Date
2023-07-07

Low Noise Factory

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.

LNF-PS4 is a compact linear power supply designed for DC biasing up to four LNF's Low Noise Amplifiers. Each drain voltage (Vd) and drain current (Id) can be set individually within a wide range by simple adjusting trimmer potentiometers on front panel. Vd is provided by internal constant voltage source, while, as the LNA become a part of the automatic regulation loop, the specific Id 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 an essential voltage-drop. It provides with possibility of observing Vd's on or close to LNA hence offers a good way to compensate for voltage drop along power rails by readjusting Vd's.
LNF-PS4 can be provided two options of – 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.
Vd's, Id's and Vg's are displayed on 4.3" touch screen for easy individual monitoring and setup of Vd's and Id'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) does eliminating any digital noise which can be generated by it.
LNF-PS4 is intended to be supplied by LNF-PBA-HP but it also can be supplied with LNF-PBA or other PSU which can provide with required +/- voltages and currents.
The LNF-PS4 is delivered with a 1.5-meter cable to be used between it and the LNF-PBA-HP. The part number of this cable is LNF-CAB_PS3b. Also, LNF can provide with cables for DC Bias outputs. The LNF-PS3b end one version of LNF-PS4 use the same M12 connectors for DC Bias outputs to provide with back-compatibility. 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 Supplay 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 maximum load of four LNAs	295*		~450	mA
I(V-=-12V)	DC current on -12V with maximum load of four LNAs	51*		53	mA

Table 1

*** display switched off**

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_{PK-PK}
Vg noise	Gate ripple and noise		0.1	<0.5	mV_{PK-PK}

Table 2

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

Table 3

[1] 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

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 provide with 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.

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

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

The connectors Ch1 to Ch4 are providing with DC Outs i.e.Vd, Vg, Vd_sense+ and Vd_sense- for four LNAs. The connector to the left is for powering the LNF-PS4 from preferably LNF-PBA-HP. LNF-PBA-HP can supply eight LNF-PS4.

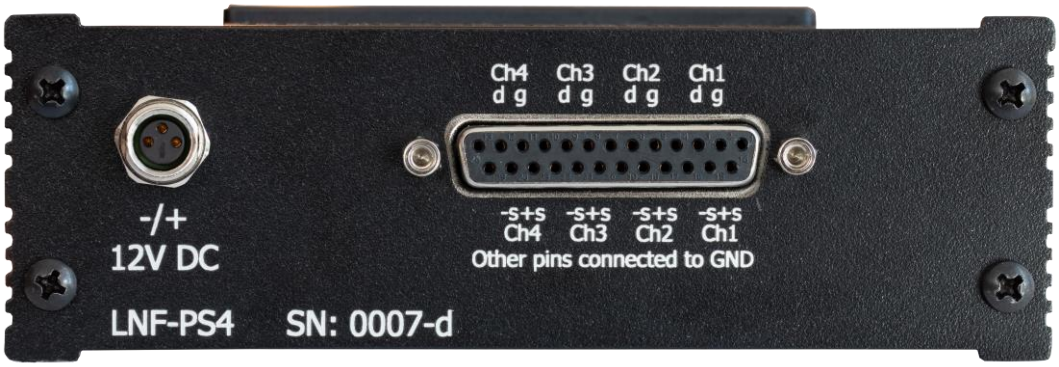

Figure 3 Rear panel equipped with female socket d-sub 25p connector.

The d-sub connectors (to the right) is providing with DC Outs i.e.Vd, Vg, Vd_sense+ and Vd_sense- for four LNAs. Again, the connector to the left is for powering the LNF-PS4 from preferably LNF-PBA-HP. LNF-PBA-HP can supply eight LNF-PS4.

Figure 4 Front panel

Figure 4 is showing the front panel of the LNF-PS4. There are two push-button latch-up switches Display On/off and Main On/Off. Display On/Off is used to switch on/off the touch screen display only if wanted and Main On/Off is used to switch on/off complete LNF-PS4. (Note: The touch screen display cannot be switched on without that Main On/Off in on.) For indication that the LNF-PS4 is running there is a signal LED lamp above the Main On/Off switch – it lit when the LNF-PS4 is on. There eight trimmer potentiometers (Vd1, Id1, .., Vd4, Id4) for manual setting Vd's and Id's individually by using a flat 2mm screwdriver.

4. Accessories

- 1 pcs of cable LNF-CAB_PBA_PS3b for DC supply of LNF-PS4

5. Recommended Optional Accessories

- cable(s) LNF-CAB_PS3b_LNA for DC bias of LNA(s) in case of LNF-PS4 equipped with M12 5p circular connectors on rear panel.
- cable LNF-CAB_d-sub_LNA in case of LNF-PS4 equipped with d-sub 25p connectors on rear panel.

6. 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.

7. Pinout and Wiring

Pinout for wiring DC Power In cable 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

Table 5 Pin numbering for DC Power In Connector

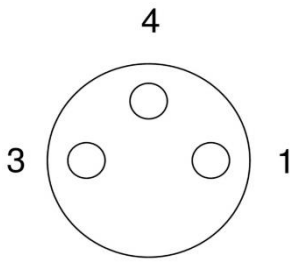

Figure 5 Pinout of M8 3p DC Power In Connector - seen from outside.

Pinout for wiring cables compliant with M12 Connectors (Ch1-Ch4) is found in Figure 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

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

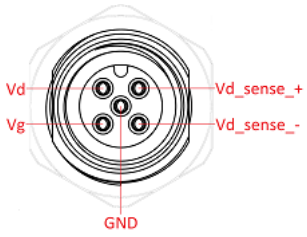

Figure 6 Pinout of M12 DC OUT Connector - seen from outside.

Pinout for wiring cables compliant with d-sub connector is found in Table 7. It is recommended to use LNF- LNF-CAB_d-sub_LNA for these purposes.

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

8. Connecting LNA to LNF-PS4

Each LNA needs to be connected to LNF-PS4 according to the schema shown in Table 8 Connecting LNA to LNF-PS4

. Depending on which variant of LNF-PS4 is used you need to check in Table 6 or Table 7 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
*** optional** (In the general case, 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-PS8 is for room temperature operation, solder the 9-pin nano-D connector pigtail connector to the open end of this cable. For cryogenic LNAs, a connector compatible with your cryo cooler should be used. It is recommended to not connect the shield in the LNA end. A similar way of connecting LNA(s) when d-sub connectors are used is recommended.
In the general case, 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 10 ohm each. We set Vds = 0.5 V and Ids=12 mA on the LNF-PS4. The actual Vds at the LNA terminals will be:

$$V_{dsLNA} = V_{ds\_supply} - R_{drain} \times I_{ds} - R_{gnd} \times I_{ds}$$
$$V_{dsLNA} = 0.5 - 10 \times 0.012 - 10 \times 0.012$$
$$V_{dsLNA} = 0.26\,V$$

Where:

V_{dsLNA}= the actual V_{ds} at the LNA terminals
V_{ds_supply}= V_{ds} supplied by the 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 which performs maximally. 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 10 Ohm 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 4 ohm. In floating mode, this means 2 ohm in each of the drain and ground wires.

If the Vd sense function is decided to be used, 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 close to the nano-D connector.

9. Graphical User Interface

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 start screen when the display is turned on is shown in Figure *7*.

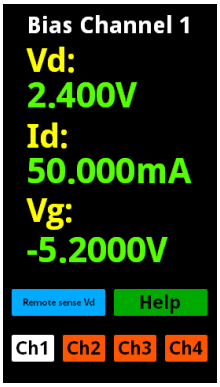

Figure 7 Default start screen

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 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 1 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 **Help**. By pressing **Remote sense Vd** the LNF-PS4 is reconfigured to measure Vd's on the 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 but). The screen is also going to change to screen shown inFigure *8*. It is clearly visible that the yellow **Vd:** label has changed to **Vd_sense:** indicating that the LNF-PS4 is in the remote measurements mode.

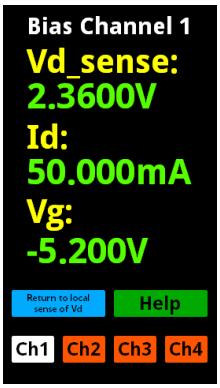

Figure 8 Screen when LNF-PS4 in remote sense mode

To get back to local (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.

Help button gets you to following screen – see Figure 9.

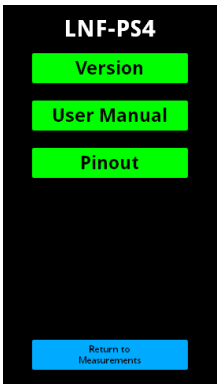

Figure 9 Help screen.

If you check **Version** button you are going to see software version information, **User Manual** gets you 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 measurements, choose the blue button on the button of the screen.

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 the can be adjusted and observed individually by selecting proper 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=~2.5V and Id=~70mA but they shall not be assumed as nominal. To be able to trim **Vd** to ~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 you are approaching the LNAs limits but it is still far enough from the absolute max values to keep LNAs i safety and you shall be very careful if you are running it 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 measure Vd in the LNF-PS4 itself. The locally measured Vd is always somewhat higher that 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 use this instrument you need LNF-PBA-HP or some other PSU which can provide with volatges and current values shown in Table *1*.
Once the wiring is done according to sections 7 and 8 , the instrument can be taken into operation.
Do not forget to withtake all necessary ESD precaussions.

FIRST TIME POWER UP

1. Connect the LNF-PS4 to the LNF-PBA-HP with the included cable LNF-CAB_PBA_PS3b.
2. Ensure the LNF-PBA-HP is in non-floating mode by installing the jumper plug between earth and common.
3. Switch on the LNF-PBA-HP.
4. Switch on the LNF-PS4.
5. Select the DC Bias channel by pressing corresponding button at the bottom of the touch screen panel.
6. Set Vds to nominal value of the LNA using corresponding trimmer potentiometer (Vd's) on the front panel of the LNF-PS4.
7. Repeat step 5 and 6 for each used DC Bias channel.
8. Switch off LNF-PS4.
9. Connect the LNF-PS4 to the LNA(s).
10. Switch on the LNF-PS4.
11. If floating mode is desired, remove the jumper plug from the LNF-PBA-HP.
12. Adjust Ids to nominal value of each LNA by selecting propper DC Bias Channel and using corresponding trimmer potentiometer (Id's) on the front panel.
13. If the Vdsense function is used, press **Remote sense Vd button** – the blue one. The display will now show the actual Vds 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.
2. Switch off the LNF-PS4 using the Main On/Off switch on the front panel.
3. Switch off the LNF-PBA-HP using the mains switch.

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.
2. Switch on the LNF-PBA-HP using the mains power switch.
3. Switch on the LNF-PS4 using the Main On/Off switch on the front panel.
4. If not yet, turn on the display using Display On/Off switch.
5. Remove the jumper plug from the LNF-PBA if floating mode is desired.