Availability of RF power

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CERN

- ***Availability of amplifiers at CERN, RAL etc.***

RF Power Amplifiers available at CERN/PS

202.56 MHz:

1 amplifier (spare for Linac2) 2 MW, (could be upgraded to 4 MW)
1 amplifier (from Linac1, needs refurbishing for 200 kCHF) 4 MW
(FTH triode tube, ex-TH 516, water-cooled version)

The first one should be used as driver for the second one
⇒Total available power now 4 MW

This could go up to a total of 8 MW, provided we find another driver amplifier of several hundred kW

RF Power Amplifiers available at CERN/PS

88 MHz:

1 amplifier available 2 MW
(FTH triode tube)
driver (LHC type, modified) available

If amplifier is modified 4 MW achievable, but driver must be pushed

1 amplifier (from Linac1, needs refurbishing for 200 kCHF) 4 MW
(pushed) driver needs to be found or the amplifier above must be used.

Comment by Roland: A second 88 MHz cavity could be made available (i.e. another ex-PS 114 MHz cavity needs to be modified)

RF Power Amplifiers available at CERN/PS

200 MHz:

3 amplifiers 350 (400) kW, one available now, 2 more in a few years (with Siemens tube no longer built).

Still several spare tubes in stock. One tube good for up to 15 000 h in 300μs, 1 Hz, not full power regime.

Needs power supply for 40 kCHF. Switching via cathode (5 kCHF).

RF equipment at CERN/SL

A possibility for a driver of about 300 kW (pulsed)

(Dixit Trevor Linnecar; assuming the LHC project leader gives his approval:)

The scheme for LHC is to get the 300 kW at 200 MHz by combining the output of four 200 MHz tetrode amplifiers using hybrids. A 5th amplifier is used as a driver amplifer.

We have 20 amplifiers left over from the SPS period and should be able to lend up to 10 amplifiers.

We will be installing these amplifiers in LHC in 2007/8 when the intensity increases to nominal values UNLESS the beam quality is so bad from the SPS that we need them from LHC startup. In this case we would install them in LHC in 2006.

The power supplies are also recuperated from the SPS - they are big beasts and difficult to transport.

RF equipment at CERN/SL

As I said we will be making a test set-up to test the 300 kW amplifier itself, the 200 MHz cavities and the power couplers. We have estimated that the cost of all hybrids, detectors, lines, loads, pre-driver, circulator etc. will be of the order of 750 kCHF. We do not include controls etc. which will probably add for us a further 350 kCHF!

If you are content with an amplifier giving 90kW pulsed, say 75kW continuous, and if you do not need a circulator at the output then the ensemble will be very much cheaper.

RF equipment at RAL

One spare amplifier with Thomson tube TH 116 (ex TH 516)

Good for 4 MW for 100 to 200 ms

Comes with solid state cathode modulation and 40 kV anode supply

Driver available (4616) for 200 kW

RF equipment at RAL

Comments from David J S Findlay

We have four main 202.5 MHz amplifier sets here to drive our 4-tank 70 MeV H- linac. All four sets can deliver 2 MW in pulses 400 µs long at 50 pps, but we only ask for 1 MW from the set driving Tank 1. The amplifier chain is as follows:

200 W transistor amplifier,

3 kW Burle 7651 tetrode amplifier,

200 kW Burle 4616 tetrode amplifier,

2 MW Thomson TH116 triode (grounded grid) amplifier.

We have recently bought 4 kW Dressler solid

state amplifiers to replace the 7651 tetrode amplifiers, and we hope to make

the first such replacement this month.

At present, the maximum peak power output from the TH116s is probably determined by the limit on the anode mean power dissipation.

The valves should be able to deliver 4 MW for shorter pulses, but they would require more drive. Obviously we hold a fair number of spare items for the RF amplifier sets, but we do not have any spare complete amplifier sets which could be used for MICE, and nor do we have spare complete anode power supplies for the penultimate and final stages. We do have one spare coaxial structure for the final Thomson TH116 valve, but a few minor bits are missing, and the structure would require some remedial mechanical work done on it before it could be used.

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We have drawings of all the apparatus making up the amplifier sets, of course, and so copies could certainly be made. And obviously we have a lot of experience in running these sets. Further, it would probably not be particularly difficult to move the frequency to 201.25 MHz if American cavities were used. But the amplifier sets are quite old, and one might be better building apparatus to new designs rather than to old designs.

It is true that the R5.2 building at RAL in which a MICE experiment could be carried out is tantalisingly close to the R5.1 building housing the 70 MeV linac and the RF systems described above. And it is also true that if we did not have to run ISIS, we could probably pipe RF from R5.1 into R5.2 without too much difficulty. But given our present commitments on ISIS and our stretched manpower resources, it would not be easy to turn the contiguity of the two buildings to immediate advantage.

So, overall, I do not think we can be of much practical help to you on the RF front in the short term. Nevertheless, we appreciate the importance of the MICE project, and are keen to see it succeed, and so I shall be happy to maintain contact with you and give you whatever help I can.

RF equipment at FNAL

Video conf. 29/4/02

Al Moretti: old pieces available for a 5MW amplifier with "floating deck" modulator (= hard tube modulator) giving 45 kV and 300 A for 500 micros at 15 Hz for 200 MHz. Storage capacitors available, including grounding switches + crowbars. Whole cabinet about 4x4x6 m needs to be built. 7 V and 2000 A filament supply ok. Driver for 250 kW fairly complete. In addition: 1 FTE engineer + 2 FTEs technician. Whole setup costs minimum 350 k$ and maximum 600 k$ + manpower. Define situation at the latest by the RAL meeting.

RF equipment at GSI

108 MHz transmitter with 180 kW pulse power

Planned to convert one to 217 MHz

3 or 4 transmitters free (High Trap has an option for 2 or 3)

Peak power achieved at 108 MHz: 240 kW

RF equipment at CERN

Modulator (typically 4 MW, 200μs)

RF equipment at CERN

Transmitter 200 MHz (typically 2 - 4 MW, 200μs)

RF equipment at CERN

Top of 200 MHz transmitter (typically 2 - 4 MW, 200μs), modulator on left

RF equipment at CERN

Transmitter 100 MHz, some 100 kW

RF equipment at CERN

Top of 200 MHz transmitter (typically 2 - 4 MW, 200μs)

RF equipment at CERN

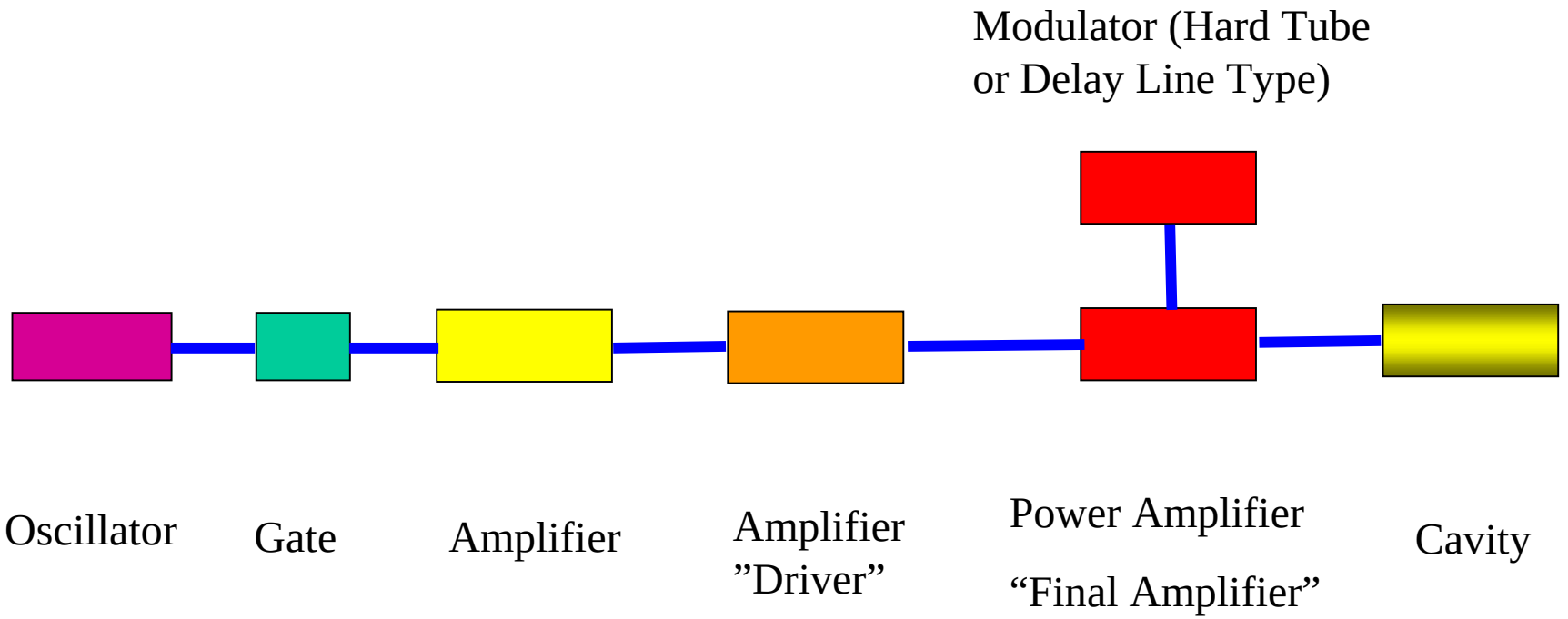
200 MHz transmitter (typically 2 - 4 MW, 200μs)

RF equipment at CERN

200 MHz transmitter (typically 2 - 4 MW, 200μs)

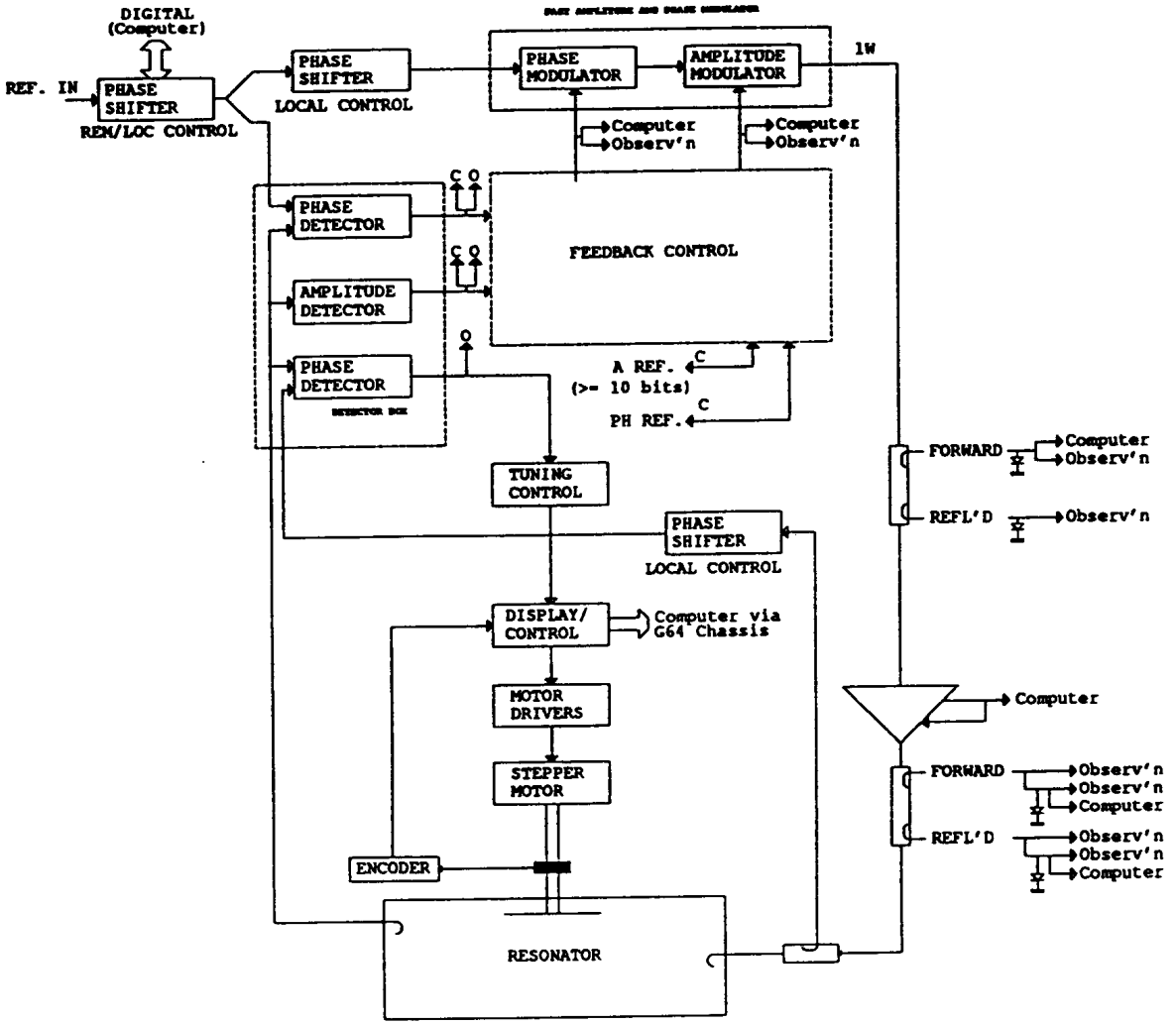
RF equipment at CERN

Principal layout



RF equipment at CERN

Principal layout



Thomson DIACRODE TH 628

Information given to W. Pirkl in 1999

Wanted: Tube for 200 MHz, pulsed, peak power 4 MW, 400 to 500 µs and 1pps.

Possible: TH 116, but low gain

Alternative: TH 628, modern, developed for 1 MW cw, 3 MW peak with 2.25 ms and 600 kW mean power.

Proposed driver: TH 781 (tetrode) instead of TH 681 (needed for higher mean power)

Achieved during tests: 4.1 MW (limited by power supply), could go higher…

4.5 MW achieved later

Higher gain than TH 116

Proposed: Diacrode TH 628: 171,200 €

Cavity TH 18628: 137,500 €

What is needed to proceed:

Exact frequency

Power requirements ← Needs simulations to determine accuracy of emittance measurements.

This determines the needed cooling factor and hence the RF power.

and duty cycle: → This determines the mains power and to a good extent the cost