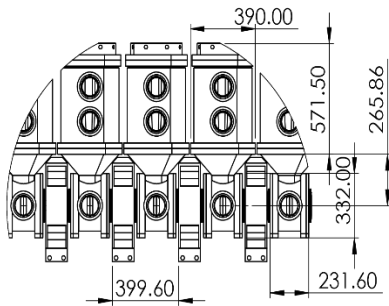


Design of an accurate LLRF system for an array of two-gap resonators

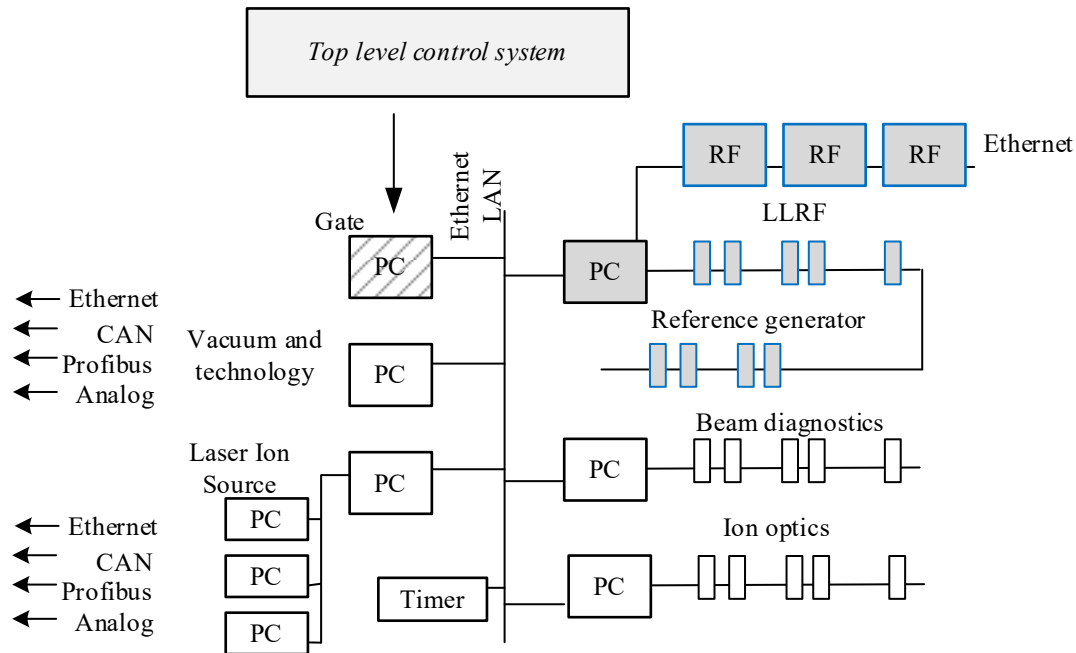


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Moskva, Russian Federation

2021

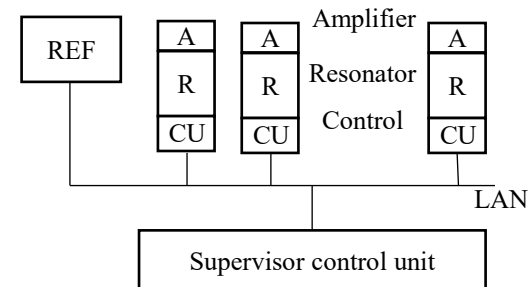
LLRF is a part of more general control system



LLRF performs resonator frequency adjustment, RF field phase and magnitude control

The system consist of

- Multichannel reference generator REF
- RF power amplifiers, accelerating resonators with resonator control unit CU
- Supervisor computer
- Virtual local area network LAN

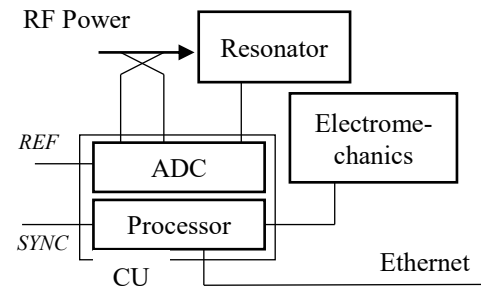


LLRF performs resonator frequency adjustment, RF field phase and magnitude control

Each resonator equipped with electromechanical tuner. RF setup measurements are performed by mean of directional coupler and calibrated control loop.

RF phase is measured relative to the common reference signal.

For the general synchronization the timing pulse is provided. All local delays and timed sequences are the responsibility of the processor unit.



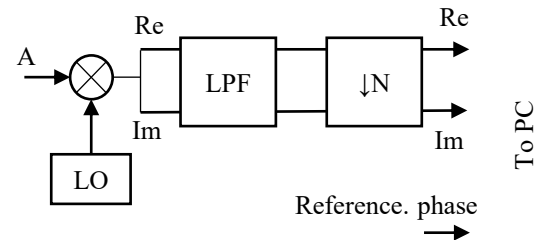
RF signal vector measurement units guarantee accurate phase and amplitude distribution along whole structure

RS signal measurements use a direct sampling of the input signal.

The ADC signal intermediate frequency due to undersampling is in the range 1...3 MHz

The digital processor (see figure) shifts the frequency downward and rarefies the data stream.

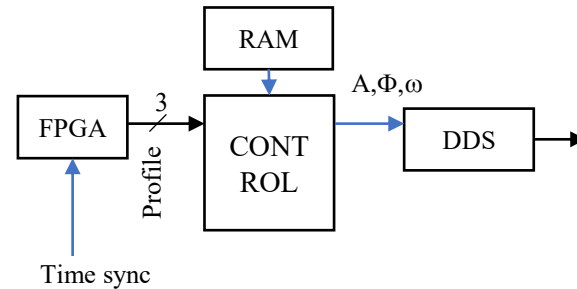
Resulting complex amplitude array is ready for transmission to the supervisor.



Each channel of the reference generator is able programmatically correcting the beam loading effect

The reference generator is a set of synchronized multi-channel modules that use direct digital signal synthesis (DDS)

When it is necessary the DDS is able to perform a beam loading effect compensation (see figure) using a prerecorded in RAM pulse shape



CONCLUSION

Proposed low-level RF control system solves general problems such, as frequency generation, stabilisation of the accurate phase and magnitude distributions over multiple resonators, stabilisation of the resonant frequency for each resonator in the system.

The DDS-based multichannel reference generator provides precise phase and magnitude manipulation. The distributed system of control units is a high-quality cost-effective system which corresponds to the distributed nature of the array of accelerating resonators.

Thank you