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# RF System Overview

Alex Zaltsman

September 19-20, 2007

# EBIS HLRF 1.6.1

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- 5 Systems
  - Linac and RFQ
    - 350 kW pulsed output
  - 3 Bunchers
    - 5 kW pulsed output

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## RFQ & Linac

Frequency	100.625 MHz
Bandwidth	2 MHz
Peak power	400 kW
R/Q	108 for RFQ & 30 for Linac
Pulse width	1 mS
Pulse rise time	0.2 mS max
Duty cycle	1%



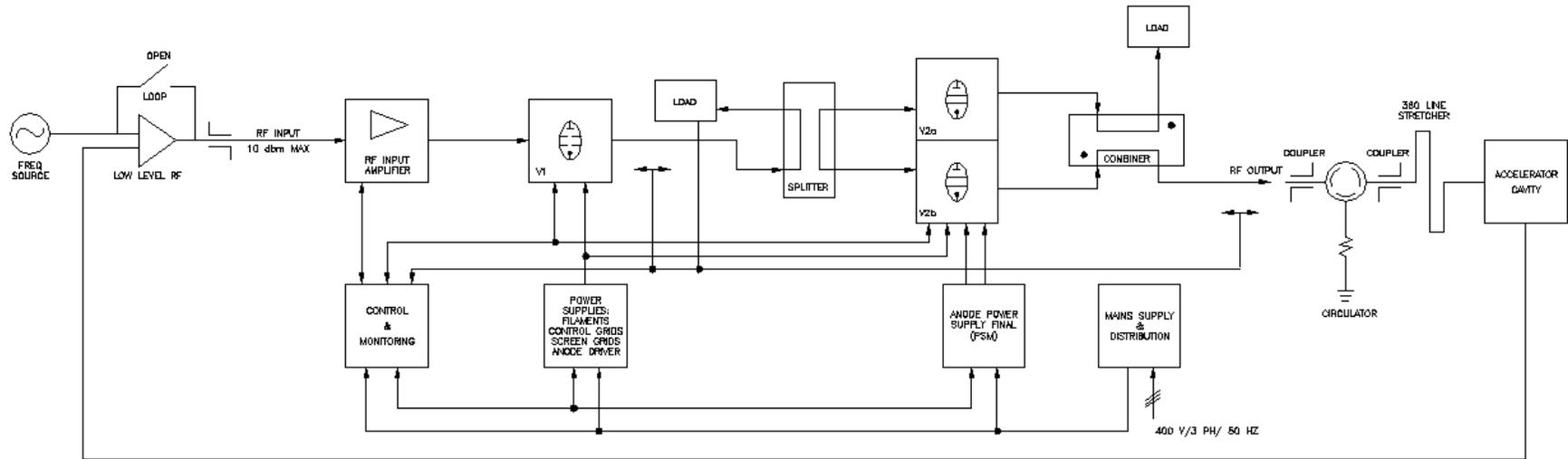
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# 350 kW RFPA Block Diagram

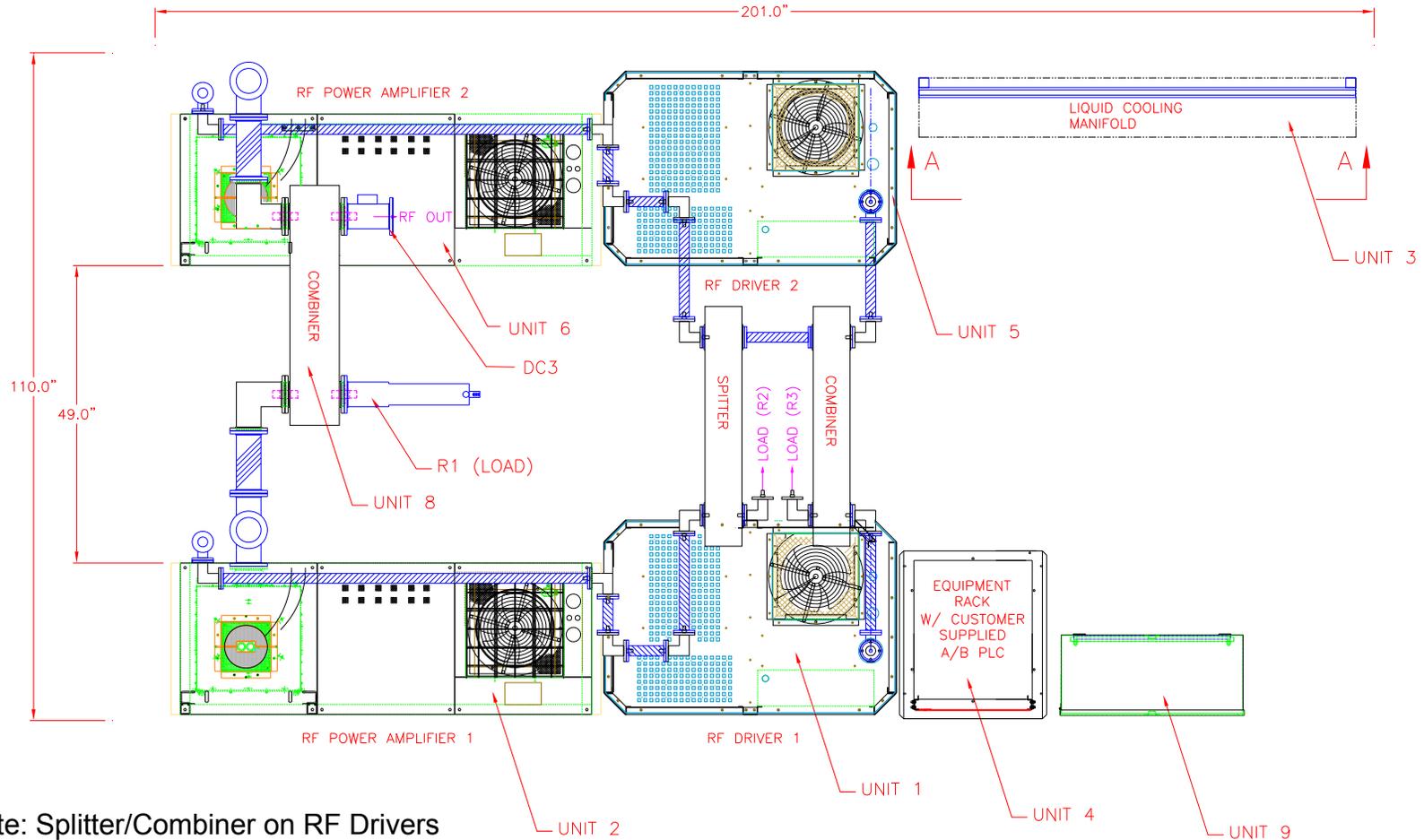


TYPICAL OVERALL BLOCKDIAGRAM OF THE RF AMPLIFIER SYSTEM

Note: Splitter/Combiner on RF Drivers used at CEC discretion.

Assembly Drawing 203500-a

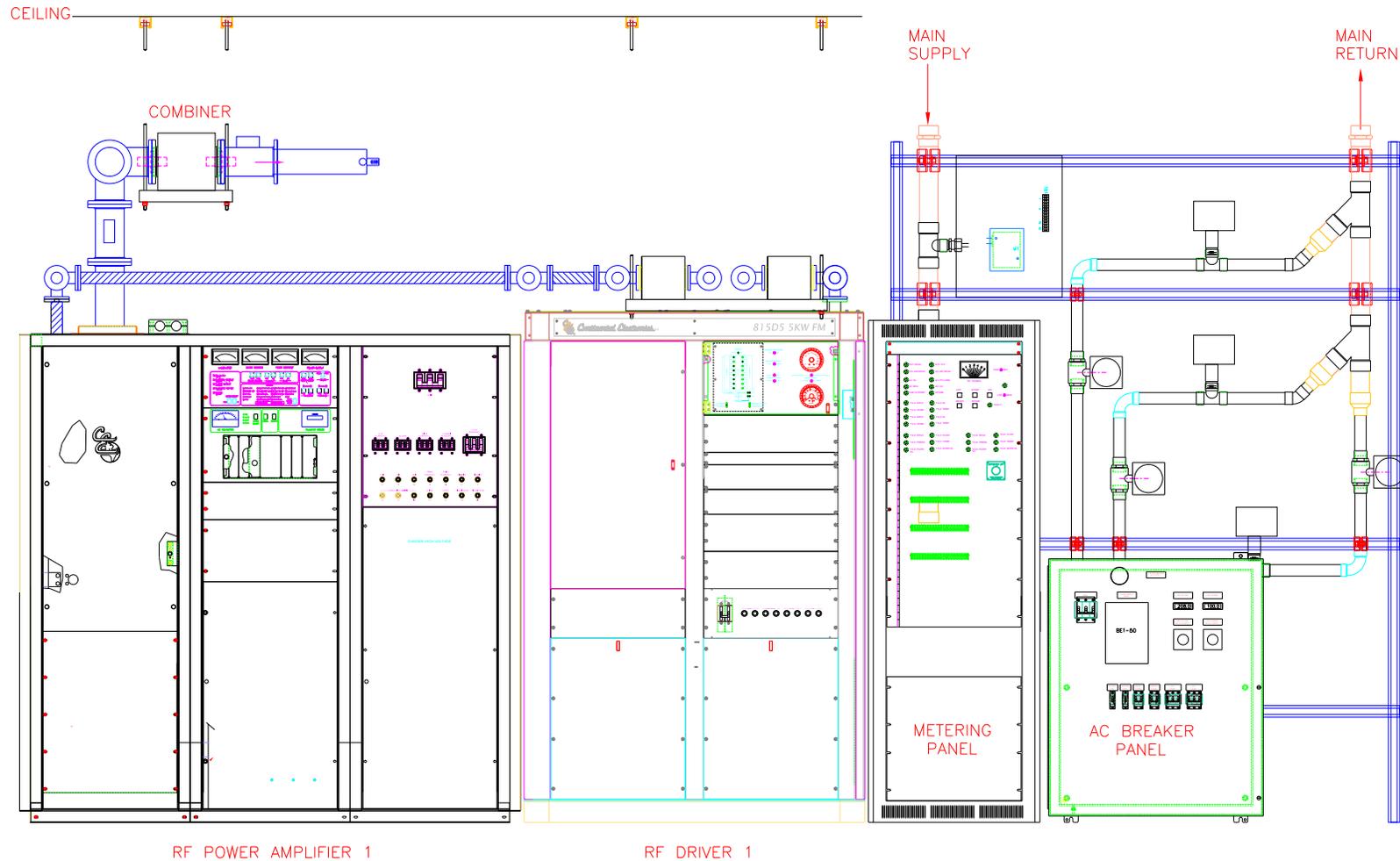
# Linac and RFQ amplifiers



Note: Splitter/Combiner on RF Drivers used at CEC discretion.

Assembly Drawing 203500-a

# Linac and RFQ amplifiers



Assembly Drawing 203500-a

# Linac and RFQ PA's: Output stage

- Two in system
- Based on commercial FM 816HD series transmitter
- PA consists of Thales cavity and tube
- Tube is water-cooled
- 175 KW RF pulse output power
- 200-250 VAC, 3 $\Phi$
- Interlocked with micro-switches
- Metering of RF FWD and RFL power,  $V_p$ ,  $I_p$ ,  $V_{sg}$ ,  $I_{sg}$ ,  $V_{cg}$ ,  $I_{cg}$
- LED indicators for fault and interlock statuses
- Interface for remote monitoring and control



816HD

# Linac and RFQ PA's: Driver Stage

## 5 kW

- Two in system
- Based on commercial FM 5 KW solid state transmitter
- Consists of 16 PA modules and 1 driver module
- Air-cooled
- 200-250 VAC, 1 $\Phi$
- Interlocked with micro-switches
- Metering of RF FWD and RFL power,  $V_D$ ,  $I_D$
- LED indicators for fault and interlock statuses
- Interface for remote monitoring and control



815D5

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- **Milestones:**

- First system fully assembled in the factory test stand  
10/29/07
- Second system fully assembled in the factory test stand  
11/12/07
- Pre-Factory acceptance tests 11/2007
- Factory acceptance tests 12/3 to 12/14/2007
- **Both systems delivered to BNL 1/7/2008**



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- Buncher Amplifiers
  - Frequency            100.625 MHz
  - Bandwidth            2 MHz
  - Peak Power           4 kW
  - R/Q                    1.5 k

# EBIS LLRF 1.6.2



- Digital LLRF system based on the common controller platform of the C-AD LLRF Upgrade.
  - **Controller = Carrier + N Daughter Modules**
    - 19" stand alone chassis, 1U or 2U TBD.
  - **Carrier**
    - Externally, a standard FEC on controls network, based on Xilinx V5 dual embedded PowerPCs.
    - Internally, replaces complete VME crate.
      - High bandwidth communication and configuration platform for daughter modules.
      - 2GB DDR2 SDRAM, FLASH, 10/100/1000 Ethernet, Controls Link Decoding, System Synchronization, Diagnostic Data Engine, Remote Reconfiguration.
  - **Daughter Module**
    - XMC Format (allows for COTS hardware if needed)
    - RF and Baseband DACs and ADCs, DSP
    - Provide interface between analog and digital worlds, required signal processing, control loops and diagnostic data acquisition.
    - All modules share common Xilinx V5 FPGA, DDR2 SDRAM, FLASH, Clock Distribution and Carrier Interface. Ease design and improve reliability.
    - Specific functionality module by module
      - 4 CH RF ADC, 4 CH RF DAC, 16 CH + 16 CH Baseband ADC/DAC, Dual DSP



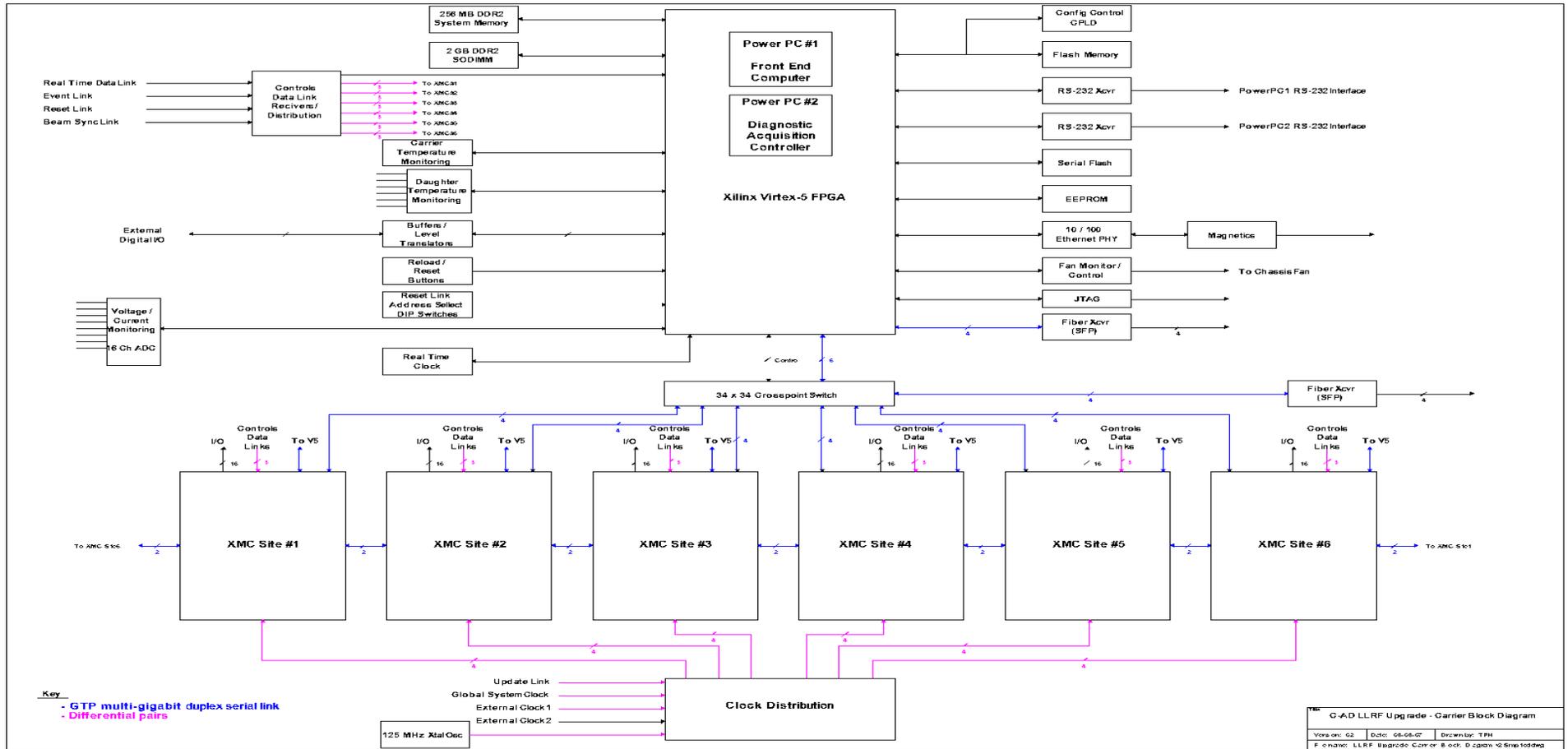
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# EBIS LLRF 1.6.2



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# EBIS LLRF 1.6.2



- Current Status and Schedule
  - PMC (communication interface bus) Prototype Module
    - Designed, fabricated and assembled.
    - Successfully demonstrated as a fully functional VxWorks FEC with standard controls software. Completely transparent to controls network.
    - Also demonstrated DDR2 and SDR SDRAM interfaces, Ethernet Interface, FLASH Interface, 3.125 Gb Serial Interface on Cu and Fiber.
    - Continues functioning as an embedded development platform. Exploring “soft” cores and other O/S options.



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# EBIS LLRF 1.6.2



- Current Status and Schedule (Cont.)
  - First generation Carrier, RF ADC and RF DAC
    - Hardware, firmware and software in design now.
    - Expect hardware in house Jan. 2008.
    - Initial testing of hardware with basic firmware and software expected complete by March 2008.
  - Production hardware
    - Expect two controllers, one for RFQ and LINAC, one for Bunchers.
    - Ready by October 2008.

