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Interface Control Document
for
325 MHz, 7 kW Solid State Power Amplifier (SSPA) System
Rev. 1 (August 16, 2017)

IIFC Approvals

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This is a joint document of the Indian Institutions and Fermilab Collaboration (IIFC), prepared by Fermilab and DAE under the DOE-DAE Discovery Science Implementing Agreement, Project Annex I. This joint document is governed by all terms and conditions contained in Annex I to the Agreement on Science and Technology Cooperation Between the Government of the United States of America and the Government of the Republic of India.

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A note to reviewers and approvers of Rev. -

As of the revision date of this document, not enough design information is known about 325 MHz, 7kW RFPA and its interfacing systems to write a complete, comprehensive interface control document. The expectation is that this document will be revised when the design has progressed far enough that all interfaces may be completely specified. (Once signed, further changes should be of minor nature and should not affect the design of SSPA)

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1.0 Purpose-325 MHz, 7kW, RF Power Amplifier

The purpose of this document is to map out the external interfaces of the 325 MHz, 7kW RF solid state power amplifier (SSPA), i.e. how it interfaces with the connected systems of PIP-II and the PIP-II Injector Test. This document endeavors to cover all connections to the RFPA that will be made in the PIP-II Injector Test or PIP-II gallery. Figure 1.1 shows the SSPA and its various interfaces.

2.0 Facility Environment and Utility Connections

2.1 Gallery Environment

- Mountable in 19" available width, 90" available height rack.
- Possible environment temperature: 10-40 °C.
- Possible environment humidity: 30-90%.

2.2 Water Cooling

- Maximum inlet water pressure: 125 psig
- Maximum water pressure drop: 60psi
- Required flow: 32 lpm minimum
- Cooling water temperature nominal: 26-30 °C.
- Cooling water header: Copper/SS NPT (male) of 1" size

2.3 AC Power

- AC input power: 3-phase, 4-wire (delta with ground), 480 VAC, 60 Hz
- Maximum 480 VAC current pull: 32 amps
- 480 VAC connection: internal terminal block
- Separate power source for amplifier's interlock, protection, and monitoring system (IPMS), modifiable for single phase 120 VAC, 60Hz.

3.0 RF Power Output

- Connection: 3-1/8" EIA flange on rear panel for 3-1/8" hard line (50 ohm), coaxial RF distribution
- Maximum output power: 7 kW at 325 MHz

4.0 RF Input (LLRF)

- Connection: 50 ohm N connector (F), 50 ohm, on rear panel for ½" flexible, coaxial cable
- Input return loss: -15 dB minimum
- Input drive for max power: +6.5 dBm minimum
- Input drive: 15 dBm maximum

5.0 RFPI

Name	Signal Type	Connector	Cable	Polarity
SSA_Inhibit	50 ohm TTL	50 ohm BNC	RG-58	Active Low
DC_Inhibit	50 ohm TTL	50 ohm BNC	RG-58	Active Low

SSA_Ready/Fault	50 ohm TTL	50 ohm BNC	RG-58	Active High

6.0 Safety Permit

- Active closed relay contact input, optically isolated in RFPA.
- Connection – Twin-ax connector for two-wire, shielded, twisted pair cable.

7.0 Controls

7.1 PLC Connections

- Connection – Standard 15-pin HD-connector for ribbon cable

Name	Signal Type	Connector Pin	I/O	Polarity	Signal Origin
ON/OFF (start)	Opto-isolated 5V	#3 for +ve, and #4 for -ve	Input	Active High	PLC Controls
SSA Reset	Opto-isolated 5V	#5 for +ve, and #10 for -ve	Input	Active High	PLC Controls
SSA_Ready/Fault	Optocoupler C-E (or D-S) pair	#9 for +ve, and #15 for -ve	Output	Active High	SSPA
Remote/Local	Optocoupler C-E (or D-S) pair	#8 for +ve, and #11 for -ve	Output	Active High	SSPA
Pulse/CW Mode	Opto-isolated 5V	#2 for +ve, and #1 for -ve	Input	Active Low	PLC Controls

7.2 Timing/Gating Signal

- Connection – 50 ohm BNC connector for RG-58 cable
- Signal Type – 50 ohm TTL

7.3 Ethernet Communication

- Connection – RJ45 Ethernet for n-wire Ethernet cable
- Protocol – MODBUS/TCP