RF Power Linac

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RF Power for Linac

Modulator / Klystron TurnKey System
Made by Scandinova
Modulator type: K2-2
Total cost 1 M€
( Modulator + 3 Klystrons )
Factory Acceptance Test: 14/12/2016
Delivery next month
RF Power for Linac

Parameters:

RF Peak Power max.: 40 MW
Peak Voltage max.: 330 kV
Peak Current max.: 350 A
Electrical Peak Power max.: 92 MW
Pulse Width: 6,2 µS
Rep. Rate: 50 Hz
Jitter: ±4 nS

Modular System
RF Power for Linac

Dimensions: 1,5mX2mX2m
RF Power for Linac Composition

Modulator
- HV Power supplies
- Pulse Forming Units
- Pulse Transformer
- auxiliaires Systems, control & measurement
- Remote Control

Klystron
- Thoshiba
RF Power for Linac

Modulateur

HV PS

Pulse Forming

Step up Transformer

Kly.

Auxiliaires systems, control, measurements &
hardware interlock
Local and Remote control system

Accelerator.
RF Power for Linac Modulator Parts

HV Power supply

2 HV capacitor charging power supplies
Pulse width modulation at 25 kHz
Control of PWM by FPGA
Commutation: resonating $\frac{1}{2}$ bridge of 2 IGBT
Power: 25 kW
Charging rate: 25kJ/s
Voltage max: 1400 V  Current max: 18 A
Optical isolation control to avoid noise
Fine tune to set the capacitor at charge value
ThomX RF Power Linac
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Modulator Parts

Pulse Forming

7 Units dedicated for the pulse forming
Capacitor-energy storage: 141 µF
partiel discharge of 5 %
Commutation element: IGBT
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1- Capacitor-energy storage
2- Current measurement
3- PCB driver
4- PCB driver
5- Cooling
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Modulator Parts

Pulse Transformer

It’s the Key component of the modulator
- Several primary windings & split core
  low inductance & low voltage primary
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Modulator Parts

Auxiliaires Systems:
- Timing et Triggering
  - Timing generation interne/externe
  - Optical isolation of timing distrib. ➔ Modules

- Hardware interlock & Measurements
  - Dynamic: Over current; Over voltage; etc...
  - Static: Cooling; Acces; Radioprotection
  - External interrupt required; etc...

- Control System
  - Local and Remote
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Modulator Parts

Auxiliaires Systems for Klystron:
- Heater power supply
  Voltage: 20 V  Current: 20 A
- Focus Magnet (Solenoid)
  2 PS for 6 windings
- RF Power supply
  Ampli 400 W 3 Ghz
- Vacuum (Ion pump) Power supply
  Voltage: 3.5 kV  Current: 1 mA
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Klystron: Toshiba E37310

RF power(output): 37,5 MW
RF power(input): 325 W
Cathode Voltage: 285 kV
Cathode Current: 308 A
Cathode Heater Current: 17 A
RF Pulse Width: 4,5 µS
Rep. Rate: 50 Hz
Efficiency: 42,9 %
Gain: 50,6 dB
Perveance: 2,02 [µa/v^{3/2}]
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Modulator Factory Test

The FAT was done from 14/12/16 to 16/12/16
Modulator/Klystron running in HV mode (no RF)
All ccs where checked out, long time test (8 hours)
RF Power for Linac Modulator Factory Test

Rise Rate: 346 kV/µS
Fall Rate: 278 kV/µS
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Flat top during pulse: 1.2 %
Flat top during 1 µS: 0.2 %
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RF Network