

RESEARCH , DEVELOPMENT AND TESTING NATIONAL  
INSTITUTE FOR ELECTRICAL ENGINEERING



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ROMANIA

LIT

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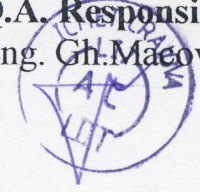
**TEST REPORT**  
**No.40048 / 14.05.2004**

- 1.**Product:** Early Streamer Emission Lightning Conductor–ESELc type Schirtec-DA
- 2.**Test:** Evaluation of the initiation advance
- 3.**Producer:** SCHIRTEC Trading GmbH
- 4.**Customer:** SCHIRTEC Trading GmbH
- 5.**Customer's adress:** Ignaz – Köck Strasse 8 / Top 3 A – 1210 Wien Austria
- 6.**Test result:** They are presented the measurements results
- 7.**Test responsible:** Eng. I.Badea *[Signature]*

**Test Supervisor**  
Eng.A.Ungureanu

*[Signature]*

**Q.A. Responsible:**  
Eng. Gh.Macovei



**APPROVED**  
**LABORATORY HEAD**

Eng. Dorin Popa



- 8.**The test report contains 12 pages.**
- 9.**The test report was edited in 4 ex.; 1 ex to LIT and 3 ex to customer.**
- CAUTION:**
  - a. The test result makes reference only to tested product .
  - b. Integral reproduction of the test report is forbidden.
  - c. Any part of this test report may be reproduced only with the accord of LIT .
  - d. Reports without original signatures are not valid.



## 1. Tested material

Early Streamer Emission Lightning Conductor (ESEL) type Schirtec - DA

See photo on page 10

See drawing on page 9

Lightning Conductor supplied by SCHIRTEC Trading GmbH - Austria

## 2. Type of tests

A switching impulse wave negative polarity and a DC voltage of negative polarity are applied on the upper metallic plane.

## 3. Specification

N F C 17 – 102 / 1995 Appendix C

## 4. Test equipment

Laboratory inner dimensions: 48 m x 32 m x 27 m (height)

Altitude: 100 m above sea level

4200 kV High Voltage Impulse Generator type SPF 340; 340 kW, TUR  
Dresden - Germany

1000 kV Rectifier cascade type GS 1000 / 30; 30 mA; TUR Dresden –  
Germany

1400 kV Damped capacitive divider, ICMET Craiova, Romania;

TR – AS transient – recorder, Dr. Strauss System Elektronik, GmbH- Germany

Impulse calibrator type KAL – 1000, 0.84 / 60  $\mu$ s and 20 / 3000  $\mu$ s Dr. Strauss  
System Elektronik, GmbH – Germany

Fluke calibrator type 5500 A.

## 5. Test circuit

See the test circuit diagram on page 11

The 1400 kV damped capacitive divider was calibrated by official Accredited Laboratory DKD – K – 18702, Romania with certificate 0060 of 14<sup>th</sup> January 2004 and checked before beginning of measurement with the impulse calibrator KAL 1000, calibrated by PTB – Braunschweig – Germany, calibration certificate 2727 PTB 02, and Fluke 5500 A calibrator calibrated by Metrology National Institute of Romania, order calibration certificate No.3.1 – 112 / 26.02.2004

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The TR – AS transient – recorder was calibrated by Accreditation laboratory DKD – K – 11701 – Germany, with calibration certificate 275 of 10<sup>th</sup> Sept.2002 and checked before beginning of measurement with KAL 1000 calibrator.

Expanded uncertainty of measurements parameter inside of limits, prescribed by IEC 60060 – 2 / 1994 for SI Approved Measuring Systems (3 % for peak values and 10 % for time parameters).

### 6. Mounting arrangement

See the test set up on page 12

See photo on the page 10

The lightning conductor tested is put on a 5 x 5 m grounded metallic plane and connected to ground.

A square metallic plane, dimensions: 4.5 m / 4.5 m / 0.2 m with the edges rounded, is suspended above the lightning conductor and connected the high voltage.

### 7. Test procedure

The DC polarization of the upper plane is adjusted on the square metallic plane.

The negative impulse wave is adjusted in order to obtain a flashover.

The height of the lightning conductor (h) and the distance between the ground and the square plane (H) are measured at the beginning of each test.

The atmospheric conditions taken before and after each test.

The peak value ( $U_p$ ) of the impulses and the triggering time ( $T_B$ ) are recorded at each impulse.

One hundred significant impulses are applied on the lightning conductor.

The early streamer emission lightning conductor (ESEL) is to be compared with a simple rod lightning conductor (SRLC). Tests are performed in the same conditions and configuration for each lightning conductor.

The simple rod lightning conductor (SRLC) was simulated by short circuiting of the Schirtec - DA ESEL.

The test on SRLC (100 significant impulses) was performed in two series and compared by the test on the ESEL.

Height of lightning conductor (h) adjusted to: 1042 mm

Distance between ground / square plane (H) adjusted to: 2200 mm

h / H: 0.47

Polarization voltage: 55 kV

Front time of the full wave: 487  $\mu$ s

Time interval between consecutive impulses: > 1 min



## 8. TEST ON SRLC (Schirtec - DA shortcircuited) BEFORE AND AFTER TEST OF ESELC type Schirtec - DA

### 8.1. Atmospheric conditions

	FIRST SERIES	SECOND SERIES
<b>BEFORE TEST</b>	Beginning of the test: 9h25 p = 999 mbari t = 15.4 °C hr = 63.4 %	Beginning of the test: 13h30 p = 999 mbari t = 15.7 °C hr = 62.4 %
<b>AFTER TEST</b>	End of the test: 10h47 p = 999 mbari t = 16.0 °C hr = 63.3 %	End of the test: 15h10 p = 998 mbari t = 16.3 °C hr = 60.3 %

### 8.2. Results

See tables on page 6

Number of significant impulses: 100

Average of significant  $T_B$ :

- calculated from the experimental wave  $T'_{PTS} = 305.08 \mu s$
- transferred on the reference waveform:  $T_{PTS} = 370.45 \mu s$

See curves on page 8



9. TEST ON ESELCT TYPE Schirtec - DA

9.1. Atmospheric conditions

BEFORE TEST	Beginning of the test: 11h <sup>00</sup> p = 999 mbari t = 16.0 °C hr = 63.3 %
AFTER TEST	End of the test: 13h15 p = 999 mbari t = 15.6 °C hr = 62.7 %

9.2. Results

See tables on page 7

Number of significant impulses: 100

Average of significant  $T_B$ :

- calculated from the experimental wave  $T'_{PDA} = 241.44 \mu s$
- transferred on the reference waveform:  $T_{PDA} = 295.14 \mu s$

See curves on page 8

Triggering advance:  $\Delta T = T_{PTS} - T_{PDA} = 370.45 - 295.14 = 75.31 \mu s$



Test on SRLC ( Schirtec - DA short-circuited) before and after test on ESELc type Schirtec - DA

Impulse no.	T <sub>B</sub> μs	Impulse no.	T <sub>B</sub> μs	Impulse no.	T <sub>B</sub> μs
1	NS	44	329	85	NS
2	348	45	NS	86	282
3	397	46	263	87	381
4	361	47	334	88	238
5	261	48	251	89	275
6	260	49	243	90	NS
7	363	50	277	91	343
8	NS	Second series		92	242
9	NS	51	NS	93	260
10	347	52	249	94	342
11	357	53	234	95	303
12	NS	54	220	96	NS
13	249	55	217	97	407
14	311	56	238	98	NS
15	299	57	302	99	327
16	391	58	482	100	268
17	303	59	330	101	394
19	335	60	279	102	320
20	314	61	NS	103	321
21	291	62	237	104	326
22	398	63	NS	105	351
23	275	64	247	106	288
24	308	65	NS	107	325
25	398	66	260	108	260
26	332	67	275	109	229
27	367	68	333	110	276
28	NS	69	371	111	268
29	212	70	261	112	NS
30	334	71	392	113	335
31	NS	72	291	114	261
32	NS	73	NS	115	260
33	249	74	266	116	313
34	342	75	349	117	269
35	336	76	374	118	242
36	379	77	276	119	230
37	NS	78	332	120	304
38	262	79	348	121	294
39	304	80	NS	122	293
40	274	81	382	123	277
41	NS	82	325		
42	318	83	NS		
43	282	84	280		

NS: No significant  
T<sub>B</sub>: Break-down time



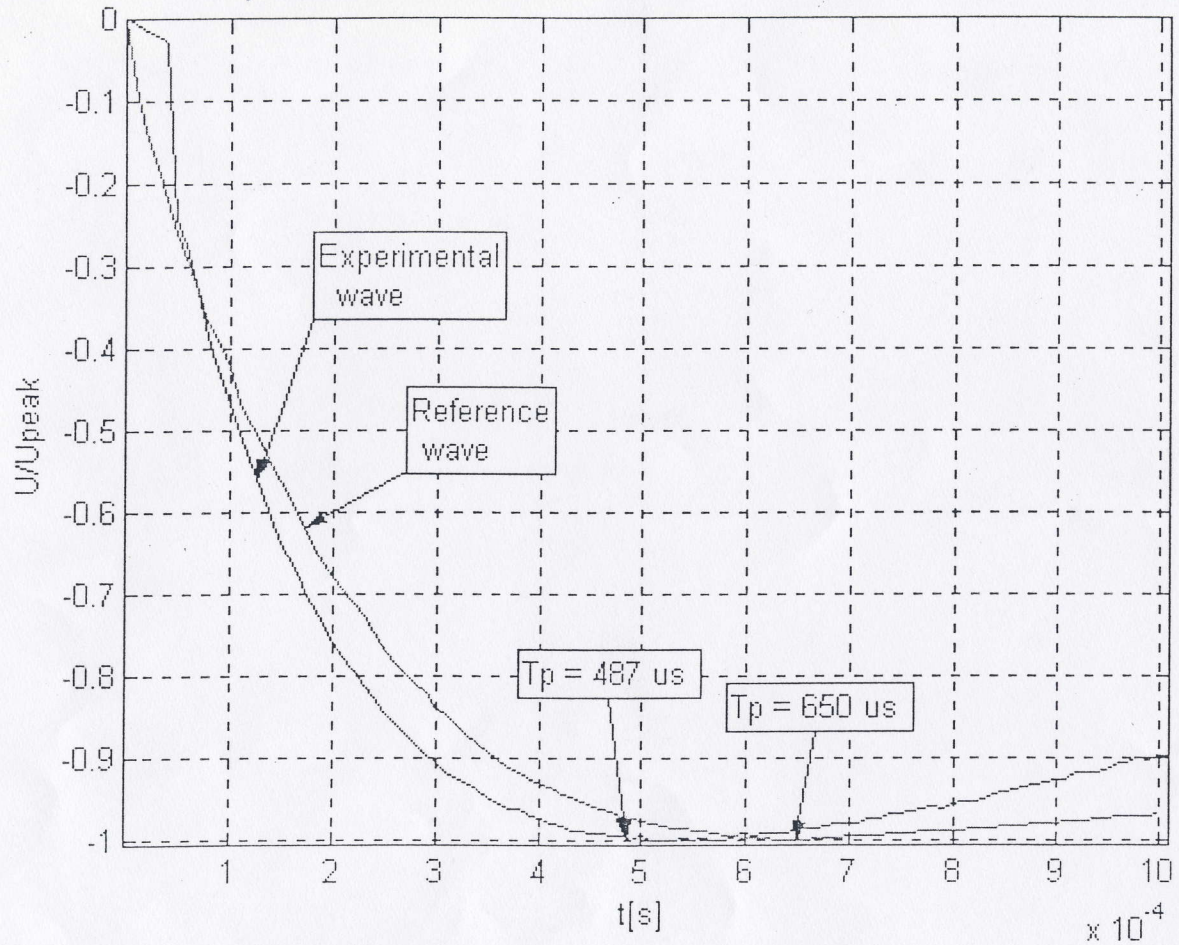
Test on ESEL C type Schirtec - DA

Impulse no.	T <sub>B</sub> μs	Impulse no.	T <sub>B</sub> μs	Impulse no.	T <sub>B</sub> μs
1	NS	44	325	87	229
2	255	45	313	88	203
3	307	46	261	89	204
4	245	47	NS	90	256
5	216	48	302	91	218
6	324	49	242	92	202
7	199	50	NS	93	246
8	247	51	202	94	177
9	299	52	251	95	186
10	215	53	314	96	171
11	268	54	327	97	266
12	320	55	288	98	308
13	NS	56	221	99	211
14	NS	57	198	100	180
15	205	58	190	101	186
16	208	59	202	102	226
17	371	60	204	103	217
18	305	61	203	104	189
19	NS	62	205	105	222
20	274	63	197	106	214
21	251	64	220	107	198
22	234	65	198		
23	245	66	217		
24	297	67	191		
25	209	68	273		
26	341	69	223		
27	221	70	176		
28	254	71	216		
29	308	72	208		
30	206	73	292		
31	225	74	250		
32	228	75	203		
33	236	76	282		
34	217	77	242		
35	295	78	193		
36	220	79	225		
37	243	80	192		
38	304	81	214		
39	NS	82	232		
40	342	83	266		
41	266	84	233		
42	300	85	275		
43	293	86	176		

NS: No significant  
T<sub>B</sub>: Break-down time



Experimental wave / Reference wave ESEL - Schirtec.da

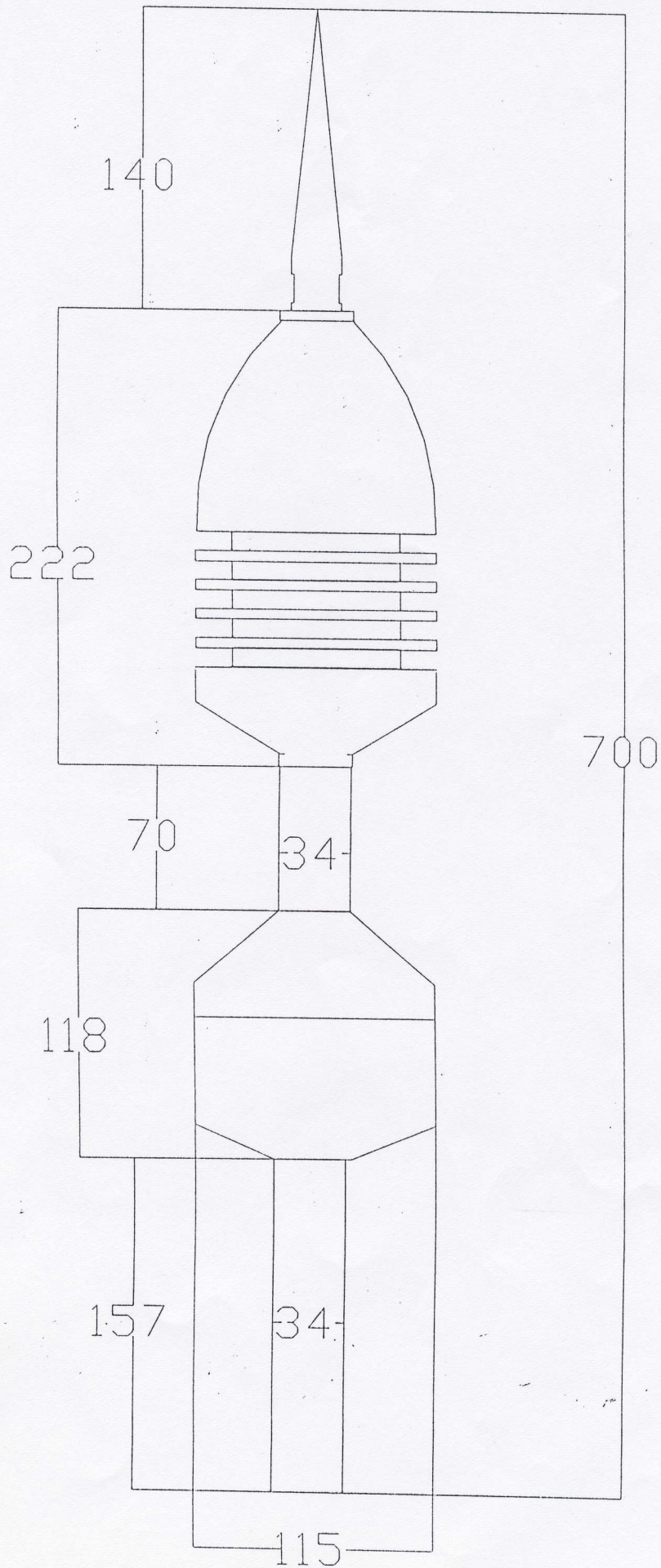


$t'_{PTS} = 305.08 \mu s$   
 $t'_{PDA} = 241.44 \mu s$   
 $t_{PTS} = 370.45 \mu s$   
 $t_{PDA} = 295.14 \mu s$   
 $\Delta t = t_{PTS} - t_{PDA} = 75.31 \mu s$

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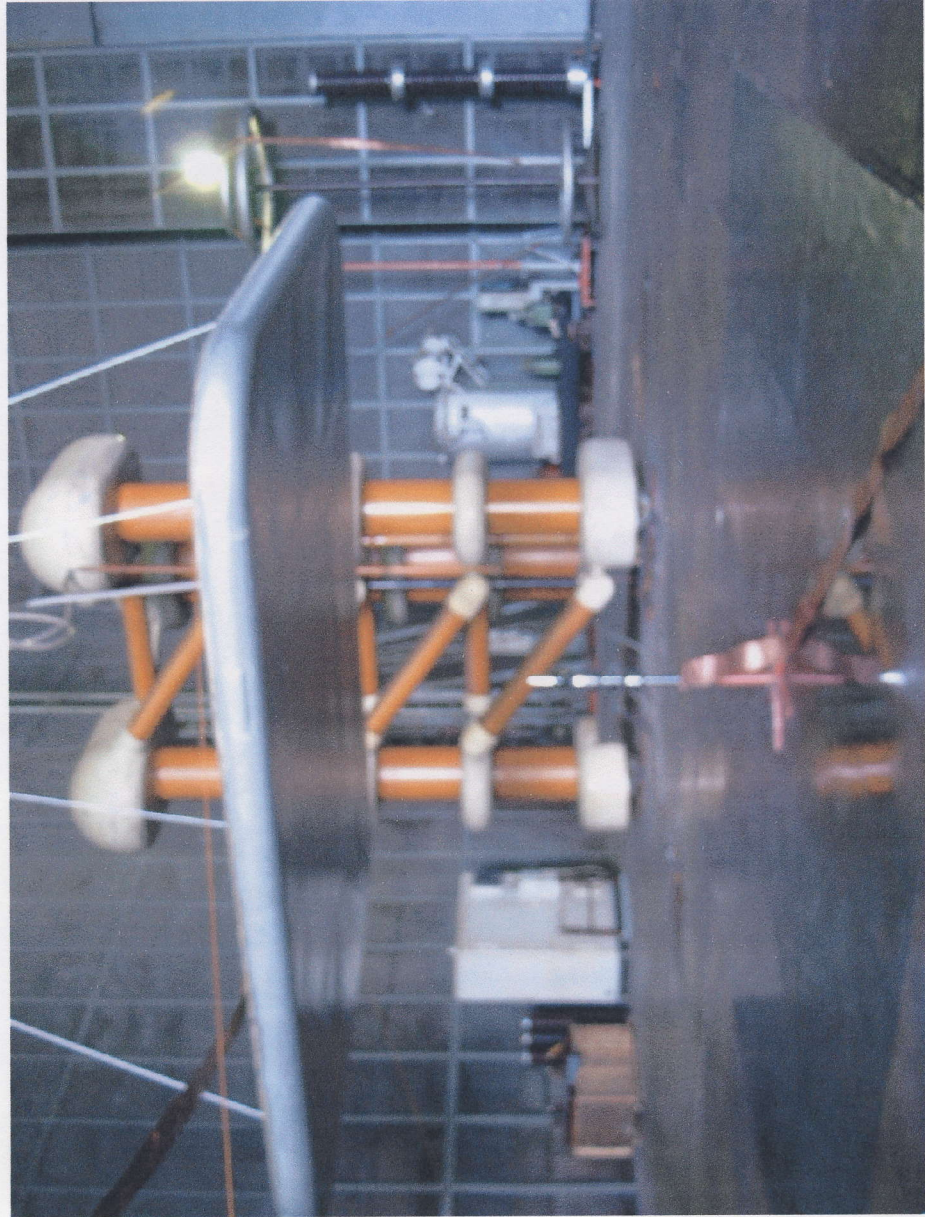
schirtec-da



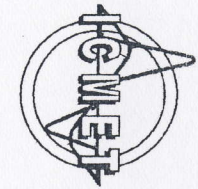
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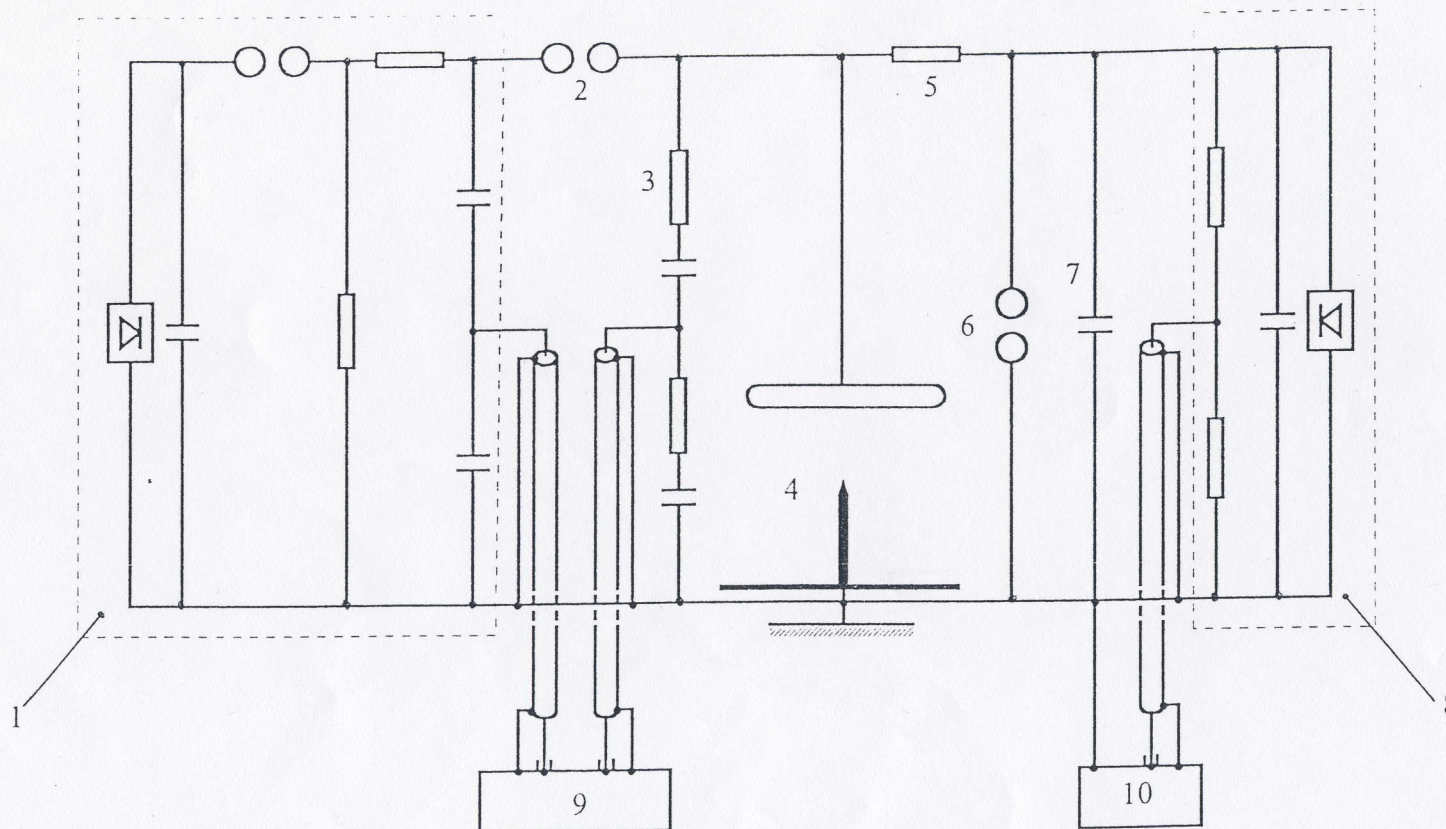
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*Paul*



Test circuit diagram on lightning conductor

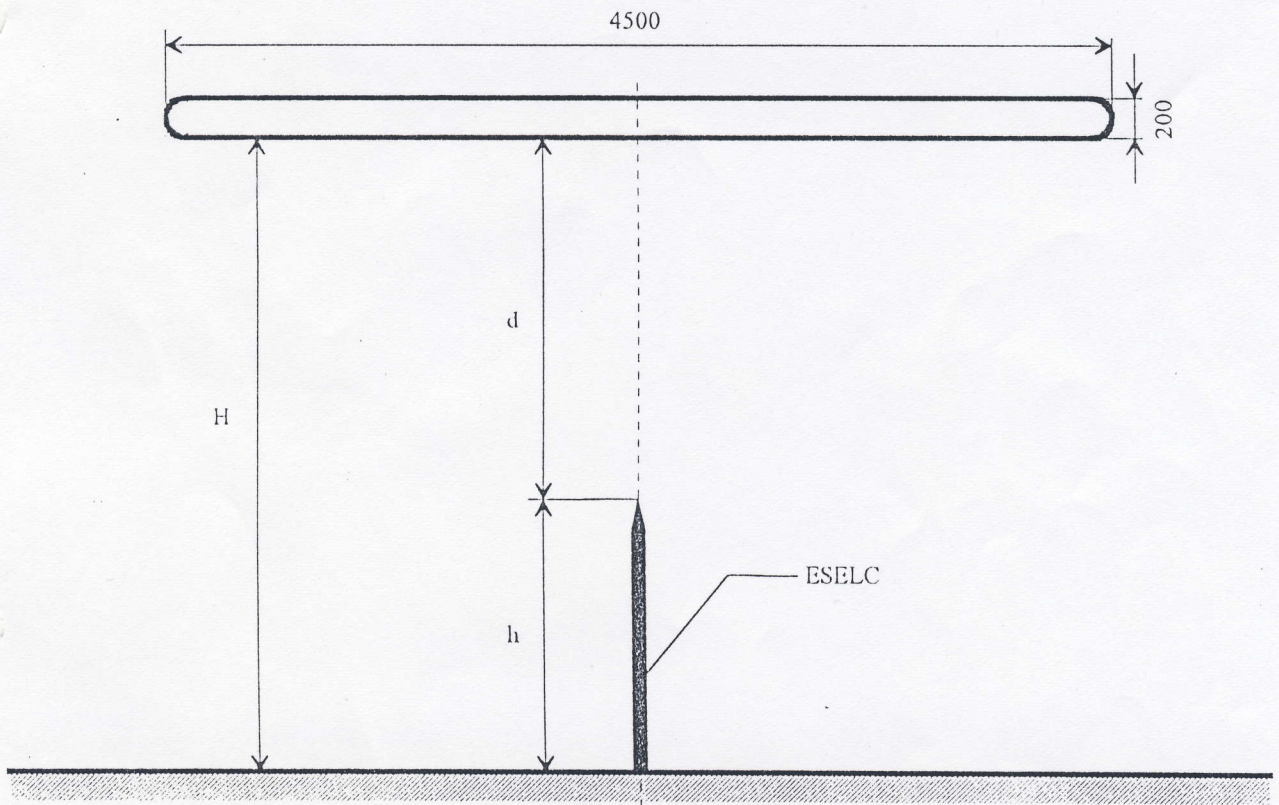


- 1 - HV Impulse Generator SPF 340/4200
- 2 - Serial protective gap,  $\Phi = 250$  mm
- 3 - Damped capacitive divider, 1600 kV
- 4 - Test configuration
- 5 - Resistance 2 M $\Omega$

- 6 - Parallel protective gap,  $\Phi = 500$  mm
- 7 - Capacitor 4,5 nF
- 8 - Rectifier cascade GS 1000/30
- 9 - Transient recorder TR - AS 100 - 10
- 10 - Measurement voltmeter



TEST SET UP ON EARLY STREAMER  
EMISSION LIGHTNING CONDUCTOR  
(ESEL)



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