Neuralynx
High Density Electrophysiology Recording Systems

Lynx 8 Amplifier User Manual

Set-up and Operation of the Differential input, 8-channel amplifier

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1 Document Overview

This document describes the setup and operation of the Lynx-8 amplifier. It also lists all related specifications and appropriate pin-out assignments.

2 Lynx-8 Amplifier Overview

The Lynx-8 amplifier is a computer controlled eight-channel amplifier, which is designed for neuroscience electrophysiology recording. It allows control of each channel's gain and high-pass and low-pass filters via a 16-bit parallel digital output port. The amplifier input stage is of a differential input design. The amplifier's control and analog output back panel connector was designed to be compatible with the Data Translation DT3010 tm series of A/D board.

3 Technical Specifications

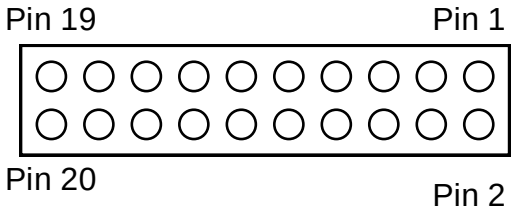
Number of Channels	8
Input Configuration	Differential
Gain Selection (at input gain=100)	12 to 50,000 (4095:1 range in 4095 steps)
Input Stage Gain Selections	1, 10, 100, 200, 500 (via internal jumper selection)
Input Signal Range	50 uv to 10 volts (peak-to-peak)
Output Signal Range	+/-10v (peak-to peak)
Low Cut Filter Settings	.1, 1, 10, 100, 300, 600, 900 Hz
Hi Cut Filters Settings	50, 125, 200, 250, 275, 325, 400, 475, 3000, 6000, 9000 Hz
Filter Rolloff	12 DB per Octave
Filter Type	Butterworth (or Flattest Amp)
Output Noise	10 mv p-p
Input Noise	15 uv p-p
Input Impedance	2.5 Megaohms
Input Stage AC Coupling	.1 Hz
CMRR at 60 Hz	90 db (110 db typical)
Inter-Channel Isolation	70 DB
Frequency Response	.1 Hz to 10 kHz
Signal Inputs	Front panel 20-pin IDC connector
Signal Outputs	A/D board connector on rear panel (DT3010 compatible) Analog Output – 3M MDR 36 pin connector on rear panel Front panel buffered Monitor connector
Output Signal Sense	Inverted from positive input signal connection (negative up)
Power Requirements	+/- 15 volts at 160 milliamps - 4.8 Watts
Height/Size	1.75” - One 19” Rack Mount Slot - 12” deep

4 Front Panel

The front panel contains:
- Input connector;
- Monitor output connector; and
- Program/Lock switch.

4.1 Input Connector

The input connector is a standard 20-pin IDC ribbon cable connector. Four pins are used for ground and 16 pins are used for the plus and minus inputs of the eight input channels.



Input Connector - Front Panel View

The connector has the following pin-out:

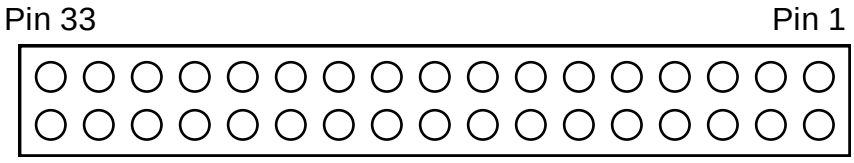
Pin 1	Ground
Pin 2	Ground
Pin 3	Channel 1 + Input
Pin 4	Channel 1 - Input
Pin 5	Channel 2 + Input
Pin 6	Channel 2 - Input
Pin 7	Channel 3 + Input
Pin 8	Channel 3 - Input
Pin 9	Channel 4 + Input
Pin 10	Channel 4 - Input
Pin 11	Channel 5 + Input
Pin 12	Channel 5 - Input
Pin 13	Channel 6 + Input
Pin 14	Channel 6 - Input
Pin 15	Channel 7 + Input
Pin 16	Channel 7 - Input
Pin 17	Channel 8 + Input
Pin 18	Channel 8 - Input
Pin 19	Ground
Pin 20	Ground

4.2 Monitor Output Connector

The Monitor Output Connector has 3 types of signals:

- each of the 8 amplifier outputs (buffered by unity gain opamps);
- the two DAC outputs from the DT3010 board; and
- the DT3010 External Clock and External Trigger signals.

The eight amplifier channel outputs are buffered and placed on this connector to allow monitoring of the signals via an oscilloscope and/or audio monitor. The DT3010 DAC outputs are connected to this connector to allow the use of these signals by the user, as the amplifier connects directly to the DT3010 A/D board and doesn't allow any other connection to the A/D board. The DT3010 External Clock and External Trigger signals are connected to this connector for the same reason.



Monitor Connector - Front Panel View

The connector has the following pin-out:

Pin 1	Channel 1 Output
Pin 2	Ground
Pin 3	Channel 2 Output
Pin 4	Ground
Pin 5	Channel 3 Output
Pin 6	Ground
Pin 7	Channel 4 Output
Pin 8	Ground
Pin 9	Channel 5 Output
Pin 10	Ground
Pin 11	Channel 6 Output
Pin 12	Ground
Pin 13	Channel 7 Output
Pin 14	Ground
Pin 15	Channel 8 Output
Pin 16	Ground
Pin 17	No Connection
Pin 18	Ground
Pin 19	No Connection
Pin 20	Ground
Pin 21	No Connection

Pin 22	Ground
Pin 23	DAC 0 Output (Unbuffered and direct connection from the DT3010 A/D board)
Pin 24	Ground
Pin 25	DAC 1 Output (Unbuffered and direct connection from the DT3010 A/D board)
Pin 26	Ground
Pin 27	No Connection
Pin 28	Ground
Pin 29	No Connection
Pin 30	Ground
Pin 31	External Clock (direct connection to the DT3010 A/D board)
Pin 32	Ground
Pin 33	External Trigger (direct connection to the DT3010 A/D board)
Pin 34	Ground

4.3 Program/ Lock Switch

The Program/Lock switch on the front panel allows the current gain and filter settings to be locked, or unchangeable, if a software package is run on the computer which does not "nicely" control the DT3010 Parallel I/O Digital port in a manner which the amplifier "expects". In other words, if you use the Discovery Clocked Sequence to setup the amplifiers gain and filter settings and you want to run a different program, you can put this switch in the LOCK position and the gain and filter settings will be held at the current values. The gain and filter settings can only be changed when the switch is in the Program position. Note: if amplifier power is turned off the gain and filter settings will be lost and must be reprogrammed.

5 Rear Panel

The Rear Panel has 7 items:

- Power Supply 5 Pin Connector;
- Program/Lock LED Indicator;
- External Program/Lock Select 2 pin connector;
- Data Translation DT3010 A/D Board Connector - 50 pin;
- 20 Pin Digital Control Port;
- 36 Pin 3M MDR Style Analog Output Connector; and
- Chassis Ground wing nuts (2);

5.1 Power Supply Input Connector

There is a 5 pin (.156 Molex connector) which is used to power the amplifier. This should be connected to the "braided 3 wire" DC Power Cable supplied. The connector has the following legend over it:

GG_BR

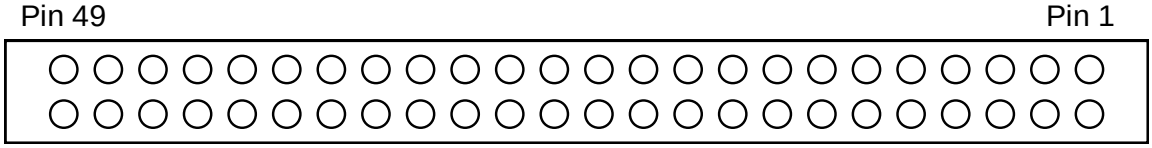
The 4 wires present in the Molex power connector (2 green, 1 black and 1 red) should be aligned with the legend. Note: the "G", "B" and "R" denote the Green, Black and Red wires respectively in the connector.

Caution: The 5-pin power connector MUST be correctly connected to the amplifier. While connecting the power to the amplifier use a flashlight to enhance your vision of the area to avoid problems. If it is not connected correctly a short circuit on one of the power supply voltages will be created. It is very easy to misalign the connector as it does not have a shroud around it.

5.2 A/D Board Connector

The A/D Board Connector is a 50 pin IDC ribbon cable connector that is compatible with the DT3010 series of PC A/D interface boards. The only difference is that the A/D board inputs 8->15 are grounded to the amplifier ground because the amplifier does not use these channels and it was assumed that only one amplifier would be connected to one A/D board. This connector pinout is not described further. The 50-pin ribbon cable supplied with the amplifier is used to connect this connector to the A/D board.

Caution: when connecting this cable (as with any large ribbon cable) be sure not to bend the connector pins when inserting/removing the cable. It is very easy to "roll" the ribbon cable in/out of the connector, which will bend several of the end pins.



DT2821 A/D Connector - Rear Panel View

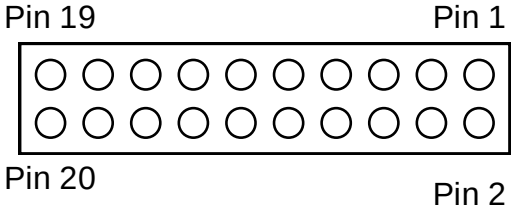
The connector has the following pin-out:

Pin 1	Channel 0 Output
Pin 2	Ground
Pin 3	Channel 1 Output
Pin 4	Ground
Pin 5	Channel 2 Output
Pin 6	Ground
Pin 7	Channel 3 Output
Pin 8	Ground
Pin 9	Channel 4 Output
Pin 10	Ground
Pin 11	Channel 5 Output
Pin 12	Ground
Pin 13	Channel 6 Output
Pin 14	Ground
Pin 15	Channel 7 Output
Pin 16	Ground
Pin 17	Ground
Pin 18	Ground
Pin 19	No Connection
Pin 20	No Connection
Pin 21	Ground
Pin 22	No Connection - also connected to Pin 23 on the front panel Monitor Connector
Pin 23	Ground
Pin 24	No Connection - also connected to Pin 25 on the front panel Monitor Connector
Pin 25	Ground
Pin 26	Ground
Pin 27	Ground
Pin 28	Digital Input 0
Pin 29	Digital Input 1
Pin 30	Digital Input 2
Pin 31	Digital Input 3
Pin 32	Ground
Pin 33	Digital Input 4
Pin 34	Digital Input 5
Pin 35	Digital Input 6

Pin 36 Digital Input 7
Pin 37 Ground
Pin 38 Digital Input 8
Pin 39 Digital Input 9
Pin 40 Digital Input 10
Pin 41 Digital Input 11
Pin 42 Ground
Pin 43 Digital Input 12
Pin 44 Digital Input 13
Pin 45 Digital Input 14
Pin 46 Digital Input 15
Pin 47 Ground
Pin 48 Ground
Pin 49 No Connection - also connected to Pin 31 on the Front Panel Monitor Connector
Pin 50 No Connection - also connected to Pin 33 on the Front Panel Monitor Connector

5.3 20 Pin Digital Control Connector

This connector is an IDC ribbon cable connector (dual row 2x10 ribbon cable header) which is wired in parallel to the 50 pin A/D Connector, pins 27 through 46. This connector is used when connecting to the Neuralynx Cheetah Data Acquisition System or other custom data acquisition system.



Digital Input Control Connector - Rear Panel View

The connector has the following pin-out:

Pin 1 Ground
Pin 2 Digital Input 0
Pin 3 Digital Input 1
Pin 4 Digital Input 2
Pin 5 Digital Input 3
Pin 6 Ground
Pin 7 Digital Input 4
Pin 8 Digital Input 5
Pin 9 Digital Input 6

Pin 10 Digital Input 7
Pin 11 Ground
Pin 12 Digital Input 8
Pin 13 Digital Input 9
Pin 14 Digital Input 10
Pin 15 Digital Input 11
Pin 16 Ground
Pin 17 Digital Input 12
Pin 18 Digital Input 13
Pin 19 Digital Input 14
Pin 20 Digital Input 15

5.4 36 Mini-D Connector

This connector has the 8 amplifier channel outputs (wired in parallel to the 50 pin A/D Connector) on the odd pins 1 -> 15 and ground on the even pins 2-> 16 & 17 & 18. This connector is used for connecting to the Neuralynx Cheetah Data Acquisition System or other custom data acquisition system.

Note: The 3M Mini-D Connectors can be difficult to use without proper assembly tools and fixtures. If you need to use this connector, contact Neuralynx for purchase of a ribbon cable with and attached connector.

5.5 Program Select Indicator

There is a single yellow LED that is visible from the rear. This LED will be lit when the amplifier is in PROGRAM MODE. For the amplifier to be selected and enabled for programming the following must be true:

- Front panel PROGRAM/LOCK switch must be in the PROGRAM position (up); and
- Rear External Program Enable Input must have a logical “0” (low) signal.

5.6 Chassis Ground Wing Nuts

The wing nuts on the back of the amplifier case are used to connect the amplifier board ground to the case and to make any other electronic or mechanical connection to the chassis/rack ground. Make sure that this connection is "strongly finger tight".

5.7 External Program Enable Input

There is a two pin input connector directly to the left of the DT3010 50 pin input connector which is an additional Program Enable control signal. The connector pin on the left is connected to the amplifier board ground and the pin on the right is the actual control input signal. This input must have a logical "0" (low) signal for the amplifier to be in the PROGRAM MODE. This input is provided for recording setups that require an additional external signal to control the Program/Lock function of the amplifier. The amplifier is shipped with a shorting jumper across the input's signal and ground pins, which will enable the front panel Program/Lock switch. A high input on this connector will disable Programming operations of the amplifier. It may be controlled with an external TTL/CMOS signal.

6 Internal Connections

NOTE: The following information is provided to allow the user to have knowledge of the full capabilities of the Lynx-8 amplifier. This information should not be misused, and any desired changes in the internal jumpers and adjustments should first be discussed with Neuralynx before making any changes so that the user is aware of any ramifications. Any unauthorized changes and/or adjustments will void the warranty, damage caused by users is not covered by the warranty.

6.1 Input Stage Gain Selection Block

The input stage gain can be changed with a simple 4 way jumper. The available input gains are: 1, 10, 100, 200 and 500. The default setting is at the 100 position. There are some serious ramifications if this setting is changed. Contact Neuralynx before changing these jumpers.

6.2 Input Stage Common Mode Rejection Adjustment

The input stage has an adjustment to maximize the Common Mode Rejection Ratio merit figure for each input channel. This adjustment is set using a 60 Hz input signal on both the plus and minus differential inputs for each channel. The adjustment is made for the lowest possible output signal with this input condition. Each channel of the amplifier channel should have a CMRR of at least 100 db.

6.3 Output Networks Sockets

There are two 16 pin sockets, labeled N1 and N2, which can accept 16 pin headers to which resistors and capacitors can be mounted, connected to the amplifier outputs to allow customizing the amplifier's output impedance or signal equalization for very long custom cabling installations. These network connections are connected to the amplifier's

A/D Output and front panel Monitor Output signals. These networks are only needed for situations where the electrical loading or custom cabling required a different output impedance. Consult Neuralynx if you have such needs.

7 Quarks, Got-cha's, and Practical Notes

This section notes some of the practical tips of using the amplifier.

7.1 Power the Amplifier on whenever the Computer is On

This is a practical note and it really applies whenever there is an interface connected (especially when the control is via a digital port) to a PC. The reason for this is that digital inputs (and analog inputs also) are "electrically different" when powered off/on. When the amplifier is powered off, the control inputs look like a diode connected to ground and can overload the controlling TTL parallel output port. The other problem is that the DT3010 A/D inputs can be damaged by having large signals present and having the computer power off. You can cause problems in both the computer and the amplifier if this rule is not followed. **It is best to power the "complete system" on at once using a common power strip.**

7.2 Loading the Amplifier File Settings when Discovery starts

You can program Discovery to load a default setting from a file during initialization in the SU_USR.C file. This allows convenience to the operation. Contact support@neuralynx.com for instructions on this procedure.

7.3 Output Signal Oscillations

A few times users have observed a high frequency oscillation at the output of the amplifier. This seems to be caused by one or more of the following conditions:

- extremely large input signal swings;
- ground loops which couple signal from the amplifier outputs back to the inputs; and/or
- large capacitance loads on the output of the amplifier caused by excessive cabling on the outputs.

The ground loops become more critical as the gain of the amplifier is increased. If possible, reduce the Lynx-8 amplifier gain setting and increase the A/D board gain setting. These oscillations usually "fall out" after a few seconds.

The capacitance load (from output to ground) can be reduced by using unshielded output cables. The amplifier output signals are low impedance, large signals that usually do not need to be shielded.

If you have oscillation problems please contact support@neuralynx.com.

8 Grounding and Shielding

This is a subject on which many books and courses have been based. A good rule of thumb is that a shielded cable, whether carrying analog or digital signals, should be grounded at one point only.

The amplifier output impedance is very low and the output signal level is usually in the range of several volts and therefore is not very susceptible to interference. A shielded output cable is not required unless the cable must be run directly over or in back of a CRT or other strong interference generation source.