PERFOMANCE OF THE CROWBAR OF THE LHC HIGH POWER RF SYSTEM

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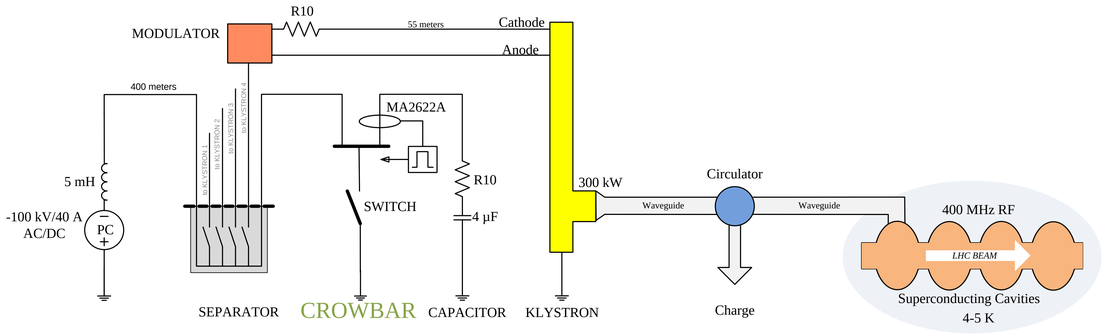
IPAC'12 International Particle Accelerator Conference 2012

INTRODUCTION

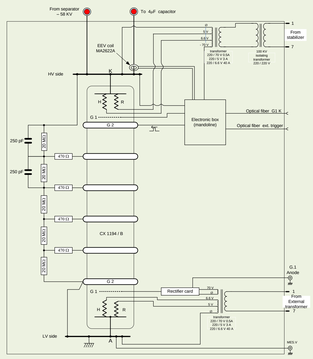
In case of an arc occurring inside a klystron, which is operated at -58 kV and 9 A, the high voltage energy is removed from the tube by triggering a thyratron which then becomes conducting and acts as a short circuit of the HV power supply to the ground.

Thyratrons are reliable from the point of view of protecting the klystron, but suffering from auto-firing!
A solid state solution, based on a stack of thyristors, has been designed for a direct thyratron replacement and has recently been implemented.



THYRATRON

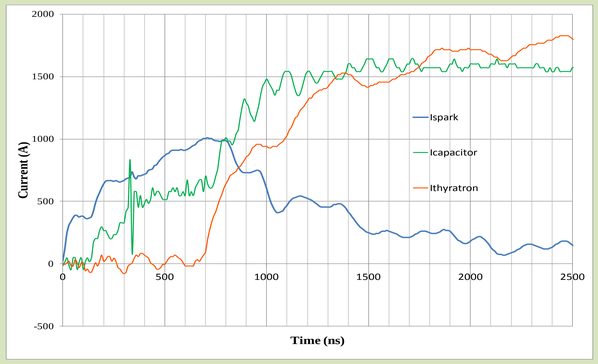
The current CROWBAR made by a 5 gap double ended thyratron (CX1194/B) is requiring a very fine adjustment.



- reliable from the point of view of protecting the klystron,
- suffering from auto-firing!

PARAMETERS

550 ns Turn ON Delay, 1200 ns rise time

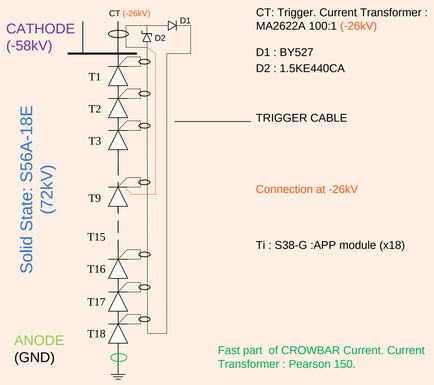


SOLID STATE THYRISTOR

PARAMETERS

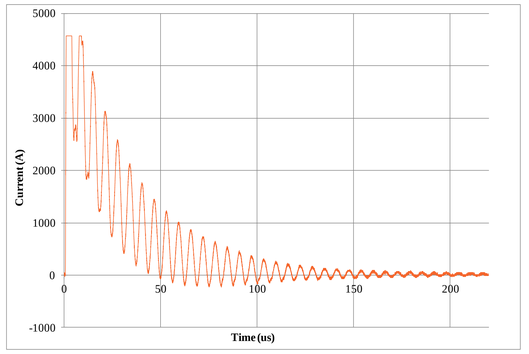
350 ns Turn ON Delay, 2500 ns rise time

New CROWBAR made by a solid state device (APP S56A-18-E), made up of 18 single thyristors stages no need for any extra control electronics

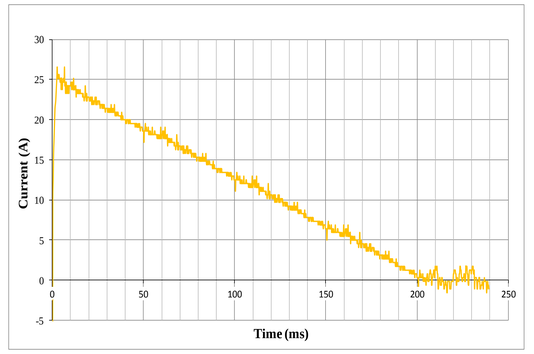


CROWBAR PERFORMANCE

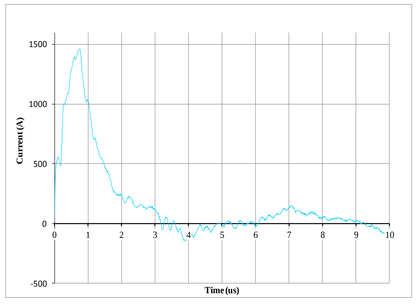
fast discharge of the 4 µF capacitor & the long coaxial cables (≈ 6000 A, 200 µs)

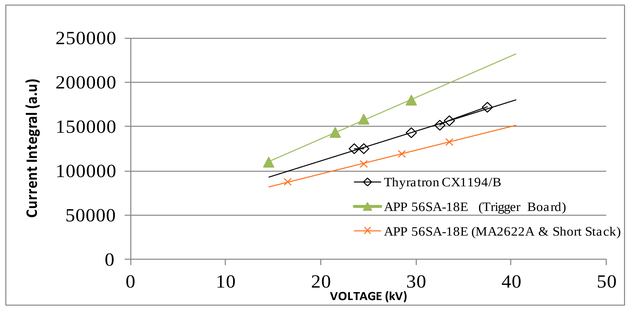


slow discharge of the 5 mH coils of the power converter (≈ 60 A, 340 ms)



ARC ENERGY DISSIPATION





CONCLUSIONS

A fully validated upgraded thyristors stack has been installed in LHC in February 2012. It equips one of the four HV bunker. Until now the device has proven to be very reliable and give full satisfaction. Other thyristors based crowbars are in production to equip the three other bunkers.

A long reliability run as well as complementary measurement of the energy lost into the arc will be made in the near future.

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