

ARTISAN®
TECHNOLOGY GROUP

Your **definitive** source for quality pre-owned equipment.

Artisan Technology Group
(217) 352-9330 | sales@artisantg.com | artisantg.com

Full-service, independent repair center
with experienced engineers and technicians on staff.

We buy your excess, underutilized, and idle equipment
along with credit for buybacks and trade-ins.

Custom engineering
so your equipment works exactly as you specify.

- Critical and expedited services
- In stock / Ready-to-ship
- Leasing / Rentals / Demos
- ITAR-certified secure asset solutions

Expert team | Trust guarantee | 100% satisfaction

All trademarks, brand names, and brands appearing herein are the property of their respective owners.

Find the *Digitimer NeuroLog NL900C* at our website: *Click HERE*

Digitimer

NeuroLog

SYSTEM

Intracellular & Extracellular Recording

Pressure or Force Measurement

Multi-Channel Isolated Amplification

Isolated Electrical Stimulation

Trigger Pulse Generation

Filtering & Signal Conditioning



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

The NeuroLog System - An Overview

The NeuroLog System is now widely accepted throughout the world by scientists who demand high quality, dependability and innovation in their research instrumentation. Typical applications include: intracellular recording, extracellular recording, spike detection, electrical stimulation, pulse & train generation, multi-channel isolated EMG or EEG recording, pressure or other transducer recordings. NeuroLog System sales and service is available worldwide, through Digitimer Ltd. and its network of distributors.
Because the NeuroLog System is fully modular, it has the following well recognized advantages over non-modular “multi-purpose” instruments:

Greater Flexibility Complex systems can be quickly assembled or modified.

Enhanced Efficiency Modules can be shared among several set-ups, expanding capabilities without duplication. Only those modules required for a particular task are tied up and occupy rack space.

Wider Compatibility Input & output levels, impedances, connectors, etc., of different modules in the system are compatible, minimizing the problems encountered in interconnecting pieces of equipment of diverse origin.

Cost Effective Only those modules actually required are purchased. You do not pay for all those functions added to an instrument to make it “general purpose”. Individual modules can be added to the system at any time, as the scope and orientation of your application changes.

The NL900D Case & Power Supply unit allows up to thirteen modules to be installed. This means that a single NeuroLog System can be used to monitor several different parameters, such as extracellular spikes, intracellular potentials or even blood pressure, as well as produce outgoing trigger pulses to other pieces of equipment, electrically stimulate a preparation or carry out signal conditioning tasks.





This brochure, like any other, is a snap-shot of the product line at one particular time. When the product is in a continuous state of development, as in the case of the NeuroLog System, the brochure is out of date almost before it is printed. It is our practice to supplement this brochure with periodic product announcements to keep our customers (and potential customers) informed about new products as soon as they become available. In addition, our web site (www.digitimer.com) contains a wealth of up to date information on the components of the NeuroLog System as well as downloadable support documents such as specific Application Notes and User’s Manuals which can be invaluable when selecting the appropriate modules for a particular application. We are always happy to discuss your requirements if you are unsure what components you require.

The NeuroLog System Modules

The front panel of each module measures 30mm wide by 122mm high. The attached printed circuit board is 152mm long by 102mm high. Each module has a split ring handle attached to its front panel; this serves as a cable run as well as a handle for withdrawing or inserting the module into the case. All module outputs are short circuit proof. The extensive use of standard transistor-transistor logic (TTL) and standard linear integrated circuits ensures the lowest

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

possible cost and highest possible compatibility with other instruments. The output levels and impedances of the linear inputs and outputs are appropriate for general purpose oscilloscopes, low gain chart recorders and data acquisition interfaces. The NeuroLog System is also compatible with the components most frequently used in special circuitry built by individual investigators to meet their own particular needs. Undrilled front panels and special printed circuit boards - assembled as the NL50 Blank Module are available to encourage the design and use of such special purpose modules with the NeuroLog System.

NL900D NeuroLog System Rack & Power Supply (up to 13 modules)

The NL900D case has handles and included rack mounting hardware so that it can be shifted directly between rack and bench top. The case measures 133mm high (without feet) by 483mm wide by 317mm deep; it contains 13 module bays plus power supply panel. The case and power supply (without modules) weighs 5.5kg.

The NL900D has an integral module retention system, consisting of a simple, slide action lever on the power supply panel. Thus fittings such as retained screws, D-Locks, etc., on individual module front panels are unnecessary; this simplifies the modules mechanical design, reduces their cost and greatly improves the ease with which rapid changes in module arrangements can be made.

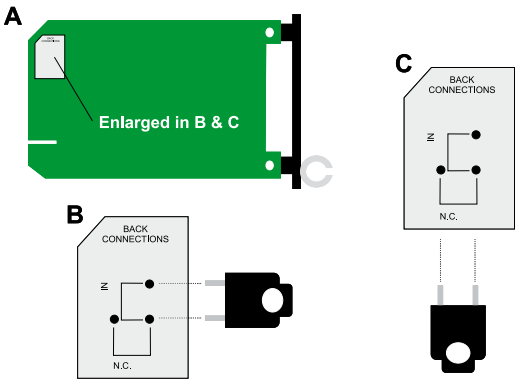
The power supply produces three voltages (+15V, +5V and -15V), stabilized against line and load variations. The voltage outputs are rated at 650mA, 3.0A and 650mA respectively. All three supplies have internal “fold-over” current limiting; the 15V supplies, in addition, are protected with series fuses. Each supply has less than 15mV line ripple at maximum load. The power supply transformer employs a sectionalized winding former for additional safety and complies with the requirements of IEC60601-1. The power supply provides sufficient power for any mix of single width NeuroLog modules, plus up to 2 NL750 Averagers.

A unique feature of the NeuroLog power supply is a built-in error circuit which indicates (by extinguishing the power supply indicator on the front panel) excessive loading of one or more of the three supply outputs. While it is expected that a power supply failure will never occur using NeuroLog modules, the fault indication is invaluable when testing custom circuits built in the NL50 Blank Module.



NL905 Compact NeuroLog System Rack & Power Supply (up to 4 modules)

The NL905 is a compact case & power supply unit for the NeuroLog System which is offered for users who require no more than 4 modules for their given application or are short of space. The case measures 130mm (high) x 164mm (wide) x 271mm (deep), has overload protection fuses, a front panel on/off switch, an LED power indicator as well as flip-out feet for bench placement. It is fully compatible with all NeuroLog System modules, either current or discontinued.



Module Interconnection

The general problem of module interconnection has been minimized in the NeuroLog System by a unique method of automatic connection of outputs and inputs of neighbouring modules through the case edge connectors. Thus, for many linear arrangements of modules, only the input and output cables connecting the system to the preparation and to output devices such as oscilloscopes, recorder or data acquisition interfaces are required. Front panel controls are therefore not obscured by cables which merely connect each module to the next. More complex module arrangements will, however, require some front panel cable interconnection; between 5 and 10 cables of various length will be required for a typical 13 module system. No cables are supplied with the case.

The diagram opposite shows how the shorting pin on a typical module printed circuit board is used to make the connection between the input of this module and the output of the module in the adjacent bay to its left. (A) shows the location of the jumper pin in the upper left hand corner of the p.c. board, while (B) shows the jumper position enabling connection via the rear of the module and (C) shows the position for no rear connection. Some modules with more than one output have a similar jumper pin arrangement for selecting the output to be relayed through its edge connector to the input of the module in the bay to its right.

Cables & Accessories

Only micro-miniature coaxial connectors with a “snap-on” action are used in the NeuroLog System, eliminating the nuisances caused by connectors such as the BNC and UHF types which have a “twist-on” or “screw-on” action. All external connections between modules are made through miniature, screened coaxial cable, which reduces cross-talk and transient pick-up, as well as eliminating the “rat’s nests” of fine, unscreened wires and 1mm, 2mm or 4mm plugs frequently used for patching in other modular systems.



NL951B-2m Lemo to BNC Cable

A variety of assembled cables, plugs, sockets, BNC to NeuroLog adaptors and “T” connectors are available from Digitimer Ltd., and its agents for the NeuroLog System (see Accessories Section). The connectors are manufactured by Lemo (Switzerland) and were chosen for the NeuroLog System because they are the finest micro-miniature snap-action connectors available. Without these particular plugs and sockets, the front panels of the NeuroLog System would necessarily have been substantially larger. This would have reduced the number of modules which would fit into a standard 483mm (19”) case, and increased the total system cost.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

TYPICAL APPLICATIONS

This brochure gives us the opportunity to illustrate some of the ways the NeuroLog System can be employed in your laboratory, however, this is by no means an exhaustive list of applications. As our module range continues to evolve and your requirements also change, new applications will arise and it is hoped that many of these will either find their way onto these pages in future editions or onto our web site (www.digitimer.com). The web site already contains a comprehensive range of application notes available for download in PDF format, including versions of those given below. If after consulting our application notes or browsing our web site you think the NeuroLog System may be suitable for your particular application, please contact us to discuss it further.

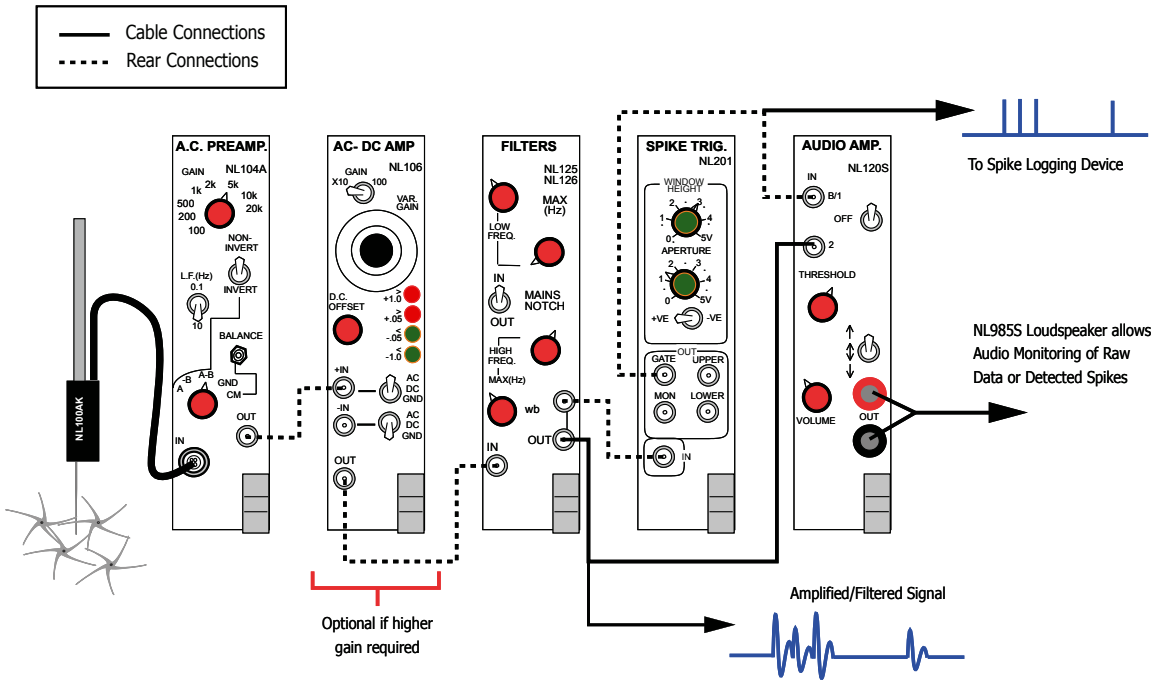
In each of the illustrated application notes, modules are either joined by solid lines, indicating cable connections or by dotted lines, indicating connections made through the rear of neighbouring modules. We generally recommend that you use the rear connections whenever possible as it saves on the number of cables you need to purchase and reduces clutter around the front panels of the modules, however, in some instances cables are required. We can supply cables of various types and lengths, please refer to the Accessories Section of this brochure. When using the rear connections, make sure that the jumpers on the printed circuit boards of the modules are correctly positioned (please refer to the users manual for each module for full details) and remember that communication through the rear connections ONLY occurs from left to right between immediately neighbouring modules.

Amplification & Signal Conditioning

The NeuroLog System provides AC or DC coupled amplification of biological signals from transducers, single electrode or multi electrode configurations. DC coupled amplifiers output absolute voltage levels and are most commonly employed for intracellular or transducer recording where baseline membrane potentials or slower changes in parameters are of interest. With AC coupled amplifiers, the "DC baseline" is removed by low cut filtering. Such amplifiers are used for extracellular recording of action potentials in neuronal preparations, ECG, EMG or EEG waveforms. The variety of NeuroLog pre-amplification and amplification modules means that users can develop systems specifically suited to their particular application. The NeuroLog range also contains a number of filter and signal conditioning modules which can be used prior to final data acquisition.

Extracellular AC Recording

The NL100AK PRE-AMPLIFIER HEADSTAGE and NL104A AC PRE-AMPLIFIER combine to provide an excellent low noise amplification, impedance matched system for extracellular AC recording from *in vitro* preparations or *in vivo*. The NL104A can be used in differential or single ended modes and can amplify a signal by x100 to x20k. A 0.1Hz or 10Hz low frequency cut-off filter allows removal of DC components. If the signal of interest requires further amplification, the NL106 AC/DC AMPLIFIER can be used to boost the gain by up to x100. Notch (50/60Hz), low and high cut filtering is provided by the NL125/6 FILTER. The output from the NL125/6 can be fed into a computer via an ADC for acquisition, or alternatively, individual spikes can be discriminated using the NL201 SPIKE TRIGGER module. The aperture size, polarity and height of the discriminator window can be monitored on an oscilloscope with the raw data superimposed (MONITOR). The various outputs on the NL201 produce a TTL compatible pulse in response to a spike which crosses the lower threshold only (LOWER), upper threshold (UPPER) and lower but not upper thresholds (GATE). These pulses can be collected by a computer data acquisition system enabling spike frequency logging to be carried out alongside acquisition of the raw signal.



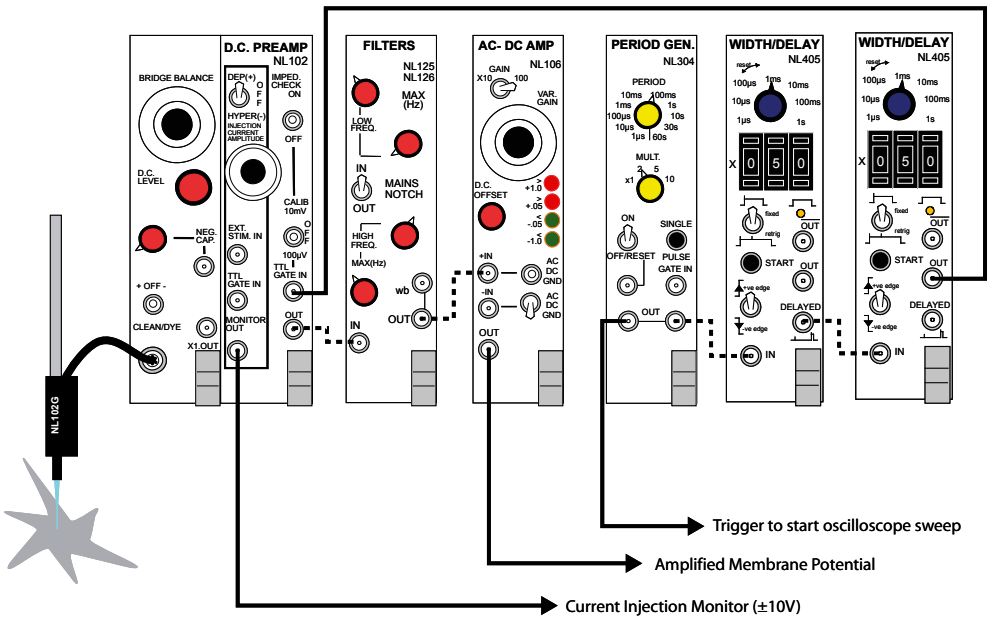
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

It is often desirable to be able to hear the spike activity during an experiment and with the NL120S AUDIO AMPLIFIER and NL985S LOUDSPEAKER, this is made possible. As the NL120S has two inputs, you can switch between listening to the raw filtered/amplified signal or the "clicks" resulting from the detection of individual spikes (using the NL201).

This particular configuration of modules requires only one Lemo interconnection cable (NL951), as all other module connections are made through the NL900D CASE & POWER SUPPLY UNIT. Additional cables and "T" connectors would be required to feed the signals into a data acquisition system.

Intracellular DC Recording with Current Injection

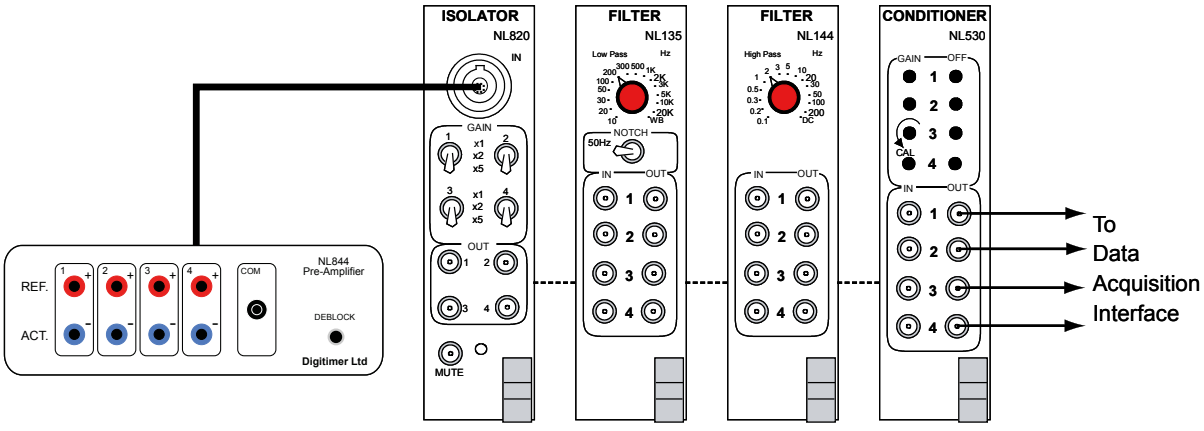
The NL102G DC PRE-AMPLIFIER features capacity neutralization, current injection, low leakage current and low DC drift. It is particularly suitable for intracellular recording through fluid filled micro-electrodes. Electrode attachment to the dedicated compact pre-amplifier headstage is made via our NL101-xx ELECTRODE CHAMBERS. Features of the NL102G include electrode impedance check, calibrator, stimulus bridge balance DC level adjustment (±2V) and current injection/monitor. A maximum current injection of up to ±100nA is possible through the front panel control or from an external analogue input. Current injection occurs either when the toggle switch is moved to the DEP or HYPER positions or in response to an input at the TTL GATE IN socket and/or EXT. STIM. IN socket. Electrode impedance checking and output calibration features can be easily accessed using the controls on the right hand side of the of the NL102G. The timing of these functions can be controlled by other modules or devices via the TTL GATE IN socket. In the setup illustrated, the impedance checking/calibration functions are controlled by a 50ms gating pulse which is generated by other NeuroLog modules once every 200ms. The first NL405 WIDTH/DELAY module delays the pulse from the NL304 PERIOD GENERATOR while the second NL405 gives the duration of the pulse. However, such pulses could possibly be provided by your chosen data acquisition interface/software, making these extra modules unnecessary.



Please note that all newly supplied NL102G DC PRE-AMPLIFIERS now include the hand-held NL412 PULSE unit. This provides a remote BUZZ control which activates the capacitance compensation circuitry briefly in order to facilitate micro-electrode cell penetration.

Four Channel Isolated Amplification for EEG, EMG or ECG Recording

An ideal system for multi-channel isolated AC recording of physiological signals such as EEG, EMG or ECG in the non-diagnostic (research) environment. The system provides a wide range of amplification and filter settings. The NL844 4-CHANNEL AC PRE-AMPLIFIER can be positioned near the recording site, so reducing the length of the electrode cables and minimising interference. The outputs are connected to the



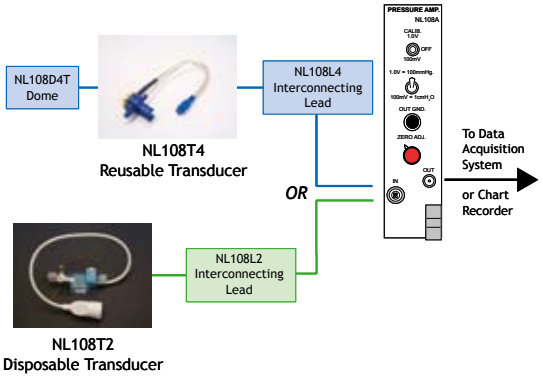
Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

NL820A ISOLATOR (housed in an NL900D or NL905 NeuroLog case), where further amplification of the signals can be selected on a channel by channel basis. Further filtering can be carried out by the various NL144 or NL134/5/6 FILTERS, which offer high pass, low pass and notch filter options. In addition, the signal can be conditioned prior to ADC input using the NL530 CONDITIONER which has facilities for signal gain, filtering and DC offset adjustment. Signals are passed between the modules through rear connections, thus reducing the number of additional cables required and improving the signal to noise ratio of the system.

Physiological Pressure & Force Measurement

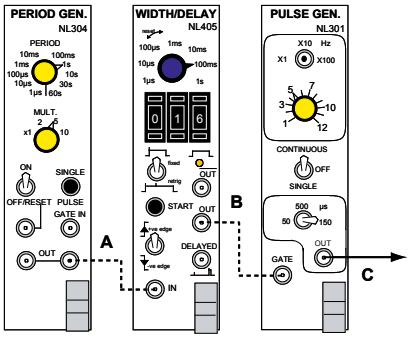
The NL108A PRESSURE AMPLIFIER provides an easy method of monitoring physiological pressure changes and can be used in combination with our disposable (NL108T2) or reusable (NL108T4) pressure transducers. The NL108A has two amplification ranges, making it suitable for measuring high pressures such as blood pressure as well as lower pressures including intra-tracheal pressure. The module includes a calibrate button as well as a DC offset control allowing you to zero the baseline. Your chosen transducer is connected to the NL108A module via an interconnecting lead with the output from the NL108A feeding into a chart recorder or ADC interface.

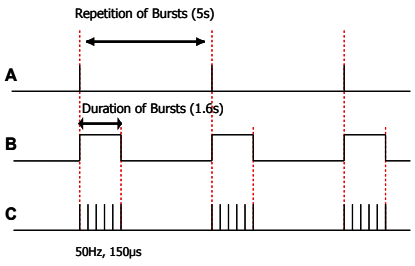
The NL108A PRESSURE AMPLIFIER can also be interfaced with isometric force transducers such as our NL61 and NL62 (see page 18). As with pressure monitoring, the analogue output of the NL108A can be fed directly to a chart recorder or ADC interface for PC-based data acquisition.



Pulse Generation & Electrical Stimulation

The NeuroLog System includes a range of modules capable of pulse generation, timing control and electrical stimulation. Pulse patterns can be pre-defined in a variety of ways, allowing you to control other modules within the NeuroLog rack or send TTL compatible trigger pulses to external devices, such as stimulators or acquisition systems. The NeuroLog range includes the small, constant current NL800A STIMULUS ISOLATOR which can be controlled by other NeuroLog modules (e.g. NL510A PULSE BUFFER) or other compatible devices. Our new NL512 BIPHASIC BUFFER allows one or two NL800A's to be controlled by an analogue waveform, such as that generated by a computer controlled DAC. Used in this way, the NeuroLog System can become a multi-channel, computer controlled, biphasic, constant current, independently isolated stimulator.



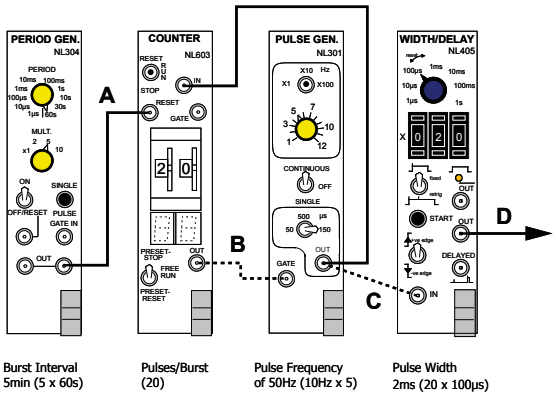


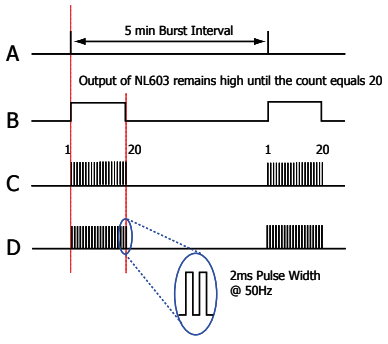
A Regular Burst of Pulses with Control of Burst Duration/Repetition and Output Frequency/Width

This scheme provides a simple means of generating a repeating burst of pulses which can be used to trigger other NeuroLog modules or TTL compatible devices, such as electrical stimulators. These modules allow control over the duration and repetition of the burst as well as the duration and frequency of the individual output pulses. The NL304 PERIOD GENERATOR is used to set the repetition of the burst, while the NL405 WIDTH/DELAY module determines the duration of the burst. Note that older "Width" modules such as the NL401 DIGITAL WIDTH and NL403 DELAY/WIDTH can be used in place of the NL405. Finally, the NL301 PULSE GENERATOR sets the output pulse frequency and width (50, 150 or 500 µs). If these pulse widths are too limiting, it is quite possible to add a further NL405 after the NL301 to provide greater flexibility, as demonstrated below.

A Regular Burst of Pulses with Control of Burst Frequency, Pulses per Burst & Pulse Frequency/Width

This application was designed to allow a NeuroLog user to deliver a burst of stimuli to a biological preparation every five minutes, with control over this interval, the number of pulses in the burst as well as control over the stimulus pulse width and frequency. Ultimately, the output at (D) was fed into the NL510A PULSE BUFFER and NL800A STIMULUS ISOLATOR in order to convert the 2ms output pulses from the NL405 WIDTH/DELAY into a constant current stimulus of adjustable amplitude.



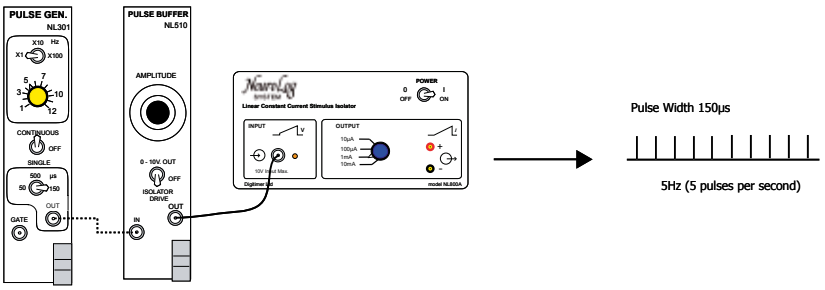


Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

This simple arrangement of four modules is based around the NL304 PERIOD GENERATOR, the settings of which determine the interval between bursts. Once in the "ON" position, the module sends a regular output pulse at the interval set on the front panel. This output resets and activates the NL603 COUNTER, sending it's output at (B) "high" until the count reaches the preset value of 20.
But how is the counting done? The "high" output from the NL603 is used as a gate which allows the NL301 PULSE GENERATOR to pass a burst of pulses. The burst of pulses is fed into the NL405 WIDTH/DELAY in order to give them width and also fed back to the input of the counter module. Once the counter detects 20 pulses, the output goes "low" thereby ending the gating pulse at (B). This gating pulse remains "low" until the next reset pulse is sent by the period generator and a new burst is initiated.

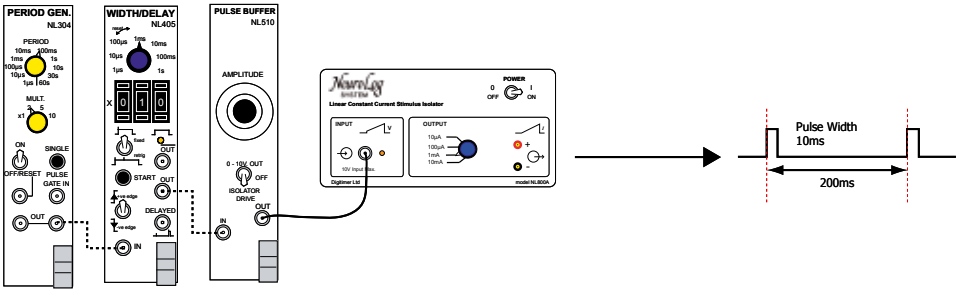
Basic Stimulation with Limited Pulse Duration Control

The arrangement below shows the simplest method by which single stimuli or continuous stimulation trains can be produced with the NeuroLog System. Pulse frequency is continuously variable from 1Hz to 1000Hz, three output pulse widths (50, 150, 500µs) are available and output



amplitude is continuously variable over four ranges from 0 to 10mA, with an isolated stimulus output supplied by the NL800A STIMULUS ISOLATOR. Note that the NL510A PULSE BUFFER can be used without the NL800A to generate a 0-10V non-isolated output for low voltage stimulation applications.

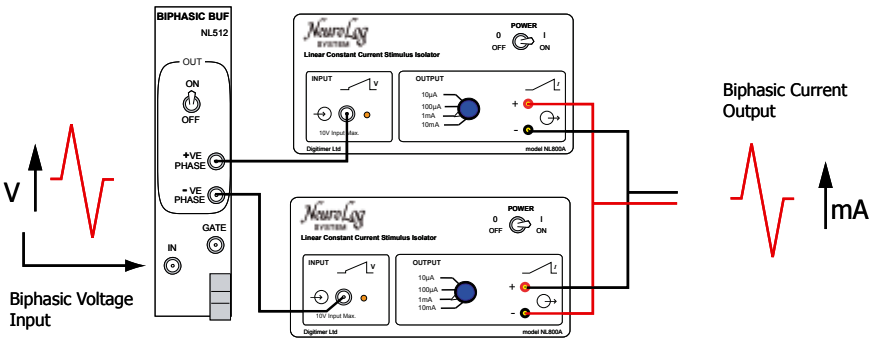
Repetitive Stimulation with Pulse Duration Control



By substituting the NL301 with an NL304 PERIOD GENERATOR, the pulse interval range can be greatly extended. In addition, because the NL304 only outputs a 0.5µs long pulse, the actual stimulus width can be more flexibly defined using the NL405 WIDTH/DELAY module. Amplitude is controlled in the same manner as Example 1.

External Analogue Control of Biphasic Stimulation

The NL512 BIPHASIC BUFFER can be used in combination with two NL800A modules to allow a biphasic analogue signal to be converted into a constant current stimulus. The resulting configuration is "current out for voltage in", meaning that the amplitude of the analogue input is proportional to the amplitude of the resulting constant current stimulus. Biphasic stimulation has the advantages that the preparation does not suffer the deleterious effects of "charging-up" and electrodes do not become oxidised. The biphasic analogue signal can be generated by a PC controlled DAC or by other NeuroLog System modules. If you want to stimulate several preparations using multiple sets of the NL512/NL800A configuration at different times, the GATE input of the NL512 allows for digital output lines from a PC to enable each NL512 individually.



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

PRE-AMPLIFIERS & AMPLIFIERS

NL100AK AC PRE-AMPLIFIER HEADSTAGE



The NL100AK AC pre-amplifer headstage is a differential input, low noise, high impedance buffer amplifier suitable for extracellular recording. The headstage is supplied as standard with a removable 6.4mm diameter stainless steel manipulator mounting rod. Power is supplied by the NL104A AC pre-amplifier via a 4 way lemo plug and socket, however, this headstage can also be used in conjunction with older NeuroLog amplifiers (NL103, NL104, NL107), please specify with your order. Each headstage is supplied with an NL973A accessory kit which contains 1mm and 2mm plugs, a U-shaped input jumper and an allen key.

SPECIFICATIONS:

Input resistance: 100MΩ; gain: x1; input noise: <2µV (peak to peak) with inputs shorted, <25µV for typical tungsten microelectrode in saline, <30µV with a 1MΩ resistor between inputs (bandwidth in all three cases, 10Hz to 10kHz); dimensions: 35.6mm x 9.5mm diameter; cable length: 2m; connections: +IN (2mm socket) for non-inverting input (accepts plugs supplied and optional NL101 electrode chambers), -IN (1mm socket) for inverting input connection to reference electrode or via U connector (supplied) to ground socket (GND). GND (1mm socket) connected to mains earth.

NL100RK AC PRE-AMPLIFIER HEADSTAGE (FEATURING STIMULUS CONTROL)

The NL100RK is comprised of a switchable NL100AKS AC pre-amplifier headstage and an NL100C stimulus control module. The NL100AKS headstage combines the same differential amplification specifications as the NL100AK (above) with the addition of a relay controlled by the NL100C, which allows you to stimulate your preparation through your recording electrode without having to disconnect the headstage from the electrode. This system would be ideal for electrical lesioning of tissue in order to identify an extracellular recording site once an experiment is concluded.



The NL100C Stimulus Control Module has two 2mm shrouded sockets for connection to your chosen stimulator (e.g our DS2A or DS3 units) and features a three position toggle switch which enables, disables or permits external gated control of the stimulus relay. The module also incorporates a socket for connection to the NL100AKS headstage as well as an output socket (and interconnecting cable) for connection to the NL104A AC pre-amplifier (supplied separately). The NL100C will accept stimulus voltages of up to 100V.

SPECIFICATIONS:

Input resistance: 100MΩ; gain: x1; input noise: <2µV (peak to peak) with inputs shorted, <25µV for typical tungsten microelectrode in saline, <30µV with a 1MΩ resistor between inputs (bandwidth in all three cases, 10Hz to 10kHz); dimensions: 40mm x 50mm x 15mm; cable length: 2m; connections: +IN 2mm socket for non-inverting input (accepts plugs supplied and optional NL101 electrode chambers), -IN (1mm socket) for inverting input connection to reference electrode or via link to ground socket (GND). GND (1mm socket) connected to mains earth.

NL102G INTRACELLULAR DC PRE-AMPLIFIER

The NL102G is a direct coupled pre-amplifier designed specifically for biological recording. With features such as capacity neutralization, current injection, low leakage current and low DC drift, it is particularly suitable for intracellular measurements through high resistance fluid-filled electrodes.



The high impedance headstage of the NL102G is fitted in a metal tube at the end of a 2m cable. The headstage is matched with the main amplifier module supplied with it and is not interchangeable with other NL102G DC pre-amplifier modules without recalibration (the serial numbers on the headstage and module MUST match). The central 2mm input socket (IN) is the capacity-compensated signal input through which current can be injected. The shield socket (1mm) is the x1 output and may be used as a capacitance ground or shield around the electrode and preparation. The third socket (1mm) is the system earth (ground) and connection should be made to the indifferent electrode only.



FEATURES INCLUDE:

Electrode impedance check ♦ Calibrator ♦ Four current injection ranges (±100nA, ±50nA, ±20nA, ±10nA) with four corresponding bridge balance ranges (100MΩ, 200MΩ, 500MΩ and 1000MΩ) ♦ External gating of above facilities ♦ Bridge balance ♦ Constant current capacitance compensation (neg. Cap.) which largely eliminates re-adjustment, due to changes in input source resistance, common with voltage feedback circuits. ♦ Dye/clean (+ OFF -) toggle switch which can be used either for clearing blocked micro-electrodes or depositing dyes through extracellular pipettes (max. current ±1.0µA) ♦ For low capacitance screening purposes the headstage has a driven shield output (x1 out) ♦ x1 output amplifier has a ±10V dynamic input signal range ♦ Current injection monitor ♦ Supplied NL412 Pulse Module provides "buzz" capability to ease micro-electrode impalement.

AMPLIFICATION - Two outputs are available:

i) x1 OUT - voltage present at "+" input referred to GND including any potential dropped across electrode resistance by injection stimulus current

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

applied. Max. voltage range of amplifier ±10V.

ii) x10 OUT - 10 times signal present at "+" input referred to GND less voltage generated across electrode resistance Re when bridge balance control is correctly set for a value of Re. BRIDGE BALANCE range ±10V corresponds to 100MΩ at 100nA, 200MΩ at 50nA and 1000MΩ at 10nA depending on the setting of the inject current selector, (printed circuit board mounted). DC LEVEL control enables x10 amplifier to back off up to ±2V at the input.

CURRENT INJECTION

Stimulus currents can be injected into the electrode system in either direction under the following conditions:

i) Set by current inject control in magnitude, direction by front panel HYPER/DEP switch and gated ON or OFF by TTL gate pulses at front panel socket.

ii) Set in magnitude and direction by analogue voltage applied at front panel socket - signal range ±10V. Current injection can be a combination of both control systems. Full scale current injection conditions can be set by printed circuit board selector at 100nA, 50nA, 20nA or 10nA.

The MONITOR OUT socket allows connection of an oscilloscope to monitor the injection current (+10V/ + full scale injection current).

Other injection current possibilities are:

Max. non-controlled current for dye injection to preparations or clearing of blocked electrodes. Current is dependent on electrode resistance and can be up to 1μA max. Repeated reversal of the selector switch will usually clean blocked electrodes.

Impedance check measurements selected by front panel switch injects a current (1nA) through the electrode giving a signal at the x1 output which is a pulse wave of amplitude 1mV/MΩ or 10mV/MΩ at the x10 output.

CAPACITY COMPENSATION

The NL102G has a front panel control to adjust the amplifier section to compensate for capacity to ground at the electrode. Adjustment is easily made by switching on the impedance check signal and setting the NEG CAP control for a fast risetime square wave without excessive overshoot at the output. The range is sufficient to compensate for capacities up to 30pF. The amplifier can be deliberately put into an oscillatory mode (buzzed) by pressing the push button located on the NL412 Pulse module which is supplied with the NL102G. This feature is designed to aid cell penetration when attempting intracellular recordings.

CALIBRATION

A square wave calibration signal is built into the NL102G for calibration through a complete system. This is selected by a front panel switch as one of two magnitudes: 10mV or 100μV or it can be gate controlled by a TTL signal applied to the front panel sockets. The signal (approx. 150Hz) is summed with the bridge balance signal at the input of the x10 amplifier section.

SPECIFICATIONS:

Input resistance: 10^{11}Ω; input voltage: ±10V; gate leakage current: adjustable to zero; risetime (zero source resistance): 1μs (20MΩ source resitance: 15μs); injection current/bridge balance (selectable ranges): 100nA/100MΩ - 50nA/200MΩ & 20nA/500MΩ - 10 nA/1000MΩ; zero stability: ±100 μV/Day; output impedance: 600Ω; maximum noise level at 10 kHz bandwidth, referred to input (zero source resistance): 20μV peak to peak/4μV RMS (10MΩ source resistance: 180μV peak-peak/36μV RMS); DC level range: ±2V; output voltage range: ±11V; calibrator: 10mV or 100μV, 150Hz square wave; external stimulus input range (referred to input): ±10V corresponds to ± full scale current, depending on range selected; voltage gains: x1, x10 fixed; absolute max. input voltage range: ±14V; capacity neutralization: 0-30pF; electrode impedance check: x1 out = 1 mV/MΩ, x10 out = 10 mV/MΩ; headstage dimensions: 35.6mm x 9.5mm diameter.

NL104A EXTRACELLULAR AC PRE-AMPLIFIER



The NL104A AC pre-amplifier is a low noise, high input impedance, differential preamplifier. It can be used alone for making recordings from low resistance (gross) electrodes, or with the NL100AK or NL100RK headstages for microelectrode recordings. The NL104A features a wide dynamic balance adjustment for asymmetrical inputs (useful for balancing out interference and shock artefacts), a choice of two input time constants, 8 gain ranges and 3 high frequency filter settings. An internal 50Hz oscillator is provided for precisely balancing the input (input switch in the CM position).



SPECIFICATIONS:

Gain: 100, 200, 500, 1k, 2k, 5k, 10k or 20k; input resistance: 10MΩ; high frequency cutoff: Selectable for 100Hz, 700Hz, 6kHz or W.B. (>40kHz); low frequency cutoff: 0.1Hz or 10Hz; common mode rejection ratio: 10,000:1 at 50Hz; input noise: <10μV (peak to peak) with inputs shorted to ground and bandwidth of 0.1Hz to 10kHz; dynamic balance adjustment: gain for one input can be varied ±50% with respect to the other; output voltage range: ±12V (max.).

NL106 AC/DC GENERAL PURPOSE AMPLIFIER

The NL106 AC/DC amplifier features attenuation or amplification which is continuously adjustable, using a locking ten-turn potentiometer, from 0 to x10, or 0 to x100. Its input controls are similar to those of conventional oscilloscope vertical amplifiers, allowing operation in AC or DC coupled, single ended (inverting or non-inverting) or differential modes. Up to ±2V DC at either input can be zeroed using the ten-turn DC OFFSET adjustment. The output voltage is shown by 4 light-emitting diodes: two red LED's show outputs in excess of 50mV and 1.0V; two green LED's show corresponding negative outputs. Thus, adjustment of gain and DC offset can be accomplished without an oscilloscope monitor. Low drift, low noise and moderate input impedance make the NL106 suitable either as an amplifier for low impedance sources, or as a variable gain stage following a preamplifier.

SPECIFICATIONS:

Input voltage range: ±15V; input impedance: 1MΩ; gain: 0 to x10 or 0 to x100 continuously variable by a ten-turn potentiometer; small signal frequency response (±1V out): >30kHz; low frequency cutoff in AC mode: 2Hz; output voltage range: ±12V; output impedance: 600Ω: DC offset range: ±2V at either input, ten-turn potentiometer adjustment; common mode rejection ratio: >2500:1 at 50Hz.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

NL109 BRIDGE AMPLIFIER



The The NL109 BRIDGE AMPLIFIER is DC coupled, differential amplifier intended for use with transducers which require a bridge excitation voltage, including our own force transducers (see NL61, NL62 and NL63). It can also accept our NL100AK Headstage for DC coupled microelectrode recordings. The output from the NL109 is the amplified and filtered difference between the +IN and -IN signals. An onboard jumper allows the user to set the NL109 to a "Half Bridge" mode for single-ended inputs. The input socket mates with the NL963 plug, which is not included.

SPECIFICATIONS:

Input Voltage Range: ±1.5V (Working), ±15V Max.; Gain: x1 to x5,000; Calibration: Cal. control provides 0 to -40% gain reduction; High Frequency Cut: 0.3 to 30kHz (±10%); Low Frequency Cut: DC, 0.1 or 10Hz; Zero Button with bi-colour LED; Excitation Voltage: 1 to 15V; Output Voltage: ±13.5V; Common Mode Rejection Ratio: >90dB @ 50Hz.

NL108A PRESSURE AMPLIFIER

The NL108A pressure amplifier module provides two gain settings, one appropriate for blood pressure measurement (1.0V at the output corresponds to 100mm Hg pressure at the transducer) and the other for low pressure measurement such as intra-tracheal pressure (100mV at the output equals 1cm H_2O at the tranducer port). An internal voltage calibrate provides the appropriate deflection (1.0V or 100mV) for these two ranges. Other features include excellent DC stability, a push button switch for setting the zero pressure baseline on the recorder instrument, and a sensitive zero offset control. Although the NL108A is designed to mate perfectly with our own pressure tranducers (NL108T2 or NL108T4), due to its internally adjustable gain and bridge excitation voltage, it can be used with a variety of other standard pressure transducers. If another transducer is being used an input plug type NL963K must be correctly wired to the particular pressure transducer to be used with the NL108A.



SPECIFICATIONS:

Input voltage range: ±10V; input impedance: $10^9\Omega$ (typical); gain: 1V/100mm Hg or 100mV/cm H_2O (for a pressure tranducer having an output of 50µV/mm Hg); DC offset: ±80cm H_2O, ±60mm Hg (when switched to appropriate range); bandwidth: DC to 150Hz; output voltage range: ±12V; output impedance: 600Ω (nominal) except "zero out", where output is short circuited to Ground.

NL108T2 DISPOSABLE PRESSURE TRANSDUCER

The NL108T2 disposable pressure transducers provide a straight-forward, cost effective and reliable means of monitoring physiological pressures. The transducers feature a large uniform lumen reducing the chance of incomplete filling, which can lead to bubble formation. The transducer is fitted with a short lead which is to be connected via our 2.5m long NL108L2 cable to the NL108A pressure amplifier. Whilst these transducers are justifiably used on a disposable basis in the clinical environment, with careful use, their life-time in a non-human research laboratory can be extended further.

SPECIFICATIONS:

Pressure Range: -50mm Hg to +300mm Hg; over-pressure tolerance: 10000mm Hg; bridge resistance: 1000Ω (input) nominal, 350Ω (output) nominal; excitation voltage: up to 10V DC or AC maximum, up to 5kHz; zero offset: ±40mm Hg, maximum; maximum inaccuracy: ±2% of reading or 1mm Hg, whichever is greater.

NL108T4 PRESSURE TRANSDUCER

Suitable for both arterial and venous blood pressure monitoring, the NL108T4 is to be attached to the NL108A pressure amplifier via a 2.5m long NL108L4 cable, allowing continuous pressure monitoring. The NL108T4 is a highly accurate and rugged re-useable transducer, which is used in conjunction with disposable domes (NL108D4T). These disposable domes are easy to fill and attach to the transducer body and are available from Digitimer in packs of 10 or individually (one dome is included with each transducer). The components of the transducer are electrically isolated from the transducer housing, which is in turn isolated from the saline solution by the silicone membrane of the dome. The transducer is gold plated, making it easier to clean.

The transducer is designed primarily for use during blood pressure monitoring, but equally well operates as a monitor for intracranial, gastrologic or intrauterine pressures, as well as urodynamic measurements.



SPECIFICATIONS:

Pressure range: -20 to 300mm Hg; max. overpressure: 10,000mm Hg; sensitivity: 50µV/V/cm Hg; resonance frequency: 300Hz typical (transducer and dome); max. electrical excitation: 15V DC or AC; input resistance: 700Ω; output resistance: 1000Ω; non-linearity & hysteresis: max. 0.5% of full scale; zero balance: max. ±30mm Hg; thermal sensitivity: 0.15%/ºC; thermal zero shift: max. 0.25mm Hg/ºC; operating temperature range: +10 to +50 ºC; storage temperature range: -20 to +70 ºC; insulation resistance: min. 10MΩ; leakage current: max. 1.5µA at 250V, 50Hz; high voltage resistance: 10kV between saline in dome & transducer leads; weight: 26g (without cable); length of cable: 0.3m.

NL120S AUDIO AMPLIFIER

The NL120S audio amplifier is a power amplifier for driving a 4Ω or 8Ω loudspeaker such as the NL985S. It has sufficient power amplification to raise a ±20mV signal to a moderate sound level. The module features an input selector for switching between two input signals, and the options

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

of amplifying only positive or negative peaks (useful when baseline noise masks the sounds of nerve spikes of interest). The output is shaped to improve the low frequency response of small loudspeakers, and is power limited to minimize the nuisance caused by large transients such as shock artifacts.

SPECIFICATIONS:

Input impedance: 10kΩ; bandwidth: 10Hz to >15kHz; output voltage range: ±1.5V; minimum load resistance across output: 3Ω.

NL820A 4-CHANNEL ISOLATOR



The NL820A isolator provides four channels of high level signal isolation and a ±13V (nominal) isolated supply to power separate pre-amplifier stages (e.g. NL822, NL824 or NL844). Connection of all four output channels to other four channel modules (NL134/5/6, NL144 and NL530) is provided via the mother board, without external cables being necessary.

SPECIFICATIONS:

Input signal: ±1.2V maximum; gain: x1, x2, x5 with individual channel control; bandwidth: DC to 25kHz (-3dB); channel cross modulation: -60dB; auxiliary supply: ±13V 40mA unregulated; power requirement: ±15V 80mA (from NeuroLog System Case).

NL844 4-CHANNEL PRE-AMPLIFIER

The NL844 pre-amplifier is specifically designed to operate in conjunction with the NL820A Isolator. Its low noise and high impedance differential inputs make it particularly suitable for use as a headstage pre-amplifier close to the preparation, ideal for isolated EMG, EEG or ECG applications. It features 4 pairs of colour coded 1.5mm DIN "touch proof" sockets for electrode connection as well as a COM input. The unit can be operated in 1,2,3 or 4 channel modes with unused channels switched off using the rear panel toggle switches. This unit is particularly suited for use where there are very large stimulus artefacts, for example when used close to a magnetic stimulator coil. The input circuit automatically adjusts to the DC input conditions plus a non-linear filter modifies its time constant if the differential input signal exceeds its normal ±20mV working range. Therefore, fast, short artefacts do not block the subsequent stages. This results in an amplifier with a very fast recovery time from stimulus artefact pulses.



SPECIFICATIONS:

Gain: x100, x1000, x10,000 (operated in channel pairs); LF cut: 3, 10, 30Hz (operated in channel pairs); input impedance: 100MΩ; input channels: 4; common mode: 10,000:1 (-80dB) (with NL820A -120dB); noise: 5μV RMS full bandwidth; lead length: 2.5m.

FILTERS & SIGNAL CONDITIONERS

NL125/6 FILTER (HIGH & LOW PASS, 50/60Hz NOTCH)

The NL125/6 filter module employs two active sections to control the high and low pass characteristics. The low frequency cutoff point can be set continuously from 0.5Hz to 5kHz with a single turn potentiometer, in four switched ranges. Similarly the high frequency cutoff can be set continuously from 5Hz to 50kHz in four switched ranges. DC and WB (wide band) switch positions bypass the lower and upper filter sections, respectively. An active notch filter is provided for the rejection of line frequency interference; this can be operator set at 50Hz or 60Hz, with a 20Hz notch width (-3dB points).



SPECIFICATIONS:

Input voltage range: ±10V; input impedance: 56kΩ; low frequency cutoff range: DC, 0.5Hz - >5kHz continuously adjustable; high frequency cutoff range: wide band (>50kHz), and 5Hz to 50kHz continuously adjustable; gain within passband: +1.0; attenuation beyond cutoff: 40dB/decade; notch attenuation: >50dB; notch width at -3dB points: 20Hz. Output voltage range: ±10V; output impedance: 600Ω.

NL134-6 & 144 4-CHANNEL FILTERS



The NL134/5/6 and NL144 filters are 4-channel, second order (two-pole) low-pass (NL134-6) and high pass (NL144) with mains frequency notch reject (NL135/6 only) filter modules. They are ideal partners for the NL820A isolated amplifier system with its 4-channel AC (NL844) or DC (NL832/834) pre-amplifiers and the NL530 4-channel conditioner module. The filter settings have been selected for most electrophysiological and clinical research protocols but other frequencies can be factory set to order. The design is implemented using low noise active linear circuitry and does not suffer any of the aliasing problems that are encountered when cheaper methods are used. A rotary switch selects the 14 frequency settings giving repeatability over a wide range with 12dB/octave (40 dB/decade) attenuation above the selected frequency value. The 'WB' (wide-band) switch position bypasses the filter sections completely (both low-pass and notch). The active notch filter provides rejection of line frequency (50Hz (NL135) or 60Hz (NL136)) interference when switched in. (No switch is fitted on the NL134).

NL134-6 SPECIFICATIONS:

Input voltage range: ±15V max. > ±10V operating; input impedance : 120kΩ; filter settings (-6dB): 10, 20, 30, 50, 100, 200, 300,

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

500,1k, 2k, 3k, 5k, 10k, 20k Hz and WB; cut-off accuracy: (±2%, ±1.25Hz at < 630Hz) or (±2%, ±62.5Hz at > 630Hz); gain before cut-off: +1.0; attn. beyond cut-off: 40dB/decade, 12dB/octave; notch attenuation: >50dB; notch width (-3dB): 20Hz; crosstalk: better than -60dB; noise: <100µV rms; output DC offset: <±10mV; output voltage range: ±10V; output impedance: <600Ω.

NL144 SPECIFICATIONS:

As above except, filter settings (-6dB): 0.1, 0.2, 0.3, 0.5, 1, 2, 3, 5, 10, 20, 30, 50, 100, 200 Hz and DC (no filter); gain after cut-off: +1.0; attn. below cut-off: 40dB/decade. Rear connections to the motherboard allow Input and Output interconnections between this and (newer) NL820A and NL530 modules without the need of front panel cables.



NL143 - THREE CHANNEL DIFFERENCE MODULE

The NL143 is a 3-channel difference amplifier with 4-channels of input. Internal selection allows the difference between any of the four input channels to be made. Internal preset controls (finger operated) allow an offset to be nulled or added as required. High input protection allows for signals coming from units that are not part of the NeuroLog System. This module allows the difference between two signals of interest to be continuously monitored and was originally developed in order to allow measurements of foetal blood pressure to be determined *in utero*, in combination with our NL108A pressure amplifier. However, it can also be used to null troublesome DC offsets introduced by computer DAC interface cards.



NL530 4-CHANNEL SIGNAL CONDITIONER

The NL530 4-channel conditioner is designed to give gain and offset set-up controls when interfacing signals to the analog-to-digital converters (ADCs) of PCs. The module contains four channels each with independently adjustable filter settings and front panel gain and offsets presets. There is also a master ADC offset control to allow unipolar ADCs to be used with bipolar signals. ADC boards have precise input range (outside of which damage may occur) and this module features on-board preset controls to set all channels to 'CLIP', or limit, at independently set positive and negative (or zero) levels.

SPECIFICATIONS:

Input: absolute max: ±100V (working: ±10V) ; impedance: 20kΩ; gain: x0.1, x0.2, x0.5, x1, x2, x5 or x10; variable gain: x1 (CAL) to x2.5 (nom.); offset control: ±1V or ±5V; filters: 100kHz, 1kHz, 10kHz, none; bandwidth: DC to 100kHz; crosstalk: <-56 dB between channels. OUTPUT: range: ±11V minimum, impedance: <5Ω (for up to 10mA load). COMMON TO ALL CHANNELS: clip limits: positive: +4V to +11V min.; negative: -11V min. to 0V; ADC offset: zero (0V) or +2.5V. Output = [input x gain] + [(ADC + variable) offsets].

ANALOGUE & A/D INTERFACE MODULES

NL201 SPIKE TRIGGER

The NL201 spike trigger is a gated amplitude discriminator for nerve spikes and other events which produces separate output pulse trains for spikes which: a) cross the upper voltage threshold; b) cross the lower voltage threshold or c) cross the lower threshold but not the upper threshold.



The WINDOW HEIGHT potentiometer sets the DC level of the "window" and the APERTURE potentiometer sets the separation between the two voltage thresholds of this window. Thus, slight changes in signal amplitude require adjustments of only one setting, and it is impossible to set the upper voltage threshold lower than the lower voltage threshold.

A front panel switch selects either positive or negative slope and level triggering and there is a choice of two internally selected input voltage ranges. The MONITOR output socket provides a display of the input signal with the lower and upper levels super-imposed on it to enable easy setting of the discrimination levels. This module is essential for converting spike trains (which are analogue signals) into trains of digital pulses; these can be analysed using other modules (such as the NL700 LOG Display) or used to synchronise displays, trigger averaging, etc. An internal jumper allows the input to be DC coupled or have a time-constant which is appropriate for nerve spikes with rise times less than 200µs - modifications for longer rise times are available by special order.

SPECIFICATIONS:

Input voltage: ±10V max.; input impedance: 1MΩ; input time constant: 0.2s or DC; lower range (height): 0 - 5V; aper - 5V; gain: x1 or x10 (internally); triggering: +ve or -ve slope; threshold calibration: ±10%. OUTPUTS: upper: TTL, pulse; lower: TTL, 200µs (±10%) pulse; gate: TTL, 15µs (±10%) pulse; monitor: input plus upper and lower levels.



NL254 RATEMETER

The NL410 calibrator can be used for the precise calibration of the gain of an amplifier system by adding a pulse of accurate amplitude and duration to a recording trace. The output of the Calibrator is isolated allowing for the user to choose the best method of preparation grounding to optimise recordings. Switches allow selection of 1 of 3 calibrated output levels with 1 of 2 calibrated triggered pulse widths of either polarity. The calibration level at the preset amplitude and polarity may also be enabled or pulsed manually from a front panel switch.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

NL410 CALIBRATOR



The NL410 calibrator can be used for the precise calibration of the gain of an amplifier system by adding a pulse of accurate amplitude and duration to a recording trace. The output of the Calibrator is isolated allowing for the user to choose the best method of preparation grounding to optimise recordings. Switches allow selection of 1 of 3 calibrated output levels with 1 of 2 calibrated triggered pulse widths of either polarity. The calibration level at the preset amplitude and polarity may also be enabled or pulsed manually from a front panel switch.

SPECIFICATIONS:

Trigger level: +2V on the positive edge with a 200mV hysteresis; trigger input limit: ±15V maximum; trigger input impedance: >1MΩ; output level: 0.1mV, 1mV, 10mV switch selectable; output level accuracy: ±2%; output pulse duration: 1 or 10ms (triggered) or under manual control; pulse duration accuracy: ±2% (triggered); polarity: positive or negative - switch selectable; output impedance: 2Ω, 20Ω, 200Ω for output levels of 0.1, 1, 10mV respectively; output isolation: 50V.



NL506 ANALOGUE SWITCH

The NL506 analogue switch contains a single pole change-over analogue switch, the state of which is controlled by a logic signal. This signal can be generated externally or by the internal Flip-Flop that can be toggled by the negative going edge of a logic input. A front panel switch allows direct selection of the switch state which is indicated by an LED. The switch is bi-directional allowing it to be used as a 1-input, 2-output or a 2-input, 1-output device. Also, as the switch is analogue, it can handle signals up to ±15V as well as being of low enough impedance to handle TTL signals. Applications include:- selection of one of two signals, under logic control, for recording or monitoring; distribution of a logic signal to one of two stimulators, as in bipolar stimulation using two stimulators; multiplexing two analogue signals onto one oscilloscope channel, a very useful secondary function. NOTE: the analogue switch is robust but has a current limit, especially when the NeuroLog power supply is off. Only signals originating from within the same Neurolog Case should be coupled to the NL506.

SPECIFICATIONS:

ANALOGUE SWITCH: range: ±15V; ON resistance: <35Ω; OFF leakage: <50nA; switching time: <200ns; break-before-make delay: <10ns. INDICATOR: an amber LED indicates the switch position. SWITCHES: the SET/-/RESET toggle forces the selection of the analogue switch. It also presets the internal Flip-Flop. In the mid position the IN/FF switch selects the control signal for the analogue switch. FLIP-FLOP: is preset by the SET/-/RESET toggle switch and toggled by the negative (-ve) going edge of a logic input signal. INPUT: allowed signal: ±15V max.; logic threshold: +1.4V approx. (suits TTL); impedance: 10kΩ approx.

NL601 PULSE INTEGRATOR



The NL601 pulse integrator has a digital counter which produces an analogue output proportional to the count. A pulse at the input socket increments the counter towards a full scale count of 255, 2550 or 25500, selectable by the front panel scale switch. The counter will continue to increment on input pulses until the unit is reset. This can be done manually (with the on, off/reset switch) or by applying a pulse to the reset socket. Alternatively, with the unit set to internal-reset, when the counter reaches full scale the unit will automatically reset. There is one other reset function, the external reset/latch function. On a reset pulse the output will be held at the previous count level until the next reset pulse. In effect the counter is reset but the output is held at its value at the time of the pulse. The NL601 has two outputs, the first is a simple pulse out when the counter reaches full scale count the output goes high until the counters are reset. The second is the analogue output. Adjustable between 1V and 11V for full scale count (using the front panel output adjuster potentiometer) the output will increase by 1/255 (for a full scale count of 255) for every input pulse and will stay at maximum voltage for every pulse after 255 until the unit is reset.

SPECIFICATIONS:

Inputs: TTL pulses; pulse out: TTL; analogue out: adjustable between 1V and 11V for full scale via front panel pot.; output steps: 255; pre-scaler: none, 10, 100.

NL700 LOG DISPLAY



The NL700 log display converts intervals between input pulses into ramps whose heights are proportional to the logarithms of the interval durations. The peak of each log ramp is sampled, and the peak amplitude is maintained by a “sample and hold” circuit until the arrival of the next pulse. The sample and hold output is thus a continuous signal proportional to log interval duration; by inverting this signal, a continuous output (S&H OUT) proportional to log firing rate (instantaneous frequency) is obtained, with each interval represented. The S&H OUT output can be used to drive a chart recorder, thus representing firing rates of up to 1kHz on a low frequency output device. The S&H signal can also be averaged on ordinary signal averagers to give a very high resolution analysis of changes in firing rate. Controls on the front panel provide for adjustment of the gain and DC level of the output so that the whole output range can be displayed full scale, or only part of a selected decade displayed. Pulses are available for brightening an oscilloscope screen. The log display is used to display firing rates of muscle units, nerve cells, heart rate, etc.

SPECIFICATIONS:

Input: TTL pulses; outputs (LOG RAMP OUT): ±12 V, output resistance 1kΩ; (S&H OUT): ±10V, output resistance 560Ω; (BRIT): +15V, 50µs pulse, output resistance 3.3kΩ; output log relation: adjustable from 1V per decade to 3V per decade; input interval range: 1ms to > 10s (1kHz to <0.1Hz).

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

NL701 LIN DISPLAY

The NL701 lin display is generally similar to the NL700 unit but with a linear output voltage pulse interval characteristic and consequently restricted frequency range of approximately 100:1 on the selected range.

SPECIFICATIONS:

Input: TTL pulses; outputs: (Lin ramp out); ±12V output resistance 1kΩ; (S & H out); ±10V output resistance 560Ω; (Brit); +15V, 50µs pulse, output resistance 3.3kΩ; output/input relation: adjustable from 1V to 4V at 0.1Hz, 1Hz or 10Hz as set by range selector switch, linearly reducing with repetition rate over 100:1 range, e.g. on 1Hz range interval of 1s between pulses gives 1V to 4V dependent on gain setting, reducing to 10mV to 40mV at 10ms pulse interval.

NL703 EMG INTEGRATOR

The NL703 EMG integrator was designed to produce an analogue signal to represent muscle activity. The unit will accept signals up to ±1V which it full-wave rectifies and applies to a "leaky integrator". The output of the integrator is buffered and the overall gain is set at unity. The time constant of the integrator is set by a 6 position rotary switch. A toggle switch is also provided, so that the direct signal can be viewed.

SPECIFICATIONS:

Input: the maximum signal that can be processed without distortion is ±1V; input overload: the input is protected up to ±75V; time constants: setable to 20, 50, 100, 200, 500 and 1000ms (accuracy better than 10%); integrate/direct: either the integrated signal or the input signal is selectable by this switch (if DIRECT is selected, the Integrator is reset to zero); output: the output produces a signal which has a gain of unity from the input but integrated with respect to time - at the time constant selected; output impedance: 600Ω in integrate, connected to INPUT socket in DIRECT.

DIGITAL MODULES



NL405 WIDTH/DELAY

The NL405 is a digitally controlled pulse duration generator and is used to produce precise pulses of adjustable duration with high accuracy and repeatability. This module combines many of the features of the discontinued NL401 digital width and NL403 delay/width into a single unit.

The NL405 produces TTL logic output pulses (of both polarities) that have a duration set using three decades of thumbwheels and a seven (7) position range switch. It also features a press to start button, LED indication of an output and a separate logic output signal at the end of the defined WIDTH time. It was designed as a replacement for the NL401 and, in most places where the NL403 would have been used.

SPECIFICATIONS:

Input: TTL trigger pulse (+ve or -ve edge), manual push button; output (width): TTL (driving 10 loads), active high or low output sockets; width/delay range: 1µs to 999s; accuracy +/-0.5%; indicator: amber LED; output (delay): TTL (driving 10 loads), active high; duration: 0.5, 1.5, 5 µs (+/- 20%) and 50, 150, 500 µs (+/- 10%).

NL501 LOGIC GATE

The NL501 logic gate module contains two logic gates each with two inputs and complementary outputs. Both of these gates can be independently configured by PCB mounted switches as either 2-input AND gates or 2-input OR gates. The open circuited inputs are automatically held low for the OR function or high for the AND function and a further switch allows expansion of the second gate to take the output of the first as a third input. This enables a 4-input AND gate or a 4-input OR gate to be realised. A further possibility is a 3-input AND or OR gate where one of those inputs is a 2-input OR or AND function from the other gate. Provision is made for input 1 of gate 1 to be connected to the output of the module to the left and all 4 outputs are available for selection as the output to the module to the right. This is done by jumper plugs at the rear of the PCB.

SPECIFICATIONS:

Inputs: TTL; outputs: TTL; output fan-out: 10 TTL inputs.



NL505 FLIP FLOP

The NL505 flip-flop can be operated either as a "set-reset" flip-flop or as a "toggled" complementing flip-flop. This makes it useful in setting up conditional and "single-shot" stimuli, and testing logic outputs for the presence of pulses, logic levels etc. The NL505 is useful in "stretching" or "latching" narrow outputs from units such as our NL201 Spike Trigger. Multiple NL505 modules have been used in place of the "Thalamus" interface box designed for use by Cortex data acquisition and control software (freely available from www.cortex.salk.edu). It has three inputs, Set, Complement and Clear, and two outputs (Q and Q') all of which drive or are driven from TTL logic. A LED indicator is illuminated when the Q output is at a high level. A push button control of the SET input is also included, which may be useful for set up and troubleshooting purposes.

SPECIFICATIONS:

TTL logic throughout; Inputs: IN/SET (TTL input and manual push button control), COMPLEMENT and CLEAR; Outputs: Q and Q'; LED indicator when Q output is high.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



NL603 COUNTER

The NL603 counter is a 2-digit preset decade counter with a 2-digit LED decimal readout. The counters can be externally reset and gated; they can be operated in one of three modes: PRESET-RESET in which the counters are reset to zero when the count equals the preset switch settings; PRESET-STOP in which the count is stopped when the preset number is reached; and FREE RUN, in which the preset number does not affect the count. A pulse occurs at the output when the count equals the preset number (FREE RUN and PRESET-RESET modes); a high logic level appears at the output during counting in the PRESET-STOP mode. Up to 8 NL603 Counters can be cascaded to give arbitrarily large counts. Carry, reset and preset logic signals are automatically relayed to adjacent Counters through rack edge connectors when the counters are cascaded.

NL 603 Counters can be used for digital control of pulse width, cycle duration, pulse delay (phase), number of pulses in trains, etc. Precision obtainable when used with the NL304 Period Generator is better than 0.01% in minimum steps of 1µs. The LED readout of the NL603 enables it to be used to count responses, number of stimuli delivered, etc., in addition to controlling pulse trains.

SPECIFICATIONS:

Inputs: TTL pulses; output fan-out: 10 TTL inputs; output pulse width (FREE RUN and PRESET-RESET modes): 0.5µs (nominal); maximum counting rate: 5MHz.

PULSE GENERATOR & STIMULATOR MODULES

NL301 PULSE GENERATOR



The NL301 pulse generator is a low cost module for producing trains of uniform TTL pulses. It can be operated continuously, switched off, or a single pulse can be triggered manually. It is the successor to the NL300. A GATE input socket is provided to allow synchronous trains of pulses to be gated-on by an externally applied TTL high logic level. An internal jumper either excludes (as with the NL300) or produces an output pulse coincident with the start of the GATE signal. Pulse frequency is continuously variable over more than three decades using a single 12:1 control and a three position decade switch. Three fixed output pulse widths are available. The frequency range and pulse widths were chosen to make this module suitable as a timing source for electrical stimulation of the nervous system, without the necessity of additional modules for determining the pulse width. The NL301 is also useful for a variety of other timing purposes where a widely variable rate is desirable, and precision is important but not critical. The NL301 has an on-board jumper that allows the user to select a frequency range 1/10 of that shown on the front panel. This allows a frequency range of <0.1 to >120Hz.

SPECIFICATIONS:

Total range: <1 to 1200Hz or <0.1 to 120Hz by on-board jumper; control: single turn control marked 1-12Hz with intermediary integer panel marks. Maximum range >0.5-12; accuracy: ±1% at "1" and "12" marks, ±5% at all others; multiplier: x1; x10; x100 (x0.1; x1; x10 with alternative internal jumper setting); input: TTL compatible GATE input; output fan-out: 10 TTL inputs; output pulse widths: 50, 150 or 500µs (±5%).



NL304 PERIOD GENERATOR

The NL304 period generator contains a crystal oscillator and frequency dividers for producing a precise, stable frequency standard. It can be externally gated (GATE IN) and synchronised with an external source (RESET input). The pulse train can be switched off and a single output pulse can be produced manually by a front panel push switch. The NL304 is the basic "clock" of the NeuroLog™ System as it provides the "fine grain" (1µs increments) necessary for digital control of pulse width, cycle duration, delay, etc using the NL603 Counters.

SPECIFICATIONS:

Output: TTL pulses; period accuracy: ±0.01%; period range: 1µs to 60 minutes by 1µs, 10µs, 100µs, 1ms, 100ms, 1s, 10s, 30s & 60s PERIOD switch and x1, x2, x5 and x10 MULT switch; output pulse width: 0.5µs.

NL412 PULSE



The NL412 pulse is a small, handheld, general purpose generator which can be used to "start" experiments, command the "gate" of a train of pulses or be used with an NL102G to "Buzz" electrodes. The NL412 is powered by a standard internal 9V battery and is fitted with a 2m lead terminating in the standard Lemo connector. *Start:* on pressing the button the NL412 generates an active high pulse which will trigger remote modules. *Gating:* the front panel control of the NL412 provides control for output durations over the range of 1 to 10ms. Setting this control allows different durations of trains of pulses when the NL412 is combined with a Pulse Generator such as the NL301. Used with the NL102G: when used with the NL102G (that incorporates external "Buzz" circuitry) the duration of the "Buzz" is set by the front panel control.

SPECIFICATIONS:

Pulse duration: 1 - 10ms with >20% accuracy at all settings; output level: 9V; rise and fall times: <100µs.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com



NL510A PULSE BUFFER

The NL510A pulse buffer converts TTL logic pulses into 0 to 10V pulses which can be used to drive the NL800A Stimulus Isolator. The output pulses in the ISOLATOR DRIVE mode are offset to match the input characteristics of the NL800A. Output amplitude is adjusted with a precision 10-turn potentiometer and turns counting dial. The mode switch has an OFF position, a useful feature when more than one stimulator is used. The NL510A can be used as a non-isolated voltage stimulator, relay driver, solenoid drive, oscilloscope beam brightener, etc.

SPECIFICATIONS:

Output voltage range: 0-10V; output resistance: < 10Ω; output current: 50mA; output rise and fall times: <1µs.



NL512 BIPHASIC PULSE BUFFER

The NL512 biphasic pulse buffer is the interface between any bipolar signal and two of the NeuroLog NL800A Stimulus Isolators so that bipolar, isolated, constant current signals can be used for stimulation. This is "current out for voltage in". The NL512 features a high input impedance and four input ranges to allow a number of different modules, or an external signal (such as from the ADC in a PC), to be used for the input signal. A GATE input allows multiple units to be connected to a single analogue source, with each channel being digitally enabled separately. An on board jumper allows the unit to be driven by one of four different ranges for Full Scale current output from the NL800A's. These are ±10V, ±5V, ±2.5V and ±1V.

SPECIFICATIONS:

IN: input voltage range: ±15V max. (±10V; ±5V; ±2.5V or ±1V by on-board jumper selection); input impedance: 1MΩ; frequency response: >1MHz. GATE: logic levels: TTL compatible; input voltage range: ±15V; input impedance: ~85kΩ; response time: <5µs. ON/OFF switch: overrides the GATE input to disable the module when the unit is OFF. OUT: output DC offset for NL800A: <0.7 to >2.3V - separately set for each phase; output voltage range: 0 to +10V; output current for NL800A: up to 20mA; output impedance: <10Ω.

NL800A STIMULUS ISOLATOR

The NL800A stimulus isolator is a battery powered, light-coupled, isolated stimulator. It has a constant current output, with very high output impedance, making it suitable for stimulation through micro-electrodes as well as with gross electrodes. Normally driven from the NL510A Pulse Buffer, its output current is set by a ten-turn AMPLITUDE control on the NL510A, with the output range set by the switch on the NL800A; output pulses have the same timing properties as the input pulses. Features of the NL800A are its very small physical size (for mounting close to the preparation), low battery consumption, excellent isolation (<1pF output to input or ground coupling) and fast risetime. An LED also provides visual confirmation that the NL800A is receiving an appropriate input.



SPECIFICATIONS:

Input requirements: 10V at 30mA (nominal) for full scale output; output current range: 0 to 10mA in four overlapping decade ranges; output risetime: <5µs (typical tungsten micro-electrode load); <40µs for 1MΩ resistor across output; output resistance: >900MΩ; input-output capacitative coupling: <1pF; accuracy and linearity: ±3% of full scale output for each output range; batteries: 5x GP23A; dimensions: 40mm x 64mm x 120mm, excluding knob and rubber feet.

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

SYSTEM ACCESSORIES

Unless specified, no leads or connectors are supplied with NeuroLog Systems, so it is often necessary to purchase a number of cables or cable adaptors in order to pass signals between non-neighbouring modules or to connect to other devices.



Electrode Holders

NL04 - Tungsten micro-electrode holder (pictured) - 26 gauge hypodermic needle tube soldered into a drilled out 2mm pin.
NL08 - Micro-electrode adaptor - 2mm pin to 0.8mm jack (fits commercially available electrodes).
NL101xx - Polycarbonante electrode chambers with embedded Ag/AgCl pellet for glass recording pipettes. Available with 1mm or 2mm pins and for glass of 1.0, 1.2, 1.5 & 2.0mm outside diameter.

Cables



NL951-15

NL951-xx - Standard single pole cables with male connectors on both ends; available in 5 standard lengths (15cm; 30cm; 45cm; 1m; 2m). When ordering please specify length, e.g. NL951-45cm.
NL951B-xx - Lemo to BNC cable. Available in 1m (NL951B-1m) or 2m (NL951B-2m) versions.
NL952 - 2m cable with Lemo male connector at one end and tinned leads at the other.
NL953 - 2m cable with a Lemo male connector one end and tinned leads at the other end (mates with the input socket on the NL103 AC-Preamplifier [superceded by NL104A] and NL107 Recorder Amplifier).
NL953K - 2m cable with a Lemo male connector one end and tinned leads at the other end (mates with the input socket on the NL104A AC-Preamplifier and NL108A Pressure Amplifier).
NL975 - 1m two way cable with tinned leads at one end and two 4mm plugs at the other (mates with the superceded NL120 Audio Amplifier output sockets).
NL975S - 1m two way cable with tinned leads at one end and two 2mm shrouded safety plugs at the other (mates with the current NL120S Audio Amplifier output sockets).



NL951B-2m



NL953K

Extension Cables

NL950 - 10cm (1-way) cable with male connector one end and a female connector on the other end.
NL954 - 2m (4-way) extension cable for NL100A Preamplifier, first stage for NL103 AC Preamplifier [superceded], NL107 Recorder Amplifier.
NL954K - 2m (4-way) extension cable for NL100AK/NL104A/NL108A/NL850A.
NL955 - 2m (6-way) extension cable for NL102 Differential DC-Preamplifier [superceded] (with split socket).
NL955K - 2m (6-way) extension cable for NL102 Differential DC-Preamplifier [superceded] (standard keyway).
NL956K - 2m (6-way) extension cable for NL102G DC-Preamplifier.
NL958 - 5m (9-way) extension cable for connection between NL822/824 and NL820A Isolation Amplifier.



NL954



NL950



NL956K

Headstage Accessory Kits

NL973A - NL100AK headstage accessory kit. As supplied with each NL100AK. Kit comprises: 3x 1mm gold stacking pins with wire attached, 1x 1mm stacking pin, 1x heat shrink tubing, 1x 2mm plug, 1x “U” shaped jumper with wire attached & 1x Allen key.
NL976 - NL102G headstage accessory kit. As supplied with each NL102G.



NL973A



NL976

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Plugs (for Cable Mounting)



NL963K

NL962 - The standard Lemo NeuroLog single-pole plug.
NL963 - Lemo 4-pole for NL103/NL107.
NL963K - Lemo 4-pole for NL104A/NL108A.
NL967K - Lemo 6-pole plug (matches NL102G).
NL968K - Lemo 2-pole plug. Mates with NL410 front panel socket.
NL969P - Lemo 9-pole insulated plug. (Mates with NL820A).
NL822P/10 - 2mm plugs with red (NL822P/10-Red) or black (NL822P/10-Blk) insulator. For use with NL822/824 preamplifiers or our D330 MultiStim System.
NL844P/10 - 1.5mm touch proof plugs with blue (NL844P/10-Bu), black (NL844P/10-Bk) or red (NL844P/10-Rd) insulator. For use with our NL844 preamplifier.
NL985P - Output connector plugs (pair) for user assembly. Used with NL120S Audio Amplifier, NL100C, DS2A or DS3.
NL970/10 - Gold plated 1mm stacking plug with heat shrinkable sleeve. Pack of 10. For use with NL100, NL102 and NL800.
NL972/10 - Gold plated 2mm plugs. Pack of 10. For use with NL100A, NL100AK and NL102G.



NL964

Sockets (for Panel Mounting)

NL944 - Lemo 4-pole as on NL103, NL107.
NL944K - Lemo 4-pole, as on NL104A, NL108A.
NL964 - The standard NeuroLog front panel socket.
NL969S - 9-pole insulated socket. (As used on the NL820A front panel).

Sockets (for Cable Mounting)

NL965 - 4-pole in-line socket (matches NL100A).
NL965K - 4-pole in-line socket (matches NL100AK/NL850A).
NL966K - 6-pole in-line socket (matches NL102GH).



NL965K



NL960



NL961

Adaptors & Adaptor Cables

NL957 - 2m 4-way for NL100AK to NL103 or NL107. To connect newer NL100AK to older AC preamplifier or existing NL107 Recorder Amplifier.
NL957K - 2m 4-way for NL100A to NL104A. To connect older NL100 or NL100A to a NL104A.
NL960 - Adaptor with a BNC plug and Lemo socket. This adaptor converts a Lemo plug into a BNC plug.
NL961 - 'T', or more aptly 'Y' connector can be used to make a branched connection at front panel socket.
NL969T - 'T' connector assembly to allow two NL822/832's to be connected to a single NL820 and used as channels 1 to 4.

Isometric Force Transducers

NL61-xxx - Low Range Isometric Force Transducer, for use with the NL109, NL107, NL108A DC amplifiers. Available in 7 ranges: 25, 55, 110, 220, 450, 1000, 1500g. When ordering, please replace "xxx" with appropriate range. A full data sheet is available upon request.
NL62-xxx - Dual Cantilever Beam Force Transducer, for use with the NL109, NL107 or NL108A DC amplifiers. Available in 5 ranges: 2, 5, 10, 30, 50kg. When ordering, please replace "xxx" with appropriate range. A full data sheet is available upon request.
NL63-xxx - Medium Range Single Point Load Cell, for use with the NL109, NL107 or NL108A DC amplifiers. Available in 5 ranges: 50, 100, 150, 200, 250kg. When ordering, please replace "xxx" with appropriate range. A full data sheet is available upon request.



NL61-xxx



NL62-xxx

NL63-xxx



Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Miscellaneous Items

NL910x-y - Blanking Panels, available in various widths (y) for the various models of NL900 (). For covering unused bays in the NL900 rack.
NL980 - Edge connector extender cable. Allows access to both sides of a working module for trimmer adjustments, calibration and servicing.
NL985S - Loudspeaker for NL120S Audio Amplifier.
NL800-BATT - Set of three batteries for the original NL800 Stimulus Isolator.
NL800A-BATT - Set of 5 batteries for current NL800A Stimulus Isolator.
NLMAN - NeuroLog™ System Operators Manual. As supplied with each NL900.
NL50 - Blank module for prototypes (painted panel, handle and PCB).



NL910



NL800-BATT

NOTES

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

NeuroLog

SYSTEM

Digitimer Ltd

37 Hydeway, Welwyn Garden City
Hertfordshire, AL7 3BE, UK

Tel: +44 (0)1707 328347 **Fax:** +44 (0)1707 373153
Email: sales@digitimer.com **Web:** www.digitimer.com/neurolog

CE

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

Artisan Technology Group is an independent supplier of quality pre-owned equipment

Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

Artisan Scientific Corporation dba Artisan Technology Group is not an affiliate, representative, or authorized distributor for any manufacturer listed herein.

We're here to make your life easier. How can we help you today?

(217) 352-9330 | sales@artisantg.com | artisantg.com

ARTISAN® TECHNOLOGY GROUP