RF SYSTEM DESIGN FOR THE TRISTAN ACCUMULATION RING

Eizi EZURA, Takaaki FURUYA, Toshiyasu HIGO, Shigemi INAGAKI
Kiyoshi KITAGAWA, Yuzo KOJIMA, Hiroshi NAKANISHI
Shuichi NOGUCHI, Takeo TAKASHIMA and Koji TAKATA

KEK, National Laboratory for High Energy Physics

The accumulation ring (AR) is used as an injector for the TRISTAN 30 GeV electron-positron colliding ring. The AR accumulates electrons and positrons injected from the linac at 2.5 ∿ 3 GeV and accelerates them up to 8 GeV. The RF parameters and the machine parameters relevant to the RF system are given in Table I.

The required power will be provided by two klystrons, each capable of delivering 1 MW of continuous RF power. Each klystron feeds, via magic T power splitters, four accelerating cavities of Disk-and-Washer structure operating on the π mode. Each cavity consists of 12 half-wavelength cells. No isolation in the waveguides between the klystron and the cavities is presently planned. Since the klystron sees the cavity admittance and the cavity sees the klystron admittance, the values of the system parameters should be chosen so as to maximize the power transfer to the beam and to make the system stable over all possible operating conditions.

Fig. 1 shows the block diagram of the RF station control loops. The amplitude and phase of cavity fields are controlled and stabilized by the automatic voltage control loop and the phase lock loop. To protect the klystron, the RF input is switched off when a power reflection from cavity exceeds a predetermined level. Fig. 2 shows the block diagram of the cavity control loops. The resonance frequency is controlled over a range of 400 kHz by the common motion of the two tuners. An asymmetrical level distribution along the cavity is minimized by the differential positioning of the tuners. Phase detection is made at an intermediate frequency of 1 MHz.

All electronics components will be located in the local control rooms and the klystron halls so that they are accessible during operation and easy to maintain. They are implemented in a modular format of the NIM type. The RF system will be controlled either via computer-controlled CAMAC system, or at the RF station from a manual control panel.

Table I   RF System Parameters at 8 GeV

Frequency	508.58	MHz	Peak cavity voltage per turn*	27.9 MV
Harmonic number	640			
Machine circumference	377.26	m	Fundamental mode cavity dissipation	0.89 MW
Total shunt impedance	876	MΩ		
Total length of RF structure	28.3	m	Synchrotron radiation loss	0.47 MW
Number of cavities	8		Power loss to parasitic modes	0.04 MW
Number of klystrons	2			
Number of RF stations	2		Total RF power	1.4 MW
Circulating current	30	mA	Momentum compaction factor	0.0127
Synchrotron energy loss per turn	15.6	MeV	Synchrotron frequency	47.8 kHz
			Stable phase angle	126.8 deg
Parasitic mode energy loss per turn	1.1	MeV	Natural bunch length	1.8 cm

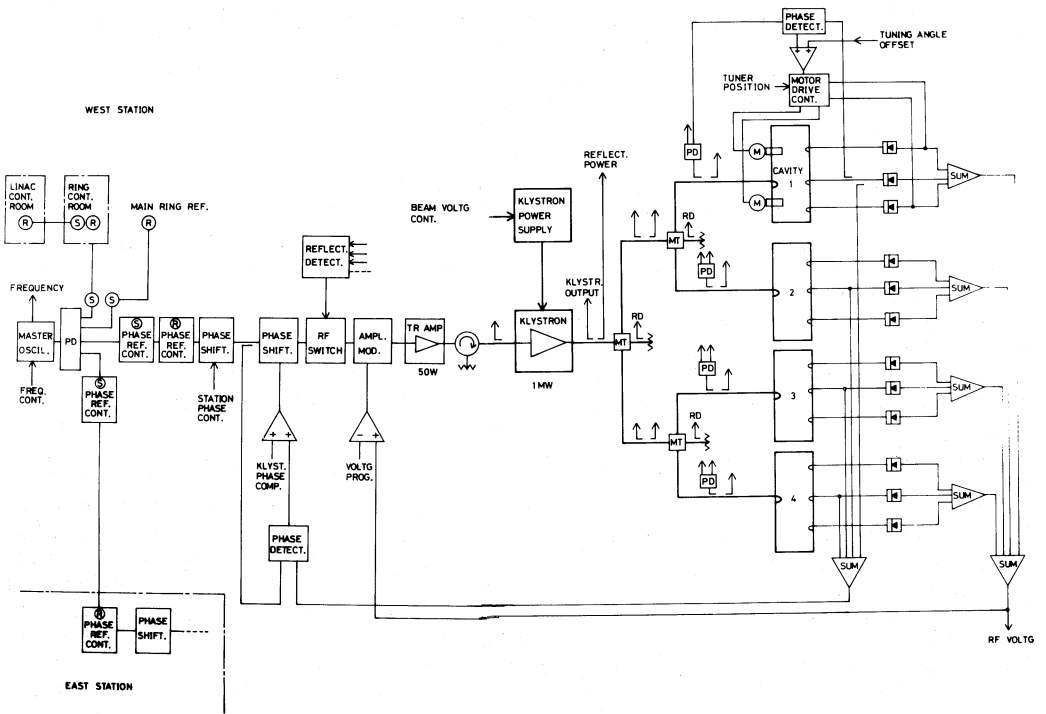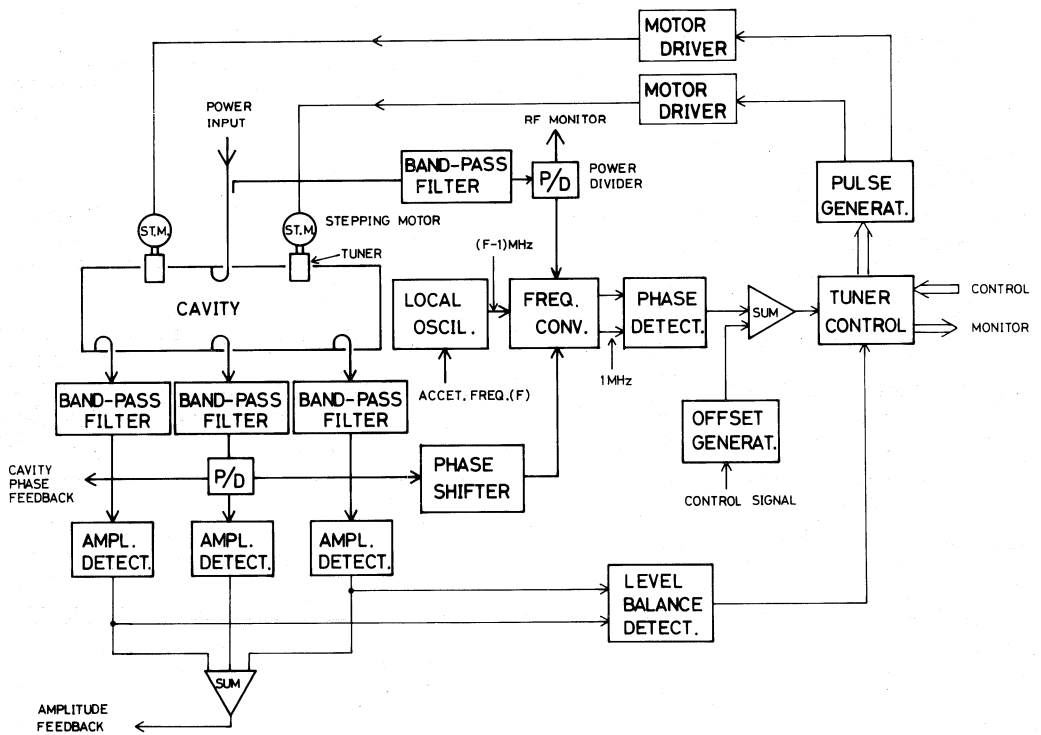* For 0.1 hour quantum lifetime.

Fig. 1   Block diagram of the RF station control loops.

Fig. 2   Block diagram of the cavity control loops.