



Beams Division / RF Department / HLRF Group
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Booster RF Modulator Start Up / Shut down Procedure

This Procedure is used for two purposes. The first is to bring the Modulator from an isolated **AC Source of Energy State** to Modulator HV Ready State (**Startup**). The Second is to bring the Modulator from a HV ON state, to an isolated state where the **AC Source of energy that feeds** the Boosters Modulator is locked out using LOTO (**Shutdown**). One must be familiar with and be able to follow all LOTO procedures mentioned in this document.

Personnel required

- 1.) At least one authorized and knowledgeable about the Booster RF System. **Need two**, at least one authorized if going into the Galleries Anode Power Supply.

Prepare and Notify

- 1) **Prepare:** The authorized employee shall understand the hazards involved and how to control them. If an authorized employee does not have this knowledge, he/she is not qualified to perform the LOTO procedure or maintenance activity.

The authorized employee shall understand and follow the [Booster Modulator LOTO procedure \(ADDP-RF 2016--0005\)](#) to isolate the sources of AC energy feeding the Modulator.

- 2) **Notify:** The authorized employee should or should have, as necessary, notify affected area personnel of the LOTO and maintenance activity. Affected personnel include those who might normally use the equipment or who would be affected by the unavailability of the equipment

Booster Modulator Startup Procedure

- 1) Verify all Filament, Power Supply, Analog/Digital and Interlock cables are connected to the top of the Modulator and both Ground cables are attached to the top rear panel.
- 2) Verify that the Modulators 480 V Plug is connected to the RF Stations Modulator receptacle.



- 3) The authorized employee shall then follow the **Booster Modulator LOTO procedure (ADDP-RF 2016-0005)** for restoring all the sources of AC energy to the Modulator if the supplies 480V has been locked out.
- 4) Turn on the Modulators Main, Deck and Filament Breakers.



- 5) Verify that the NIM Crate is ON.



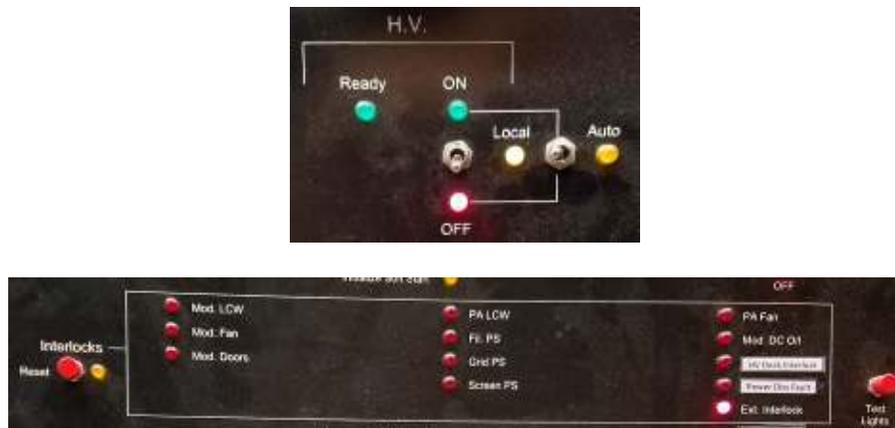
6) Turn on the Grid, Screen and Filament Power Supply.



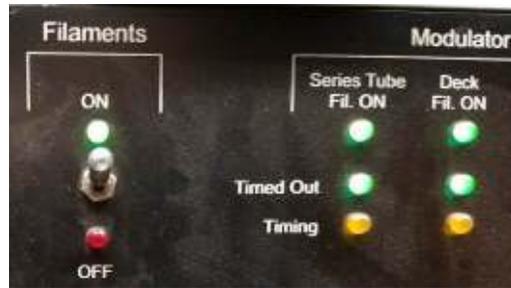
7) Check to be sure Modulator and PA Water Flows are within Range. Verify by looking at the Water Flow Turbine NIM Module that both Green LEDs are active.



8) Place the Modulator Control Unit into LOCAL and Reset the Modulator Control UNIT to clear all faults. (External Interlock excluded)



- 9) Verify that the Deck and Filament Breakers are in the ON position before Filament sequence starts.
 - a) Place Filament toggle switch into the on position. Now one should observe that the **Series Tube (3 Min)** and **PA Filaments** are timing in.
 - b) Set PA Filament **Voltage knob** around 7.5 and the **Current knob** around 4.6 (**Filament Voltage= 15.0**)
 - c) After about three Minutes one should observe that the Deck is timing in.



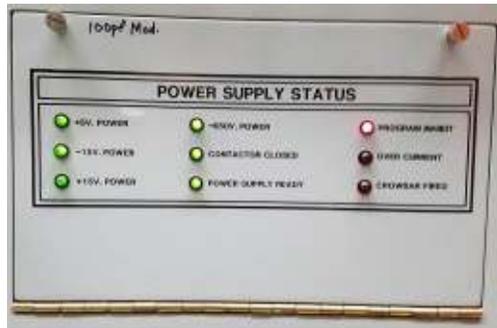
- 10) Measure the PA Filament Voltage on the RG-108 Fil monitor cable, this is accomplished by using a twinax to BNC adaptive device connect to a DVM. (**Set to 15 volts**) approx. 16 on the Meter.



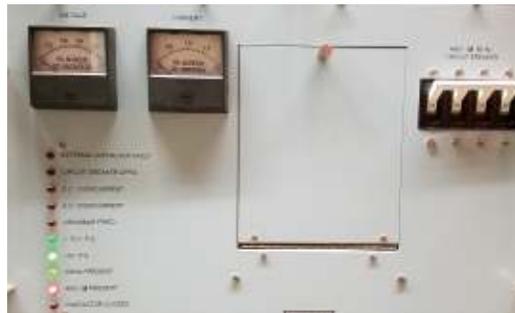
- 11) Verify the HV Deck Interface NIM Module shows that the Deck is up and ready



12) Verify that the Grid Supply is on and ready. (Will be in an inhibit State at this time)



13) Verify that the Screen Supply Breaker is on.



14) Take the Cavity Short out using the IRM Touch Panel and reset manually the MEIU.



15) Reset the Modulator Control UNIT, The Modulator Control Unit should be in a HV Ready State when the Cavity Short in the out Position, this should release the External Interlock.



This completes the requirements for returning the remaining equipment to service.

Booster Modulator Shut Down Procedure

- 1) From the Console turn modulators to HV off from page B-25 or locally by placing modulator in local mode and toggling the HV off switch.
- 2) At this point all the Galleries Modulators should be in a High Voltage Ready state.
- 3) Verify that the Anode Power Supply is OFF.
- 4) Anode power supply (APS) **Turn off Sequence**: This can be accomplished one of two ways, either locally or remotely through the Controls Console B25 page.

Locally: Place Anode Power Supply Control Panel in LOCAL mode, turn HV OFF by pushing the **Red OFF** Button. **Continue to Step #5**



Remotely: By using a Controls console, go to page B-25 turn OFF the Anode Power Supply

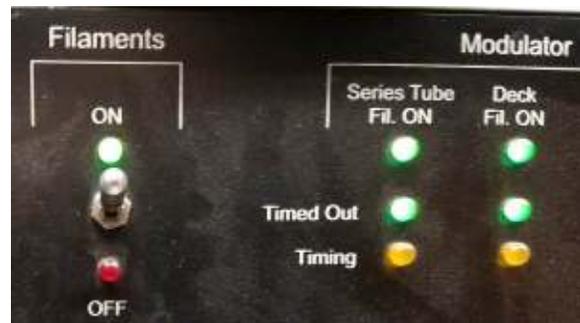
- 5) Place Anode Power Supply Control Panel in local mode. Disconnect all modulators from Anode Power Supply by using the Anode Power Supply Display Panel under **Subpage Switches**. Actuate the vacuum switches by pushing on the disconnect icon button for each Station. **Note: Disconnecting/connecting of the Switches can only be Done Locally!**



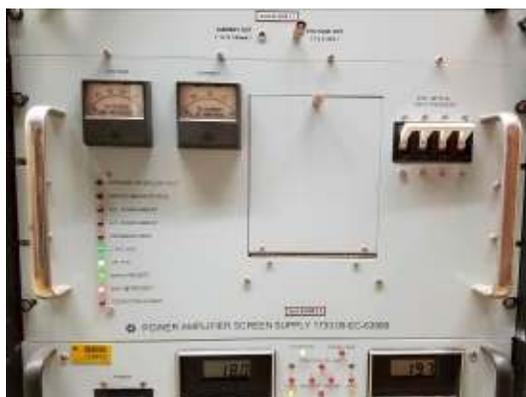
- 6) The authorized employee will follow the **Booster Anode Power Supply LOTO procedure (ADDP-EE-9933)** to isolate the sources of AC energy feeding the Anode Power supply.
- 7) The authorized employee will follow the **Booster Modulator Isolation procedure** to Isolate the Anode Power Supply from the RF Stations Modulator.
- 8) Turn down the Current Limit Knob on the PA Filament Power supply to Zero, once the Power Supply meters read Zero continue to the next step.



- 9) From the Modulator Control Unit, place the Control Unit in Local, and place the Filament Toggle Switch to the OFF position.



- 10) Place the Grid and Screen Supply Breakers in the OFF Position.



11) Place the Deck and Filament Breakers into the OFF Position, let the Modulator cool down.



12) Place the Main Breaker in the OFF Position.

13) The authorized employee shall then follow the **Booster Modulator LOTO procedure (ADDP-RF 2016-0005)** for Isolating all the sources of **AC energy** to the Modulator.

Booster R.F. Disconnect Locations and Designations

480 vac Tables

| East Booster RF Mod/SSD 480 Volt Distribution | | | | | | |
|---|-------------|--------------|--------------|------------------|--------------|-------------------|
| | | DHP-Y-BE3 | | DHP-BE6 Cir#40 | | PHP-BE5 |
| RF Station | BSTR Period | FBS Switch | FBS Breaker# | Modulator Switch | Mod Breaker# | SSD Breaker# |
| 1 | 14 | G14-SS-01 | 13-15-17 | G14-SS-02 | 01-03-05 | 01-03-05 |
| 2 | 14 | G14-SS-04 | 19-21-23 | G14-SS-03 | 02-04-06 | 02-04-06 |
| 3 | 15 | G15-SS-01 | 14-16-18 | G15-SS-02 | 07-09-11 | 07-09-11 |
| 4 | 15 | G15-SS-04 | 20-22-24 | G15-SS-03 | 08-10-12 | 08-10-12 |
| 5 | 16 | G16-SS-02 | 26-28-30 | G16-SS-01 | 13-15-17 | 13-15-17 |
| 6 | 16 | G16-SS-04 | 44-46-48 | G16-SS-03 | 14-16-18 | 14-16-18 |
| 20 | 16 | G16-SS-06 | 56-58-60 | G16-SS-05 | 26-28-30 | 26-28-30 |
| 19 | 16 | G16-SS-08 | 50-52-54 | G16-SS-07 | 25-27-29 | 25-27-29 |
| 7 | 17 | G17-SS-02 | 68-70-72 | G17-SS-01 | 19-21-23 | 19-21-23 |
| 8 | 17 | G17-SS-04 | 62-64-66 | G17-SS-03 | 20-22-24 | 20-22-24 |
| West Booster RF Mod/SSD 480 Volt Distribution | | | | | | |
| | | DHP-Y-BW1 | | | | DHP-L4-1-1 |
| RF Station | BSTR Period | FBS Switch | FBS Breaker# | Modulator Switch | Mod Breaker# | SSD Breaker# |
| 17 | 20 | G20 RF SS-2 | 80-82-84 | G20 RF SS-1 | 80-82-84 | 01-03-05 |
| 18 | 20 | G20 RF SS-3 | 74-76-78 | G20 RF SS-4 | 74-76-78 | 02-04-06 |
| 9 | 21 | G21 RF SS-2 | 13-15-17 | G21 RF SS-1 | 13-15-17 | 07-09-11 |
| 10 | 21 | G21 RF SS-4 | 19-21-23 | G21 RF SS-3 | 19-21-23 | 08-10-12 |
| 11 | 22 | G22 RF SS-2 | 25-27-29 | G22 RF SS-1 | 25-27-29 | 13-15-17 |
| 12 | 22 | G22 RF SS-4 | 31-33-25 | G22 RF SS-3 | 31-33-25 | 14-16-18 |
| | | | | | | DHP-BW-1-1 |
| 13 | 23 | G23 RF SS-1 | 50-52-54 | G23 RF SS-2 | 50-52-54 | 01-03-05 |
| 14 | 23 | G23 RF SS-10 | 56-58-60 | G23 RF SS-9 | 56-58-60 | 02-04-06 |
| 15 | 24 | G24 RF SS-2 | 62-64-66 | G24 RF SS-1 | 62-64-66 | 07-09-11 |
| 16 | 24 | G24 RF SS-6 | 68-70-72 | G24 RF SS-5 | 68-70-72 | 08-10-12 |

| West Booster BWG-124 RF FBS/Mod/SSD 480 Volt Distribution - Fed From DHP-L4-1 | | | | | | | |
|---|--------|------------|------------|------------|----------|------------|----------|
| | | | DHP-L4-1-2 | | | | |
| RF Station | Period | FBS Switch | Breaker# | MOD Switch | Breaker# | SSD Switch | Breaker# |
| 21 | 20 | FBS #21 | 02-04-06 | MOD #21 | 20-22-24 | SSD #21 | 25-27-29 |
| 22 | 20 | FBS #22 | 08-10-12 | MOD #22 | 26-28-30 | SSD #22 | 19-21-23 |

120vac Tables

| East Booster RF FBS/SSD 120 Volt Distribution | | | | |
|---|-------------------|--------------|------------------|--------------|
| RF Station | FBS BSTR Panel | 120 Breaker# | SSD BSTR Panel | 120 Breaker# |
| 1 | G15-PP-01 | #22 | G15-PP-06 | #25 |
| 2 | G15-PP-01 | #24 | G15-PP-06 | #27 |
| 3 | LP-BE-7/G15-PP-02 | #30 | G15-PP-06 | #21 |
| 4 | LP-BE-7/G15-PP-02 | #29 | G15-PP-06 | #23 |
| 5 | LP-BE-7/G15-PP-02 | #20 | G15-PP-06 | #13 |
| 6 | LP-BE-7/G15-PP-02 | #19 | G15-PP-06 | #15 |
| 20 | G15-PP-06 | #20 | G15-PP-06 | #18 |
| 19 | LP-BE-7/G15-PP-02 | #19 | LP-BE7/G15-PP-02 | #18 |
| 7 | LP-BE-7/G15-PP-02 | #18 | G15-PP-06 | #17 |
| 8 | LP-BE-7/G15-PP-02 | #17 | G15-PP-06 | #19 |

| West Booster RF FBS/SSD 120 Volt Distribution | | | | |
|---|-------------------|--------------|----------------|--------------|
| RF Station | FBS BSTR Panel | 120 Breaker# | SSD BSTR Panel | 120 Breaker# |
| 9 | LP-BW-7/G23-PP-02 | #18 | PP-BW-1-1 | #01 |
| 10 | LP-BW-7/G23-PP-02 | #17 | PP-BW-1-1 | #03 |
| 11 | LP-BW-7/G23-PP-02 | #24 | PP-BW-1-1 | #17 |
| 12 | LP-BW-7/G23-PP-02 | #23 | PP-BW-1-1 | #19 |
| 13 | LP-BW-7/G23-PP-02 | #30 | PP-BW-1-1 | #11 |
| 14 | LP-BW-7/G23-PP-02 | #29 | PP-BW-1-1 | #09 |
| 15 | LP-BW-7/G23-PP-02 | #08 | PP-BW-1-1 | #15 |
| 16 | LP-BW-7/G23-PP-02 | #06 | PP-BW-1-1 | #13 |
| 17 | LP-BW-7/G23-PP-02 | #02 | PP-BW-1-1 | #07 |
| 18 | LP-BW-7/G23-PP-02 | #04 | PP-BW-1-1 | #05 |

| BWG-124 Booster RF FBS/SSD 120 Volt Distribution | | | | |
|--|----------------|--------------|----------------|--------------|
| RF Station | FBS BSTR Panel | 120 Breaker# | SSD BSTR Panel | 120 Breaker# |
| 21 | PP-L4-1-2 | #01 | PP-L4-1-2 | #02 |
| 22 | PP-L4-1-2 | #03 | PP-L4-1-2 | #04 |
| | | | | |

Booster R.F Anode Power Supply Breaker Locations and Designations

| | | |
|---------------------------------|---------|------------------------|
| East Anode Power Supplies | 13.8 KV | EAPS |
| | 208 | G11-PP-02 |
| Anode Power Supplies Water Skid | 480 | DHP-BE-4 fka G12-PP-05 |
| | | |
| West Anode Power Supplies | 13.8 KV | WAPS |
| | 208 | LP-BW-6 fka G02-PP-02 |
| Anode Power Supplies Water Skid | 480 | DHP-BW4 fka G02-PP-01 |

Block Diagram

