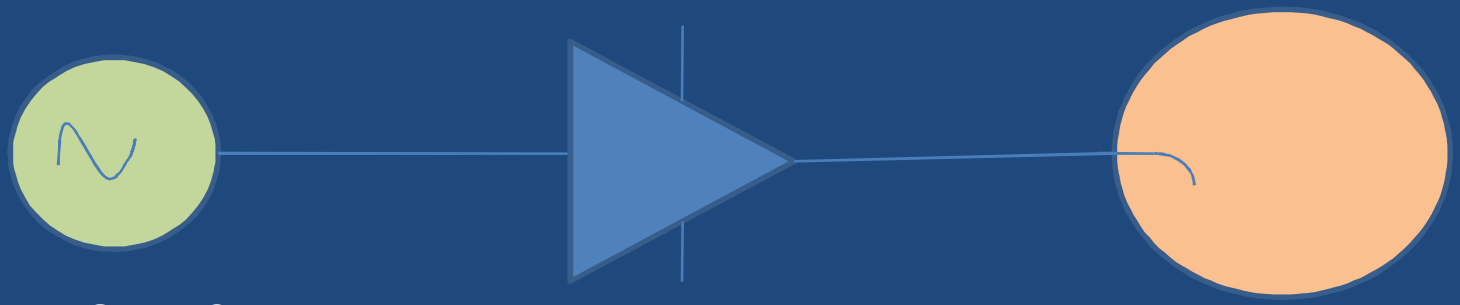
RF control system for 400Kev RFQ

Gopal Joshi, Shyam Mohan, Sandeep Bharade, Motiwala Paresh, C I Sujo, T.S.Ananthakrishnan and C.K. Pithawa

Electronics Division, BARC, MUMBAI

PCaPAC-2012 , VECC, KOLKATA

Ideal RF system



A RF signal generating low power RF energy and transferring it to the power amplifier

A RF transmitter for generating high power RF energy and transferring it to the cavity

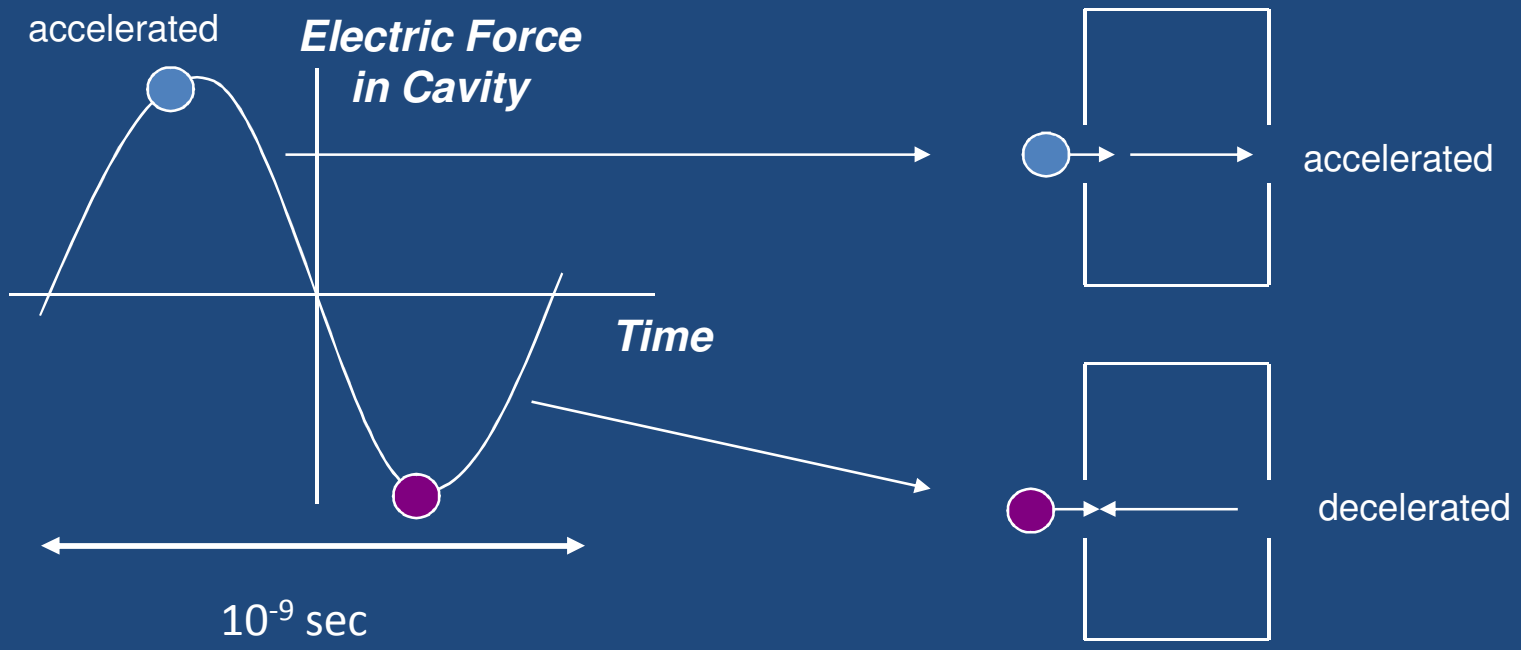
A RF cavity is a metallic structure under vacuum, consisting of one or several cells, in which an electromagnetic field interacting with the particle beam is confined.

Ideal RF system

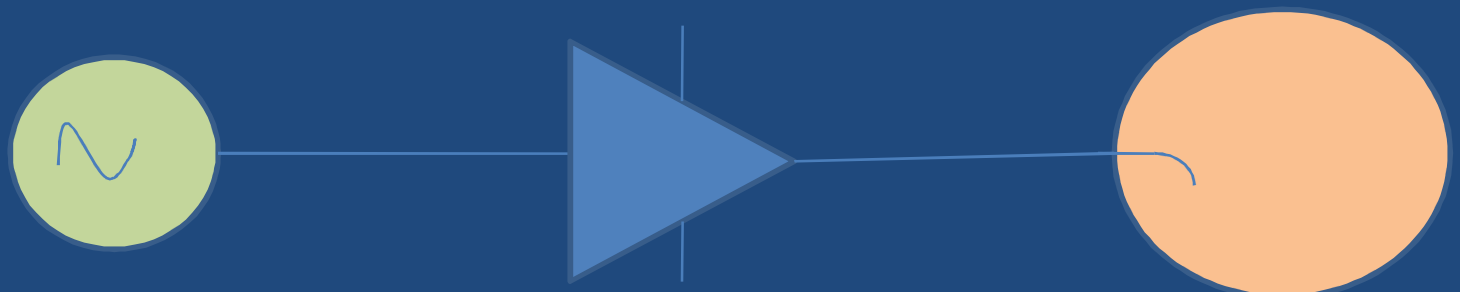
FREQUENCY SOURCE

POWER AMPLIFIER

RESONATOR



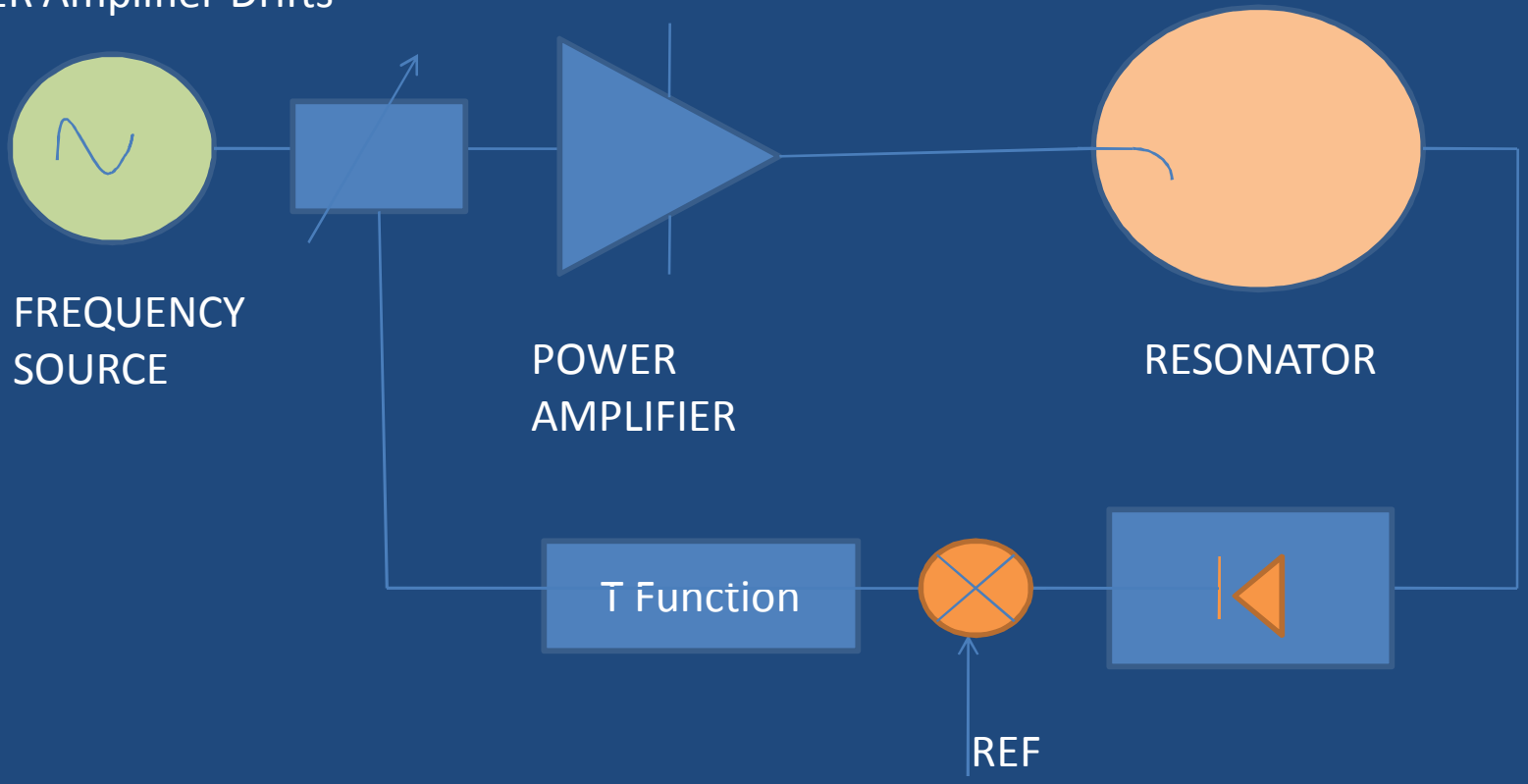
Ideal RF system



Problem:
POWER Amplifier Drifts
Resonator resonant frequency drifts

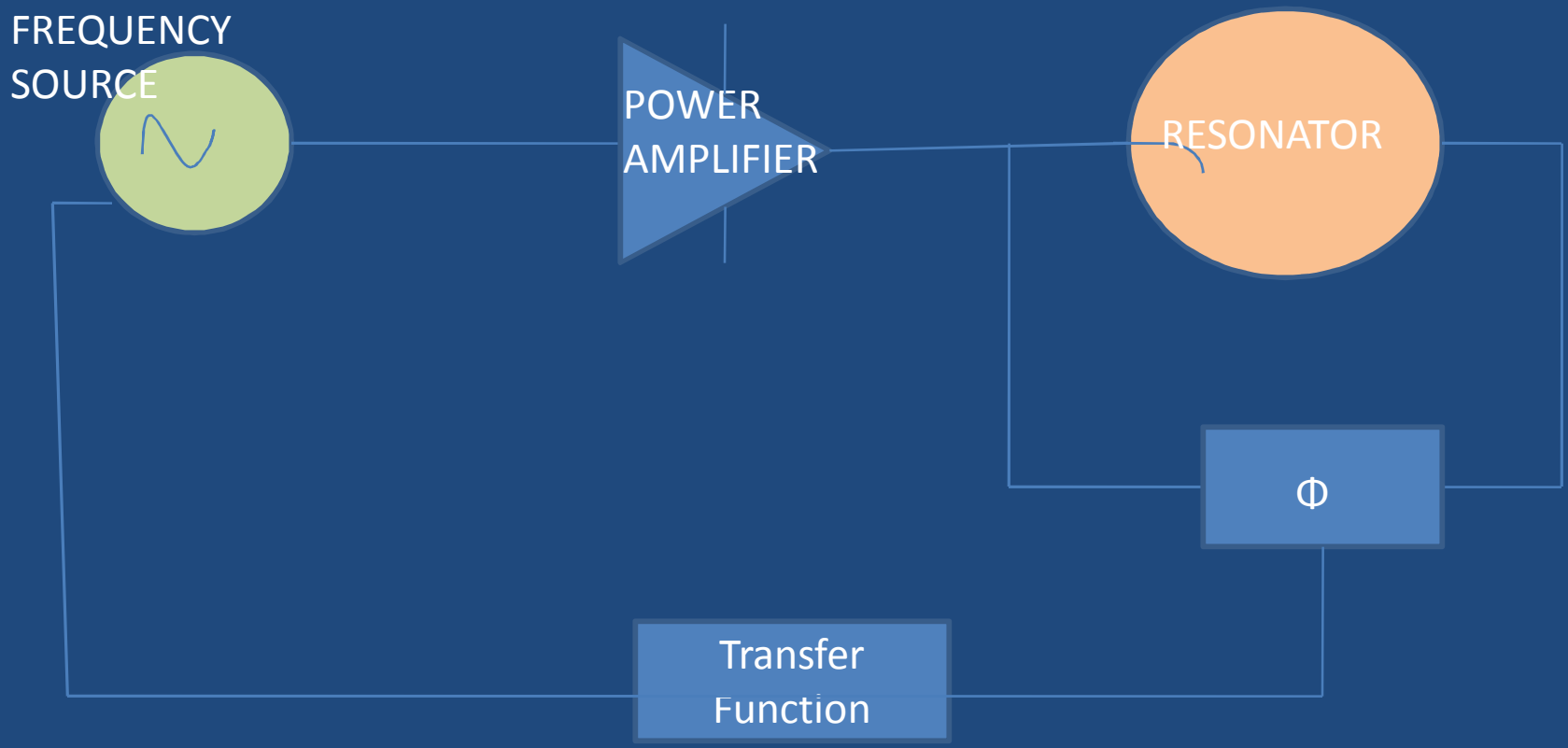
Amplitude Control loop RF system

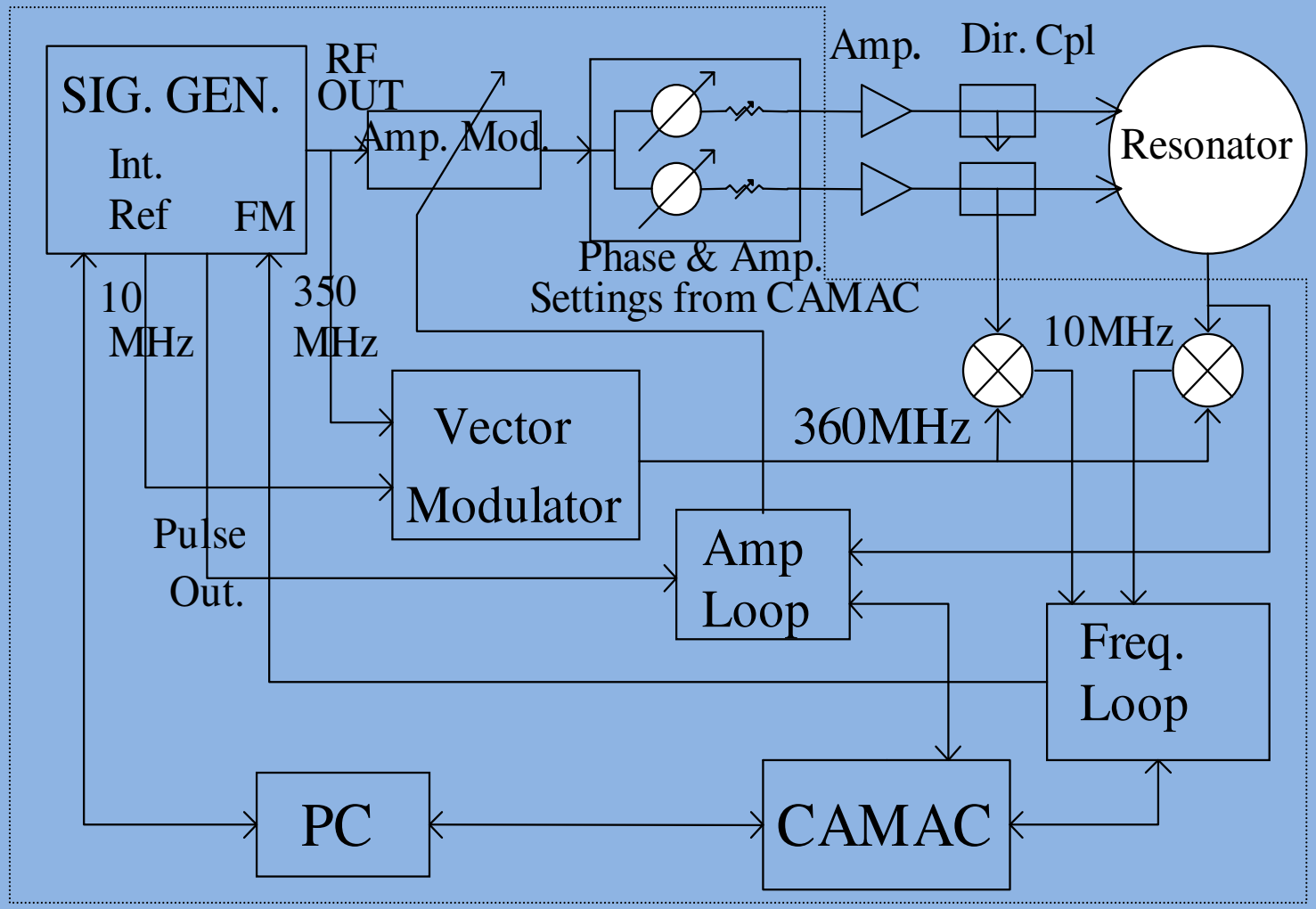
Problem:
POWER Amplifier Drifts

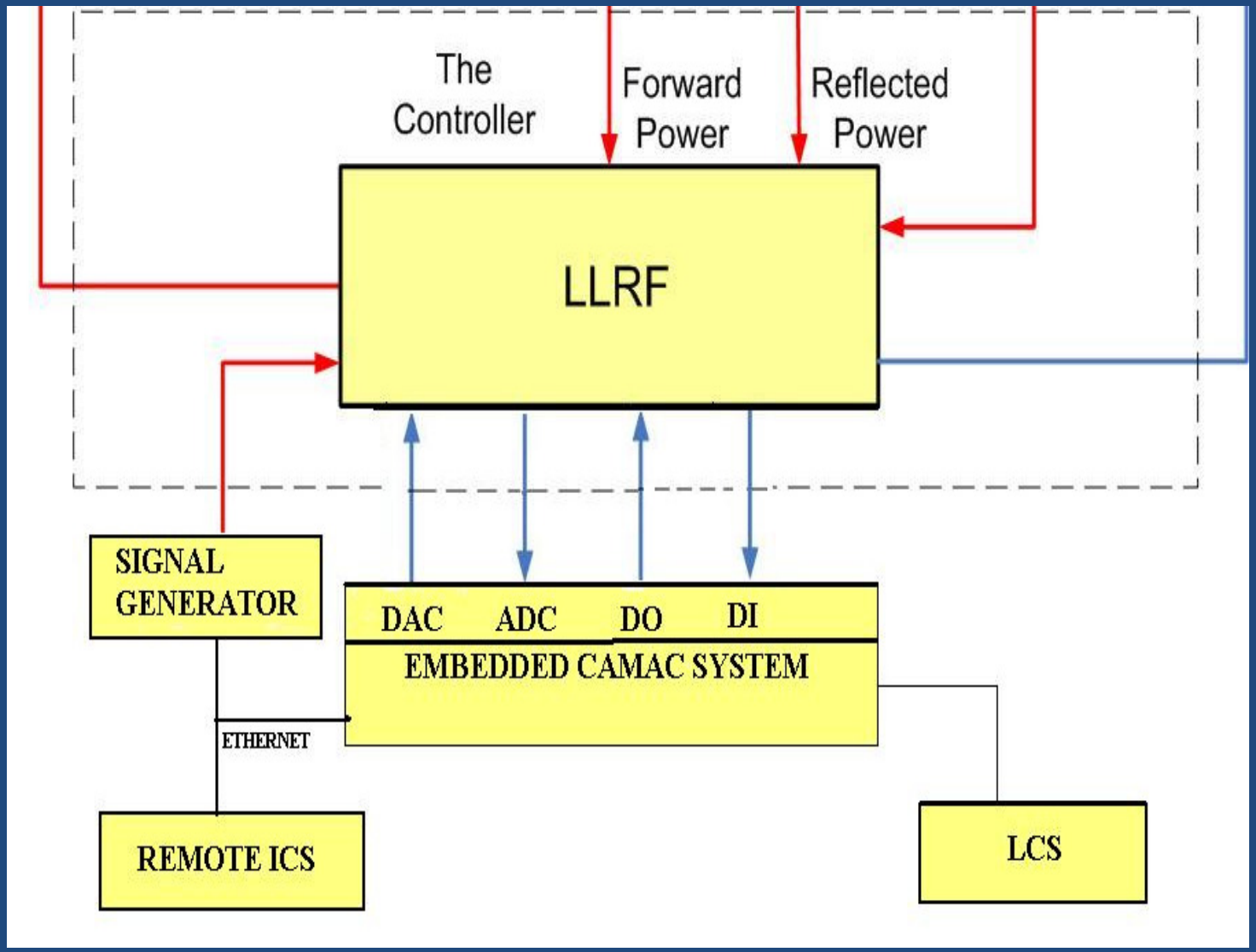


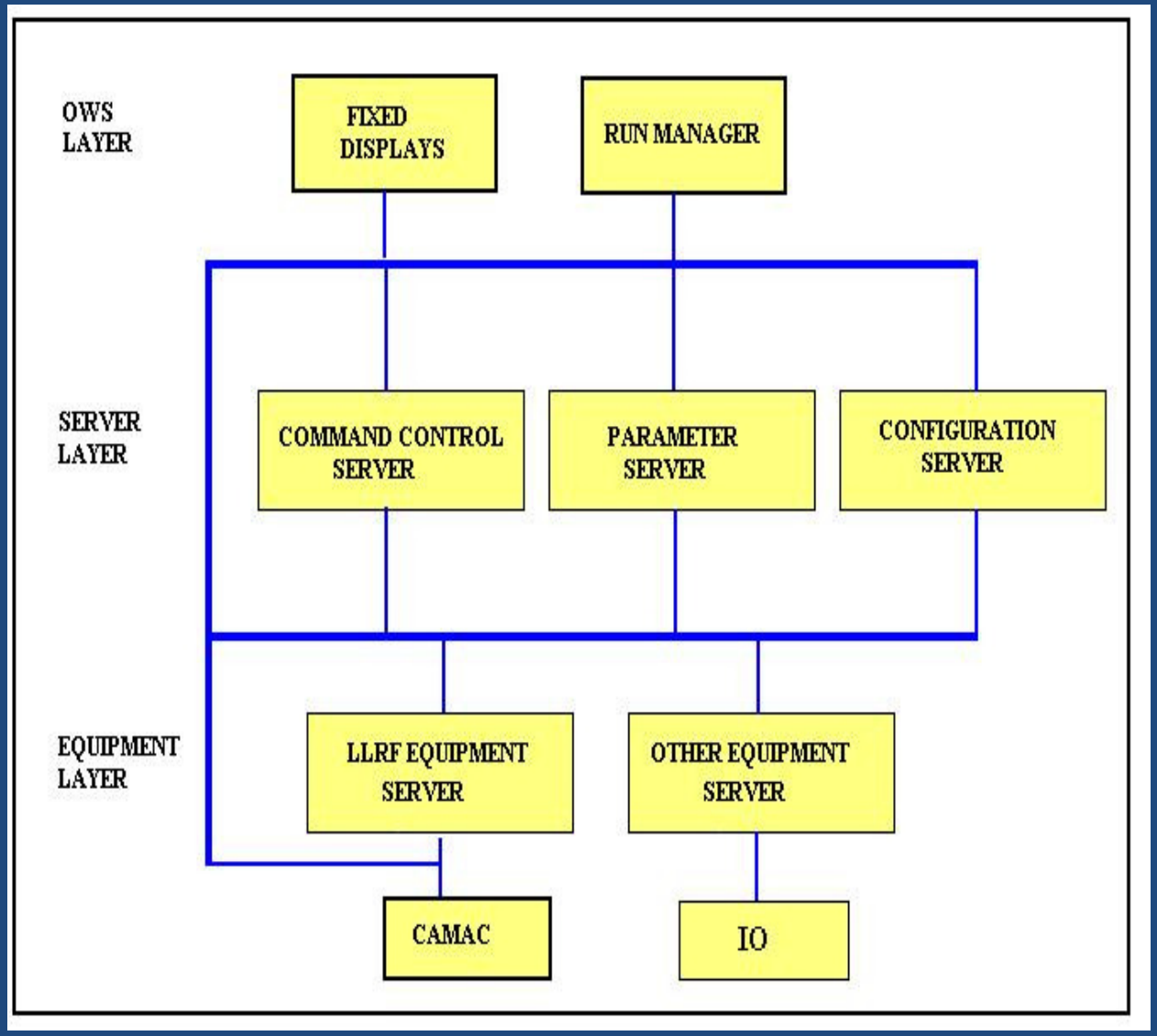
Frequency control loop

Resonator resonant frequency drifts




SIG. GEN.
Int.
Ref
FM
RF
OUT
Amp. Mod.
Phase & Amp.
Settings from CAMAC
Amp.
Dir. Cpl
Resonator
10
MHz
350
MHz
10MHz
360MHz
Vector
Modulator
Pulse
Out.
Amp
Loop
Freq.
Loop
PC
CAMAC


The Controller
Forward Power
Reflected Power
LLRF
SIGNAL GENERATOR
DAC ADC DO DI
EMBEDDED CAMAC SYSTEM
ETHERNET
REMOTE ICS
LCS


OWS LAYER
FIXED DISPLAYS
RUN MANAGER
SERVER LAYER
COMMAND CONTROL SERVER
PARAMETER SERVER
CONFIGURATION SERVER
EQUIPMENT LAYER
LLRF EQUIPMENT SERVER
OTHER EQUIPMENT SERVER
CAMAC
IO

Parameters

ReceiveThread

Parameter

FSM

F
I
F
O

Parameter-Holder

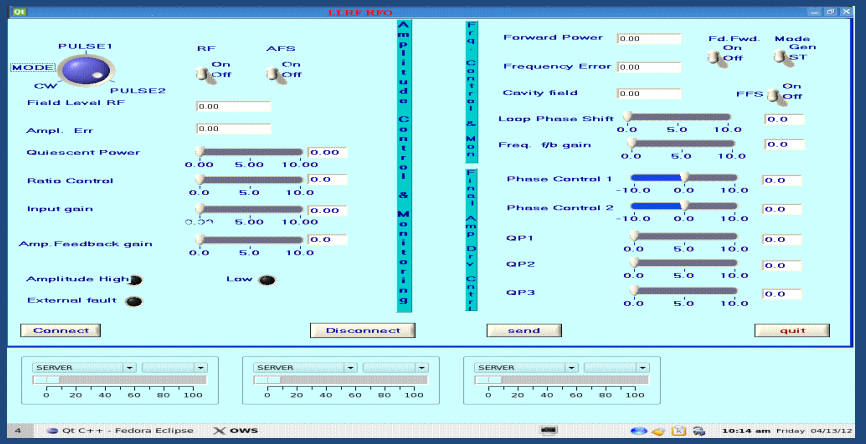
FSMController

Change Notify

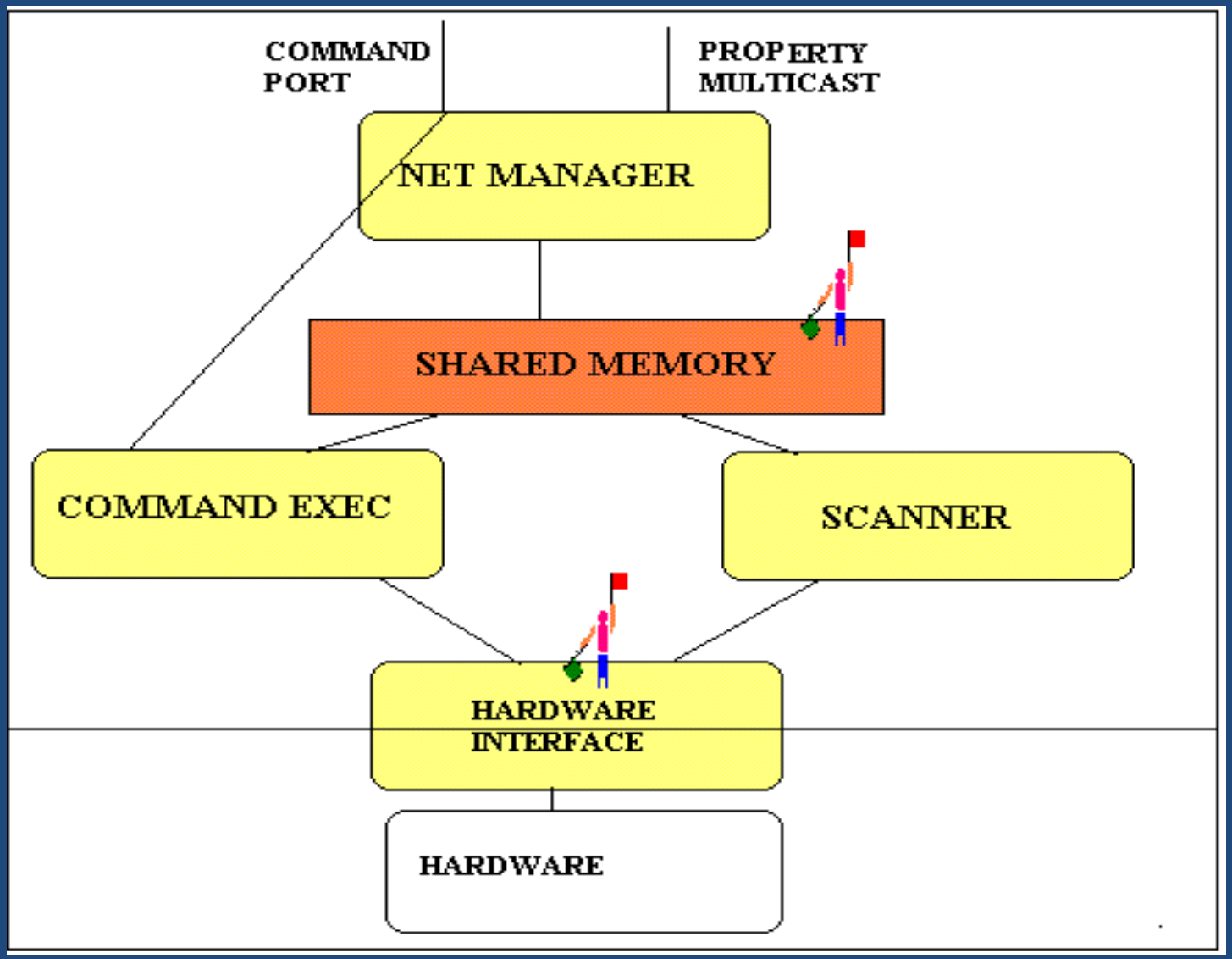
Message Thread

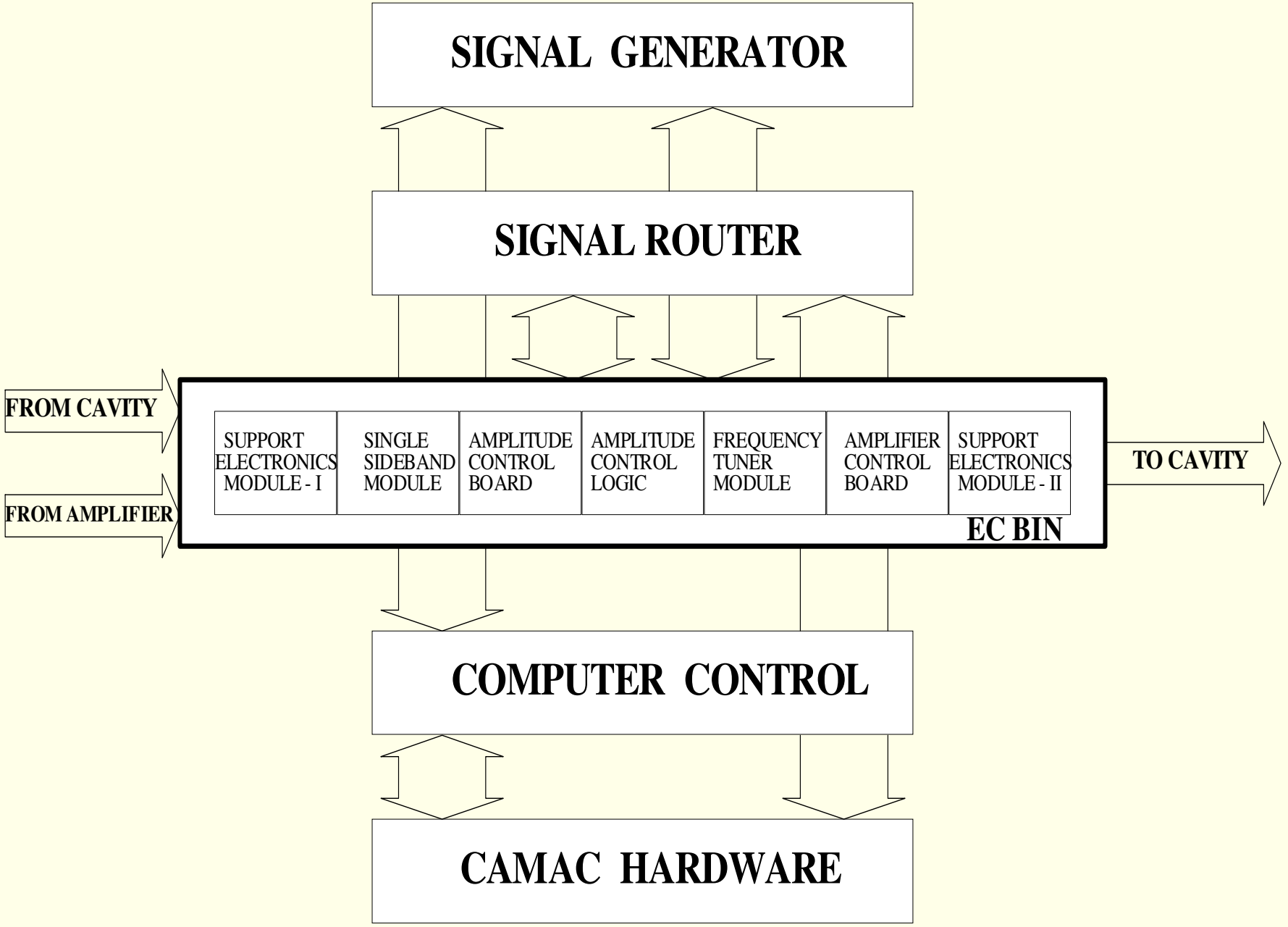
ParameterServer

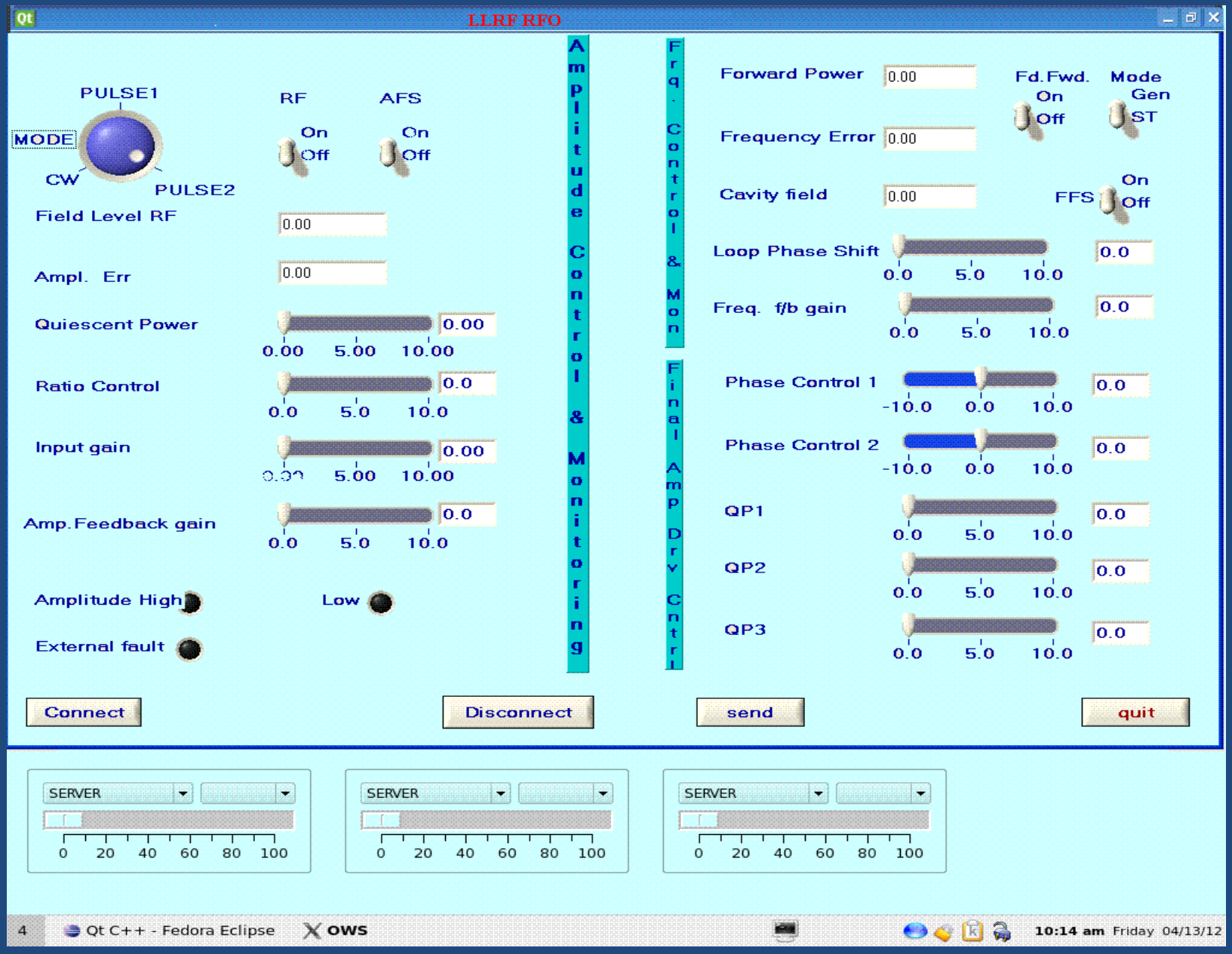
SubSystem



Concrete Subsystem


COMMAND
PORT
PROPERTY
MULTICAST
NET MANAGER
SHARED MEMORY
COMMAND EXEC
SCANNER
HARDWARE
INTERFACE
HARDWARE


SIGNAL GENERATOR
SIGNAL ROUTER
FROM CAVITY
FROM AMPLIFIER
SUPPORT ELECTRONICS MODULE - I
SINGLE SIDEBAND MODULE
AMPLITUDE CONTROL BOARD
AMPLITUDE CONTROL LOGIC
FREQUENCY TUNER MODULE
AMPLIFIER CONTROL BOARD
SUPPORT ELECTRONICS MODULE - II
EC BIN
TO CAVITY
COMPUTER CONTROL
CAMAC HARDWARE

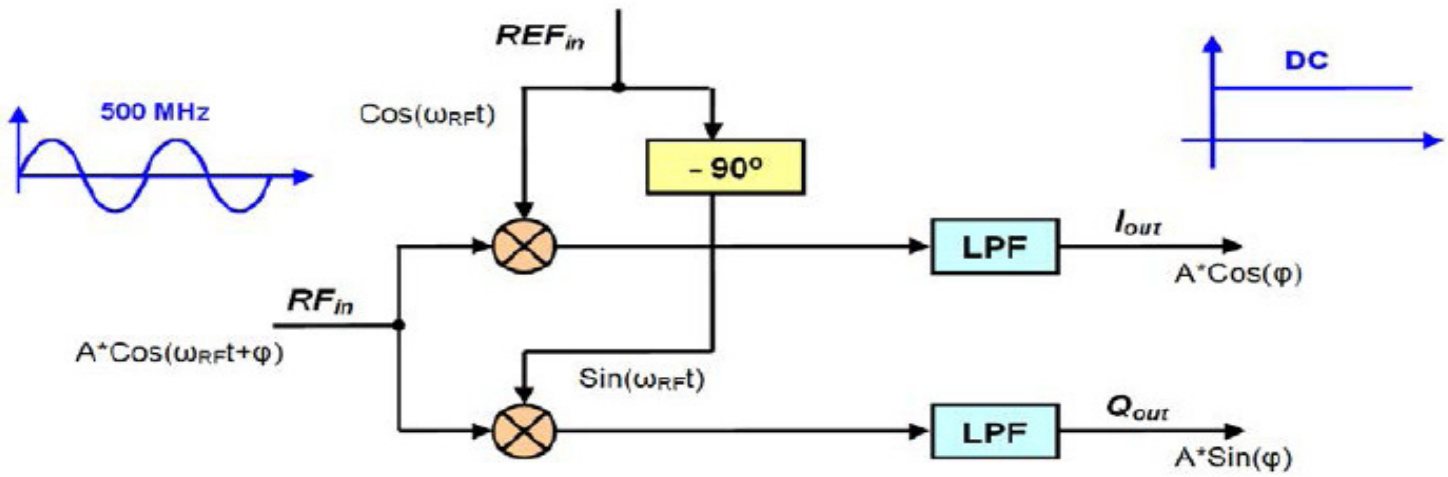

Qt
LLRF RFO
PULSE1
MODE
CW
PULSE2
RF
On
Off
AFS
On
Off
Field Level RF
0.00
Ampl. Err
0.00
Quiescent Power
0.00
0.00 5.00 10.00
Ratio Control
0.0
0.0 5.0 10.0
Input gain
0.00
0.00 5.00 10.00
Amp.Feedback gain
0.0
0.0 5.0 10.0
Amplitude High
Low
External fault
Amplitude Control & Monitoring
Frq. Control & Mon
Forward Power
0.00
Frequency Error
0.00
Cavity field
0.00
Fd.Fwd.
On
Off
Mode
Gen
ST
FFS
On
Off
Loop Phase Shift
0.0
0.0 5.0 10.0
Freq. f/b gain
0.0
0.0 5.0 10.0
Final Amp Drv Cntrl
Phase Control 1
0.0
-10.0 0.0 10.0
Phase Control 2
0.0
-10.0 0.0 10.0
QP1
0.0
0.0 5.0 10.0
QP2
0.0
0.0 5.0 10.0
QP3
0.0
0.0 5.0 10.0
Connect
Disconnect
send
quit
SERVER
0 20 40 60 80 100
SERVER
0 20 40 60 80 100
SERVER
0 20 40 60 80 100
4
Qt C++ - Fedora Eclipse
OWS
10:14 am Friday 04/13/12

Future Development

- Automation of cavity conditioning
- DLLRF implementation on CPCI
- State based control for different modes

- Contact:

Gopal Joshi gjos@barc.gov.in



$$|RF_{out}| = \sqrt{{I_{in}}^2 + {Q_{in}}^2}, \qquad \angle RF_{out} = arctan2(I_{in}, Q_{in})$$