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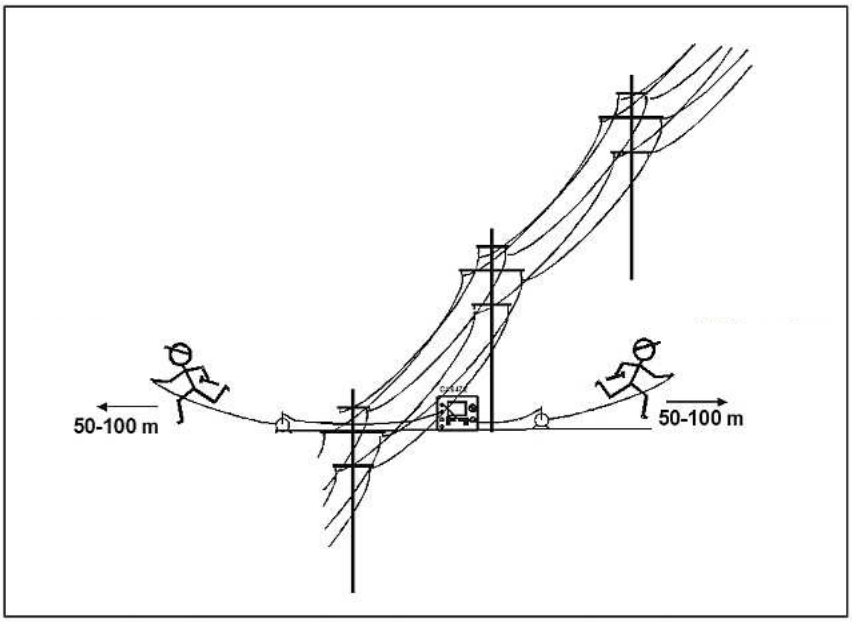
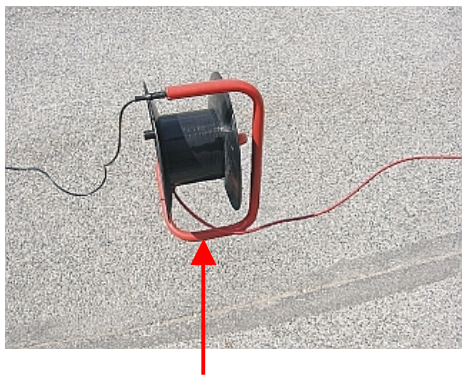
Short tutorial on Pylon measurement with C.A 6472 and C.A 6474

Connect Current (E) and voltage (ES) sockets with the tested Earth system using separate cables, connection points should lay side by side and above the Rogowski (Ampflex) coil.

Fitting of Rogowski coils on the pylon legs:

- all coils must be installed in the same sense of direction - the connection coax cables must come out in the same direction
- the more turns you use, the sensible the measurement will be - all coils must have the same number of turns





Cable roller completely rolled out

Choice of positions for H, S electrodes:

if possible, one left and the other right from the HV transmission line, minimum distance from the HV-line 50-100m. Under no circumstances place an electrode in the area of the HV-line.

Cable roller must be completely rolled out because of its inductance.

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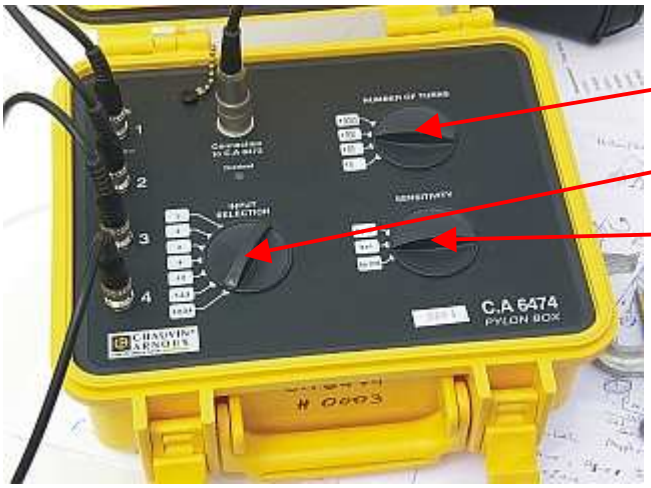

Check the rotary switches on CA6474:

number of turns must correspond to the one of installed coils

select sum of channels 1+2+3+4 for measurement of the total pylon earth current

start with amplification x10.

The C.A 6474 amplifier must swing-on after power-on - the Overload LED is on during some seconds.
If this LED is flashing all the time and C.A 6472 beeps permanently, then the current in Ampflex is too high for the selected amplification and so you have to reduce it. If the overload is still present in the 1/10 position, you have to reduce the number of turns of the Rogowski coils.

First check:

Disturbance voltages on Probe S and Auxiliary electrode H. This measurement runs permanently as long no test has been launched with the START-key.

Press DISPLAY until U-Act. with U_{S-ES} or U_{H-E} is shown. (U-Act. stays for U-actual)

U_{S-ES} = measured voltage between S and ES

U_{H-E} = measured voltage between H and E

The frequency of U_{S-ES} or U_{H-E} is shown when the corresponding voltage is higher than 0.1V.

The measured voltage is caused by the current flowing through the pylon into the Earth.

When $U_{H-E} = U_{S-ES}$, then the electrodes are well placed (far enough from the potential funnels of the pylons). If one of these values is smaller, you should reposition the electrode, which shows the smaller voltage, further away from the HV-line.

When this rule is fulfilled, the results of the active measurement (START-key) are reliable.

In other case you have to make tests using different electrode distances and analyze the results.

When both U_{S-ES} and U_{H-E} are nearly zero, then the HV-line is not in service or the top earth wire is completely corroded or not connected.

In this case, the total pylon current will be also nearly zero.

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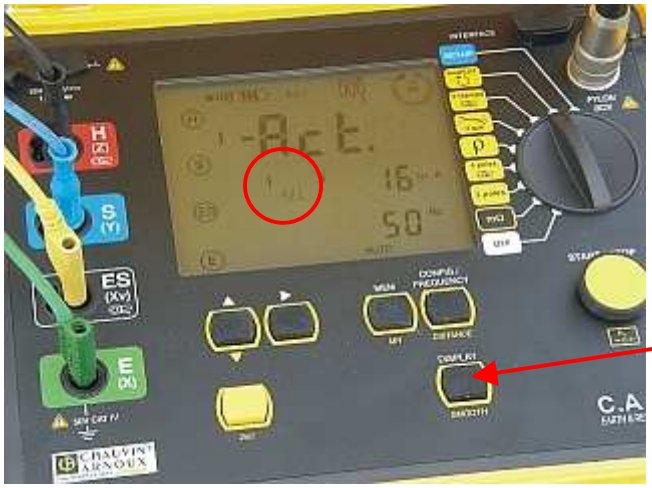


Switch with DISPLAY-key to I_{SEL} , which is the total pylon earth current, measured by the 4 Rogowski coils (channels 1+2+3+4 selected)

Switch with DISPLAY-key to R_{PASS} .

A parasitic current I_{SEL}, induced in pylon, produces a voltage drop U_{S-ES} (potential difference to the neutral Earth) on the earth-resistance of the pylon.
Having I_{SEL} and U_{S-ES} we can calculate
R_{PASS} (earth resistance passive measured)
It has an advantage, that it is measured at the nominal frequency of the network, but on the other hand it is influenced by the load fluctuations in the network as well as by the potential funnels aside the HV-line.
When the pylon earth resistance measured in the active way is nearly equal to R_{PASS} , then the result is reliable.
In the other case, the potential relationship during the active and passive measurement are different.

Second check:

Currents in the pylon legs are measured permanently as long the START-key has not been pushed.
Switch C.A 6474 to channel 1, select I_{SEL} on C.A 6472 with DISPLAY-key.

Check the current in each pylon leg by switching to channel 1,2,3 and 4 - in this way you can find corroded (or not connected) earth connections (no current is flowing).
Finally check the sum of all leg currents channel 1+2+3+4 - if it is more or less equal to the sum of single leg currents, then the top wire of the pylon is well connected. In other case this connection is probably corroded and we have only small currents flowing in the legs, which are induced in the pylon construction rods - the sum will be very small, despite that single currents can be higher (they can flow in different directions).
The measurement of R_{PASS} for single legs makes no sense - even in a case when single legs are not connected together under the earth, they influence each other.

Third check:

Start a measurement with a long push on the START-key in the 4-poles function.

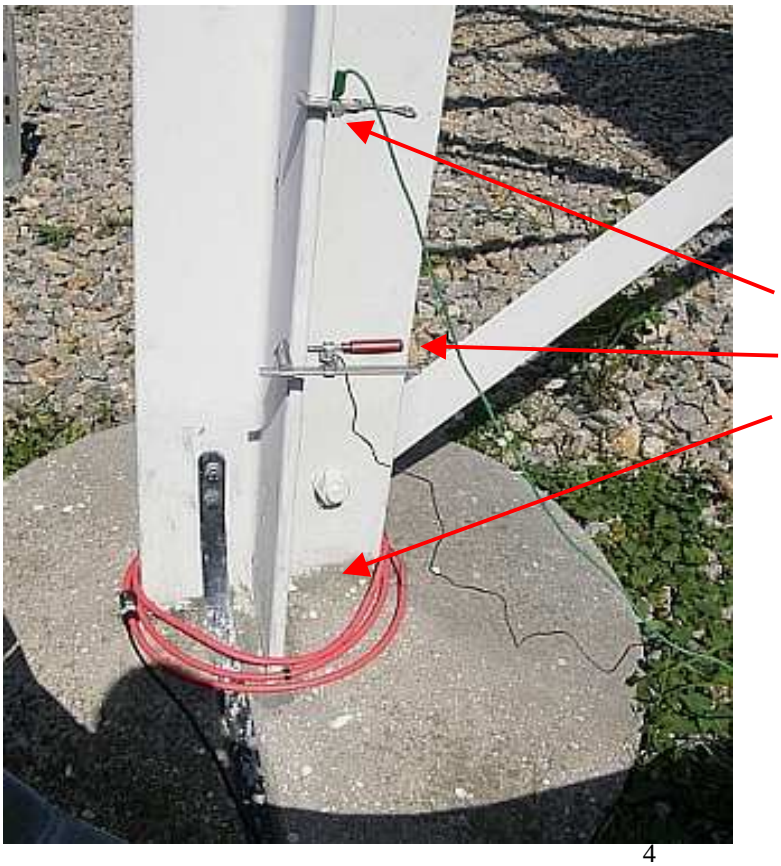
The measurement will be done with 128Hz. When a measurement is launched with a long push on START (until a second beep approx. after 2 sec. is heard), you get additionally results for resistances of electrodes Rh, Rs - both should be below 1KOhm if you want to make a Sweep test up to 5kHz.

If Rh or Rs is higher, you can place more electrodes in parallel or you can make the soil wet in the area where the electrodes are placed. Parallel electrodes shall be placed in a distance of approx. 4x drive-in depth. Especially R_H should be as low as possible, because it determines the test current.

The higher the test current, the better the measurement precision - take into account, that much of this current will flow over the top wire and only a small percentage will flow through pylon legs into the earth!
When the symbol of a input socket is blinking on the display, it means, that the corresponding lead is disconnected. The measurement will be done only if all connections are OK.

Measurement:

When all parameters are in "green zone", we can begin with 3 typical measurements on the pylon.



1st measurement:

Sweep Mode,
Ampflex measurement into the Earth,
Current injection point is above the Rogowski (Ampflex) coil.

current injection **E**

potential measurements **ES**

current measurement with Rogowski (Ampflex) coil

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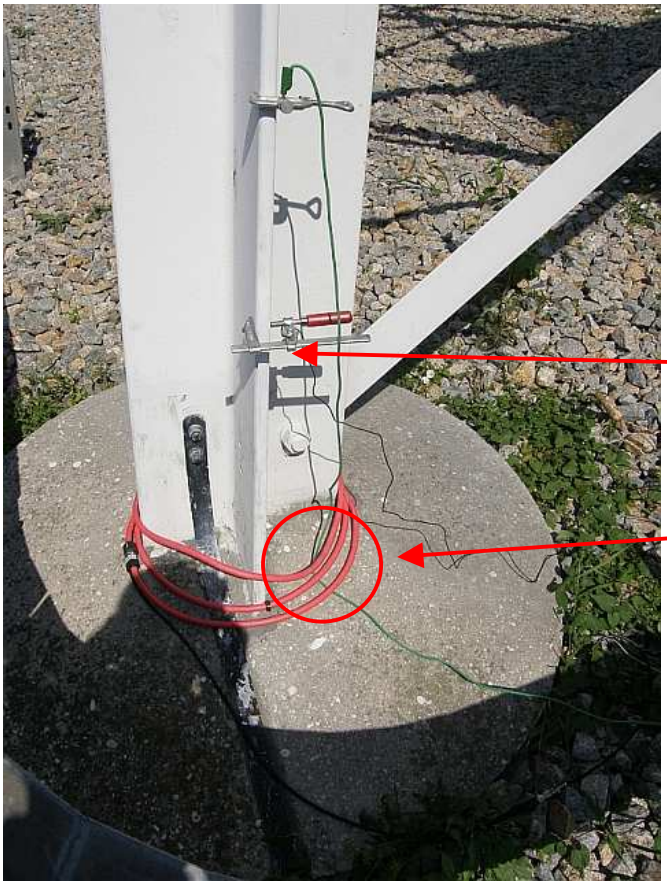

2nd measurement:

Sweep Mode,
Ampflex measurement into pylons top, current injection wire goes through the Ampflex coil on the pylons leg

ES connection stays unchanged

current injection wire goes bottom-up through the Ampflex coil on the pylons leg

3rd measurement:

Sweep Mode,
4-polesd Earth-impedance measurement (also called "lattice network" measurement).

In this case we measure the total earth impedance of all components of the earth system.

The top wire of a transmission line connects the earth systems of all pylons in parallel at low frequencies, but at higher frequencies, the inductance of this top wire starts to separate them.

Analysis:

Using the Earth Tester Utility Software, which was developed in Austria, it is easy to download all stored measurement data into a PC and show them in Excel tables. ET-Utility Software generates automatically nice Excell sheets - see sample below.
In the next step, you can make a diagram of measured earth impedance versus frequency.

The ET-Utility Software is very simple to use and can be ordered at vie-office@chauvin-arnoux.at.

You can also use Dataview software, but its export function to Excel is not so good.

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Objekt: 01 Test: 02 4 Pole AC selective with Clamp - SWEEP 16.07.07 14:09:03
Beschreib.:

	Zeit	f [Hz]	|Zsel| [O]	Us-es [V]	Ies [A]	Uh-e [V]	Ih-e [A]
1	14:09:30	**41**	**10,128**	0,07836	0,00774		
2	14:09:33	**79**	**10,087**	0,08489	0,00842		
3	14:09:35	**128**	**10,053**	0,09499	0,00945		
4	14:09:03	**183**	**10,036**	0,11093	0,01106	37,666	0,07615
5	14:09:37	**256**	**10,032**	0,13526	0,01349		
6	14:09:39	**513**	**10,025**	0,22207	0,02216		
7	14:09:41	**1025**	**10,026**	0,35087	0,03500		
8	14:09:43	**1562**	**10,055**	0,43092	0,04287		
9	14:09:44	**2051**	**10,046**	0,47536	0,04733		
10	14:09:46	**2539**	**10,060**	0,50632	0,05034		
11	14:09:48	**3516**	**10,079**	0,53927	0,05352		
12	14:09:49	**4102**	**10,098**	0,54866	0,05434		
13	14:09:51	**4688**	**10,120**	0,55267	0,05462		
14	14:09:53	**5078**	**10,140**	0,55291	0,05454		

Disturbance (Noise) 183 Hz

Uh-e [V]	0,00001	fh-e [Hz]	---	Rh [O]	493
Us-es [V]	0,00001	fs-es [Hz]	---	Rs [O]	494
Ies [A]	0,01356	fes [Hz]	---	Ze [O]	1,457
Rpass = Us-es / Ies [O]		---		(Ze: overall Earth imp.)	

Instrument A6472 Seriennr. 1015 Firmware Version V2.0