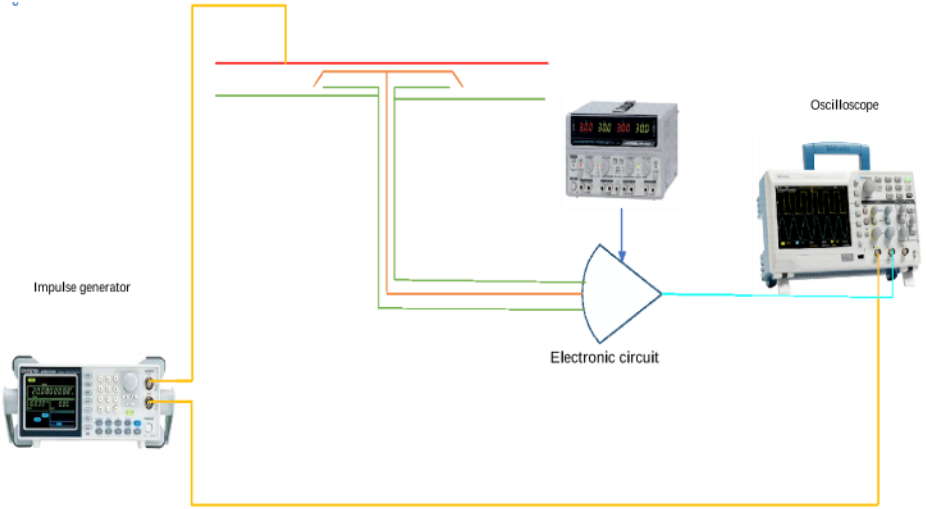
II. Instrumentation

B. *Electronic Circuit*



II. Instrumentation

C. *Calibration*

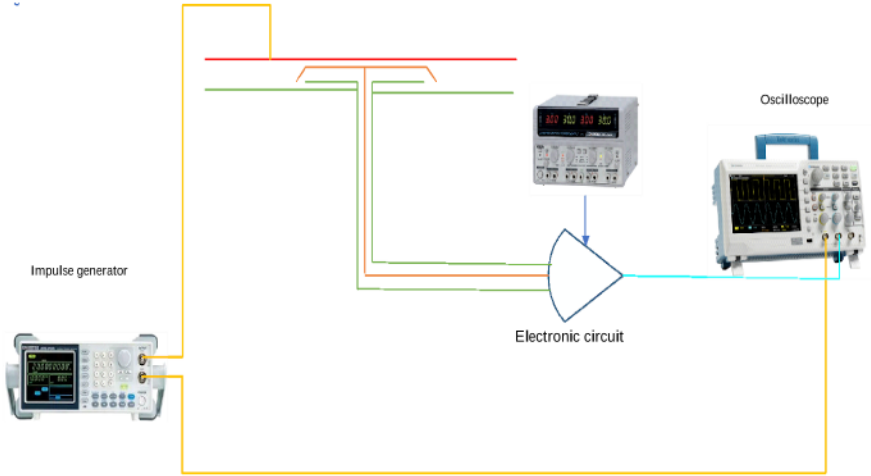


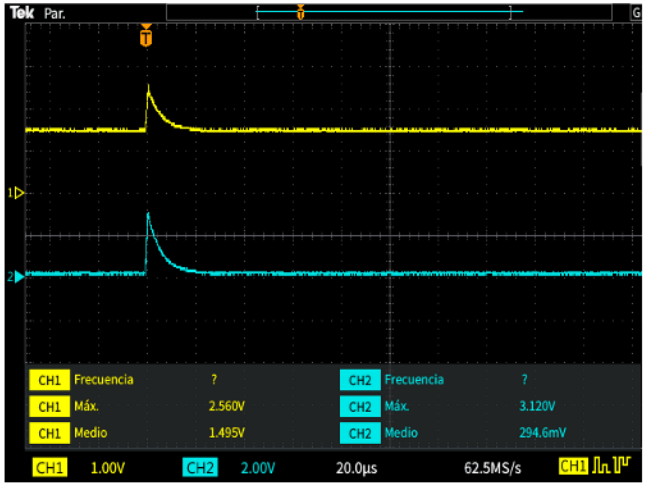
Schematic of calibration system

on-site testing

II. Instrumentation

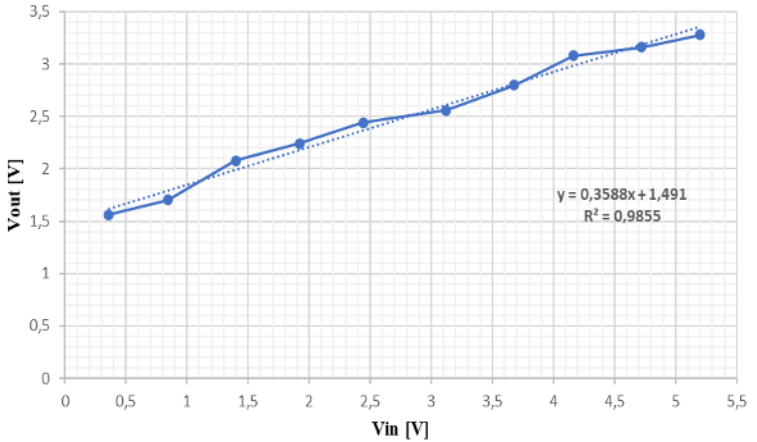
C. *Calibration*





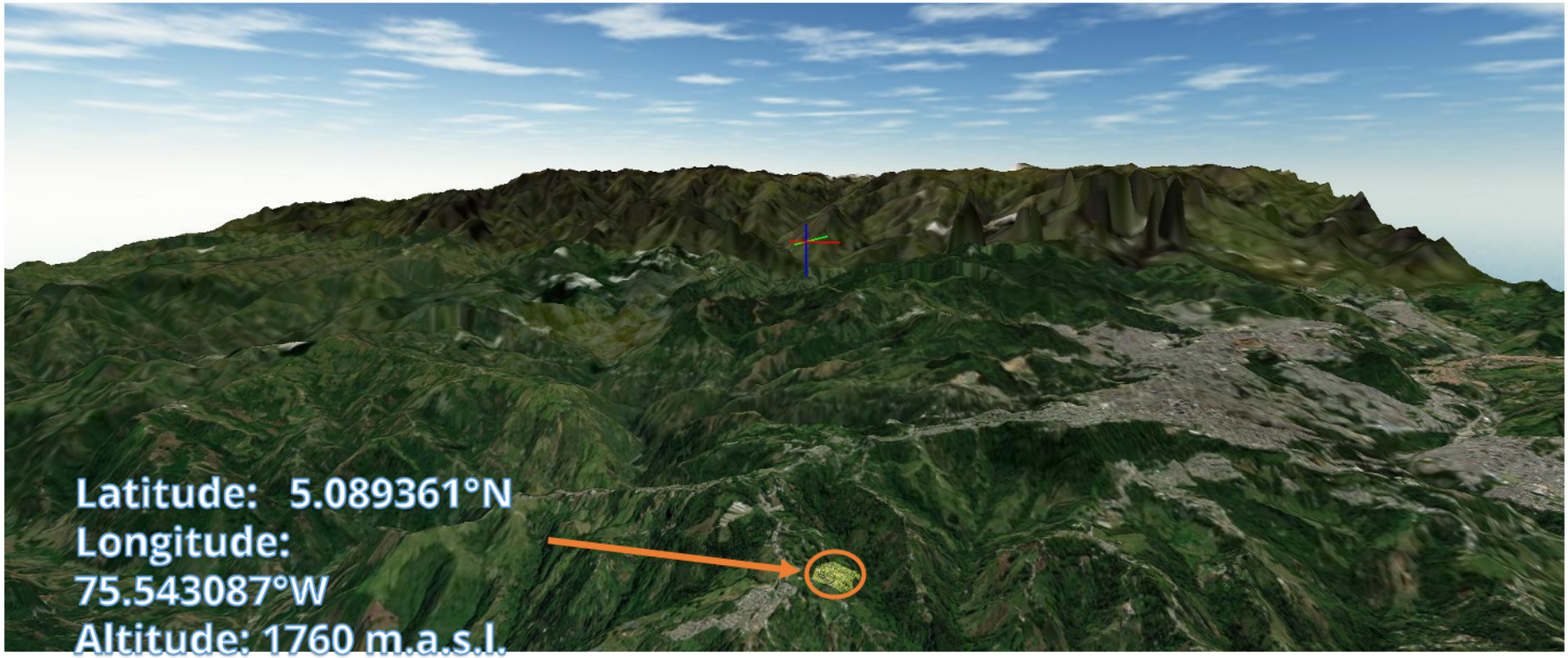
V_{out} signal

V_{in} signal



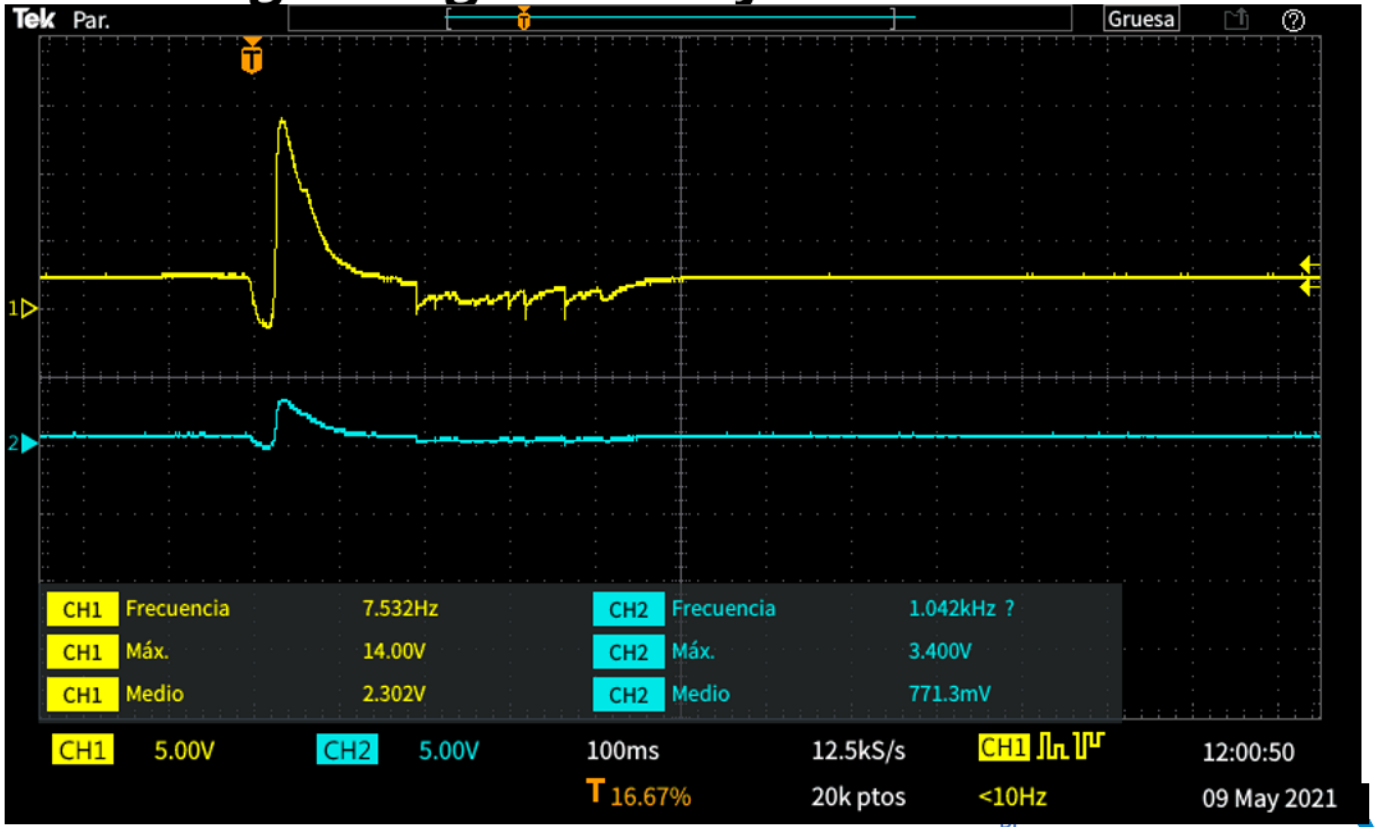
III. Methodology

A. *Location*



III. Methodology

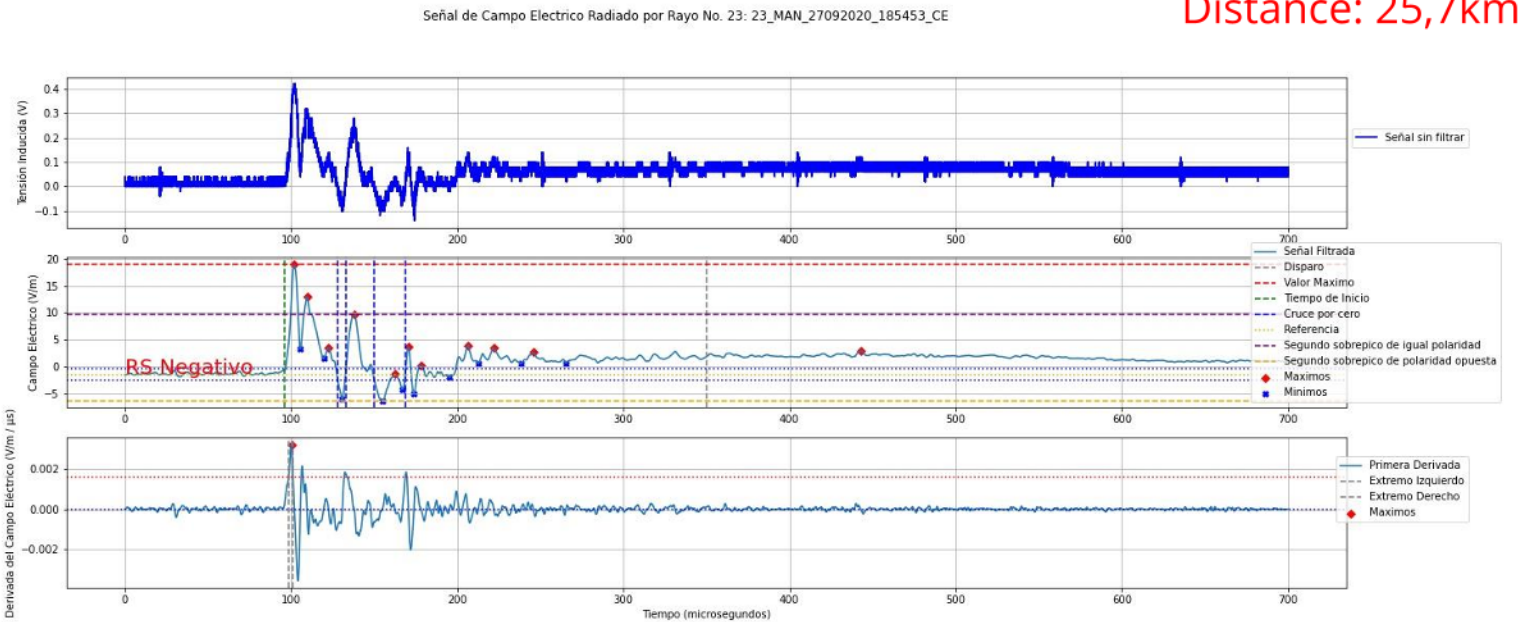
B. *Low-cost lightning electric field measurement device*



IV. Results

A. *Negatives return Strokes*

Distance: 25,7km

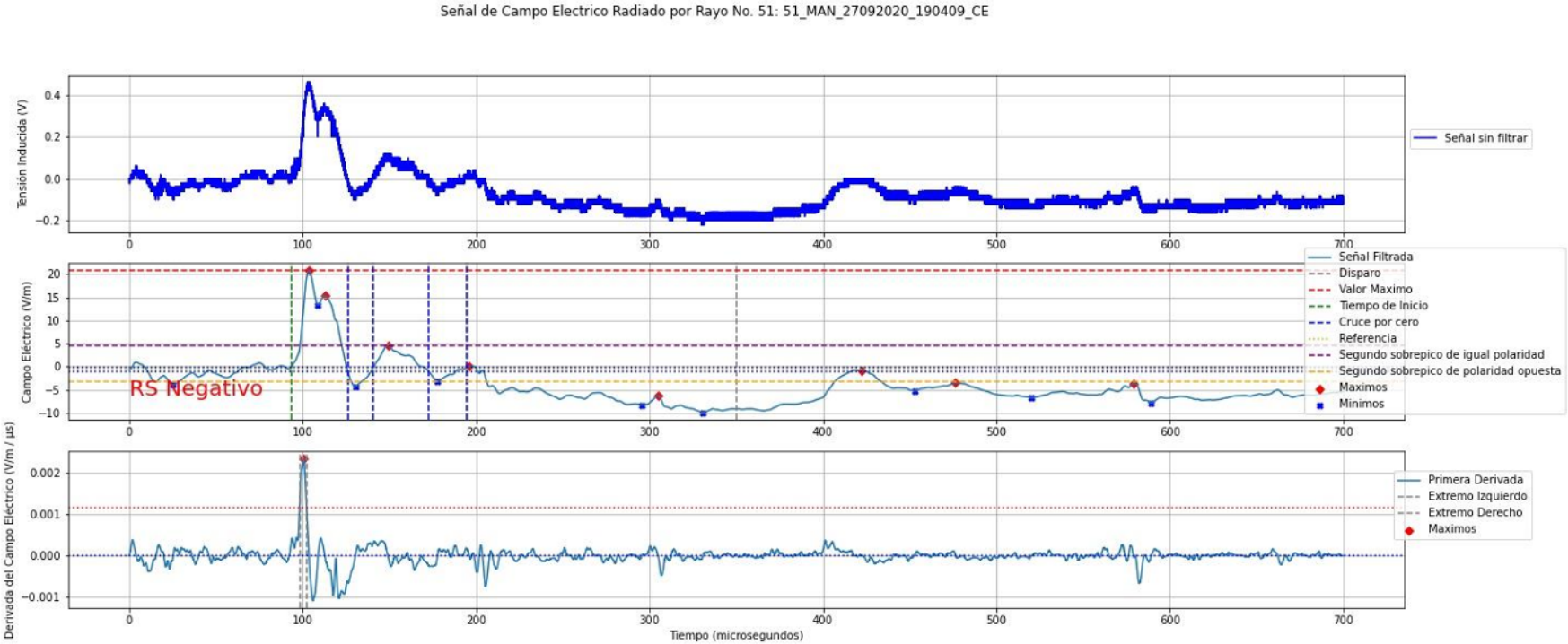


Fecha	Hora	Latitud	Longitud	Corriente (kA)	Altitud (km)	Tipo	Error(km)
27/09/2020	18:54:52.937	5.1118	-75.801	-13.8	0	1	0.348
27/09/2020	18:54:53.001	5.0978	-75.7754	-19.7	0	1	0.228
27/09/2020	18:54:53.037	5.1153	-75.7925	-10.1	0	1	0.24

IV. Results

Distance: 114,3km

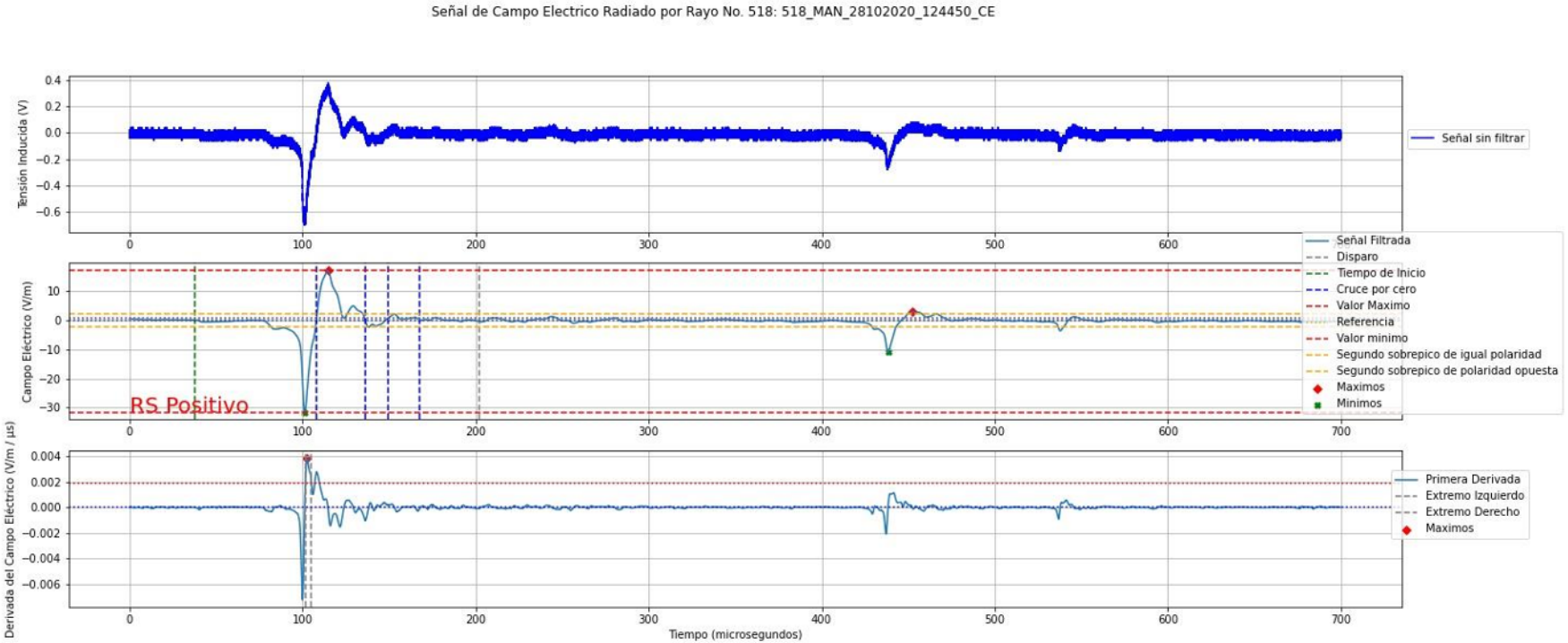
A. *Negatives return Strokes*



IV. Results

Distance: 42,35km

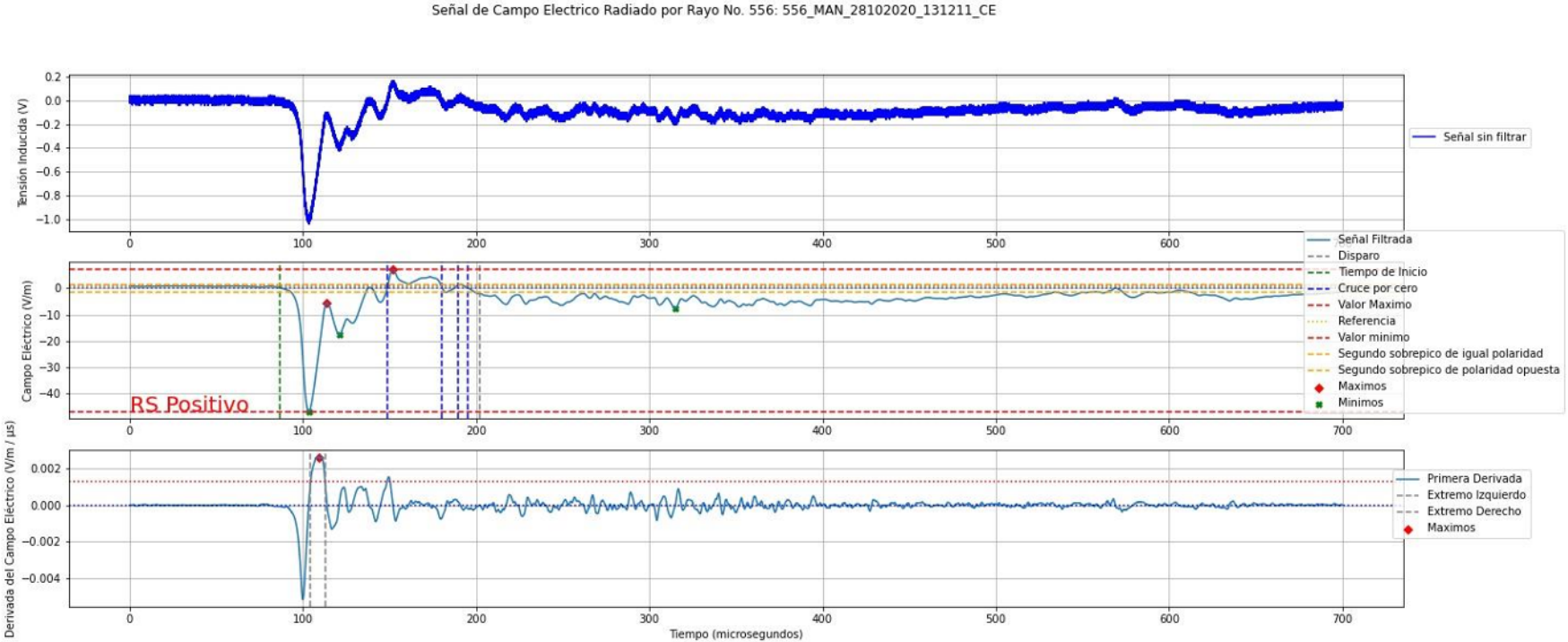
B. *Positives return Strokes*



IV. Results

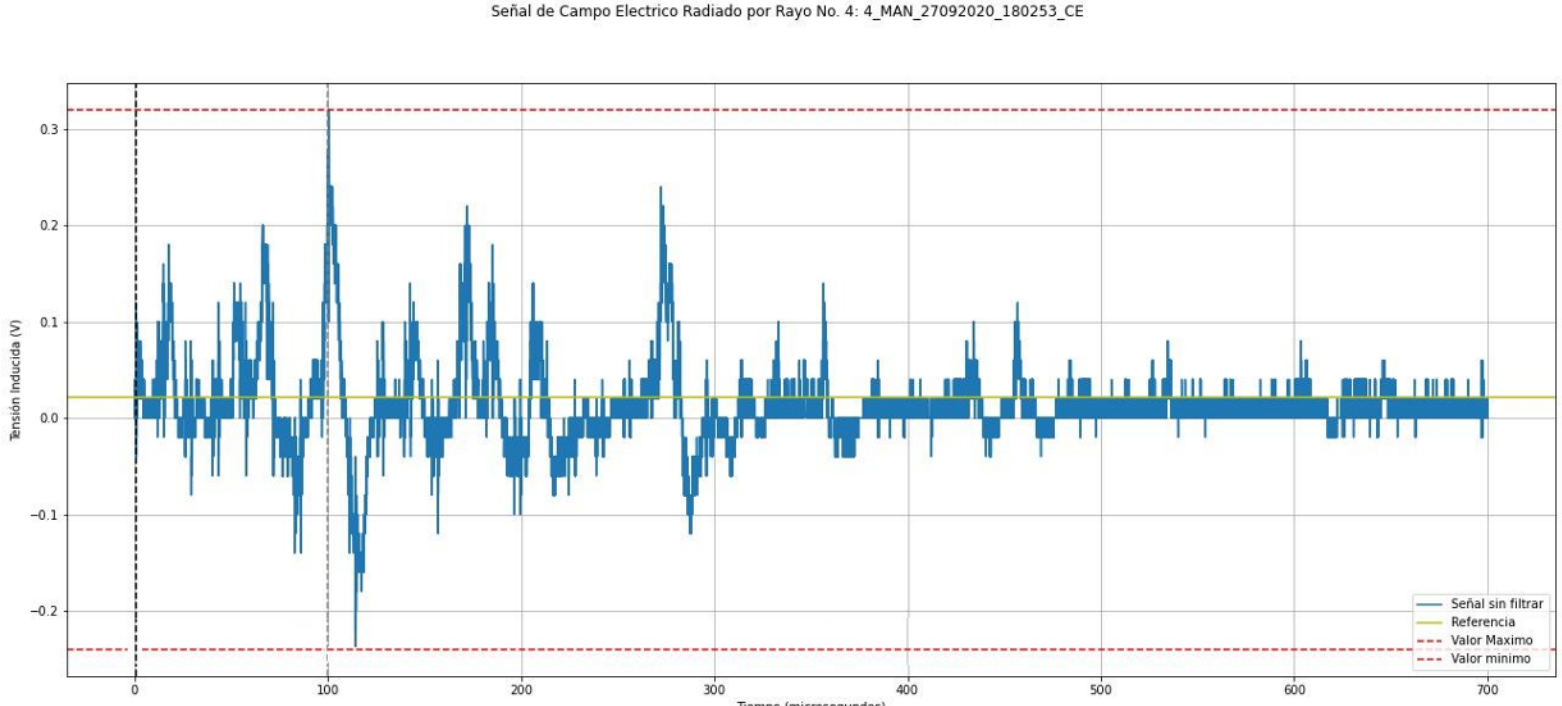
Distance: 64,87km

B. *Positives return Strokes*



IV. Results

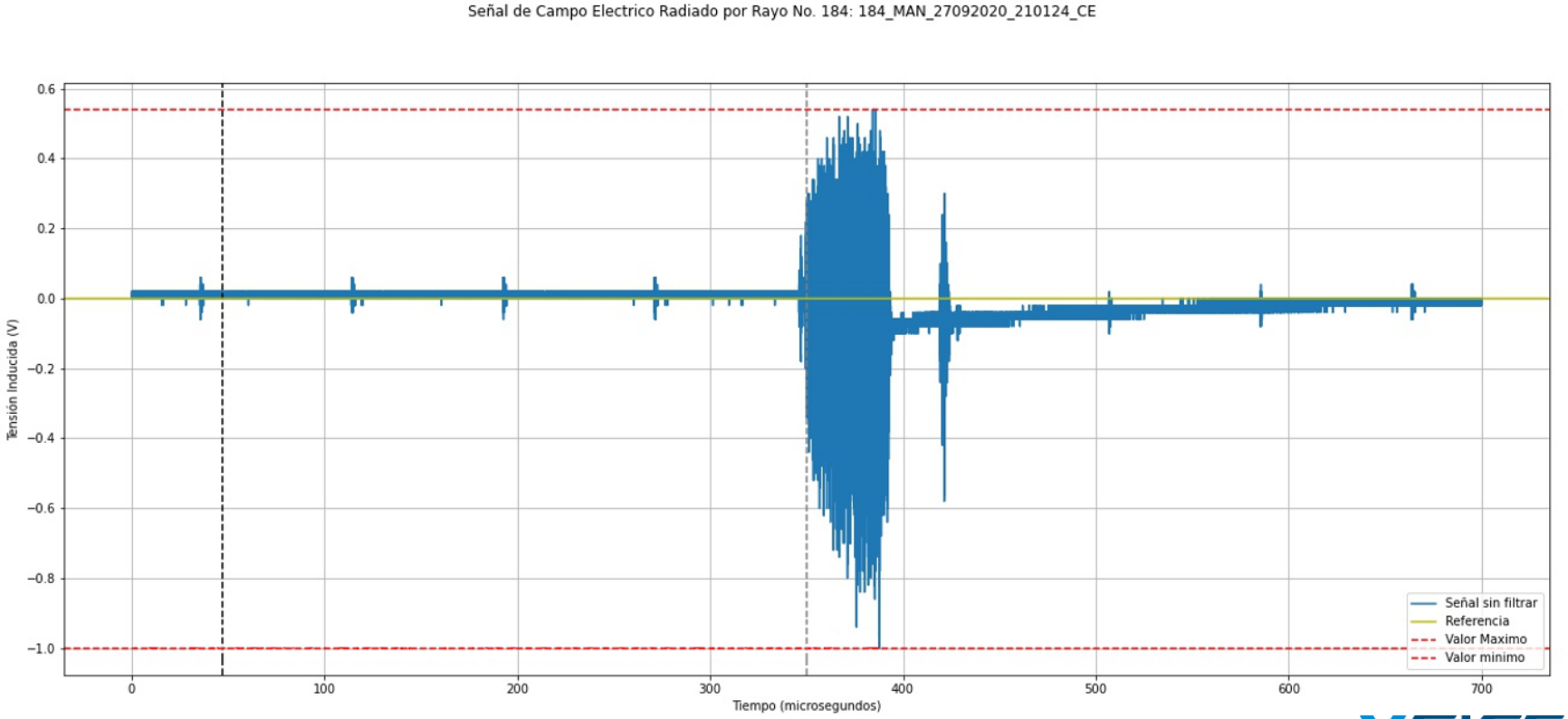
B. *Preliminary breakdown in return Strokes*



The waveform is similar to the ones reported by different authors in other locations around the world.

IV. Results

B. *Preliminary breakdown in return Strokes*



V. Conclusions

1. In this article, the adaptation and updating of an electronic circuit commonly used by different authors from the national and international, scientific community was presented.

2. This system will make it possible to characterize and to compare the temporal and magnitude parameters of the electric fields radiated by lightning in the tropical zone.

3. The results show that the device is able to record signals that allow for the identification of specific stages of the lightning formation and return stroke process.

V. Questions?