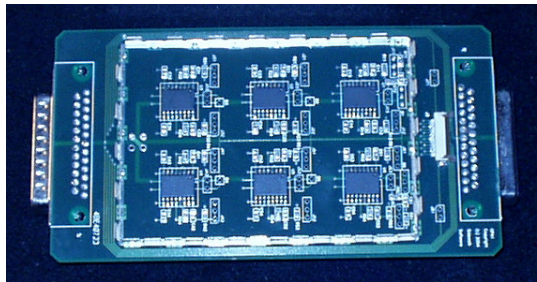




12-Channel Differential Preamplifier	ND3PA
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Multi-channel Differential Preamplifier for Neural Recording

- 12 microelectrode circuits
- 2 reference circuits
- Gain of 100
- Pass-through circuits for motor control and stimulus.
- DB-25 input and output connectors
- Alternate 24-pin ZIF input flex cable connector



Ordering Information _____

Configuration	Part Number
12-channel differential preamplifier	ND3PA-1
12-channel pass through adapter	ND3PT-1

Absolute Maximum Ratings _____

Characteristic	Symbol	Min	Typ	Max	Unit
Supply Voltage ¹	V_{Pos}, V_{Neg}	± 2.25	± 15	± 18	V
Analog Input Voltage Range	V_{in}	-40		40	V
Output Short-Circuit to Ground Duration	t_{SC}			∞	sec
Operating Temperature	T_A	-40		85	°C
Storage Temperature	T_S	-40		85	°C
Pass Through Current	I_{PT}			100	mA

¹ A neural recording buffer circuit powered via J2/J3 may have more restrictive supply voltage limits.

Specifications

At $T_A = +25^\circ\text{C}$, V_{Pos} , $V_{\text{Neg}} = \pm 15\text{V}$, unless otherwise noted.

Characteristic	Symbol	Min	Typ	Max	Unit
Differential Gain ²	A		100		V/V
Gain Error				0.15	%
Signal Input Resistance	R_I		22.1		K Ω
Input Resistance Error				1	%
Input Coupling Capacitance	C_{IC}		0.1		μF
Probe Input Filter Resistance	R_{PF}		2.2		M Ω
Reference Input Filter Resistance	R_{RF}		182		K Ω
Low Bandwidth Limit, -3 dB	F_{low}		0.01		Hz
High Bandwidth Limit, -3 dB	F_{high}		150		KHz
Output Offset Voltage	V_{OS}		± 100		mV
Positive Output Voltage ($R_L=10\text{K}\Omega$)			$V_{\text{Pos}}-1.4$	$V_{\text{Pos}}-0.9$	V
Negative Output Voltage ($R_L=10\text{K}\Omega$)			$V_{\text{Neg}}+1.4$	$V_{\text{Neg}}+0.9$	V
Output Load Capacitance	C_L			1000	pF
Settling Time After Output Saturation	T_{Set}		2		sec
Operating Supply Current (Inputs=0V)	I_S		± 8.8	± 10.0	mA
External Buffer Supply Current (Inputs=0V) ³			2.5		mA
Output Short Circuit Current				+6/-15	mA
Output Noise, (0.1-10Hz)			± 14		mV
Output Noise, (1kHz)			5		$\mu\text{V}/\sqrt{\text{Hz}}$

Description

The ND3PA preamplifier accepts 12 buffered neural probe signals and 2 buffered reference signals. Each type of input signal is shunted to ground through a signal input resistor (R_I). (See Fig 1.) These resistors provide a bias current path for external JFET buffer transistors. Each signal is coupled via a capacitor C_{IC} to a grounded filter resistor (R_{PF} or R_{RF}). The filtered neural probe signals then connect to the inverting input of a differential amplifier. A filtered reference signal is connected to the corresponding non-inverting input of the differential amplifier. Outputs from these amplifiers directly drive the signal output pins of the ND3PA.

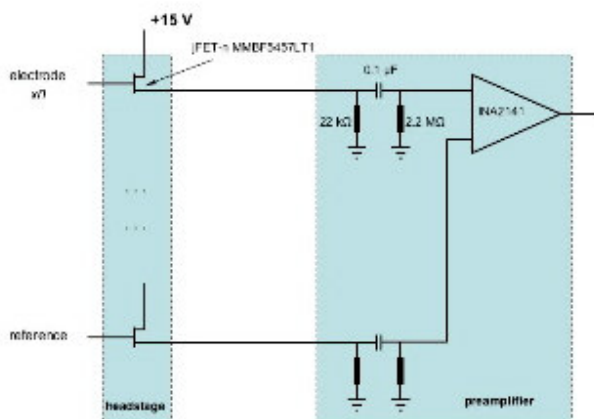


Figure 1 – Input Signal Connections

The ND3PA is pre-wired to globally route the filtered Reference Input 1 (RefIn1) signal to all 12 non-inverting differential amplifier inputs. The board can be reconfigured to use a different global

² See Texas Instruments INA2141UA Datasheet.

³ See RP Metrix ND3BAJ Datasheet.

reference (RefIn2 or Ground), or each channel can be independently configured. See 'Configuration Jumpers' in this document.

The dual bipolar power supply inputs to the board (via J1) are used internally to power the differential amplifiers. These supplies are also direct wired to the head-stage side connectors (J2/J3) to provide power to an external buffer assembly.

The board also provides a number of direct wired circuits (MotorA, MotorCom, StimulusA, etc.) to relay motor, stimulus, and other user-defined signals from J1 to J2/J3. The naming of these circuits reflects the organization imposed by the RP Metrix ND3PIF-1 12-Channel Preamplifier Interface. On the preamplifier itself, these circuits are implemented identically.

The bare board can also be configured as a Pass-Through board (ND3PT) which direct connects circuits from J1 to corresponding J2/J3 pins. A Pass-Through board is useful for circuit testing of the headstage, and to apply lesioning current to neural probes to locate their positions in neural tissue.

I/O Information

ND3PA-J1 (DB-25 Male) 25-Pin Signal Output Interface Connector

Pin #	Signal	Input/Output	Pin #	Signal	Input/Output
1	SigOut12	Output	14	SigOut11	Output
2	SigOut10	Output	15	SigOut9	Output
3	SigOut8	Output	16	SigOut7	Output
4	VPos	Input	17	RefOut2	Output
5	MotorC ⁴	Input	18	MotorB	Input
6	StimulusC	Input	19	StimulusB	Input
7	StimulusD ⁵	Input	20	Ground	-----
8	StimulusA	Input	21	MotorCom	Input
9	MotorA	Input	22	VNeg	Input
10	RefOut1	Output	23	SigOut6	Output
11	SigOut5	Output	24	SigOut4	Output
12	SigOut3	Output	25	SigOut2	Output
13	SigOut1	Output			

ND3PA-J2 (DB-25 Female) 25-Pin Signal Input Interface Connector

Pin #	Signal	Input/Output	Pin #	Signal	Input/Output
1	SigIn12	Input	14	SigIn11	Input
2	SigIn10	Input	15	SigIn9	Input
3	SigIn8	Input	16	SigIn7	Input
4	VPos	Output	17	RefIn2	Input
5	MotorC	Output	18	MotorB	Output
6	StimulusC	Output	19	StimulusB	Output
7	StimulusD	Output	20	Ground	-----
8	StimulusA	Output	21	MotorCom	Output
9	MotorA	Output	22	VNeg	Output
10	RefIn1	Input	23	SigIn6	Input
11	SigIn5	Input	24	SigIn4	Input
12	SigIn3	Input	25	SigIn2	Input
13	SigIn1	Input			

ND3PA-J3 (ZIF-24 Flex⁶) 24-Pin Signal Input Interface Connector

Pin #	Signal	Input/Output	Pin #	Signal	Input/Output
1	SigIn1	Input	2	RefIn1	Input
3	SigIn2	Input	4	VNeg	Output
5	SigIn3	Input	6	MotorA	Output
7	SigIn4	Input	8	MotorCom	Output
9	SigIn5	Input	10	StimulusA	Output
11	SigIn6	Input	12	Ground	-----
13	SigIn7	Input	14	StimulusB	Output
15	SigIn8	Input	16	StimulusC	Output
17	SigIn9	Input	18	MotorB	Output
19	SigIn10	Input	20	MotorC	Output
21	SigIn11	Input	22	VPos	Output
23	SigIn12	Input	24	RefIn2	Input

⁴ A 'Motor' signal is direct wired between connectors. It may carry a motor, stimulus, or any desired signal.

⁵ StimulusD is passed from J1 to J2, but not to J3.

⁶ Hirose Electronic Co, Ltd., FH12A-24S-0.5SH

Configuration Jumpers

Jumper blocks consist of 1, 2, or 3 pin headers. All multi-pin headers have a 45-degree cut corner near pin 1. The reference designator ("J1", etc.) is also near pin 1. The remaining pins are numbered in order: 1, 2, and 3. Jumpers are pre-wired with top surface traces for use of the board as a 12-channel preamplifier with reference input 1 driving all non-inverting side differential inputs. These pre-wired traces must be cut to change the jumper configuration. To return to the pre-wired configuration, the appropriate jumper pins must be reconnected.

The nomenclature Jx1 refers to the jumper near chip Ux, so that J41 is near U4. The reference signals have some similar jumpers identified with x = 7 and 8.

A "Pass Through" direct connect board (ND3PT) is assembled from a non-populated bare preamplifier board, by connecting SigIn1 to SigOut1 via J11 pins 2 and 3, etc. These connections are indicated in the 'direct' column.

Differential amplifier non-inverting inputs are pre-wired to the "reference" bus. The differential inputs are present on the dual pin Jx3 connectors. The reference bus is present nearby on the corresponding Bx single pin connector (for x=2,3,4,5). Each pin of the Jx3 connector is pre-wired with a top surface trace to the Bx connector. A non-inverting differential input may be wired to a new source by first cutting the corresponding Jx3 to Bx trace. The reference bus is present on B1 and B6 at pin 2. The filtered reference signal Ref1 is pre-wired via B1 to the reference bus. The filtered reference signal Ref2 is available on B6, but is not pre-wired to the reference bus. A ground connection is available on both B1 and B6 for possible alternate connection to the reference bus.

Jumper	Pin	Pre-wired	Circuit
J13	1	x	SigIn1 non-inverting differential input
	2	z	SigIn2 non-inverting differential input
B1	1	r	FRef1, (Ref1In filtered by standard passive circuit)
	2	x,z,r	Reference bus
	3		Ground
J23	1	x	SigIn3 non-inverting differential input
	2	xx	SigIn4 non-inverting differential input
B2	1	x,xx	Reference bus
J33	1	x	SigIn5 non-inverting differential input
	2	xx	SigIn6 non-inverting differential input
B3	1	x,xx	Reference bus
J43	1	x	SigIn7 non-inverting differential input
	2	xx	SigIn8 non-inverting differential input
B4	1	x,xx	Reference bus
J53	1	x	SigIn9 non-inverting differential input
	2	xx	SigIn10 non-inverting differential input
B5	1	x,xx	Reference bus
J63	1	x	SigIn11 non-inverting differential input
	2	xx	SigIn12 non-inverting differential input
B6	1		FRef2, (Ref2In filtered by standard passive circuit)
	2	x,z	Reference bus
	3		Ground

Signal and reference input/output interface connector jumpers.

Jumper	Pin	Pre-wired	Direct	Circuit
J11	1	x	x	SigIn1 from input connectors (J2/J3) SigIn1 to differential amp SigOut1 to output connector J1
	2	x		
	3		x	
J12	1	x		SigIn2 to differential amp SigIn2 from input connectors (J2/J3) SigOut2 to output connector J1
	2	x	x	
	3		x	
J21	1	x		SigIn3 to differential amp SigIn3 from input connectors (J2/J3) SigOut3 to output connector J1
	2	x	x	
	3		x	
J22	1	x		SigIn4 to differential amp SigIn4 from input connectors (J2/J3) SigOut4 to output connector J1
	2	x	x	
	3		x	
J32	1	x		SigIn5 to differential amp SigIn5 from input connectors (J2/J3) SigOut5 to output connector J1
	2	x	x	
	3		x	
J33	1	x		SigIn6 to differential amp SigIn6 from input connectors (J2/J3) SigOut6 to output connector J1
	2	x	x	
	3		x	
J41	1	x		SigIn7 to differential amp SigIn7 from input connectors (J2/J3) SigOut7 to output connector J1
	2	x	x	
	3		x	
J42	1	x		SigIn8 to differential amp SigIn8 from input connectors (J2/J3) SigOut8 to output connector J1
	2	x	x	
	3		x	
J51	1	x		SigIn9 to differential amp SigIn9 from input connectors (J2/J3) SigOut9 to output connector J1
	2	x	x	
	3		x	
J52	1	x		SigIn10 to differential amp SigIn10 from input connectors (J2/J3) SigOut10 to output connector J1
	2	x	x	
	3		x	
J61	1	x		SigIn11 to differential amp SigIn11 from input connectors (J2/J3) SigOut11 to output connector J1
	2	x	x	
	3		x	
J62	1	x	x	SigIn12 from input connectors (J2/J3) SigIn12 to differential amp SigOut12 to output connector J1
	2	x		
	3		x	
J71	1		x	RefIn1 from input connectors (J2/J3) RefOut1 to output connector J1
	2		x	
J81	1		x	RefIn2 from input connectors (J2/J3) RefOut2 to output connector J1
	2		x	