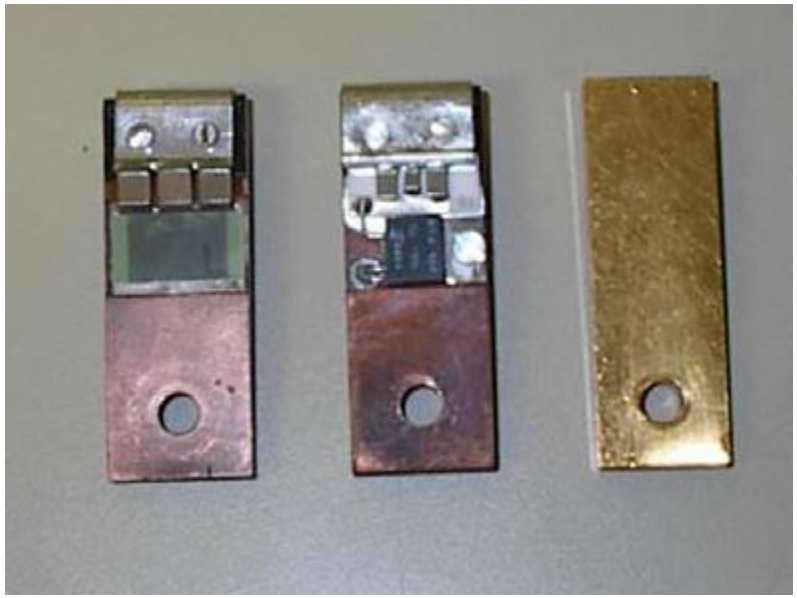
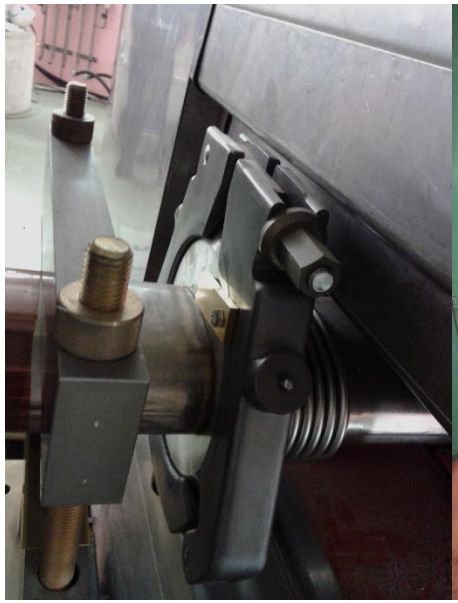
RF Bypass Impedance Measurements





RF Bypass Impedance Measurements

- On PS Ring
- About 200 flanges to be measured,
- Use of a trolley (with big pneumatic wheels because of the rails on the PS) to carry VNA, extension cord, etc…

https://goo.gl/maps/FLDS6ZpcMC22

RF Bypass Impedance Measurements

- On PS Ring
- About 200 flanges to be measured,
- Use of a trolley with big pneumatic wheels because of the rails on the PS

- **1st part of the job:** Interventions where Vacuum chambers are disconnected, we previously removed all the RF Bypasses according to a given list then once the Vacuum group has finished each one of them, we measure the impedance of the flange as the collars risk to damage the enamel insulation of the flanges and cause short-circuits. If ok, we put back the RF Bypass and make a measurement to be sure. 200uS radiation taken.

- **2nd part of the job:** Start measurement campaign from SS01 to SS100, 2 flanges per Straight Section, a few SS have 3 flanges. 230V AC plugs every 10 meters, since decades we use a 20 meters AC power cord extension in order to make several measurements and limit the number of powering down the VNA to less than 20.

- Since 2014 we inserted an uninterruptible power supply UPS so it keeps the VNA powered while we move the extension cord.

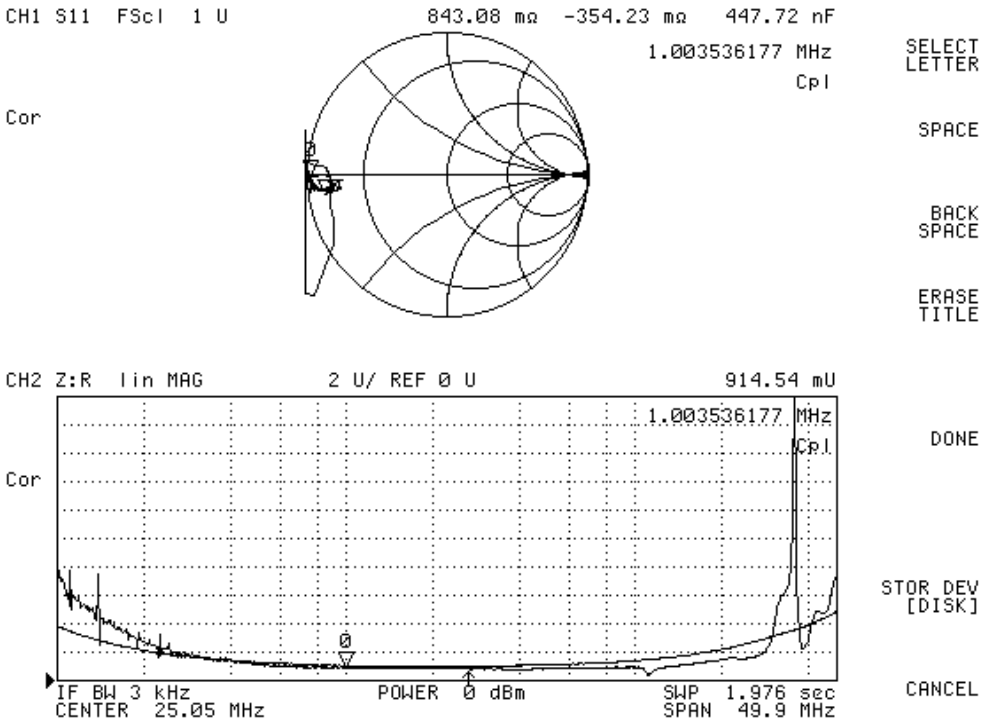
- 50uS radiation taken on this 2nd part.

RF Bypass Impedance Measurements

History

… 2013, then 2015 and 2016

Agilent 4395A



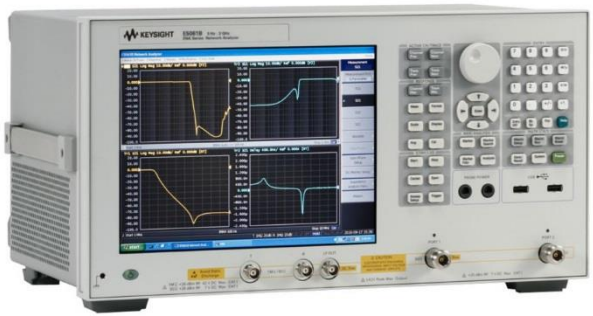
SS02 Upstream

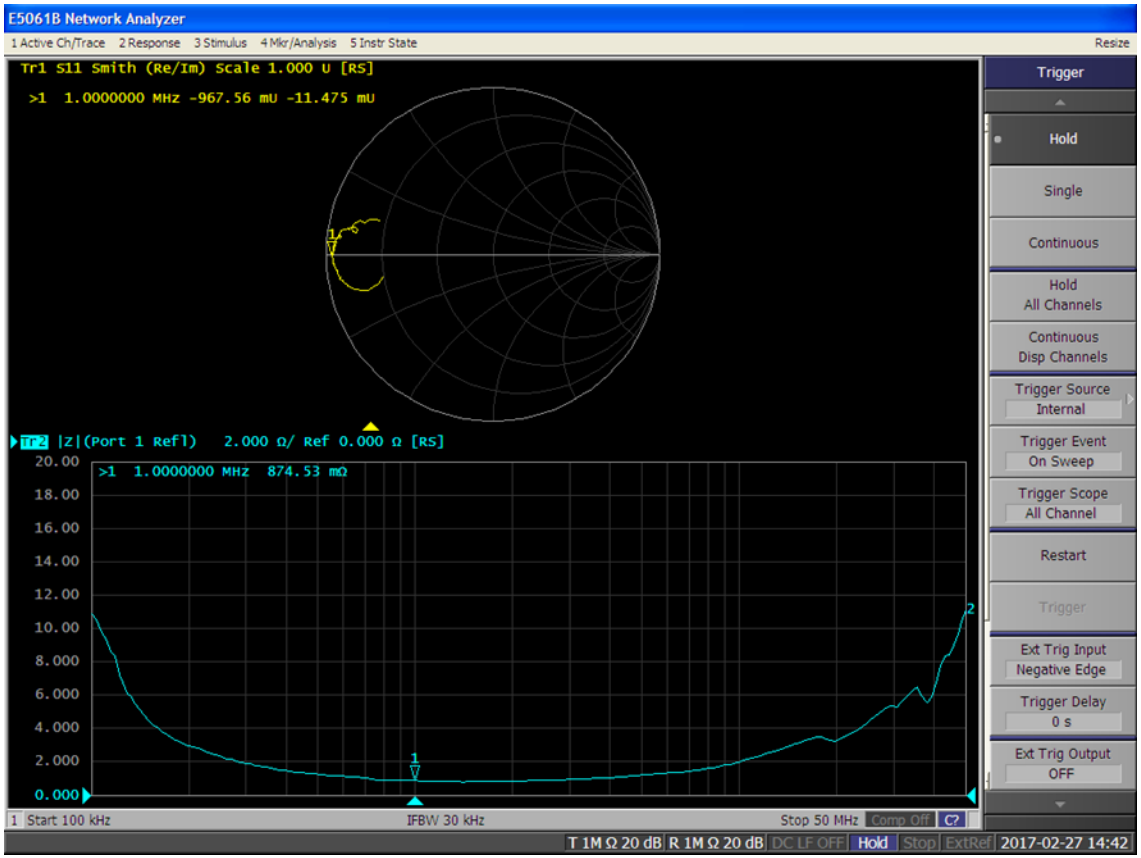
- Fast Boot 15s
- 30s state load from FDD
- Image saved to FDD, about 1 minute

RF Bypass Impedance Measurements

History

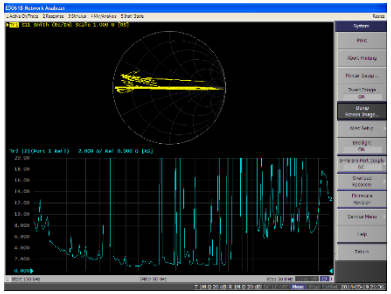
2014 and 2017 Agilent E5061B





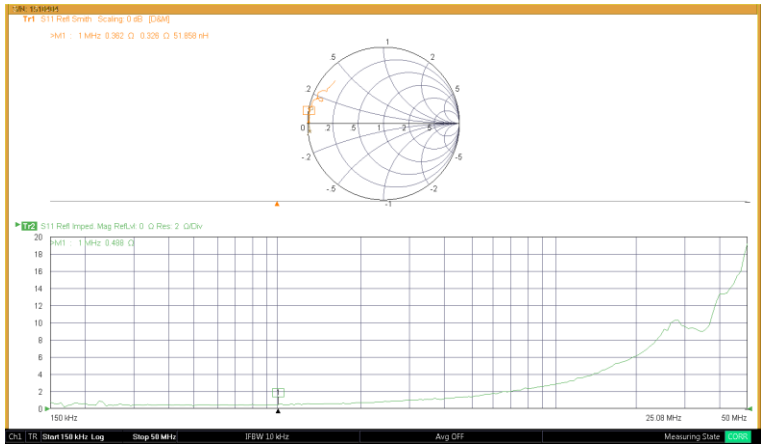
- ☹ Very slow Boot 3 minutes (MS Windows),
- ☺ Image saved to USB, about 10 seconds,
- ☺ Inserted UPS, huge gain of time
- ☹ Problems in 2015, we forgot to press hold before saving plots, this VNA continues to scan while its saving, bad contacts caused bad pictures.

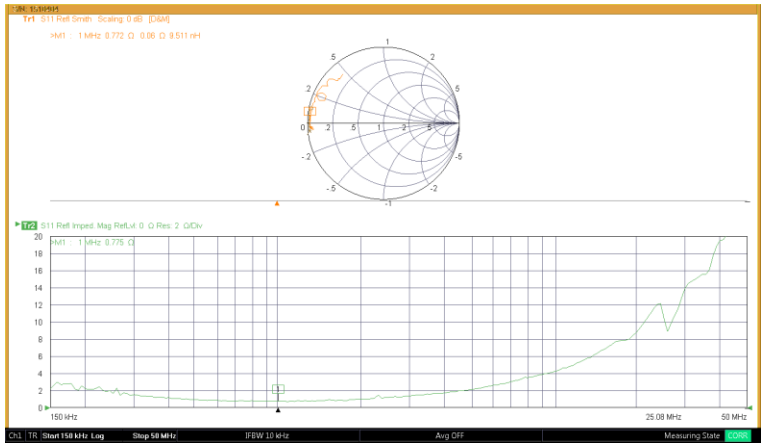
SS52 Downstream



RF Bypass Impedance Measurements

VNA Evaluations





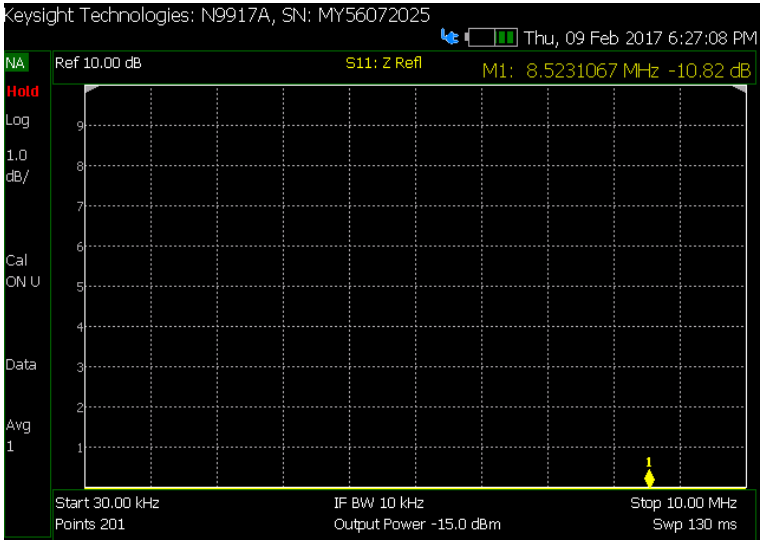
- ☺ Powered by USB Only,
- ☺ Friendly user interface software,
- ☺ Very Fast Scanning,
- ☺ Easy to save plots,
- ☹ Min Frequency starts at 150kHz ☹

RF Bypass Impedance Measurements

VNA Evaluations

- ☺ No need of PC Laptop,
- ☺ Friendly user interface software,
- ☺ Very Fast Scanning,
- ☺ Easy to save plots, (need keyboard)
- ☺ Start Frequency at 30kHz,
- ☹ Only Linear Frequency Scale ☹

SS46V



Short Circuit

RF Bypass Impedance Measurements

THE PSB

Fabrice Chapuis

https://edms.cern.ch/ui/file/1558565/3/Renovation_Collier_Impedant_Booster.pdf

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

CERN-PS DIVISION

CERN/PS 2000-025 (AE)

REDUCTION OF THE IMPEDANCE CREATED BY THE INSULATED VACUUM FLANGES IN THE PS BOOSTER

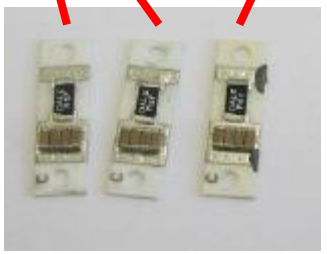
A. Blas, M. Chanel, C. Carli, C. Lacroix

Abstract

The original vacuum flange assembly in the PS Booster (PSB) was designed to present insulation at low frequency and conduction to the beam image current above 2 MHz. However, in order to satisfy the needs for the LHC, the RF harmonic in the PSB had to be changed from h=5 to h=1, leading to a reduction of the lowest accelerating frequency to 600 kHz. The RF component of the beam was therefore passing through the main resonance of these flanges giving a total (integrated around the ring) longitudinal coupling impedance of 1000 Ω at 750 kHz, taking into account some additional RF bypasses. The voltage generated by the beam current was coupling to various electronic devices which therefore had to be equipped with common-mode rejection circuits. After some non-essential insulated flanges had been replaced by conducting ones during the 1998-99 shutdown, the total impedance was lowered to about 200 ohms (still higher than the maximum value for h=5 which was 130 ohms). This was one of the improvements that made it possible to reach a new intensity record in September 1999. New RF decoupling flanges introduced in 2000 to further reduce the impedance are described here, together with the results obtained.

7th European Particle Accelerator Conference, 26th-30th June 2000
Vienna, Austria

Geneva, Switzerland
10 July 2000

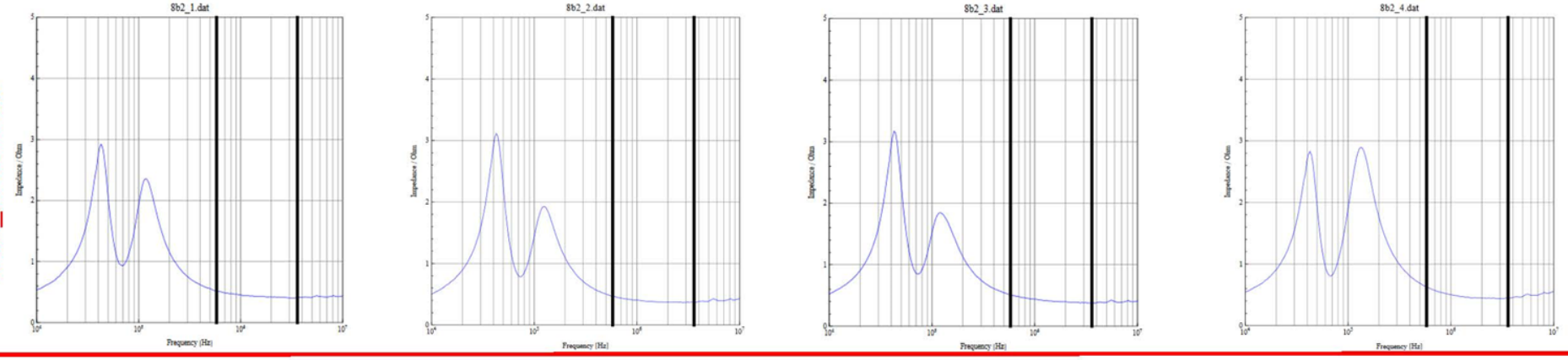


RF Bypass Impedance Measurements

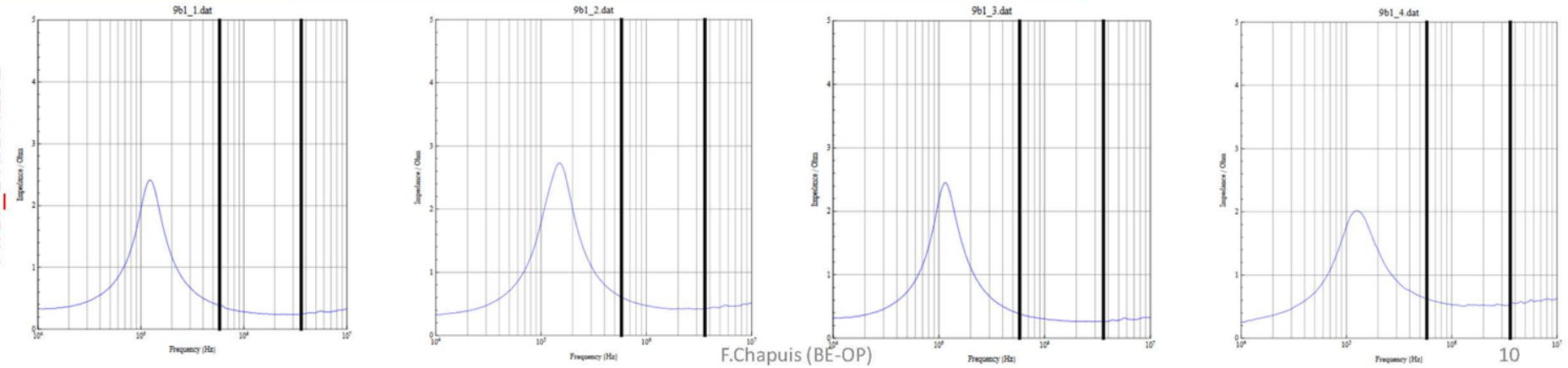
Mesures RF Bypass: après LS1 2013/2014

Mesure R1 | Mesure R2 | Mesure R3 | Mesure R4

Aval_BR.BHZ82



Aval_BR.BHZ91



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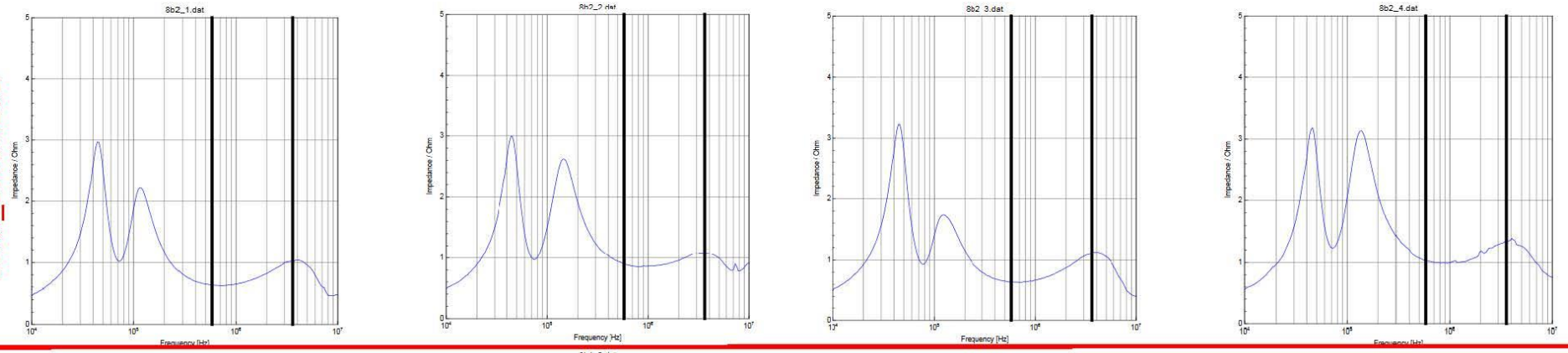
2016.09.15.Bypass_RF_section_9_du_PSB.pdf

RF Bypass Impedance Measurements

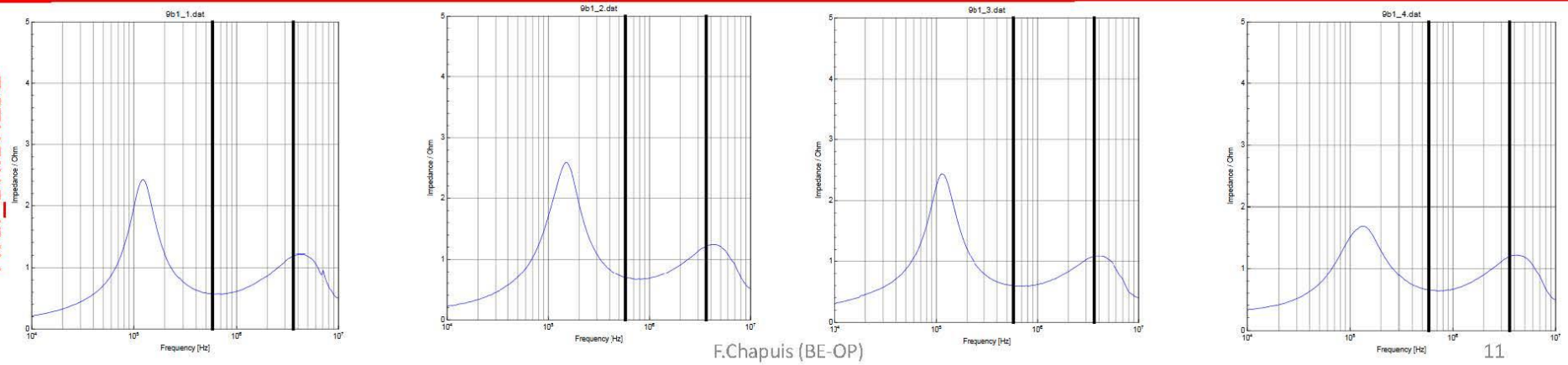
Mesures RF Bypass: YETS 2015/2016

Mesure R1 | Mesure R2 | Mesure R3 | Mesure R4

Aval_BR.BHZ82



Aval_BR.BHZ91



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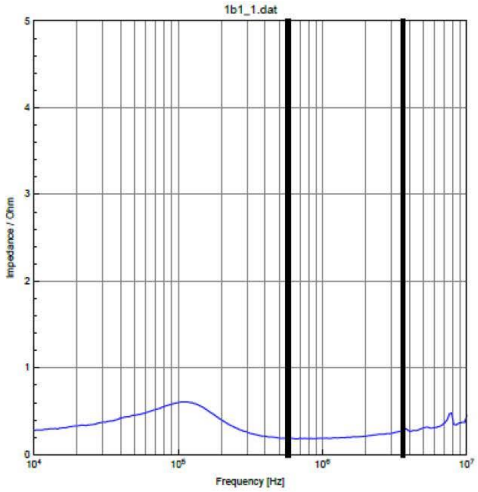
2016.09.15.Bypass_RF_section_9_du_PSB.pdf

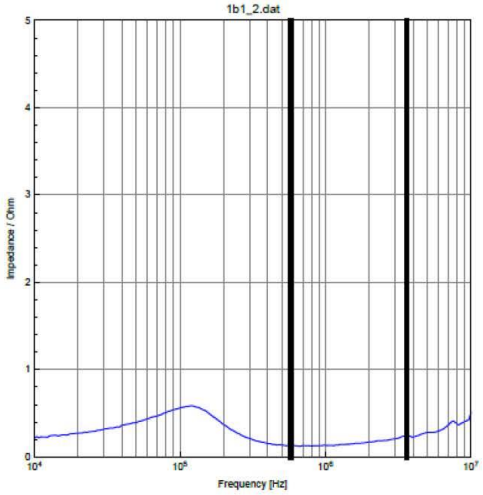
RF Bypass Impedance Measurements

Vérification des By-Pass (BE-BI) implantés sur les TRAFOS_en SS9-L1 (15-Sep-2016)

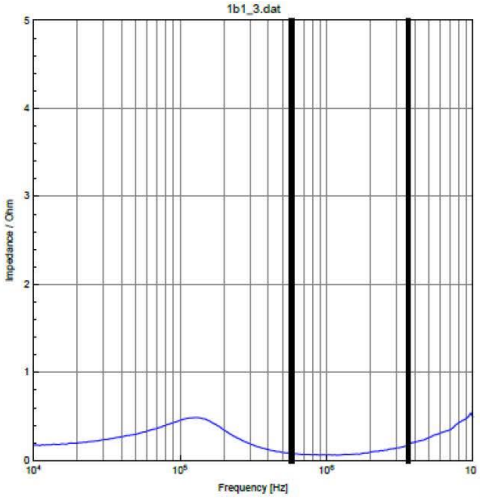
Mesure R1



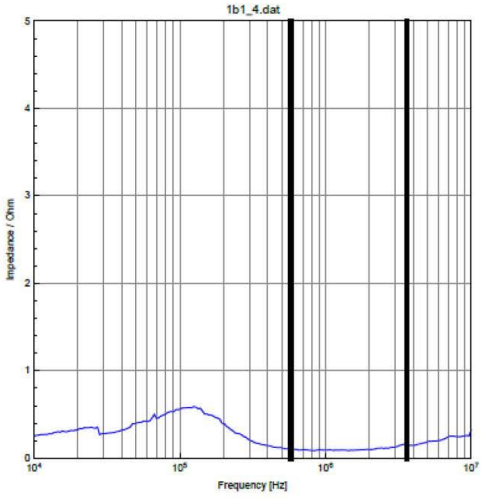
Mesure R2



Mesure R3



Mesure R4



RF Bypass Impedance Measurements

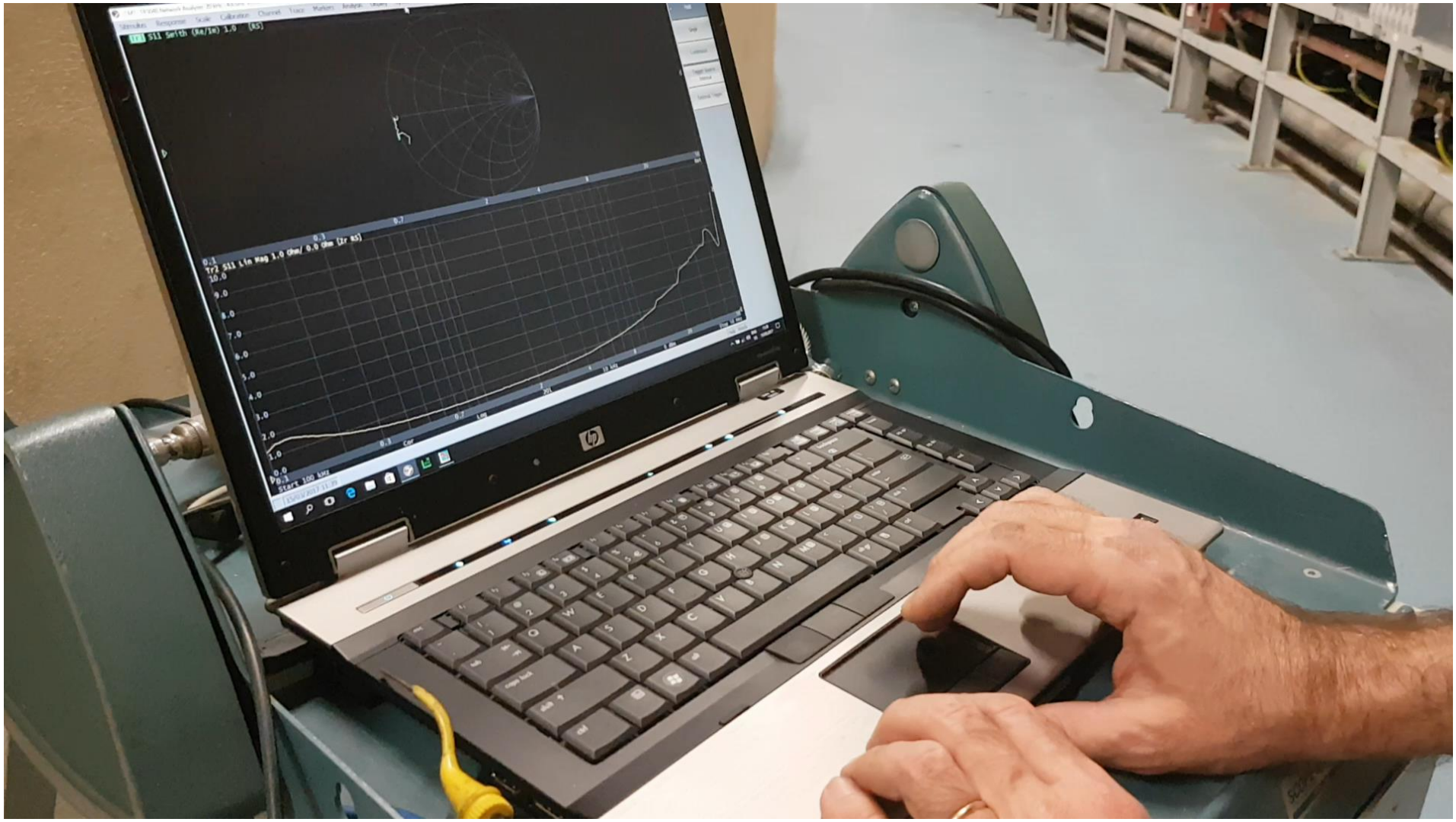
History

2017 On PSB:

Copper Mountain Technologies
TR5048

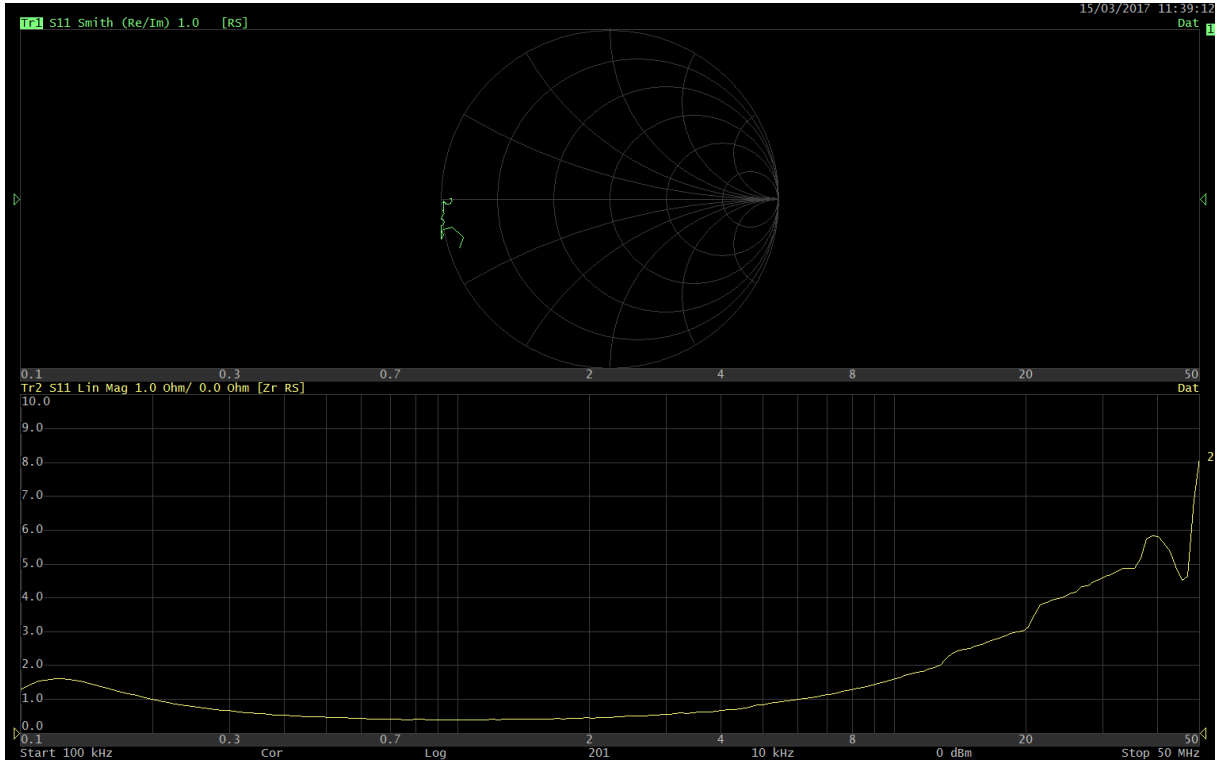
- Used with a laptop,
- Needs 1.25A, 12V, power supply,
- Very fast scanning,
- We used this trolley with only the UPS powering,
- All 120 measurements in about 1hour,
- Radiation taken: Joao 8uS, Bruno 4uS.

RF Bypass Impedance Measurements

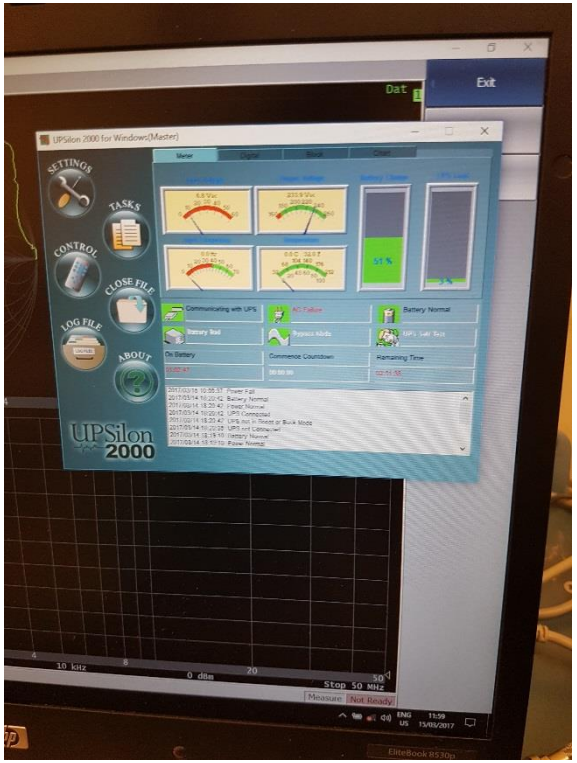


Video Showing file saving

RF Bypass Impedance Measurements



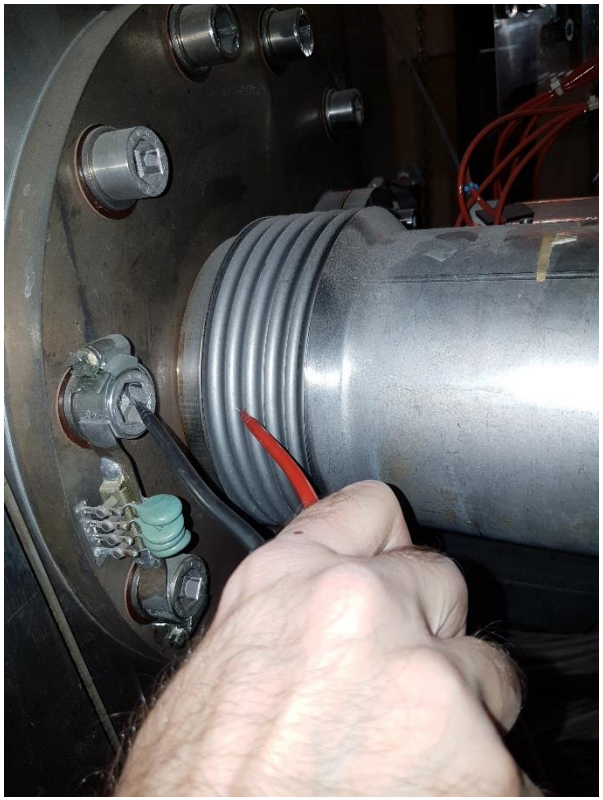
BHZ82 Ring 2

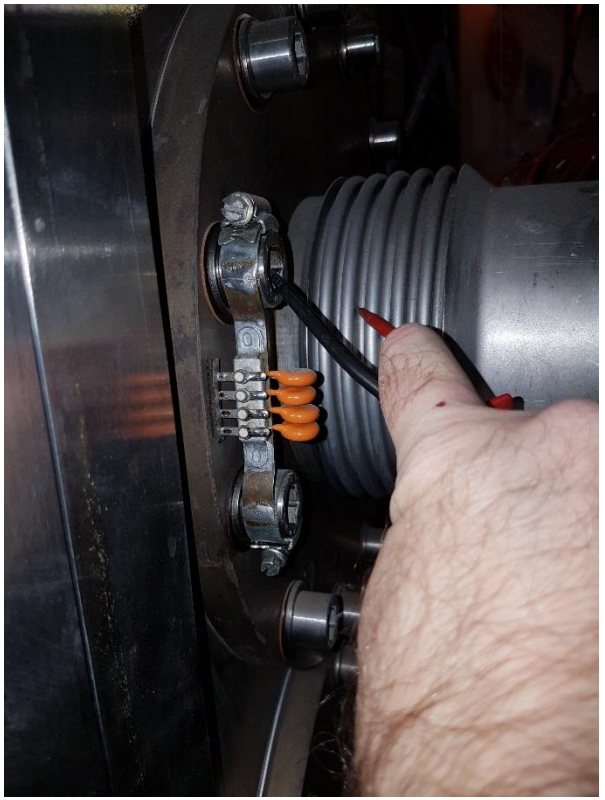


UPS Management software

RF Bypass Impedance Measurements

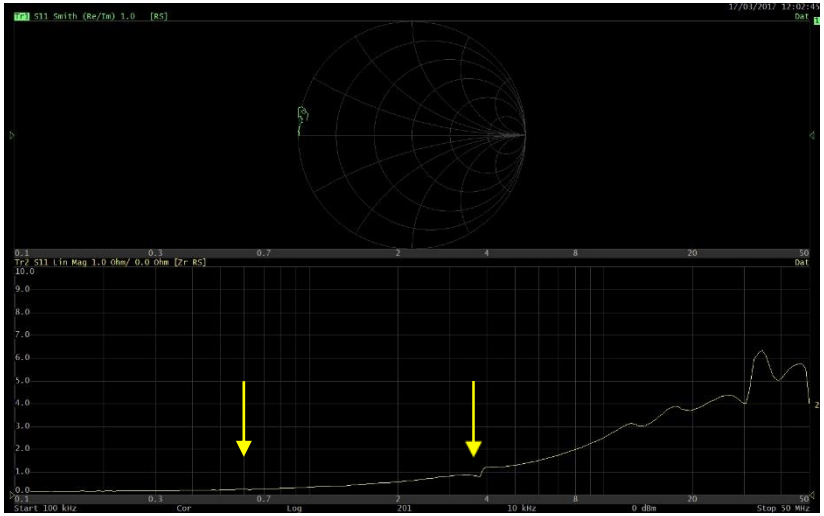
Special RF Bypasses at BI.KSW1L1



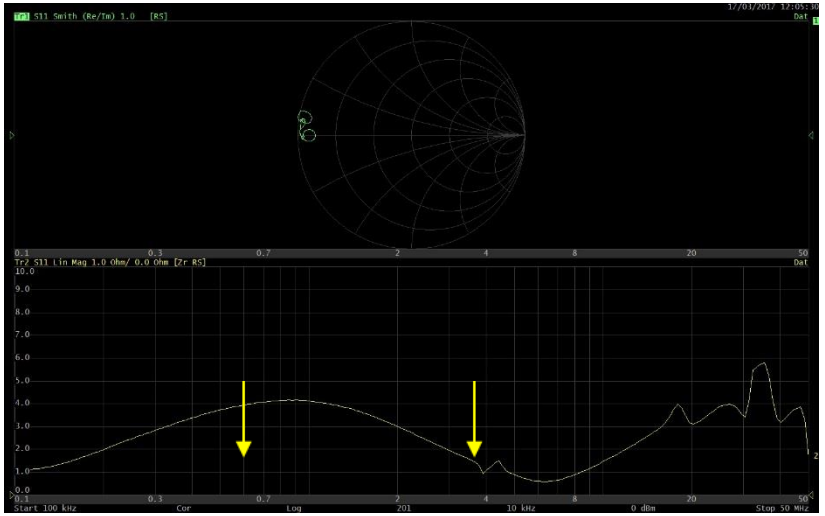


UPS
Management
software

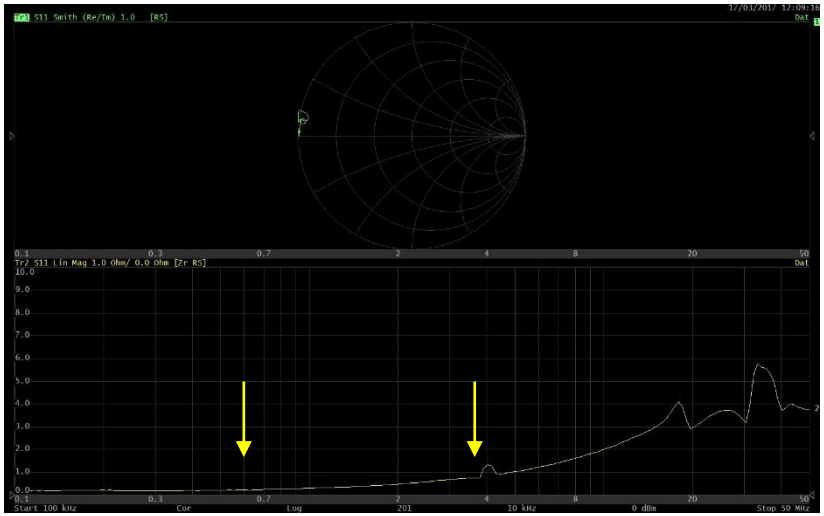
RF Bypass Impedance Measurements



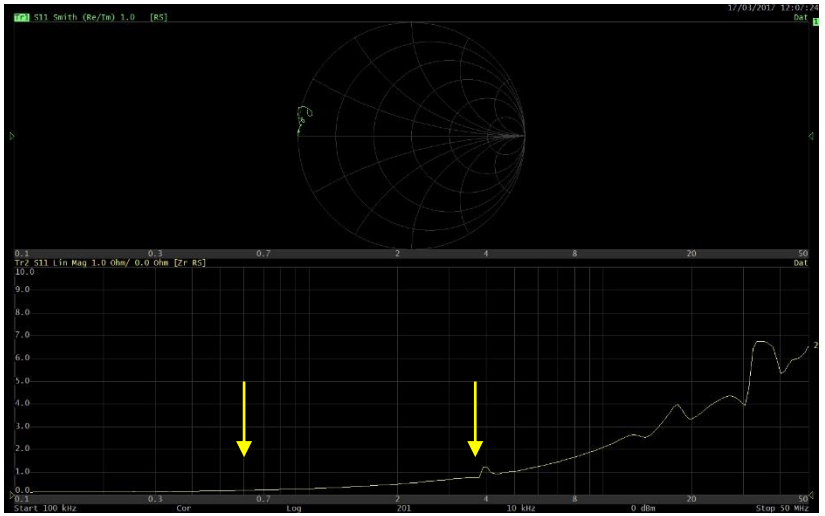
Ring 1



Ring 2



Ring 3



Ring 4

RF Bypass Impedance Measurements

All data in EDMS

PS: https://edms.cern.ch/document/434204/1

PSB: https://edms.cern.ch/document/1767548/1

Conclusion:

- All 120 measurements in about 1 hour without saving plots,
- The UPS can handle it, over 50% left,
- Radiation taken: Joao 8uS, Bruno 4uS,
- Measurement from interior or exterior of the ring could improve speed of measurements,
- The biggest part of time can be saved if cord extension is avoided,
- Continue to search a better portable USB connected VNA solution, automatization of the measurements.