TH595A SN907196 testing

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Forewords

DB Electronica 200 kWp RF station

Section A
TH595A SN907196

Installed to DB-A:
???

Removed from DB-A:
30 Sep. 2021

Filament time:
3775h

Section B
TH595A SN901204

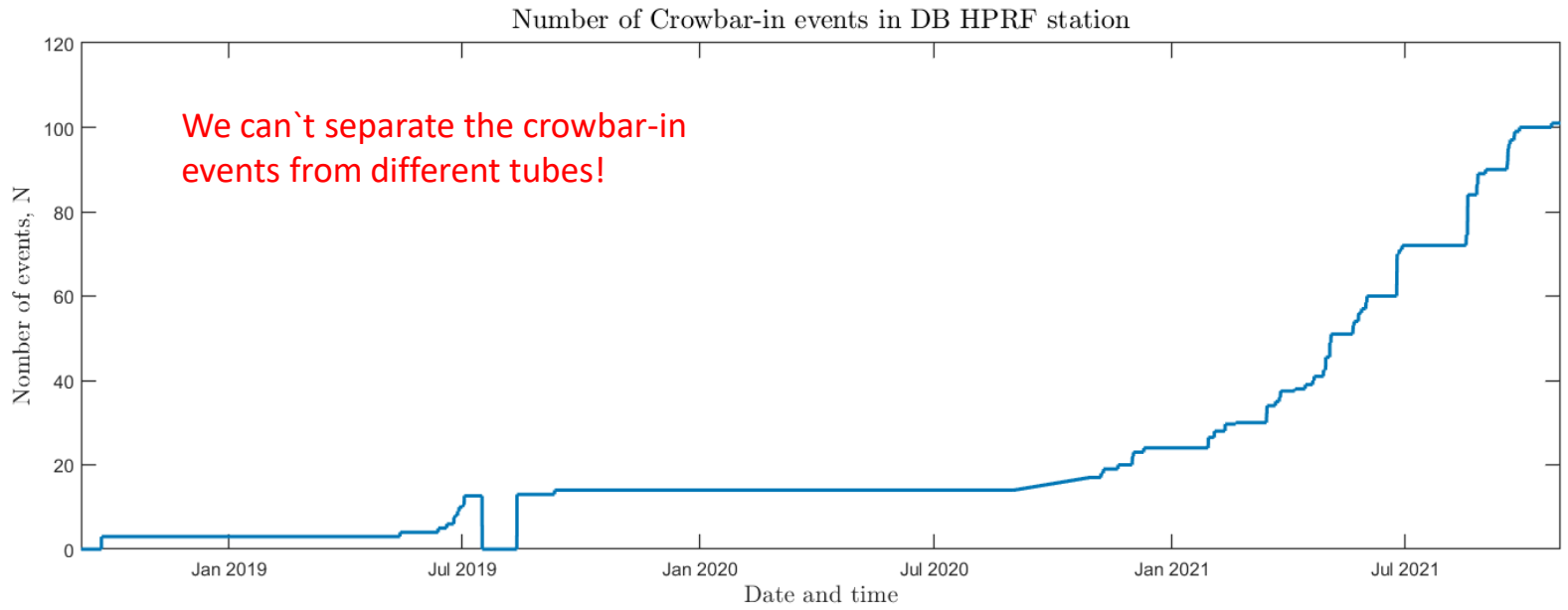
Installed to DB-A:
06 Sep. 2019

Removed from DB-A:
22 Sep. 2021

Filament time:
4882h

Total number of crowbars

100



Forewords

DB Electronica 200 kWp RF station

Section A
TH595A SN907196

Filament time:

3775h + 327h

Testing time

Interelectrode Insulation Test.

	Before test. pF	After test. pF	Test report (63062854). pF
K-G1	126.9		128 ✓
K-G2	86.8		
G1-G2	244.9		243 ✓
G1-A	20		
G2-A	22.5		20.5 ✓

Interelectrode Insulation Test.

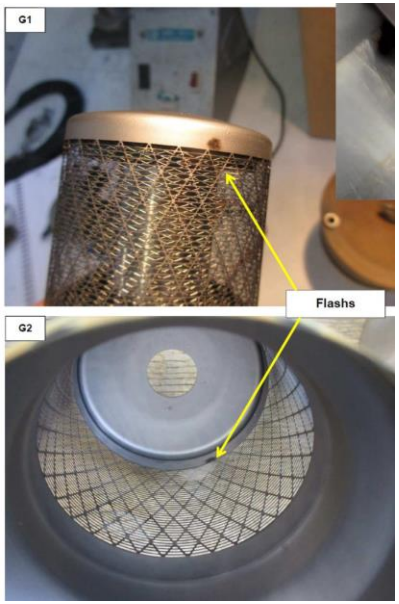
U	K^+ - $G1^-$	K^- - $G1^+$	$G1^+$ - $G2^-$	$G1^-$ - $G2^+$
V	I, uA	I, uA	I, uA	I, uA
0	0	0	0	0
100	0	0	0	0
200	0	0	0	0
300	0	0	0	0
350	0	0	**0.4**	0
400	0	0	**4.7**	0
500	0	0	**19.9***	0
600	0	0	**58.3***	0
700	0	0		0
800	**0.5**	0		0

Section B
TH595A SN901204

Filament time:

4882h

Was send to THALES and burned there during tests (absence of cooling water of anode jacket)

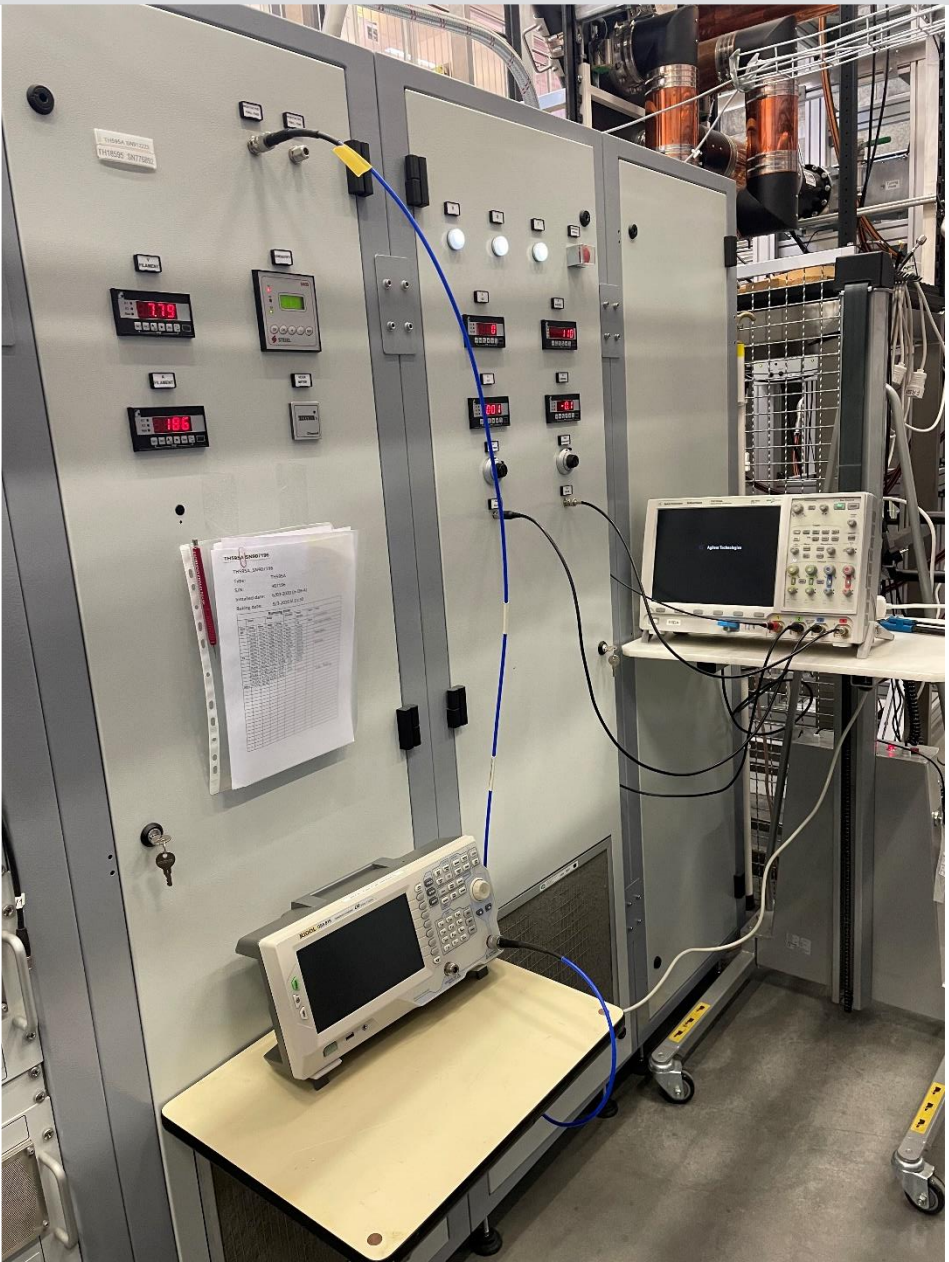


The pictures of arc marks, G1 to G2, are the only ones worth to mention further to inspection of inside the tetrode.

Before it was damaged in the bugged test bed, the returned tetrode was in good condition.

Taking the facts in account, as a commercial gesture we will replace it free of charge.

Tube testing setup



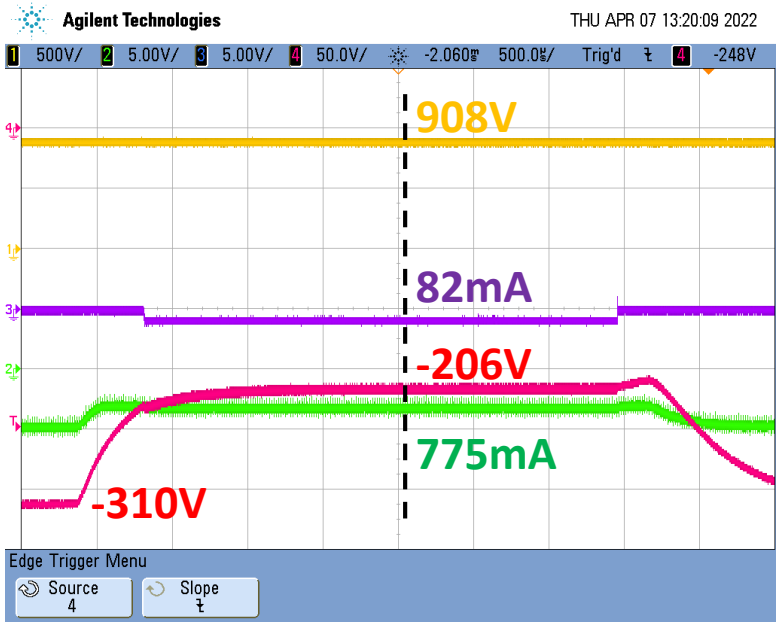
- Ia – Pulse transformer before Crowbar detection module. APS out.
- Ig1 – Terminal in front panel of G1PS.
- Ig2 – Station front panel terminal.

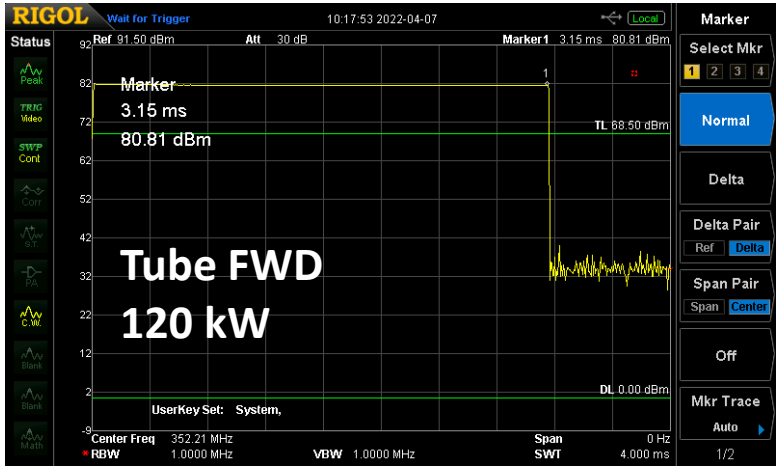
- Vg1 – Directly sampling the output voltage from G1PS.
- Vg2 – Directly sampling the output voltage from G2PS.

- Tube forward RF power monitored by SA.
- Trigger setup by VG2 falling edge. Trigger level ~ +800V.

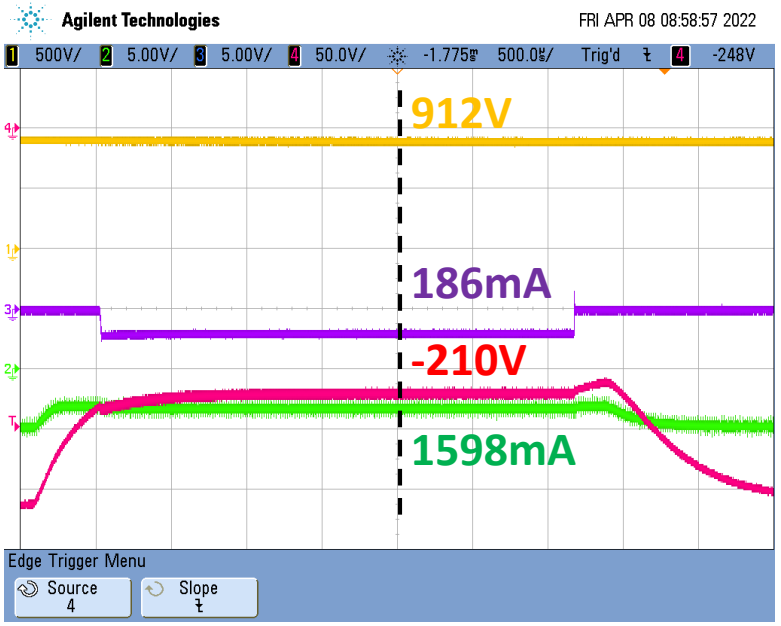
Normal operation

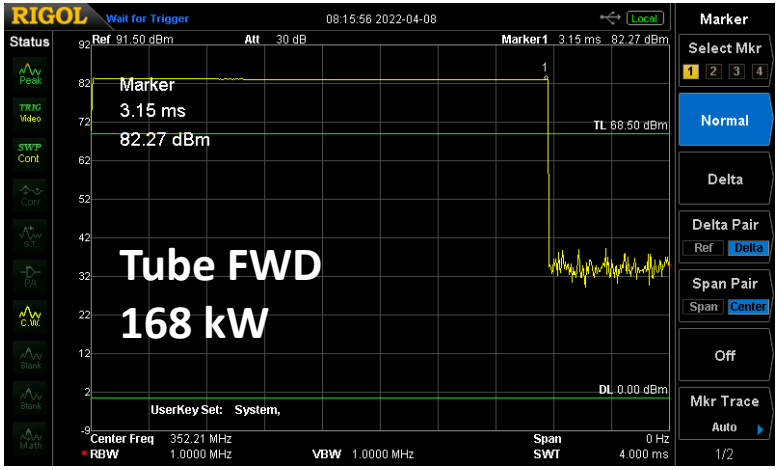
200 kW/station





300 kW/station





Ch1 - VG2
Ch2 - IG1
Ch3 - IG2 (Neg)
Ch4 - VG1

Station fails history

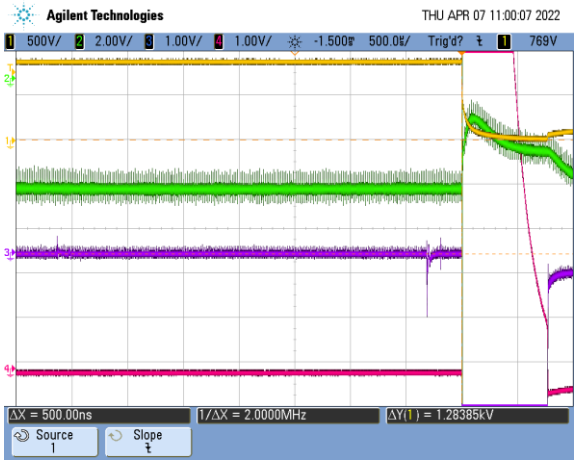
N1 – Tripped by water conductivity alarm
N2 – Crowbar-in at 200kW
N3 – Crowbar-in when HV ON, No RF
N4 – Crowbar-in at 300kW
N5 – Crowbar-in at 300kW
N6 – Crowbar-in at 300kW

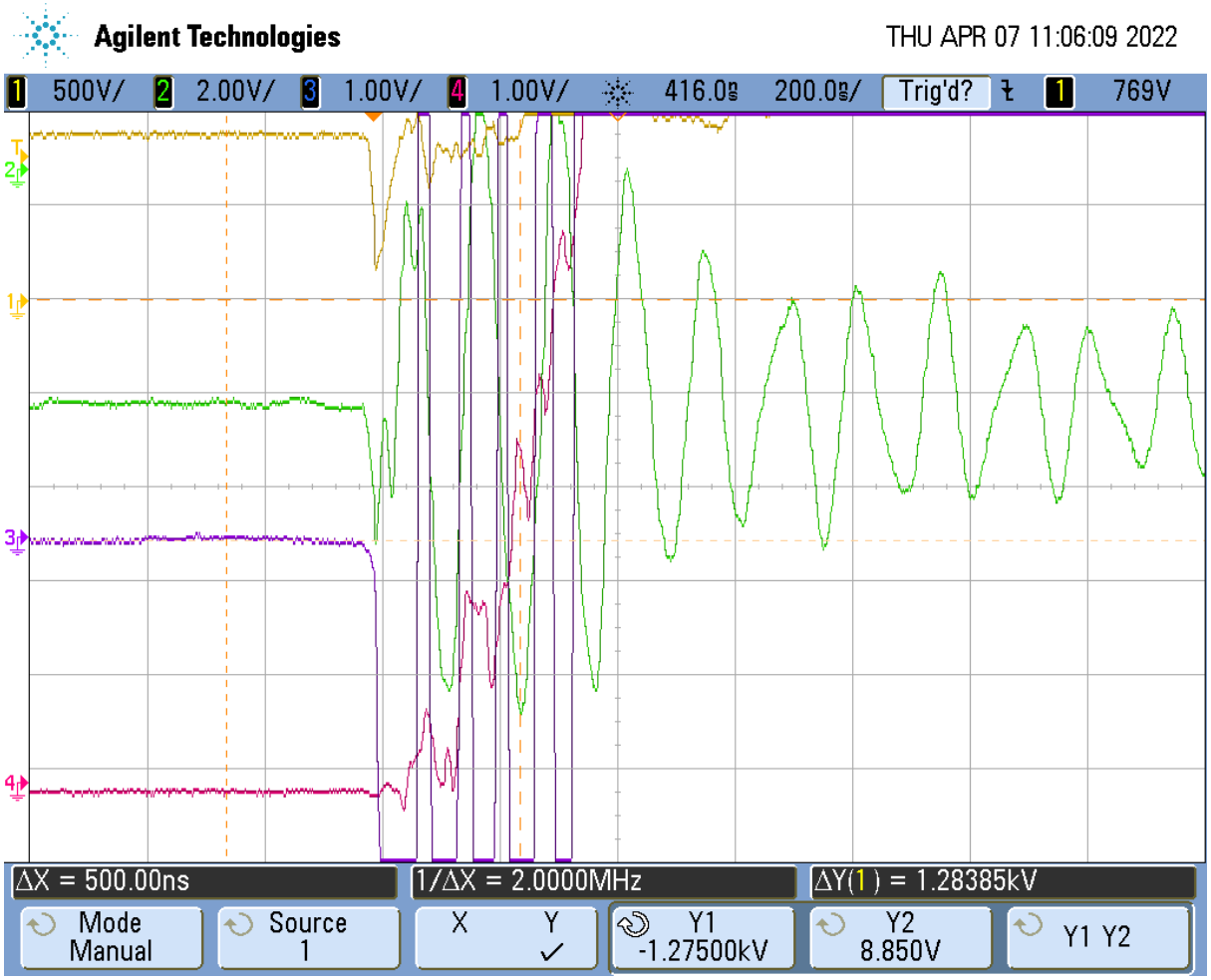
All Crowbar-in events happened outside of RF pulse:

- Blanking time bigger than pulse duration (68ms vs 3.2ms).
- During blanking time the V_{g2-g1} is maximum.
- No influence of RF pulse to Crowbar-in events

- Filament time: 327h
- APS ON time: 70h

Tripp N2





Crowbar-in at 200kW

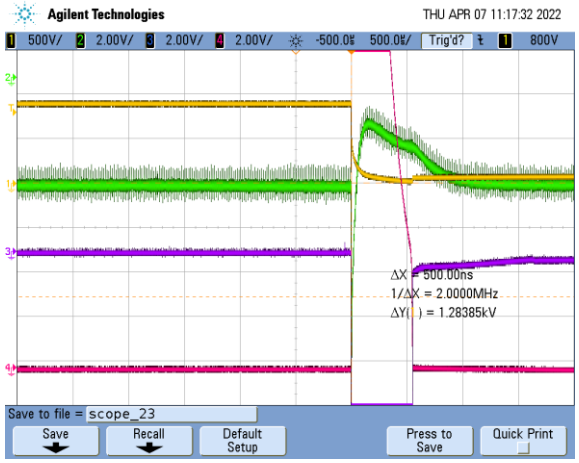
Ch1 - VG2

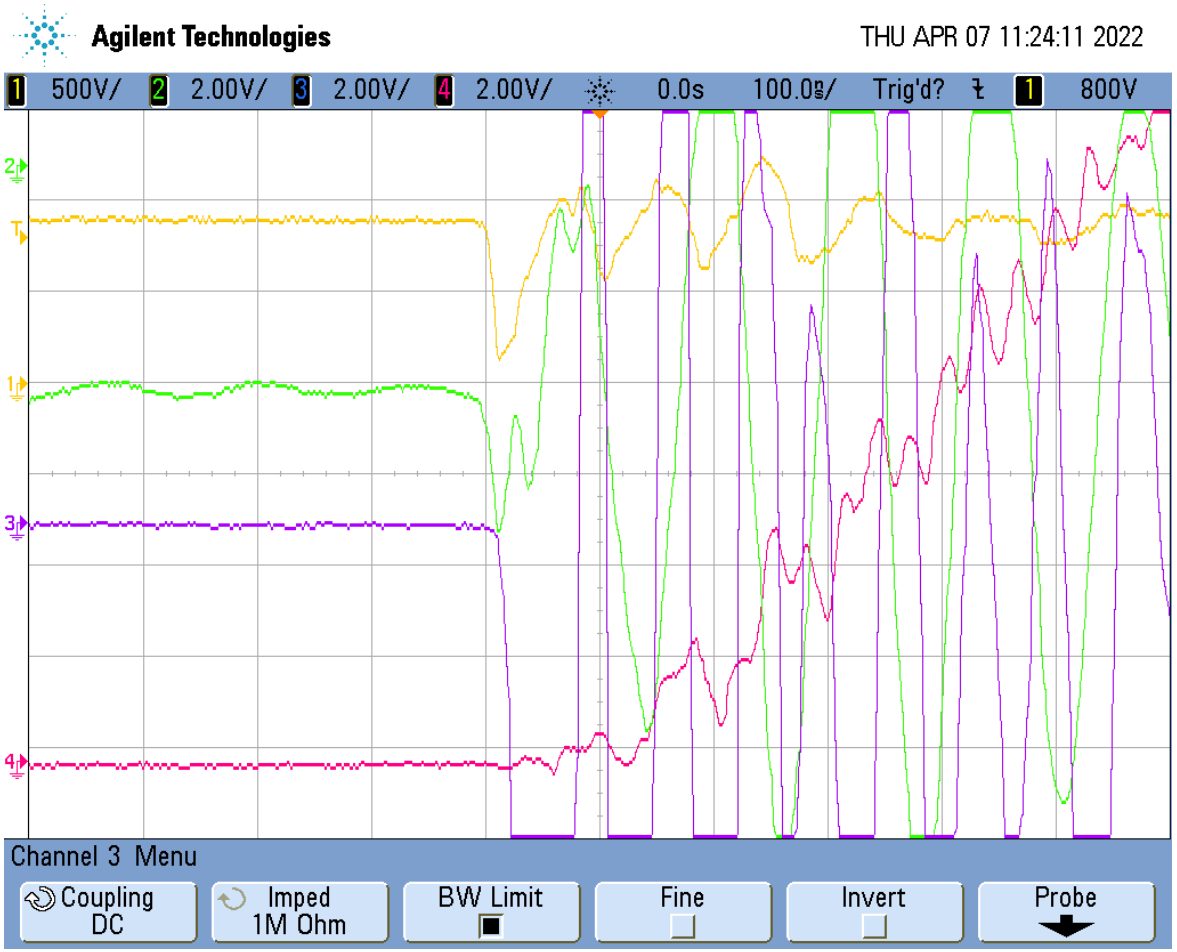
Ch2 - IG1

Ch3 - IG2 (Neg)

Ch4 - Ia

Tripp N3

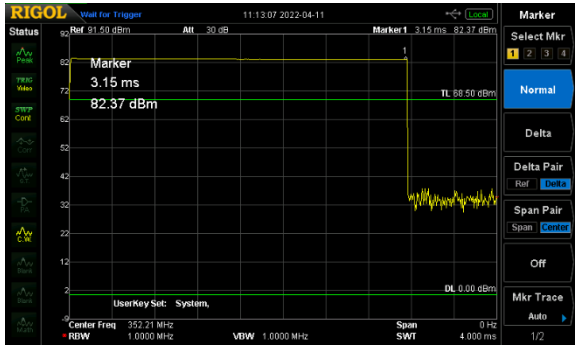




Crowbar-in at HV ON, No RF
Just next to N2

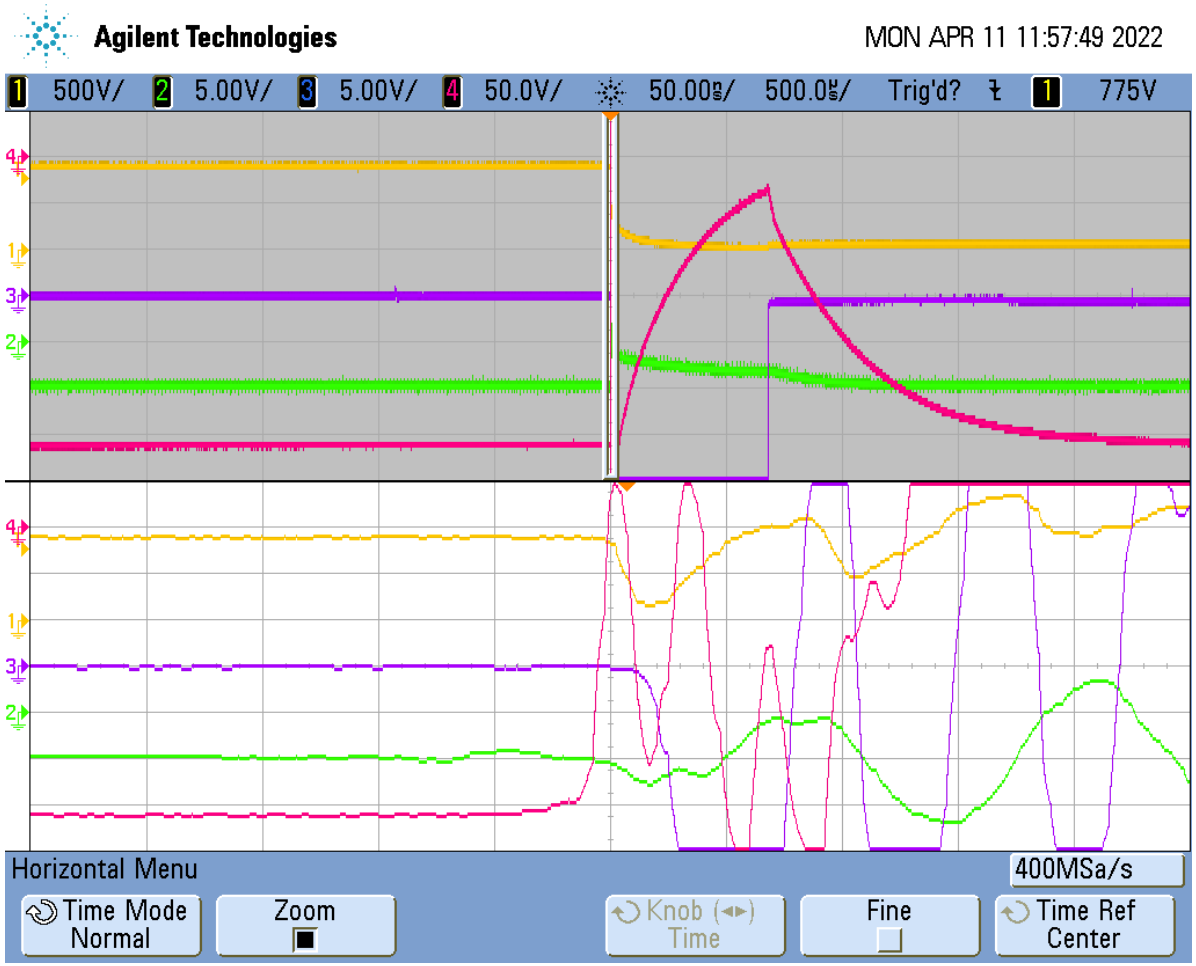
Ch1 - VG2
Ch2 - IG1
Ch3 - IG2 (Neg)
Ch4 - Ia

Tripp N4 – N5

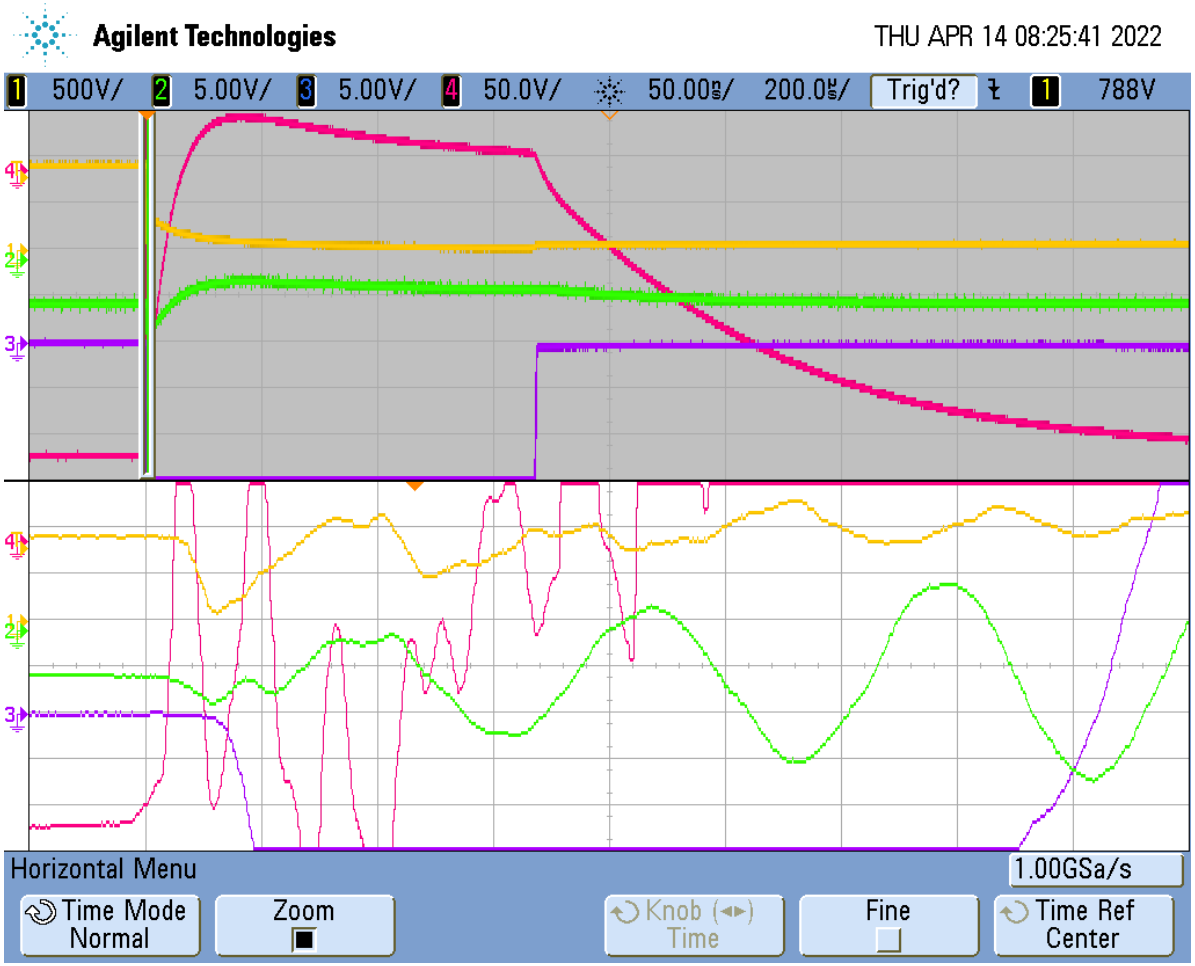


Crowbar-in at 300kW

Ch1 - VG2
Ch2 - IG1
Ch3 - IG2 (Neg)
Ch4 - VG1



Tripp N6

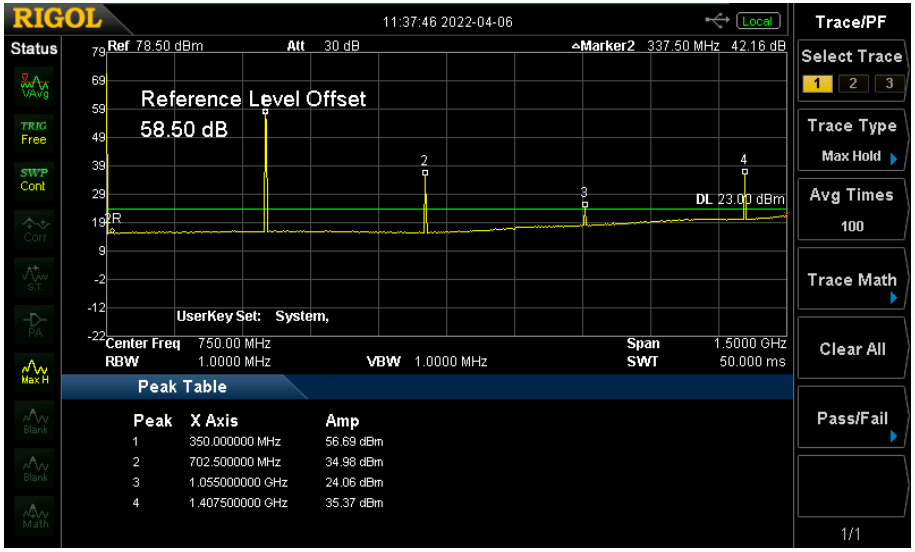


Crowbar-in at 300kW

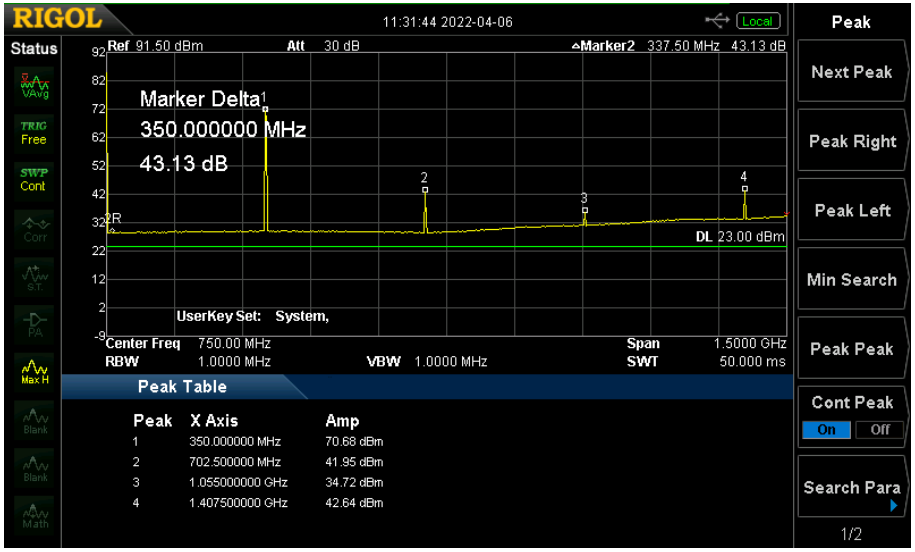
Ch1 - VG2
Ch2 - IG1
Ch3 - IG2 (Neg)
Ch4 - VG1

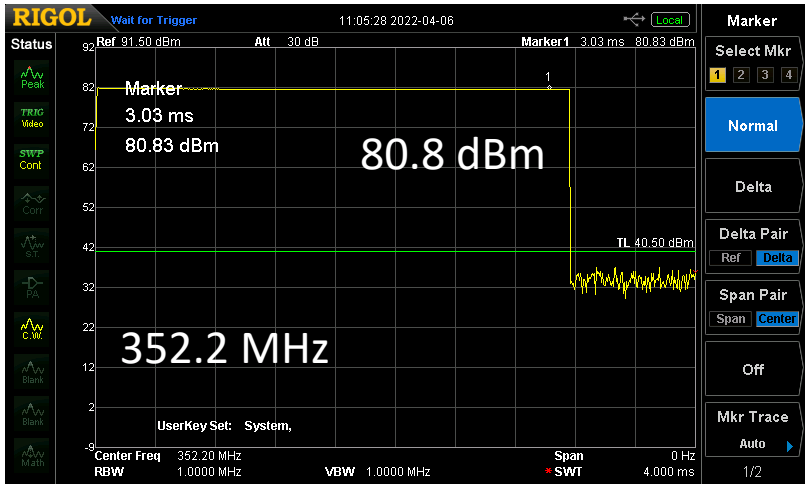
HOM in DB-B

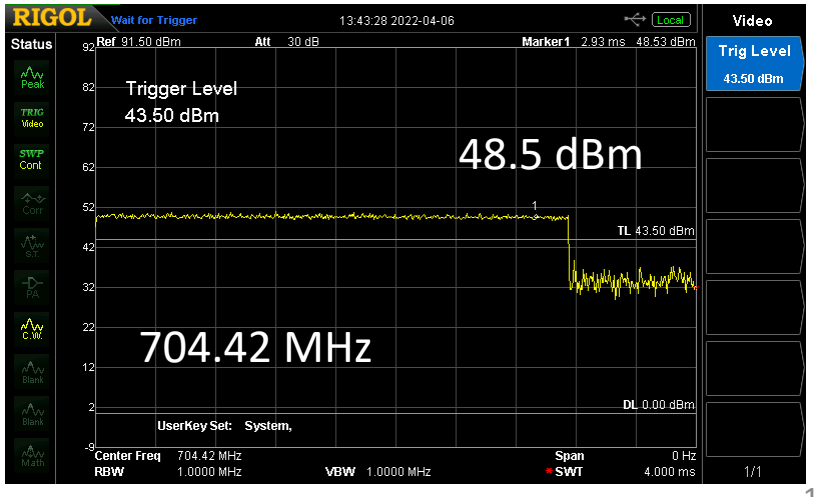
SSA FWD



Tube FWD







After tests

Interelectrode Insulation Test.

	Before test. pF	After test. pF	Test report (63062854). pF
K-G1	126.9	127.3	128
K-G2	86.8	87.1	
G1-G2	244.9	245.0	243
G1-A	20	20.5	
G2-A	22.5	22.2	20.5

Interelectrode Insulation before test.

U	K^+ - $G1^-$	K^- - $G1^+$	$G1^+$ - $G2^-$	$G1^-$ - $G2^+$
V	I, uA	I, uA	I, uA	I, uA
0	0	0	0	0
100	0	0	0	0
200	0	0	0	0
300	0	0	0	0
350	0	0	**0.4**	0
400	0	0	**4.7**	0
500	0	0	**19.9***	0
600	0	0	**58.3***	0
700	0	0		0
800	**0.5**	0		0

Interelectrode Insulation after test.

U	K^+ - $G1^-$	K^- - $G1^+$	$G1^+$ - $G2^-$	$G1^-$ - $G2^+$
V	I, uA	I, uA	I, uA	I, uA
0	0	0	0	0
100	0	0	0	0
200	0	0	0	0
300	0	0	0.5	0
350	0	0		0
400	0	0	2.7	0
500	0.2	0	**5.3**	0.7
600	0.6	0	**23**	1.4
700			**50.2**	1.2
800			**89**	2.5

AP1. TH595A SN901204 history.

Date	Event	Note
06.09.2019	TH595A SN901204 was installed DB Electronica HPRF station in section B.	Fast test. 96h.
03.09.2020	In operation.	
22.09.2021	Removed from DB Electronica HPRF station in section B.	Crowbar when HV ON. Without RF. Replaced by TH595A SN912223. 4882h in operation.
22.09.2021	Check the shorts – not found.	
22.09.2021	Interelectrode capacitance measured: K-G1: 0.160 nf K-G2: 0.123 nf G1-G2: 0.293 nf G1-A: 0.6 nf G2-A: 0.067nf	Looks like ~30pf offset of our meter.
23.09.2021	HV insulation test. A-G2: up to 20kV no visible current. K-G1: up to 2kV no visible current. G1(+) - G2(gnd): 0V – 0mA 500V – 0mA 750V – 0.1mA Short time CC mode. 1000V – 0.4mA. PS switched to CC mode.	Referent values taken from TH595 SN755307 Test report. K-G1: 2kV <1uA G1-G2: 1.5kv <6uA A-G2: 20kV 2 – 12uA All measurements done when tetrode in vertical position. Without filament voltage. HVPS current limit set at 1mA.
23.09.2021	2nd insulation test. G1(+) - G2(gnd): 0V – 0mA 500V – 0.01mA 1000V – 0.01mA 1500V – 0.15mA	Clear see the trend to decreasing of current. Looks to possible conditioned the electron emission.
23.09.2021	Try to conditioned the G1-G2 emission. Start from 1500V and slowly decrease the current limitation (keep PS in CC mode). When PS switch CV mode, decrease the current limitation. Insulation test after conditioning: G1(+) - G2(gnd): 0V – 0mA 1000V – 0mA 1500V – 0.01mA	
27.09.2021 28.09.2021	Verification Crowbar system in DB Electronica HPRF station in section B.	3 times in row pass the “wire” test.
29.09.2021	Outgoing capacitance test before transportation K-G1: 126pf G1-G2: 259.0 pf G2-A: 23.2 pf	LCR meter BK precision 880. Tube in horizontal position.