

# Data Sheet/User Manual

## LNf-PS4

Four Channel Low Noise HEMT Power Supply





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## 1. Introduction

**Important: This product is ESD sensitive and shall be handled as such. Please, read this manual thoroughly before start using this product.**

The LNF-PS4 is a compact linear power supply designed for DC biasing up to four LNF's Low Noise Amplifiers. Each drain voltage ( $V_d$ ) and drain current ( $I_d$ ) can be set individually within a wide range by simple adjusting trimmer potentiometers on the front panel.  $V_d$  is delivered from internal constant voltage source, while, as the LNA become a part of the automatic regulation loop, the specific  $I_d$  is kept constant by continuous controlling the corresponding gate voltage of the specific LNA.

There is also a remote drain voltage sense option for situations where DC bias rail(s) resistance is significant and cause a significant voltage-drop. It provides with possibility of observing  $V_d$ 's on, or close to, LNA hence offers a good way to compensate for voltage drop along power rails by readjusting  $V_d$ 's.

LNF-PS4 can be provided in two variants – one with four circular five pins connectors similar to the connector used with LNF-PS3b (compliant with LNFs cable LNF-CAB\_PS3b\_LNA) and one with standard d-sub 25 positions connector nestling all four DC Bias channels.

$V_d$ 's,  $I_d$ 's and  $V_g$ 's are displayed on 4.3" touch screen for easy individual monitoring and setup of  $V_d$ 's and  $I_d$ 's. The graphical user interface shown on the screen is developed to be intuitive and user friendly. It also provides the user with basic user manual and quick access to information for connectors pinout.

The display can be switched off while not affecting DC Bias of LNA(s) – it is eliminating any digital noise which can be generated by the display.

LNF-PS4 is intended to be supplied preferably by LNF-PBA-HP (it can be supplied even with LNF-PBA\*) or some other PSU which can provide with required +/- voltages and currents.

The LNF-PS4 is delivered with LNF-CAB\_PBA\_PS3b - 1.5-meter power cable to be used to connect it and the LNF-PBA-HP (or the LNF-PBA). The version of LNF-PS4 with four circular five pins connectors use the same M12 connectors for DC Bias outputs as the LNF-PS3b to provide with back-compatibility. The version with d-sub connector requires a standard d-sub 25p cable. Regardless which version of LNF-PS4 is used the suitable cable for the DC Bias outputs should be blunt on the opposite end to get possibility for the end-users to fit their connector to mate with their system.

## 2. Specifications

Input					
DC Supply Voltage	Description	Min	Nom	Max	Unit
$V^+$ range	+12 V rail input voltage range	-10%	12	+10%	VDC
$V^-$ range	-12 V rail input voltage range	-10%	-12	+10%	VDC
$I(V^+=+12V)$	DC current on +12V with no and maximum load of four LNAs	~240*		~510	mA
$I(V^-=-12V)$	DC current on -12V with no and maximum load of four LNAs	~86*		~86	mA

Table 1 Power Ratings

\* LNF-PBA-HP has a capacity of powering up to eight LNF-PS4 while LNF-PBA has capacity of powering up to three LNF-PS4 units.



Output					
Parameter	Description/Conditions	Minimum	Nominal	Maximum	Unit
Vd range		0.00		2.40	VDC
Id range		0.00		65.00	mA
Vg range		-10		+10	V
Vd noise	Drain ripple and noise		0.1	<0.5	mV <sub>PK-PK</sub>
Vg noise	Gate ripple and noise		0.1	<0.5	mV <sub>PK-PK</sub>

Table 2 DC Output Ratings

Environmental					
Parameter	Description/Conditions	Minimum	Nominal	Maximum	Unit
Storage Temperature		-40		85	°C
Operating Temperature		5		40	°C
Relative Humidity <sup>1</sup>	Non-Condensing	5		80	%RH

Table 3 Environment Requirements

<sup>1</sup> The LNF-PS4 is for indoor use only, pollution degree 2.

Physical	
Weight	~820 g
Dimensions	133 (W) x 47 (H) x 207 (D) millimeters

Table 4 Physical Data

### 3. Description

A panoramic view LNF-PS4 is shown in Figure 1:



Figure 1 LNF-PS4

The touch screen display on the top of LNF-PS4 is intended to show up the actual values of Vd, Id and Vg for each of four connected LNAs. The top and front panels are provided with ventilation slots which may not be covered to not disturb airflow through them.

LNF-PS4 can be provided in two variants – one with four five positions connectors (M12 size) (see Figure 2) and one with a standard 25p d-sub connector (see Figure 3).



Figure 2 Rear panel equipped with four female socket 5p connectors size M12.

The connectors Ch1 to Ch4 (see Figure 2) are providing with DC Outs i.e. Vd, Vg, Vd\_sense+ and Vd\_sense- for four LNAs. The connector to the left (+/- 12V DC) is for powering up the LNF-PS4 from, preferably, LNF-PBA-HP (or the LNF-PBA). The LNF-PBA-HP can power up to eight LNF-PS4 units while LNF-PBA has capacity of powering up to three LNF-PS4 units.



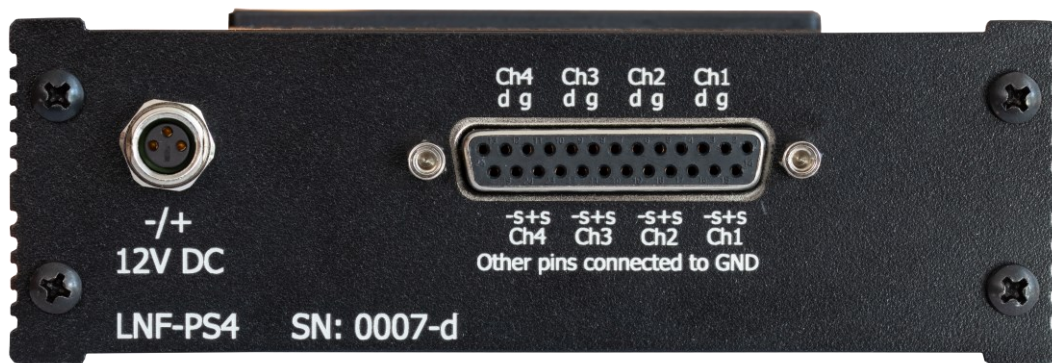


Figure 3 Rear panel equipped with female socket d-sub 25p connector.

The d-sub connectors (see Figure 3) is providing with DC Outs i.e. Vd, Vg, Vd\_sense+ and Vd\_sense- for four LNAs. The connector to the left (+/- 12V DC) is for powering up the LNF-PS4 from, preferably, LNF-PBA-HP (or the LNF-PBA). Again LNF-PBA-HP can power up to eight LNF-PS4 units while LNF-PBA has capacity of powering up to three LNF-PS4 units.

Figure 4 is showing the front panel of the LNF-PS4. There are two switches - Display and Main. The Main switch is used to turn on/off LNF-PS4 completely while the Display switch is used to turn on/off the touch screen display only. (Note: The touch screen display cannot be switched on without that Main switch is on). For indication that the LNF-PS4 is running the button of the Main switch is lit.

There eight trimmer potentiometers (Vd1, Id1, .., Vd4, Id4) for manual setting Vd's and Id's individually by using a flat 2mm screwdriver.



Figure 4 Front panel

The bottom panel is provided with four rubber feet and (after April 1st 2024) even with four self-clinching M5 nuts attached from inside – see

Figure 5. These self-clinching nuts are plugged with removable plugs (see Figure 5).

The self-clinching nuts are intended to offer a possibility for vertical attaching of the unit to other suitable mechanical structure in the lab.

For easy integration of the units in a larger system LNF is providing with 3D model found LNF home page ([LNF-PS4 - Low Noise Factory](#)).



Figure 5 Bottom panel – before (left) and after (right) 1 April 2024

#### 4. Accessories

- 1 pcs of cable LNF-CAB\_PBA\_PS3b for DC supply of LNF-PS4

## 5. Before Starting Use

Dont forget to withtake all necessary ESD precaussions.

After unpacking the unit make a visual inspection of it and make sure that there are no visible injuries. If any damage is found, please contact Low Noise Factory prior to taking it into operation.

**Important:**

In case that the self-clinching M5 nuts are used for fastening the unit the M5 screws absolutely **must not** go deeper than 7mm into the enclosure measured from the outhter surface of the bottom panel – see Figure 6.

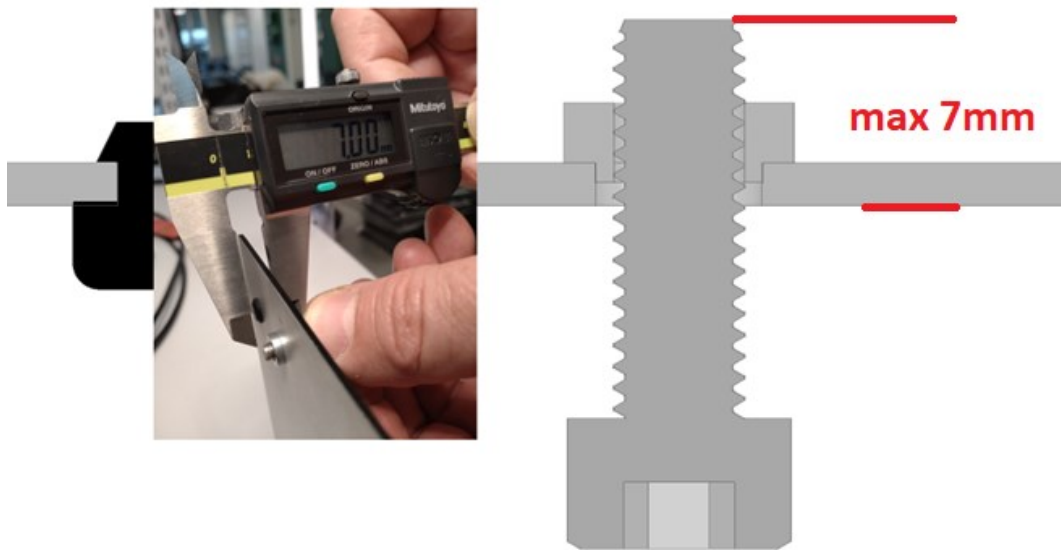


Figure 6 Maximum allowance for M5 screws



## 6. Pinout and Wiring

Pinout for wiring +/-12V DC is found Table 5 and Figure 5. It is recommended to use LNF-CAB\_PBA\_PS3b for this purpose.

DC Power In Connector M8 – Pin Numbering	
Pin #	Function
1	+12 V
3	-12 V
4	GND
Shield	Earth

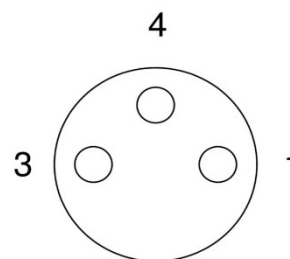


Figure 7 Pinout of M8 3p DC Power In Connector - seen from outside

Table 5 Pin numbering for DC Power In Connector

Pinout for wiring cables compliant with M12 Connectors (Ch1 - Ch4) is found in Table 6Figure 6 and Figure 6. It is recommended to use LNF-CAB\_PS3b\_LNA cables for these purposes.

DC Bias Out Connector M12 – Pin numbering	
Pin #	Function
1	Vd
2	Vd_sense+
3	Vd_sense-
4	Vg
5	GND
Shield	Earth

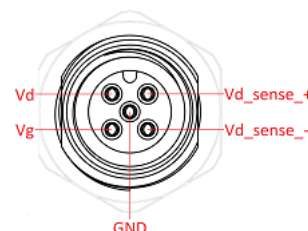


Figure 8 Pinout of M12 DC OUT Connector - seen from outside

Table 6 Pin numbering for DC Out (LNA DC Bias) M12 5p Connector

Pinout for wiring cables compliant with d-sub connector is found in Table 7.

Pinout of d-sub DC Bias Out Connector			
Pin #	Function	Pin #	Function
1	GND	7	GND
14	Vd1_sense_+	20	Vd3_sense_+
2	Vg1	8	Vg3
15	Vd1_sense_-	21	Vd3_sense_-
3	Vd1	9	Vd3
16	GND	22	GND
4	GND	10	GND
17	Vd2_sense_+	23	Vd4_sense_+
5	Vg2	11	Vg4
18	Vd2_sense_-	24	Vd4_sense_-
6	Vd2	12	Vd4
19	GND	25	GND
		13	Not connected
		Shield	Earth

Table 7 Pin numbering for DC Out (LNA DC Bias) d-sub 25p Connector

## 7. Connecting LNA to LNF-PS4

Each LNA needs to be connected to LNF-PS4 according to the schema shown in Table 8. Depending on which variant of LNF-PS4 is used you need to check in Table 6 (4x5p version) or Table 7 (d-sub version) for finding out the right pinning.

DC Bias Out M12 or d-sub 25p Connector		Connected to	LNA	
Pin #	Function		Pin #	Function
check in Table 6 or Table 7	Vd	-->	see data sheet for used LNA	Vd
Check in Table 6 or Table 7	Vd_sense+	-->*	see data sheet for used LNA	Vd
check in Table 6 or Table 7	Vd_sense-	-->*	see data sheet for used LNA	GND
check in Table 6 or Table 7	Vg	-->	see data sheet for used LNA	Vg
check in Table 6 or Table 7	GND	-->	see data sheet for used LNA	GND
<b>* optional</b> (Usually, the Vd sense function is not needed, but if the wiring in the cryogenic cooler is made by using high resistance wires, the sense function could come in handy to compensate for voltage drop along the wires)				

Table 8 Connecting LNA to LNF-PS4

For circular connectors (see Table 6 and Figure 6) the cable LNF-CAB\_PS3b\_LNA is recommended and for the version with d-sub 25p connectors a standard shielded 25p d-sub cable is recommended. Cable LNF-CAB\_PS3b\_LNA has a 5 pin M12 connector in one end while the other end is blunt for the end-user to attach a suitable connector for their system. If the LNA to be powered by the LNF-PS4 is for room temperature operation, solder the 9-pin nano-D connector pigtail connector directly to the open end of this cable. For cryogenic LNAs, a connector compatible with the cryo cooler should be used. It is preferred to not connect the shield at the LNA end. A similar strategy for connecting LNA(s) is recommended when d-sub connector is used. Usually, the Vd sense function is not needed, but if the cryo cooler is equipped with high resistance wires, the sense function could come in handy. It is recommended to keep the actual Vds at the LNA terminals to +/-0.05 V of the nominal Vds.

We can consider the example when nominal Ids and Vds are 12 mA and 0.5 V respectively and the drain and ground wire resistance in the fridge are 10Ω each. We set Vds = 0.5 V and Ids=12 mA on the LNF-PS4. The actual Vds at the LNA terminals will be:

$$\begin{aligned}
 V_{dsLNA} &= V_{ds\_supply} - R_{drain} \times I_{ds} - R_{gnd} \times I_{ds} \\
 V_{dsLNA} &= 0.5 - 10 \times 0.012 - 10 \times 0.012 \\
 V_{dsLNA} &= 0.26 \text{ V}
 \end{aligned}$$

Where:

$V_{dsLNA}$  = the actual  $V_{ds}$  at the LNA terminals

$V_{ds\_supply}$  =  $V_{ds}$  supplied by the LNF-PS4

$R_{drain}$  = Drain wire resistance

$R_{gnd}$  = Ground wire resistance

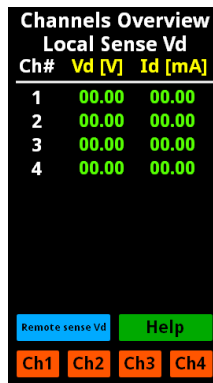
In this example using the Vd sense function would ensure a properly biased LNA. Note that if the power supply is not run in floating configuration, the ground return current is likely to take a different path back to the power supply than through the 10Ω ground wire. The LNA's DC-ground is connected to its chassis and the chassis likely is connected to the ground of the fridge. In this case, the voltage drop is likely to be about half of what it is in the example above.

$$R_{max} = \frac{0.05}{I_{ds}}$$

The equation above can be used as a guideline of the maximum wire resistance Rmax (sum of drain and ground resistance) allowed without having to pay special attention to compensating for the voltage drop. In the example above, the maximum resistance is 4Ω. In floating mode, this means 2Ω in each of the drain and ground wires. If it is decided to use Vd\_sense feature, the Vd\_sense+ wire should be connected to the drain pin of the LNA close to the nano-D connector. The Vd\_sense- wire should be connected to the ground pin of the LNA, again, close to the nano-D connector.

## 8. Running LNF-PS4

After connecting the LNF-PS4 (see section 7) the instrument can be switched with the Main switch on the front panel (see Figure 4) – it shall lit indicating proper DC supply and that unit is on. The next step is to switch on the Display with the Display switch (see Figure 4) – the display starts up the boot up sequence with the splash screen and after a few seconds the default start screen shall appear as shown in Figure 9:



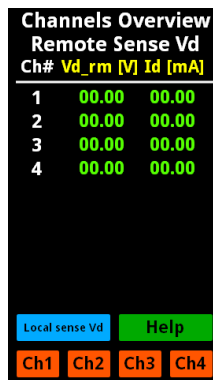
Channels Overview		
Local Sense Vd		
Ch#	Vd [V]	Id [mA]
1	00.00	00.00
2	00.00	00.00
3	00.00	00.00
4	00.00	00.00

Remote sense Vd Help

Ch1 Ch2 Ch3 Ch4

Figure 9 LNF-PS4 Default start screen – Vd sensed locally

The default start screen displays an overview of Vd's and Id's for all four channels updated sequentially. (Note: the values show in Figure 9 are just fictive example). There is the text **Channel Overview Remote Sense Vd** at the top of the screen indicating that the measurement is done locally (inside the unit itself). At the bottom of the screen there are also two buttons, one blue: **Remote sense Vd** and dark green **Help**. By pressing **Remote sense Vd** the LNF-PS4 is reconfigured to sense Vd's on, or physically, as close as it is wired to the specific LNA. **Note:** This function is going to work **only** if the cable wiring is provided with Vd\_sense+/- wires attached to the Vd and GND directly on the LNA (or close to it). The screen is also going to change to screen shown in Figure 10. (Note: the values show in Figure 10 are just fictive example).



Channels Overview		
Remote Sense Vd		
Ch#	Vd_rm [V]	Id [mA]
1	00.00	00.00
2	00.00	00.00
3	00.00	00.00
4	00.00	00.00

Local sense Vd Help

Ch1 Ch2 Ch3 Ch4

Figure 10 LNF-PS4 Channel Overview screen – Vd sensed remotely



When the **Help** button is selected the following screen pops up – see Figure 11.

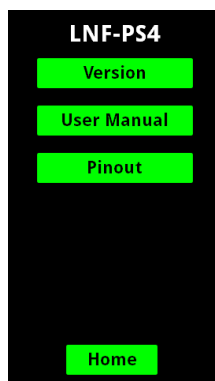


Figure 11 Help screen

Behind the **Version** button the software version information is found, **User Manual** gets the user to a brief, but, in most situation sufficient user manual and **Pinout** provides with the same pinout as that one presented in this paper. To go back to the start screen, choose the green button **Home** on the bottom of the screen.

At the bottom of the start screen Figure 9 (even Figure 10) there are four touch orange buttons **Ch1**, **Ch2**, **Ch3** and **Ch4**. They are used to select which DC Output Channel is to be observed in detail and shown on the screen (the label at the top of the display is going to change number to the number corresponding to the selected channel). To emphasize **which** channel **is selected** the pressed Ch? button lit **white**.

## 9. Graphical User Interface for Specific Channel

The touch screen display on the top of the LNF-PS4 is preprogramed to show actual values of Vd's, Id's and Vg's for specific DC Output Channel.

The default channel screen when, for example, Ch1 is selected is shown in Figure 12.



Figure 12 Channel screen

On the top of it there is a header telling which DC Output Channel is observed (in this case white label **Bias Channel 1**). Beneath it there are three yellow labels **Vd:**, **Id:**, **Vg:** and three light green numeric displays with corresponding units **V**, **mA** and **V**. At the bottom of the screen there are four touch orange buttons **Ch1**, **Ch2**, **Ch3** and **Ch4**. They are used to select which DC Output Channel is to be observed and shown on the screen (the white label Bias Channel ? is going to change number to the number corresponding to the number of the selected channel). To emphasize **which** channel **is selected** the pressed Ch? button lit **white**.

There are also two buttons, one blue: **Remote sense Vd** and dark green **Overview**. By pressing **Remote sense Vd** the LNF-PS4 is reconfigured to sense Vd's on, or physically, as close as it is wired to the specific LNA. **Note:** This function is going to work **only** if the cable wiring is provided with Vd\_sense+/- wires attached to the Vd and GND

directly on the LNA (or close to it). The screen is also going to change to screen shown in Figure 13. It is clearly visible that the yellow **Vd:** label has changed to **Vd\_sense:** indicating that the LNF-PS4 is in the remote sense mode.



Figure 13 Screen when LNF-PS4 in remote sense mode

To get back to local (i.e., Vd sensed internally in the LNF-PS4 itself) measurement mode it is to press the blue button **Return to local sense of Vd**. The channel of interest is selected by choosing **Ch1**, **Ch2**, **Ch3** or **Ch4** button at the bottom of the screen.

When the **Overview** button is selected, depending on in which mode local/remote the measurements are made the display will jump back to overview display local/remote as shown in Figure 9 and Figure 10.

## 10. Adjusting LNA Bias and Understanding Alarms

The trimmer potentiometers on the front panel are used to adjust Vd's and Id's. Each of them can be adjusted and observed individually by selecting DC Bias channel by pressing corresponding orange button on the touch screen.

The LNF-PS4 is intended to provide with the nominal values shown in Table 2, i.e. Vd up to 2.4V and Id up to 65mA. In reality it is capable to deliver Vd $\approx$ 2.5V and Id $\approx$ 70mA but they shall not be assumed as nominal. To be able to trim **Vd** to  $\sim$ 2.5V is done intentionally to provide with capability to compensate for voltage drop along wires when the LNA is used close to its recommendable max Vd (but still far enough from its absolute maximum) i.e. 2.4V. The colour of the numbers representing value of Vd and Id value are going to swap to **red** when you are trimming them over 2.4V and Id over 65mA. It is an **alarm** telling you that settled values are approaching the LNAs limits, but it is still far enough from the absolute max values for LNAs. User shall try to avoid running LNA while any of Vd or Id is lit red.

The typical situation when Vd turns red can arise when you adjust Vd to 2.4V while observing it remotely, i.e. directly over the LNA and then press the blue button **Return to local measurements of Vd** and reconfigure LNF-PS4 to sense Vd internally in the LNF-PS4 itself. The locally sensed Vd is always somewhat higher than that on the LNA and that difference can cause that Vd locally can be higher than 2.4V and turn red.

## Using the Instrument

To power up this instrument you need preferably LNF-PBA-HP or the LNF-PBA or some other PSU which can provide with voltages and current values shown in Table 1.

Once the wiring is done according to sections 8 and 9, the instrument can be taken into operation.

**Do not forget to withtake all necessary ESD precautions.**

### FIRST TIME POWER UP

1. Connect the LNF-PS4 to the LNF-PBA-HP- use the included cable LNF-CAB\_PBA\_PS3b.
2. Ensure the LNF-PBA-HP (or the LNF-PBA) is in non-floating mode by installing the jumper plug between earth and common.
3. Switch on the LNF-PBA-HP (or the LNF-PBA).
4. Switch on the LNF-PS4 by using the Main switch – it shall lit.
5. If not yet, switch on the Display switch.
6. Select the DC Bias channel by pressing corresponding button at the bottom of the touch screen panel.
7. Set  $V_{ds}$  to nominal value of the LNA using corresponding trimmer potentiometer ( $V_d$ 's) on the front panel of the LNF-PS4.
8. Repeat step 5 and 6 for each used DC Bias channel.
9. Switch off LNF-PS4 – use the Main switch.
10. Connect the LNF-PS4 to the LNA(s).
11. Switch on the LNF-PS4 – use the Main switch.
12. If floating mode is desired, remove the jumper plug from the LNF-PBA-HP (or the LNF-PBA).
13. Adjust  $I_{ds}$  to nominal value of each LNA by selecting proper DC Bias Channel and using corresponding trimmer potentiometer ( $I_d$ 's) on the front panel.
14. If the  $V_{dsense}$  function is used, press **Remote sense  $V_d$  button** – the blue one. The display will now show the actual  $V_{ds}$  over the LNA and you can readjust it to compensate for voltage drop in the wires.

### POWER DOWN

1. Ensure the jumper plug is installed on the LNF-PBA-HP (or the LNF-PBA).
2. Switch off the LNF-PS4 using the Main switch.
3. Switch off the LNF-PBA-HP (or the LNF-PBA) using the its main switch on its rear panel.

### SECOND TIME POWER UP

This procedure assumes everything is connected and voltages and currents set to nominal value of the LNA.

1. Ensure the jumper plug is installed on the LNF-PBA-HP (or the LNF-PBA).
2. Switch on the LNF-PBA-HP (or the LNF-PBA) using the main power switch on its rear panel.
3. Switch on the LNF-PS4 using the Main switch.
4. If not yet, turn on the display using the Display switch.
5. Remove the jumper plug from the LNF-PBA-HP (LNF-PBA) if floating mode is desired.