



# **Digitimer**

**Life Science**  
Product Catalogue

# ABOUT DIGITIMER

## Overview

### COMPANY HISTORY

For over 50 years, Digitimer has designed and manufactured quality medical and laboratory scientific instruments. By working closely with leading universities and hospitals, we have supported cutting-edge research and assisted with the development of novel medical treatments and instrumentation.

The first "Digitimer" (DIGital Time Interval Marker and Event Release) was designed by the late HB (Bert) Morton at The National Hospital, London in the early 1960's. This was then manufactured and sold worldwide by Devices Limited. Other complementary products for medical research followed and Digitimer Limited became an independent company specializing in electronic instruments for medical research and clinical investigations in 1972. Today, Digitimer continues to manufacture instrumentation for the clinical and research communities and the company operates within a quality system certified to ISO 13485: 2016 (EN ISO 13485: 2016). ISO 13485 is identical to the well-known standard for Quality Management Systems ISO 9001, but with the more stringent controls that are required for the manufacture of medical equipment.

### EXPERTS IN THE DESIGN OF AMPLIFIERS AND ELECTRICAL STIMULATORS

Our products include low noise microelectrode amplifiers used for extracellular and intracellular electrophysiological recordings from animals or in vitro preparations. We also manufacture multi-channel isolated amplifiers for human electromyography (EMG), electroencephalography (EEG) or evoked potential (EP) applications.

Digitimer also has extensive experience in the design and development of electrical stimulators, supplying devices intended for animal, in vitro and human stimulation applications. These stimulators are employed in diverse applications, including basic neuroscience research, human nerve and muscle excitability studies, psychological testing, sports physiology or intraoperative monitoring.

### A DIVERSE PRODUCT PORTFOLIO SUPPORTED BY OUR SUPPLIER PARTNERS

In addition to our electrical stimulators and amplifiers, we also provide pulse generators and signal conditioners, including several within our renowned NeuroLog System, a modular workstation for multi-modal electrophysiology research.

As an established supplier of scientific and medical instrumentation, Digitimer distributes for several respected partner companies including Alpha MED Scientific, Automate Scientific, Narishige and Scientific Systems Design.

### PRIORITIZING PRODUCT QUALITY AND EXCEPTIONAL CUSTOMER SERVICE

We pride ourselves in our pre-sales and after-sales service, offering help and advice in a professional and friendly manner. This approach has led to a worldwide reputation of which we are immensely proud; so much so that our quality statement is: "Maintaining the Digitimer name as an acknowledgement of Quality".

### HOW TO PURCHASE FROM DIGITIMER

Our website ([www.digitimer.com](http://www.digitimer.com)) provides the most up to date information relating to our products and visitors can request formal quotations or even make purchases by credit card. Most Digitimer products are available from stock, with delivery to global destinations often accomplished within two weeks. We are pleased to have the support of a global network of knowledgeable and experienced distributors and representatives, who do their utmost to maintain the high levels of customer service expected by Digitimer.

**Digitimer**  
www.digitimer.com

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# HUMAN NEUROPHYSIOLOGY

## Overview

Our human neurophysiology range features electrical stimulators, isolated amplifiers and accessories for human neuroscience research and clinical applications. Several Digitimer devices are medically CE certified or FDA cleared for intraoperative monitoring (IOM) or neurophysiological neurodiagnostic testing.



### Isolated Stimulators & Accessories

Digitimer manufactures a range of electrical stimulators for peripheral nerve and muscle stimulation, some of which are medically approved within Europe, the USA or other countries. Most of our peripheral stimulators, including the D5TA, D5TAH and D57R deliver isolated monophasic rectangular constant current pulses in response to a TTL pulse or digital trigger input. The D5TA and D57AH are medically CE certified for human clinical applications, while the D57R is a research variant, more suited to more demanding academic research applications.

Unlike the D57 family, the D55 Bipolar Constant Current Stimulator is not triggered, but requires an analogue voltage command signal, which it converts into an isolated current pulse, mirroring the shape and size of the input waveform. This means the D55 is more suited to applications that require something other than a simple rectangular stimulus pulse.

The DS8R is our newest research stimulator and combines the high current/voltage output of the DS7R with a biphasic, charge-balanced output and external control capabilities that allow research users to automate stimulation protocols via third party software control.

The D185 MultiPulse Transcranial Cortical Stimulator is used for intraoperative monitoring (IOM) of the descending tracts of the spinal cord or activation of deep peripheral nerves and spinal roots. The D185 was the first and remains the only standalone surgical stimulator with FDA clearance for transcranial electrical motor evoked potential (tceMEP) generation.



We can supply our stimulators with a range of accessories to facilitate integration with operating theatre equipment and stimulation preferences. Products include electrode extension leads, adaptor cables, electrode connection head-boxes, digitally controlled stimulus switching units (D188), trigger cables and electrode handles.



### Isolated Amplifiers & Accessories

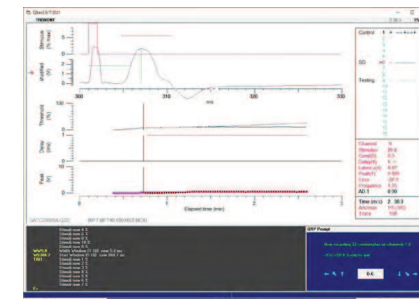
Intended for safe amplification of biological signals including electromyography (EMG), evoked potential (EP) and electroencephalography (EEG), our isolated differential amplifiers offer wide gain and filter options and feature analogue signal outputs, making them compatible with any commercially available digital data acquisition systems.

Our eight channel D360 is a CE certified medical device offering a high maximum gain, flexible high and low pass filter options and electrode impedance checking via headstage LEDs. The D440, available in two and four channel versions, is suitable for low gain recordings from human nerve and muscle. Our newest development is the D360R-4, a four channel research amplifier, based on the D360. Designed specifically for research use, the D360R-4 offers the same low noise performance as the D360, but by reducing the number of channels and removing electrode impedance checking, it provides a cost-effective alternative to this medical device.



To complement our amplifiers we manufacture several accessories including the D175 Electrode Impedance Meter, the D177 Biofeedback Unit intended for use during vestibular evoked myogenic potential (VEMP) testing and the D179 Performance Checker, which allows validation of clinical EMG/EEG system calibration.

## SEVERAL DIGITIMER DEVICES ARE MEDICALLY CE CERTIFIED OR FDA CLEARED



### Software

Digitimer is the global source for QtracW software, a flexible stimulus response and data acquisition program that includes averaging and threshold tracking facilities for studies of human nerve and muscle excitability. In addition, we also supply licenses for QTMS, a QtracW extension which adds cortical excitability protocols to this software suite.



### Electrodes & Accessories

To complement our own products, Digitimer provides electrodes and other neurodiagnostic accessories from several partner companies. Examples include self-adhesive electro-stimulation pads, bar, bipolar felt pad and EEG cup electrodes. For the most up to date information on the complete range, please visit the Digitimer website.

# ISOLATED STIMULATORS AND ACCESSORIES

THE DS7A IS COMMONLY USED IN PAIN RESEARCH APPLICATIONS

## DS5 Isolated Bipolar Current Stimulator



### Features

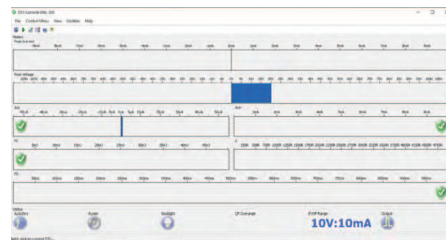
- Up to  $\pm 50\text{mA}$  output from  $\pm 120\text{V}$  compliance, in 3 output ranges.
- Isolated constant current output proportional to input "command" voltage.
- Compatible with DAQ's capable of producing an analogue voltage output.
- Safety features ensure patient/human subject protection. CE marked medical device.
- Output connection accessories, including plugs and cables and electrodes are also available.

The DS5 isolated bipolar stimulator allows computer control of stimulus amplitude and timing parameters and has a maximum constant current output of  $\pm 50\text{mA}$ . It has been designed to speed up and enhance human peripheral nerve diagnostics by facilitating semi-automated nerve excitability tests. It also has roles in wider aspects of clinical neurophysiology research, including psychological, vestibular system and nociceptive testing. The DS5 is a CE marked medical device under the European Medical Device Regulation.

The DS5 is controlled by an analogue voltage input which it translates into an isolated constant current stimulus (up to  $\pm 50\text{mA}$ ), precisely replicating the shape of the input

waveform. As a result the DS5 should be of interest to anyone wishing to control surface stimulation protocols via software/hardware combinations capable of producing a suitable command voltage waveform e.g semi-automated pain research or sensory threshold testing.

The DS5 was developed in collaboration with Prof. Hugh Bostock (UCL, London) for use with QtracW, a nerve excitability stimulus control, acquisition and data analysis software package.



## DS7A & DS7AH High Voltage Current Stimulator



### Features

- Pulse durations from  $50\mu\text{s}$  to  $2\text{ms}$  (DS7A) and  $50\mu\text{s}$  to  $200\mu\text{s}$  (DS7AH).
- $100\text{mA}$  (DS7A) or  $1\text{A}$  (DS7AH) constant current output from  $400\text{V}$ .
- Flexible TTL compatible trigger options or front panel push button.
- Alternating polarity control – a toggle switch allows the stimulator to operate in +ve, -ve or alternating polarities during stimulation.
- Output connection accessories, including plugs and cables and electrodes are also available. (See D185 accessories).

Suitable as a general purpose electrical nerve or muscle stimulator, the DS7A provides up to  $100\text{mA}$  constant current high voltage pulses of brief duration for percutaneous stimulation during investigation of the electrical activity of nerve and muscle tissue. The DS7A is also commonly used in pain research applications. The output current is continuously variable over the range  $0$  to  $100\text{mA}$  from a maximum compliance voltage of  $400\text{V}$ . The DS7AH allows currents up to  $1\text{A}$  with a reduced maximum pulse duration limit of  $200\mu\text{s}$ . This model is offered to overcome the difficulties of stimulating deep peripheral nerves, or large muscles such as the quadriceps with large area electrodes.

The DS7A and DS7AH include an alternating polarity mode to prevent polarization of the stimulation site and potentially harmful electrolytic effects of longer periods of stimulation.

The DS7A or DS7AH can be triggered by an external device such as our DG2A Train/Delay Generator.

For applications that require a higher output, we recommend our D185 MultiPulse. The DS7A & DS7AH are CE marked medical devices and have been cleared by the FDA for marketing within the USA.





# ISOLATED STIMULATORS AND ACCESSORIES

## DS7R Constant Current Research Stimulator



### Features

- Pulse durations from 50µs to 2ms
- Up to 999mA constant current output from 400V
- Designed for more demanding human research applications
- Flexible TTL compatible trigger options or front panel push button
- Operates in +ve, -ve or alternating polarity modes

The DS7R is a general purpose electrical nerve or muscle stimulator for peripheral stimulation in human research studies. The DS7R provides up to 999mA constant current high voltage pulses of brief duration for transcutaneous stimulation during investigation of the electrical activity of nerve and muscle tissue. The DS7R is recommended for human research applications where its high voltage, high current and flexible pulse duration capabilities permit stimulation of large muscle groups or deep nerves/nerve roots.

The DS7R Constant Current Research Stimulator is based on the medically approved DS7AH. The output current is continuously variable over two ranges of 0 to 99.9mA and 0

to 999mA, but where it differs is in relation to the available pulse durations. With the DS7AH, the maximum permitted pulse duration is 200µs, while the DS7R allows pulses of up to 2ms\*. Because this greater flexibility is only required in human research applications, the DS7R is NOT medically approved and is marketed for human or large animal research use only. For applications requiring external control capabilities or a truly biphasic output, please refer to the DS8R.

\*The achievable current is subject to the set current amplitude, frequency of stimulation and load impedance/available compliance voltage.



**THE DS7R IS DESIGNED  
FOR MORE DEMANDING  
HUMAN RESEARCH**

## DS8R Isolated Biphasic Constant Current Stimulator



## EXTERNAL CONTROL VIA PC SOFTWARE/ USB CONNECTION

### Features

- Current range 0-1000mA from 400V
- Pulse duration range 50-2000µs
- Biphasic Output – Charge-balanced symmetric or asymmetric
- Adjustable inter phase interval (0-50µs)
- External control via PC software/USB connection (includes API)
- Analogue control of stimulus current
- Output connection accessories, including plugs and cables and electrodes are also available

The DS8R is a new constant current, multi-mode, discrete pulse stimulator for human research studies involving nerve and muscle stimulation via surface electrodes. It features a high compliance voltage and can be triggered by a TTL compatible input, contact closure foot/hand switch or front panel "single-shot" button.

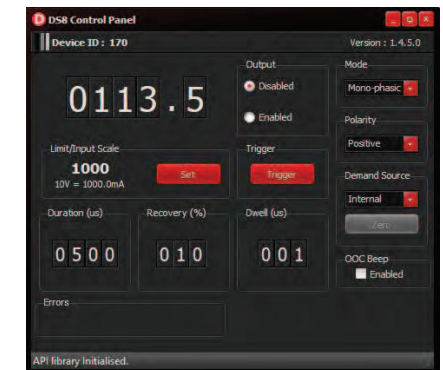
The DS8R can deliver pulses of up to 2ms duration and 0-1000mA (from 400V), however the actual current achieved will be restricted by a pulse energy limit of 300mJ per pulse and the skin/electrode resistance.

### Biphasic Charge-balanced Output

The DS8R has two pulse modes, enabling stimulation using monophasic or biphasic rectangular pulses. Additionally, in biphasic mode the DS8R allows for both symmetric or asymmetric charge-balanced stimuli through implementation of an adjustable stimulus/recovery phase amplitude ratio. Biphasic charge-balanced stimulation offers certain advantages over monophasic stimulation, as it prevents the potentially harmful electrochemical changes which occur under stimulation sites and is reported to be more comfortable for the subject during long periods of stimulation.

### External Control Capabilities – Software (via USB) and Analogue Voltage Input

Researchers often want to adjust stimulus settings (current and duration) during a stimulation protocol and with the arrival of the DS8R, such control becomes a reality. While the DS8R can operate as a standalone isolated stimulator with full control via the front panel, settings can also be modified using Windows PC control software (supplied) via a USB interface. This software provides a Virtual Front Panel for the stimulator, but more importantly incorporates an API allowing the operator to implement control from custom or commercially available software packages.



# ISOLATED STIMULATORS AND ACCESSORIES

## D185 Multipulse Cortical Stimulator



### Features

- 1000V maximum voltage output (set by user).  
1.5A maximum current output (LCD monitor).  
Risetime of 0.1A per  $\mu$ s.
- 50 $\mu$ s pulse duration.
- 1 to 9 pulses with user defined interpulse interval.
- Reversible output polarity switch.
- Interfaces with standard intra operative monitoring equipment.
- User defined trigger facilities permit integration with popular EMG recording equipment.



Now used worldwide as an effective tool for intra operative monitoring (IOM) of the spinal cord, the D185 is the ONLY standalone surgical stimulator with FDA clearance for this technique. The D185 transcranial stimulator allows transcranial motor evoked potentials (MEPs) to be used in surgical procedures such as scoliosis correction, spinal tumour resection and thoraco-abdominal aortic aneurysm (TAAA) repair. The 1000V power source means that MEPs can even be evoked in patients with pre-existing neuropathologies. The D185 is a CE marked medical device and has been cleared by the FDA for marketing in the USA.

The D185 MultiPulse is also useful for peripheral nerve stimulation. Although the D185 was designed for transcranial cortical stimulation during intra operative monitoring, the brief high voltage output also makes it suitable for use as a spinal root stimulator during differential diagnosis of peripheral nerve disorders, such as multifocal motor neuropathy and motor neuron disease. The high voltage allows effectively stimulation of deep nerve roots as they exit the spinal column, while the very short pulse duration minimises patient discomfort.

**THE D185 IS THE ONLY  
STANDALONE SURGICAL  
STIMULATOR WITH FDA  
CLEARANCE FOR THIS  
TECHNIQUE**

## D188 Remote Electrode Selector



### Features

- Rapid switching (<1ms) between up to eight pairs of electrodes.
- Digital switching or virtual front panel software control.
- Compatible with Windows 7 and higher.
- No audible cues of switching (optional LED indicators)
- Safe for human research studies.

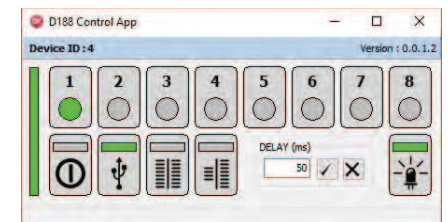
The D188 Remote Electrode Selector may be used to direct electrical stimuli from a single electrical stimulator to one of up to eight pairs of stimulation electrodes. It is particularly useful in applications where a stimulus needs to be presented to several stimulation sites, one site at a time, but only one electrical stimulator is available. A minimum of four TTL compatible digital inputs are required to permit external control of eight channel switching events, while the D188 can also be manually controlled via the supplied Windows compatible software.

A pair of touch-proof stimulus input sockets is provided for connection to a compatible electrical stimulator and there are eight pairs of 1.5mm DIN 42802 touch-proof stimulus outputs (channels), numbered from 1 to 8, each associated with a green LED to show when they are active. These LED's can be turned off for situations where it is important that the subject or operator should not know which channel is active.

Silent in operation, the D188 has been designed for safe use in humans with our range of isolated constant current stimulators, including the DS7A and DS5 and as a result has been specified to operate with stimulus sources of up to 400V. However, the D188 is not a medical device and use should be restricted to research applications.

The D188 is supplied with virtual front panel software which allows the device to be configured and controlled manually using a PC keyboard or mouse. The D188 can also be controlled by TTL compatible digital inputs applied to a socket at the rear. The D188 allows for 1:1 or 4:8 control which requires 8 or 4 digital inputs respectively, to switch between the 8 channels. An application programming interface (API) is available to allow third party software to control the D188. Details relating to the API are available upon request.

Digitimer provide a selection of input cables to permit connection of the D188 directly to our stimulators or via our D185-HB4 cable. We also offer electrode extension cables if existing electrode lead wires are too short.



**DIRECT ELECTRICAL STIMULI TO ONE  
OF UP TO EIGHT PAIRS OF STIMULATION  
ELECTRODES**



# ISOLATED STIMULATORS AND ACCESSORIES

## D185 Multipulse Cortical Stimulator Accessories

The D185 MultiPulse Cortical Stimulator can be supplied with a range of accessories to facilitate integration with operating theatre equipment and stimulation preferences. The current range includes electrode extension leads, stimulator

output plugs, a footswitch and a range of electrode connection head boxes and electrode holders/handles for peripheral nerve stimulation applications.



### Trigger Cables\*



**D185-TC1**  
Trigger cable (BNC – 3.5mm) – 1.5m.  
For connection between your EP system and the D185.



**D185-TC2**  
Trigger cable (BNC – SMB) – 1.5m.  
For connection between your EP system and the D185.



**D185-TC3**  
Trigger cable (BNC – BNC) – 1m.  
For connection between your EP system and the D185.



**D185-TC4**  
Trigger polarity inverter. For connection between your EP system and the D185.



**D185-TC5**  
Trigger cable (BNC socket – 3.5mm) – 0.6m. For connection between your EP system and the D185.

## D185 Multipulse Cortical Stimulator Accessories

### Electrode Connection Headboxes



**D185-HB1**  
Electrode connection headbox (5m cable). This extension headbox provides 5 linked pairs of 1.5mm DIN sockets for connection to MEP electrodes closer to the site of stimulation.



**D185-HB3**  
Electrode connection headbox with stimulus reversal and SEP electrode disconnection (inc. D185-CB1) – 5m. Ideal for those using SEP monitoring who want to avoid saturating their SEP amplifier during MEP stimulation.



**D185-HB4**  
Electrode extension cable – 4.5m. Straight forward extension of the output sockets of the D185, terminating in a moulded pair of 1.5mm DIN sockets. Other lengths are available.

### Electrode Holders/Handles



**D185-EH2**  
Depth Electrode – One cathode and three anodes for deep peripheral nerve stimulation.



**D185-EH3**  
Compact Standard Electrode – Single anode and single cathode (with 50mm spacing).

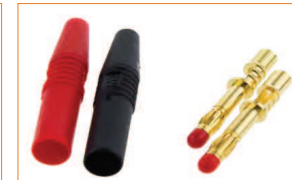


**D185-EH4**  
D180ES Style Electrode – Single anode and single cathode with long handle (with 60mm spacing).

### Miscellaneous Items



**D185-FS1**  
Foot switch to IP68. Allows foot switch control of the D185.



**D185-OC1**  
Output connector plugs for user assembly (pair). Also suitable for use with the DS7A peripheral nerve/muscle stimulator.



**D185-OL1**  
Output lead – moulded connector on 5m cable for user assembly. Also suitable for use with the DS7A peripheral nerve/muscle stimulator.



**D180-PADS**  
Pack of 10 felt pads for D180 and D185 Electrode holders.

\*There are lots more trigger cables available, please contact us.

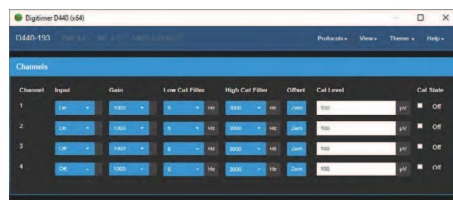
# ISOLATED AMPLIFIERS AND ACCESSORIES

## D440 2 OR 4 Channel Isolated Amplifier



### Features

- Portable, standalone design
- Extremely low noise
- AC and DC operating modes
- Analogue signal output for ultimate compatibility with data acquisition systems
- Computer control through dedicated Digitimer software or external programs
- Designed for human research applications, including nerve excitability testing



The Digitimer D440 Isolated Amplifier is a low noise solution for human EMG studies, specifically those related to nerve excitability. The D440 features an amplification range of x100 to x20k. The gain, filter and mode settings for individual channels are adjusted using Digitimer's "virtual front panel" software or other software via a COM interface. The D440 is available in two versions, the D440-2 (two channels) and the D440-4 (four channels). Each channel features a pair of 1.5mm touch proof sockets for active and reference electrode connection, but provision is also made for shielded leads with 5-pin DIN connectors. Each amplifier is supplied with a signal output cable (D connector to multiple BNC) and electrode connection cable (1.2m long with 3x 1.5mm DIN42802 sockets for electrode connection and 270 degree 5-pin DIN plug for amplifier connection).

# BASED ON THE DESIGN OF OUR EXTREMELY POPULAR 8-CHANNEL D360 PATIENT AMPLIFIER

## D360R-4 Four Channel Isolated Amplifier/Filter



### Features

- AC coupled, isolated, differential amplifier (4Ch)
- Low noise for EMG, EP and EEG
- Remote preamplifier headstage
- High-pass, low-pass and 50/60Hz notch filters
- Gain range of x100 to x3,000,000
- Analogue signal output for DAQ compatibility
- Windows PC control software (32bit and 64bit compatible)
- Safe for human research applications

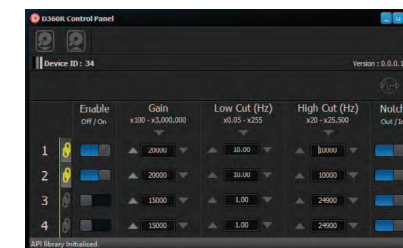
The D360R-4 is a four-channel isolated research amplifier intended for electroencephalography (EEG), electromyography (EMG) or evoked potential (EP) studies in a human research environment. Based on the design of our extremely popular 8-channel D360 Isolated Patient Amplifier, the new D360R-4 provides a compact, cost-effective, but highly-specified 4-channel research equivalent.

The D360R-4 comprises a main amplifier unit, a remote pre-amplifier headstage with four pairs of differential inputs (plus Common) and dedicated Windows-compatible Client Software. The software provides a virtual front panel for the adjustment of settings, including low-pass and high-pass filters as well as amplifier gain. The pre-amplifier headstage is attached to the main amplifier via a fully detachable 2m long cable, which is easily replaced if it becomes damaged during use.

The D360R-4 provides software and hardware de-block capabilities which can be useful to settle the amplifier inputs following electrode placement or re-positioning. In addition, a TTL controlled de-block function allows a precisely timed external de-block to be applied in situations where a large stimulation artifact might obscure a short latency response.

Analogue signal outputs mean that the D360R-4 is fully compatible with most commercially available data acquisition

systems and analysis software. Signal outputs are available on the rear panel via a 9-way "D" connector. The D360R-4 is supplied with a "D" to multi-BNC cable for connection to BNC-based data acquisition systems.



The D360R-4 supports system expansion as multiple D360R-4 amplifiers can be connected to a single computer (via several USB sockets or hub) to allow multiples of four channels to be controlled through a single software interface.

The four channel D360R-4 has been designed to meet all of the electrical requirements of the medical electrical standard IEC 60601-1, however, unlike the 8-channel D360, the D360R-4 is NOT a medical device and its use is limited to animal or human research.



# ISOLATED AMPLIFIERS AND ACCESSORIES

## D360 8-Channel Patient Amplifier

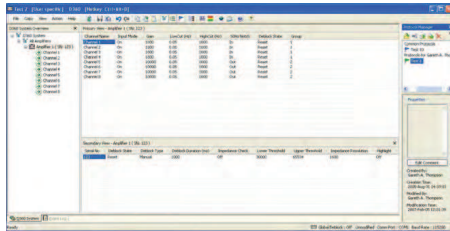


### Features

- Low noise, high gain amplifier for EMG, EP and EEG
- 8 pairs of differential inputs
- Versatile gain and filter settings
- Analogue signal outputs for wide DAQ compatibility
- Built in electrode impedance checking
- Windows compatible control software

The D360 is a computer-controlled 8-channel patient-isolated AC-coupled biological amplifier and analogue filter system, CE marked according to European medical device requirements and intended for electroencephalography (EEG), electromyography (EMG) and evoked-potential (EP) applications. The system comprises a main amplifier unit, a remote active head-box and dedicated Windows-compatible control software.

Multiple D360 amplifier systems may be connected to a single PC allowing multiples of 8 channels to be controlled through a single software interface. The D360 has analogue signal outputs making it compatible with the majority of commercially available data acquisition systems.



**THE D360 IS A COMPUTER-CONTROLLED 8-CHANNEL PATIENT-ISOLATED AC-COUPLED BIOLOGICAL AMPLIFIER AND ANALOGUE FILTER SYSTEM**

## D175 Electrode Impedance Meter



### Features

- Portable
- Battery powered
- Easy to use
- Wide impedance range Low/high LED indicators

The D175 Impedance Meter is a compact battery powered device designed to allow checking of electrode impedances prior to recording or stimulating through surface electrodes attached to the skin. In the case of electrical stimulation, high electrode impedance can reduce the amount of current that can pass through the target tissue, resulting in lower than expected stimulation and a poor evoked response. Likewise, high impedances can reduce the quality of recordings, such as ECG, EEG and EMG that rely on surface electrodes.

The D175 is a tool that allows suitably trained operators to rapidly assess surface electrode impedances in order to decide if they are low enough for the procedure being undertaken. It features green/red bi-colour LEDs allowing the operator to set a threshold impedance at which an LED will light as red rather than green. This facilitates electrode impedance checking, by providing the operator with an easily visible indication of "good" (green) or "bad"

(red) electrode impedances. The impedance values that the D175 can display are 0, 0.5, 2, 3, 5, 7, 12, 20, 30, 50 kohm. For display purposes, measured impedances are rounded up to the next highest displayable value, i.e 4 kohm lights up the 5 kohm LED. By pressing and holding the Power Button for longer than 4 seconds, the D175 will enter the SETUP MODE and allow the operator to change the level at which the LEDs illuminate green or red. In SETUP MODE, the LED corresponding to the highest "good" (green) level will flash green. The D175 preserves battery power by switching off if a button is not pressed for a period of greater than one minute.

# ISOLATED AMPLIFIERS AND ACCESSORIES

## D177 Biofeedback Unit



### Features

- Improves reproducibility of VEMP tests
- Uses standard EMG amplifier audio output
- Portable and lightweight
- Inexpensive and easy to operate

#### Designed to Improve the Reproducibility of Neurophysiological Testing

The Digitimer D177 Bio-Feedback Unit has been developed to improve reproducibility of the Vestibular Evoked Myogenic Potential (VEMP) test, however, it may be employed for any neurophysiological evaluation that requires repetitive voluntary input from the subject. The D177 provides a visual indication of the effort being exerted and this helps the subject maintain the same level of tonic activation during each successive trial.

#### Easily Incorporated into Standard EP/EMG Systems.

The D177 has a 2.8m long cable, terminating with a 3.5mm mono audio jack, to facilitate connection to the audio output

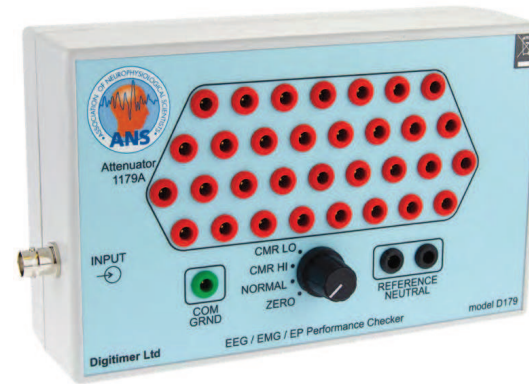
of an EMG amplifier. The D177 converts this signal into visual feedback for the subject, in the form of needle movement on an analogue level meter. The subject is instructed to make an initial movement under the direction of the operator and the 'volume' is then adjusted until the needle is in the centre of the display. No further adjustments are necessary until the test is complete for that person. All the operator need do, is ask the subject to exert enough voluntary effort to direct the needle to the centre of the display and maintain it there, during each trial.

#### Inexpensive and Suitable for Subjects with Large or Small EMG Responses.

The D177 Biofeedback Unit is a simple, inexpensive device which improves the reproducibility of neurophysiological tests including VEMPs. It is suitable for subjects with small or large EMG output, as the device is easily calibrated to an effort that each person can withstand and repeat comfortably.

**IMPROVES THE REPRODUCIBILITY OF NEUROPHYSIOLOGICAL TESTS INCLUDING VEMPs**

## D179 Performance Checker



**MORE ACCURATE THAN THE ORIGINAL EPTA 1179**

### Features

- Improved version of the EPTA 1179 Unit
- More accurate than the original 1179
- Requires fewer leads
- Designed for single-handed operation

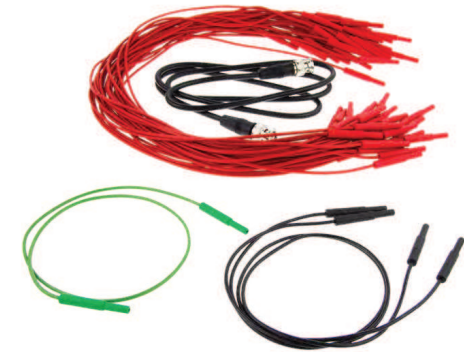
The Association of Neurophysiological Scientists (ANS, formerly known as EPTA) have transferred the manufacture of their model 1179 Performance Checker to Digitimer Ltd. As a result, we are now able to offer the updated 1179A unit (model D179) with or without the required function generator.

Guidelines drawn up by the ANS urge clinical neurophysiology departments to carry out certain routine checks on their equipment to ensure that it is operating within specified standards. While many instruments offer internal calibration functions, these checks do not of course provide any independent verification that the equipment is functioning correctly. Only by use of an independent external device to carry out EMG amplifier calibration (or EEG amplifier calibration) can such checks be conducted with complete confidence.

The D179 Performance Checker is designed to be used in conjunction with a suitable signal source. The recommended signal source for those departments wishing

to calibrate EEG amplifiers only is the TG315 Function Generator. For those departments needing to check Evoked Potential and EMG/Nerve Conduction systems as well as EEG, a signal source with a trigger input is needed. Here, the TG2511A is suggested, which is a digital function generator. Both devices are available from Digitimer and are supplied with a calibration certificate.

The 1179A Performance Checker accepts the output from either of the above sources, attenuates it by 100,000:1 (100dB) and presents it simultaneously to 32 outputs via standard 1.5mm touch-proof sockets on the top of the box. There are in addition a GROUND/Common socket and two REFERENCE/NEUTRAL sockets.





# SOFTWARE

## STIMULUS RESPONSE SOFTWARE FOR NERVE, MUSCLE OR CORTICAL EXCITABILITY

### QtracW Threshold Tracking Software

QtracW is a flexible, stimulus response data acquisition program with averaging and threshold tracking facilities, for studies of human nerves in vivo and animal in vivo/in vitro preparations.

It is best suited to situations when the excitability or response varies slowly with time, either due to changes in the stimulus parameters or to an externally initiated treatment, and the data of primary interest are the changes in selected parameters (threshold, amplitude, latency, etc.) of the response with time. Response waveforms can also be recorded, enabling the time course of additional response parameters to be calculated after the recording is finished. QtracW comprises separate stimulation and plotting programs, QtracS and QtracP. QtracW is a multi-channel program, in which the 'channels' (up to 16) may be associated with different physical inputs and outputs, or with different stimulation parameters or different operations on the response waveform. Flexibility comes from the ability to associate any combination of physical or operational parameters with any channel.

The Digitimer DS5 Bipolar Constant Current Stimulator was specifically designed to work with QtracW software for human studies of nerve excitability. The major components of a human nerve excitability setup include a PC running QtracW software, a nerve stimulator (e.g. Digitimer DS5), an isolated EMG amplifier (e.g. Digitimer D440-2) and a compatible DAQ interface. For animal studies we recommend our DS4 Stimulator.

#### Compatible DAQ Hardware

National Instruments DAQ interfaces (e.g. USB-6341-BNC) are recommended for use with QtracW software. Please consult the QtracW users manual for further details on specific models.

#### Obtaining QtracW

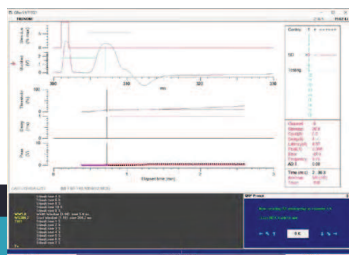
The most recent version of QtracW software can be freely downloaded from the Digitimer website. After 50 days evaluation QtracW will only function through use of a USB hardware dongle/key which is provided once a licence has been purchased from Digitimer.

#### Purchasing QtracW

New QtracW users need to purchase a 3 year licence pack from Digitimer. This pack consists of one QtracSP dongle (stimulation and analysis/plotting) and two QtracP (analysis/plotting only) dongles. Once a user becomes a registered QtracW licensee, further dongles can be purchased individually with variable lifetimes (one to five years) and capabilities (either QtracP or QtracSP). It is also possible to extend the lifetime of a dongle by paying the appropriate licence fee.

### Features

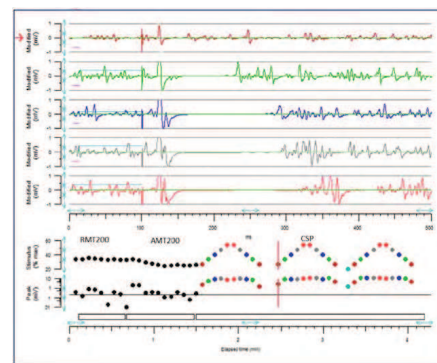
- Stimulus response software for nerve, muscle or cortical excitability
- Optional QTMS protocol extension for solo TMS operators
- Acquisition via National Instruments DAQ interfaces
- Compatible with the Digitimer DS5 and DS4 isolated current stimulators
- Software licences available for 3 or more years



### QTMS - Cortical Excitability Protocols for QtracW

QtracW software is commonly used for microneurography and studies of axonal and muscle excitability, but with a compatible transcranial magnetic stimulator (TMS), it can also be used for cortical excitability testing. Although control of magnetic stimulators has been possible for several years using standard QtracS protocols, Prof. Hugh Bostock and his colleagues at QTMS Science Ltd. have recently launched a new QTMS recording suite specifically aimed at TMS users. This suite allows a solo operator to run QtracW TMS protocols and obtain standardized recordings automatically. QTMS software licenses are now available exclusively from Digitimer Ltd and require an active QtracW license.

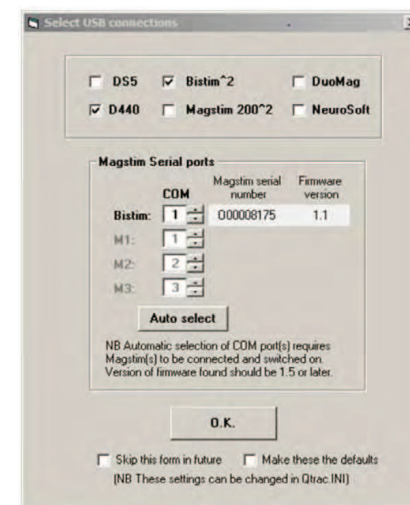
In addition to resting motor threshold (RMT), stimulus response function (SRF) and cortical silent period (CSP), this QTMS suite comprises short interval intra-cortical inhibition and facilitation (SICI, SICF), long interval cortical inhibition (LICF), and short latency afferent inhibition (SLAI). In each case, conventional tests can be compared directly with two corresponding threshold-tracking versions, serial and parallel. In the serial tracking versions, as in the TRONDNF nerve excitability protocols, test-alone stimuli on one channel are compared with conditioning + test stimuli on another, and the inter-stimulus interval (ISI) changed in steps.



### Features

- QTMS protocol extension for solo TMS operators
- Wide transcranial magnetic stimulator compatibility
- Includes protocols for RMT, SRF, CSP, LICF, SICI and more
- Requires an active QtracW license
- Minimum QTMS license duration 12 months
- Discount for academic/hospital-based users

QtracS can now control a MagStim BiStim2, a Deymed DuoMag MP Dual or a Neurosoft Neuro-MS Paired Monophasic stimulator. All these devices deliver paired monophasic magnetic stimuli through a single-coil, although they all achieve this result in slightly different ways.



# ELECTRODES AND ACCESSORIES

**DIGITIMER DESIGNS, MANUFACTURES AND DISTRIBUTES A WIDE RANGE OF QUALITY ELECTROPHYSIOLOGY EQUIPMENT**

Our extensive range of neurodiagnostic accessories is suitable for intraoperative monitoring, evoked potential, electroencephalography (EEG), electromyography (EMG) and nerve conduction studies. Our products include EEG cup electrodes, bipolar felt pad and bar electrodes, as well as self-adhesive stimulation pads.

We have long-standing partnerships with several leading neurodiagnostic consumable manufacturers, giving us access to hundreds of electrodes and accessories, which we are able to supply with our own equipment.

Our accessories range is constantly expanding, so please consult our website for the most up to date information on product availability.

If you are looking for electrodes or accessories which we don't appear to offer, please get in touch as we may be able to source them for you.

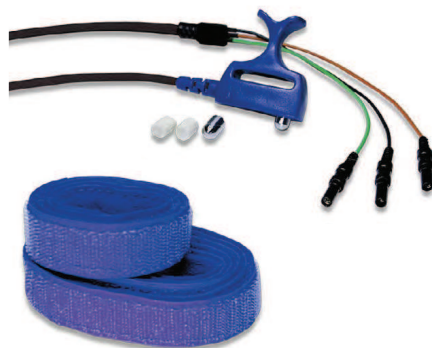
## **Nerve Conduction Studies (NCS) & Evoked Potential (EP)**

Nerve conduction studies measure how fast and how well the body's electrical signals travel along nerves, while evoked potentials are used to measure electrical activity in areas of the brain and spinal cord in response to peripheral stimulation.

We supply a variety of electrodes suitable for nerve conduction and evoked potential studies, including bipolar bar electrodes, digital ring electrodes, ear clip electrodes and stainless steel disks. In addition to these more general-purpose stimulation electrodes, we also offer the specialist "Wasp" electrodes used to induce pain in a subject. These particular electrodes are designed for nociception testing or psychology research.

## **Features**

- Extensive range of disposable and reusable electrodes
- Products suitable for recording and electrical stimulation
- Cables/adaptors compatible with Digitimer hardware
- High quality and dependable construction
- Manufacturers including Axelgaard, Technomed Europe and GVB-SPES



Many of our reusable stimulation electrodes have 1.5mm connectors suitable for use with our D185-HB4 output extension cables, however a limited number are available with 4mm plugs, for direct connection to our electrical stimulator outputs.



## **Electroencephalography (EEG)**

Electroencephalography (EEG) is typically a non-invasive method to record electrical activity of the brain via the scalp. EEG is most often used to diagnose epilepsy, which causes abnormalities in EEG waveforms. EEG is also used to diagnose sleep disorders, coma, encephalopathies, and brain death. We offer a range of cup electrodes for EEG applications, including reusable and disposable options. Our reusable silver/silver chloride, silver plated and gold plated electrodes are designed to give a reliable signal and provide ease of use time after time. The electrode head has a large dome volume and the connector is optimized for easy headbox insertion and extraction and with soft and flexible lead wires for optimal patient comfort.



## **Electromyography (EMG)**

Electromyography (EMG) measures the electrical signals generated by muscles when at rest in response to nerve activation. Digitimer supply a range of single use self-adhesive EMG electrodes and related accessories. Our electrodes feature 1.5mm DIN42802 touch-proof plugs, which connect directly to our isolated amplifier inputs. We also provide amplifier input cables for electrodes fitted with press-stud/snap or tab connectors.



## **Touchproof Plugs Adaptors & Electrode Linkers**

Digitimer products intended for human use are fitted with 1.5mm DIN42802 or 4mm touch-proof safety connectors. To ensure compatibility with electrodes from other manufacturers, we provide an extensive range of plugs, adaptors and electrode linkers. Products include our DS7A-M338 electrode adaptor leads, available in 30cm or 90cm lengths. These allow our range of Axelgaard electrostimulation electrodes or Compex motor point pen electrode to interface with our D185-HB4 stimulator output cable.



## **Intraoperative Neuromonitoring (IONM)**

Intraoperative monitoring is used during surgery to ensure that the nervous system is intact and functioning correctly. The products we supply provide high-quality solutions for intraoperative neuromonitoring and include EEG cup electrodes and subdermal needles. Our subdermal needle electrodes include a version with short (50cm) lead wires to preserve signal integrity when used for cerebral function monitoring equipment.



# LIFE SCIENCE RESEARCH

## Overview

Digitimer designs, manufactures and distributes a wide range of quality electrophysiology equipment, including amplifiers, electrical stimulators and other electronic instruments, employed by life science researchers all over the world. Our reputation as a manufacturer of high quality, precision scientific instrumentation means that the most prestigious university research departments, independent research institutes and many pharmaceutical companies use Digitimer products.

The modular NeuroLog System is a central component of our life science product range and is 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, neuronal spike detection, electrical stimulation, pulse & train generation, multi-channel isolated EMG recording, pressure or other transducer recordings. You can learn more about the multi-modal capabilities of the NeuroLog System within the later sections of this brochure.

Although Digitimer specialises in the development of electronic instrumentation, especially biological signal amplifiers and stimulators, we also offer a variety of complementary equipment for in vitro and in vivo scientific research. Digitimer currently represents several life science research instrument manufacturers, including Automate Scientific (perfusion systems and chambers), Narishige (micromanipulators, injectors and pipette fabrication) and Scientific Systems Design (temperature-controlled slice/tissue recording chambers and pre-incubators).

*NeuroLog*  
SYSTEM

### Amplifiers

The NeuroLog System includes a range of amplifier modules designed for a variety of electrophysiological recording applications. Our amplifiers are suitable for intracellular (NL102G), extracellular microelectrode and gross electrode recordings (NL100AK/NL104A), as well as isolated multi-channel EEG/EMG (NL844/NL820A). The range also includes bridge amplifiers for force (NL109) and pressure measurements (NL108A). The modular nature of the NeuroLog System means that it is possible to expand or reconfigure systems as experimental requirements change.

### Multi-channel Stimulators

The modular D330 MultiStim System was specifically designed for use in laboratories where several in vitro preparations in tissue baths or cell culture wells require field stimulation from a low impedance source. The system uses a common timing waveform for each channel but different stabilised stimuli to each preparation. The system may be user configured for individual timing/control requirements and includes modules for constant voltage and constant current stimulation.



### Stimulus Isolators for Electrophysiology

Intended for low noise applications and immensely popular in electrophysiology labs, our DS2A and DS3 stimulus isolators offer exceptionally low noise characteristics coupled with robust performance and easy to use controls. Alongside these triggered constant current and constant voltage devices, we also offer the DS4, which converts an analogue voltage "command" waveform into a proportional constant current output, allowing a software controlled DAQ system to generate an isolated biphasic constant current stimulus.

The NeuroLog System includes the NL800A, a compact, constant current, linear stimulus isolator. The NL800A can output currents from 0-10mA in four ranges via an analogue voltage input. Our NL510A Pulse Buffer and NL512 Biphasic Pulse Buffer provide interfaces between a control signal and the NL800A, allowing for the generation of amplitude adjustable, monophasic or biphasic constant current stimuli.

### Mains Noise Eliminators, Filters & Signal Conditioners

Signals recorded using biological amplifiers and other high impedance devices often become contaminated with 50 or 60 Hz mains or line noise, leading to corruption of the content of these electrophysiological signals and a degradation of the quality of subsequent data analysis. Digitimer now manufactures the original single channel Hum Bug Noise Eliminator alongside our new multi-channel D400 Mains Noise Eliminators, which are available in 2, 4 and 8 channel variants for effective removal of mains interference without signal distortion.

The NeuroLog System includes single channel and multi-channel high cut and low cut filters intended for use with our NeuroLog System amplifiers. However, these filters and other signal conditioners within the range will accept signals amplified by third party devices.



### Trigger & Pulse Generators

Our DG2A Train/Delay generator is a compact, battery-powered instrument that may be used as a TTL trigger source for a variety of devices, including our own range of electrical stimulators. Operating in multiple modes, the DG2A is specifically useful for triggering continuous stimulation or the delivery of discrete bursts of trigger pulses.

For more demanding pulse generation applications, the NeuroLog System includes a range of modules capable of pulse generation and timing control. Pulse patterns may be pre-defined in a variety of ways, allowing you to control other modules within the NeuroLog System or send TTL compatible trigger pulses to external devices, such as stimulators or data acquisition systems.

**DIGITIMER  
REPRESENTS  
SEVERAL LIFE  
SCIENCE RESEARCH  
INSTRUMENT  
MANUFACTURERS**



# AMPLIFIERS

## THE NEUROLOG SYSTEM PROVIDES AC OR DC COUPLED AMPLIFICATION OF BIOLOGICAL SIGNALS

### NeuroLog System – Overview

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 force/pressure transducer recordings 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. AC coupled 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. NeuroLog System modules must be installed into our compact NL905 or standard NL900D case and power supply units.

#### Example Application: 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 may 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 analogue output from the NL125/6 can be fed into a data acquisition system, or alternatively, individual spikes can be discriminated using the NL201 SPIKE TRIGGER module. If required, the NL120S AUDIO AMPLIFIER allows for audio monitoring of raw signals or detects spikes.



#### Example Application: Intracellular DC Recording with Current Injection

The NL102G DC PRE-AMPLIFIER features capacitance neutralization, current injection, low leakage current and low DC drift. It is particularly suitable for intracellular recording through fluid filled micro-electrodes. The NL102G includes electrode impedance checking, calibrator, stimulus bridge balance DC level adjustment ( $\pm 2V$ ) and current injection/monitor. A maximum current injection of up to  $\pm 100nA$  is possible through the front panel control or from an external analogue input. Impedance checking/calibration pulses can come from other NeuroLog modules, however, they could also be provided by your chosen data acquisition interface/software. A supplied NL412 PULSE unit provides a remote BUZZ control to facilitate cell penetration.



#### Example Application: 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 a 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 NL820A ISOLATOR, 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.



#### Example Application: Physiological Pressure Recording

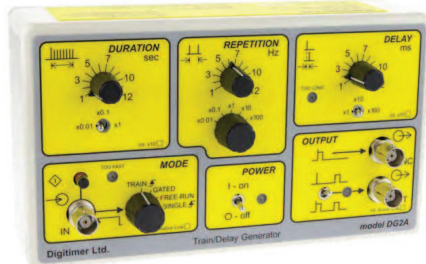
The NL108A PRESSURE AMPLIFIER provides an easy method of monitoring physiological pressure changes and can be used in combination with our disposable (NL108T2) or reusable (NL108T4) pressure transducers. The NL108A has two amplification ranges, making it suitable for measuring high pressures such as 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 DAQ interface.

As an alternative to the NL108A, the NL109 BRIDGE AMPLIFIER may be interfaced with isometric force transducers and features user adjustable excitation voltage settings, allowing for wide transducer compatibility.



# TRIGGER & PULSE GENERATORS

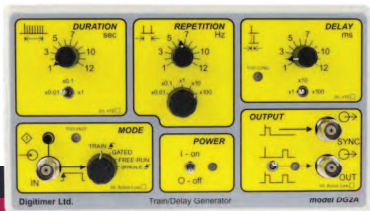
## DG2A Train/Delay Generator



This small free-standing instrument has been designed for control of normal repetitive stimulation as well as for defining the Effective Refractory Period using a second, delayed pulse. The DG2A is especially useful as a frequency generator (as a TTL trigger source) for use with our DS2A, DS3 and DS7A isolated stimulators which have their own pulse duration controls. The DG2A Train/Delay Generator has four operating modes:-

### Train

In TRAIN mode, a regular button press or TTL compatible trigger received at the IN socket is translated into a SYNC pulse train with a pulse repetition rate and train duration determined by the REPETITION and DURATION settings. The DELAY dial allows the introduction of a delayed pulse after each SYNC pulse which can be detected at the OUT-1/OUT-2 output.



## Features

- Simple TTL trigger source for our range of stimulators
- Battery powered (single 9V, PP3)
- Four operating modes (Train, Gated, Free-run, Single)
- Delayed output for study of effective refractory period

### Gated

In GATED mode, the DG2A will output a train of pulses at the SYNC socket while the input at the IN socket is TTL high. This allows the operator to GATE the train of pulses on and off with an external device. The pulse repetition rate is determined by the REPETITION setting. The DURATION control has no function in this mode. The DELAY dial allows the introduction of a delayed pulse after each SYNC pulse, which can be detected at the OUT-1/OUT-2 output.

### Free-run

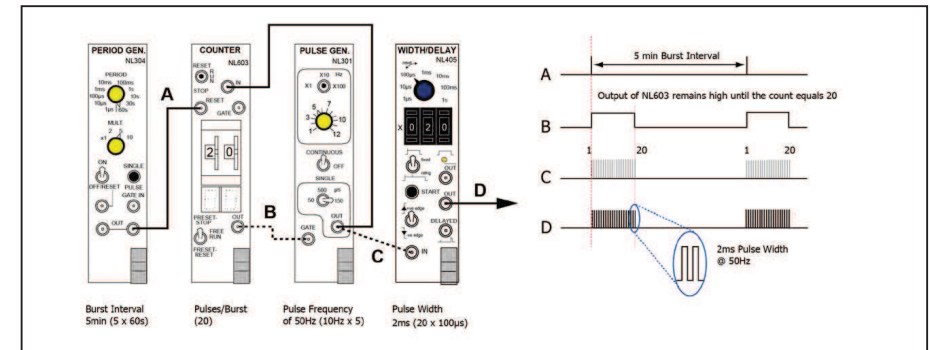
In FREE-RUN mode, the DG2A will continuously output SYNC pulses with a pulse repetition rate determined by the REPETITION setting while the unit is ON. The DURATION control has no function in this mode. The DELAY dial allows the introduction of a delayed pulse after each SYNC pulse which can be detected at the OUT-1/OUT-2 output.

### Single

In SINGLE mode, a single TTL compatible trigger received at the IN socket or push button press is translated into a single SYNC pulse. The REPETITION and DURATION controls have no function in this mode. The DELAY dial allows the introduction of a delayed pulse after each SYNC pulse which can be detected at the OUT-1/OUT-2 output.



## NeuroLog System Trigger/Timing



The NL301 PULSE GENERATOR and NL304 PERIOD GENERATOR provide the "clocks" of the NeuroLog System and allow users to set up stimulus timing protocols of variable complexity. With the addition of other modules, it is possible to develop protocols that consist of repeating bursts or trains that can continue indefinitely or stop after a certain period of time or number of pulses. Our NL412 PULSE unit provides a simple hand-held trigger to initiate stimulation sequences.

The digitally controlled NL405 WIDTH/DELAY and NL603 COUNTER are commonly used to add complexity to pulse timing protocols and can also be used to extend or count TTL inputs. Other modules in this category, such as the NL501 LOGIC GATE permit more demanding signal processing where multiple inputs control an output process.

### Example Application: A Regular Burst of Pulses with Control of Burst Frequency, Pulses per Burst & Pulse Frequency/Width

This application allows a 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. The output at (D) may be 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.



**IT IS POSSIBLE TO DEVELOP PROTOCOLS THAT CONSIST OF REPEATING BURSTS OR TRAINS**

# STIMULUS ISOLATORS FOR ELECTROPHYSIOLOGY

THE DS3 CAN BE TRIGGERED BY AN EXTERNAL DEVICE SUCH AS OUR DG2A TRAIN/DELAY GENERATOR

## DS2A Isolated Voltage Stimulator

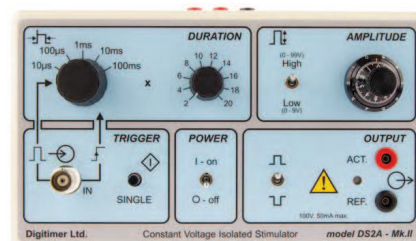


### Features

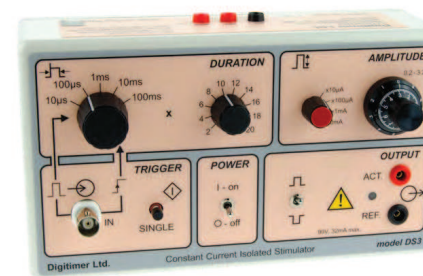
- Low noise battery power supply with up to 99V output
- Internal (20µs to 2s) or external TTL "gated" control of pulse duration
- Two voltage ranges (0-9V and 0-99V) allow precise reproducible control of stimulus output
- Single-shot trigger button
- Current is only drawn from batteries when a stimulus is being delivered

Brief pulses of electricity are used in various biomedical research applications as a stimulus to excite nerve or muscle fibers. In order to minimise artifacts introduced into electrophysiological data, it is desirable that the stimulator (stimulus isolator) used should be electrically isolated both from ground and from the trigger device. The DS2A meets both of these requirements and will deliver a low noise, precisely controlled constant voltage stimulus of up to 100V, adjustable in pulse duration and amplitude. As with the DS3

Constant Current Stimulator the output comes from self-contained batteries. The DS2A can be triggered by a TTL compatible external device such as our DG2A Train/Delay Generator. The DS2A can be fitted into a 19" rack mounting frame (D121-11) which can hold up to two DS2A's, DS3's, DS4's or DG2A's.



## DS3 Isolated Current Stimulator



### Features

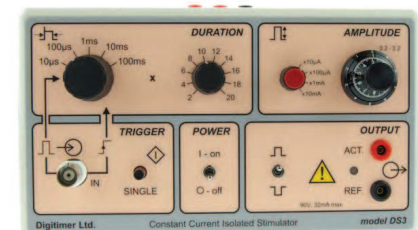
- Low noise battery power supply with 90V compliance
- Internal (20µs to 2s) or external TTL "gated" control of pulse duration
- Four current ranges allow precise reproducible control of stimulus output between 2µA and 32mA
- Single-shot trigger button
- Output discharge (Clamp) circuit prevents charge build-up during stimulus
- Current is only drawn from batteries when a stimulus is being delivered

Brief pulses of electricity are used in various biomedical research applications as a stimulus to excite nerve or muscle fibers. In order to minimise artifacts introduced into electrophysiological data, it is desirable that the stimulator/stimulus isolator should be electrically isolated both from ground and from the trigger device. The voltage required to send current through tissues can vary greatly, making it important to have control over the stimulus driving force. Large impedance variations during an experiment can result in a lack of reproducibility or total loss of the stimulus. In these circumstances, a constant current stimulator like our DS3 would be recommended over our DS2A.

The DS3 also features a "clamp" or discharge circuit which discharges the output between stimuli, preventing a charge build up on the preparation.

In other constant current devices this charge build up can lead to a loss of stimulus. The DS3 can be triggered by an external device such as our DG2A Train/Delay Generator. The DS3 can be fitted into a 19" rack mounting frame (D121-11) which can hold up to two DS2A's, DS3's, DS4's or DG2A's.

The DS3 provides a precise Constant Current stimulus (up to 32mA) controllable in Pulse Duration and Amplitude and as with the constant voltage DS2A this output comes from self-contained batteries.





# STIMULUS ISOLATORS FOR ELECTROPHYSIOLOGY

## DS4 Bi-Phasic Current Stimulator



### Features

- External voltage control permits software defined waveforms
- Isolated constant current output for low noise
- Minimal zero crossing distortion
- Inactivity sensor significantly reduces leak currents
- Battery test sockets

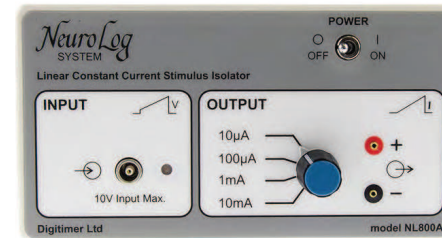
worse, low amplitude stimulation. The DS4 uses a special "inactivity sensor" to monitor the input voltage and disable the DS4 output if this voltage falls within  $0 \pm 0.15\%$  of the full scale value for a user selectable time period of 100ms, 200ms, 1s or 2s. Unlike other devices which only produce an output when the input voltage exceeds a threshold value, this "inactivity sensor" reduces battery usage and damaging "leak currents" during infrequent stimulation, while at the same time maintaining low levels of zero crossing distortion for repetitive waveforms.

The DS4 uses an external DC power supply to power the input control circuitry and readily available/inexpensive batteries to provide the opto-isolated stimulus voltage source. The DS4 can be fitted into a 19" rack mounting frame (D121-11) which can hold up to two DS2A's, DS3's, DS4's or DG2A's.



**INACTIVITY SENSOR  
REDUCES BATTERY  
USAGE AND DAMAGING  
LEAK CURRENTS**

## NeuroLog System (stimulus isolators)



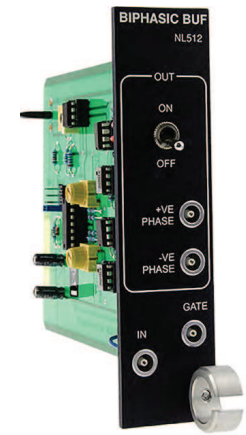
### NL800A Constant Current Stimulus Isolator

The NeuroLog System includes the NL800A CONSTANT CURRENT STIMULUS ISOLATOR. Employing an analogue voltage input for control, the NL800A outputs currents from 0-10mA in four ranges. Our NL510A PULSE BUFFER and NL512 BIPHASIC BUFFER provide interfaces between a control signal and the NL800A, allowing for the generation of amplitude adjustable, monophasic or biphasic constant current stimuli.



### NL510A Pulse Buffer

The NL510A PULSE BUFFER converts TTL logic pulses into either pulses whose amplitude can be set to between 0 and 10V pulses or input drive pulses for the NL800A Stimulus Isolator. The output amplitude is adjusted with a precision ten turn potentiometer and a turns counting dial. The NL510A may also be used as a voltage source for driving devices including relays, solenoids and LEDs.



### NL512 Biphasic Buffer

The NL512 BIPHASIC PULSE BUFFER is the interface between any bipolar signal and two of the NeuroLog NL800A ISOLATORS so that bipolar, isolated, constant current signals can be used for stimulation. This is "current out for voltage in".

The NL512 can also control two independent NL800A's - one with the positive phase and the other with the negative phase of a DAC output. 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 DAC 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. The switch, in the OFF position, disables the module.

**OUR NL510A PULSE  
BUFFER AND NL512  
BIPHASIC BUFFER  
PROVIDE INTERFACES  
BETWEEN A CONTROL  
SIGNAL AND THE  
NL800A**

# MULTI-CHANNEL STIMULATORS

## D330 MultiStim System



The D330-MultiStim System is a modular and highly versatile multi-channel stimulator designed to be used by scientists who wish to accurately stimulate a number of low impedance tissue preparations with different stimulating voltages or currents. The MultiStim System is used in laboratories where a number of in vitro preparations or cell culture wells need to be field stimulated from a low impedance source.

The system provides a choice of either constant voltage stimulation (up to 100V at 1A - D333H) or constant current stimulation (up to 500mA from a 100V source - D343). The D335 - Meter can be fitted into the system to allow precise voltage or current monitoring. A selection of timing modules are available to generate pulses, variable in frequency and width, which can be controlled as bursts using a gating waveform, variable in repetition rate and duration or pulse count. Sockets are fitted to allow full external control and synchronization. The D330-MultiStim System rack/case is available in a 19" rack-mountable unit - D337, that can house the Gated Pulse Train Generators and up to ten stimulation channels. The modularity of the system allows a system to be extended or split between smaller units for two sites.

The functions of the major system components are described below, but for more technical information and application guides please consult our separate D330 MultiStim brochure.



### D333H - Dual Stimulator

Provides constant voltage stimuli from 0 to 100V in amplitude with currents up to 1A into loads as great as 0.01μF. The voltage of the two channels is independently controlled by single turn controls and range selector switches. Each channel has an on/off switch, stimulus indicator and an overload detector/indicator.



### D343 - Dual Stimulator

Similar to the D333H except that the stimuli generated are constant current. The fully protected unit provides control of stimulus strength up to 500mA from a 100V source into low impedance baths where impedances can be as high as 200Ω.

### D342 Dual Bi-Stim (Bi-phasic) Module

Provides a switching function allowing stimuli of alternating polarity to be presented to each of two preparations. It has control of stimulus polarity (Normal, Alternating or Reverse) independently for each channel as well as warning of a stimulus timing rate that is too-fast. The control and timing for the pulses is generated by selecting other modules from the D330 MultiStim range. The module connects to the outputs of a D333 or D343 via 2mm-2mm leads (supplied).



### D335 - Meter Module

Provides a digital indication of the measured voltage or current of the stimulating waveform. The measurement channel is selected from the front panel and the measurement is shown on the LED display.



### D331AT - Sync & Gate

The right-hand side of this module provides control of the Gating function so that bursts of pulses can be delivered at an accurately set Repetition interval for accurately set Durations. The left-hand side of this module has the functions of the D334B.



### D344 - Remote

This module allows the user full external control of the timing for each independent channel. A toggle switch gives overall output control by :- a) allowing a single external Enable signal to control the system, b) permanent Enable or c) all channels OFF (for safety).



### D340 - Count & Delay

This single width module will allow a stimulus pulse of the duration set on the D332 to be added to (or be the only pulse in) the output train at a selected Delay after a selected Number of pulses. This unit may be useful in determining Effective Refractory Period.



### D334B - Sync

Provides the front panel Power switch, power-on/error LED, Pulse & Gate External (EXT) In & Synchronisation (SYNC) sockets and a Single pulse button.



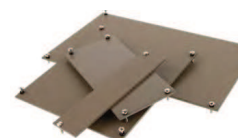
### D341A - Sync & Train

The right-hand side of this module provides control of the Gating function so that a set Number of Pulses can be delivered at an accurately set Repetition interval. The left-hand side of this module has the functions of the D334B.



### D332T - Pulse

This module provides ten-turn dial control of the pulse frequency and pulse duration when using internal timing controls.



### Blank Panels

These variable width panels are matching blank front panels to complete the enclosure of the front aperture for safety and aesthetics.

## Features

- Powerful multi-channel field stimulation
- For low impedance tissue chambers
- Optional internal timing controls
- Modular and expandable



# MAINS NOISE ELIMINATORS, FILTERS & SIGNAL CONDITIONERS

## Hum Bug Noise Eliminator



### The Problem

Signals recorded using biological sensors and other high impedance devices are often contaminated with 50 or 60 Hz noise corrupting the content of these signals and degrading the quality of subsequent data analysis.

Electrical interference is notoriously difficult to remove without altering the original signal embedded within the noise.

In theory, proper attention to ground and appropriate shielding can eliminate electrical interference. In practice, noise remains a frequent and distressing problem in many laboratories.

Noise may come and go for no apparent reason and may appear during critical phases of data collection. The effort required to maintain noise at an acceptable level is both time consuming and frustrating.

### The Traditional Approach

Faraday cages decrease the magnitude of environmental noise sources but this protection is often incomplete.

Notch or comb mains noise filters are occasionally used to suppress 50/60 Hz noise and harmonics but a line noise filter will distort the input waveform if the frequency components of the signal overlap with the filtered frequencies.

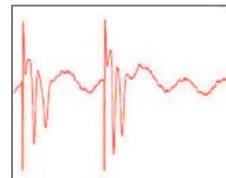
### 50 or 60Hz Noise Removal without Filtering

The Hum Bug constructs a noise replica in real time and continuously subtracts this replica from the input signal. It performs this function in the presence of biological activity even when noise characteristics evolve over time.

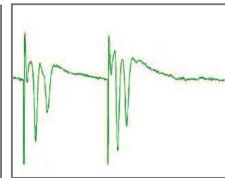
## Features

- Real-time 50/60Hz noise removal without filtering
- No phase delays or waveform distortion
- Reliable and easy to use

Without Hum Bug



With Hum Bug



In the Red trace, 50Hz mains noise is clearly seen, however, passing the same response through a Hum Bug (Green) results in the removal of the mains interference with no damage to the biological signal.

Even if the biological signal has 50Hz or 60Hz components, these will be untouched by the Hum Bug Noise Eliminator.

### Simplicity

The Hum Bug is a real-time device. Simply connect it between your preamplifier and any analysis or recording equipment (oscilloscope etc.).

It will automatically eliminate electrical interference while it lets the signal of interest pass through unchanged. No settings or adjustments are required.

The front panel switches are only used if you wish to bypass noise cancellation (BYPASS), stop the adaptation process (HOLD), or clear the noise replica (CLEAR).

## D400-2/4/8 Noise Eliminator



The D400 Multi-channel 50Hz/60Hz Mains Noise Eliminator is a standalone instrument designed for real-time removal of 50Hz or 60Hz mains noise interference, including harmonics, from amplified biological and other signals prior to acquisition by digital data recording systems. Unlike 50Hz/60Hz notch filters, the D400 noise eliminator can remove mains noise without degrading the signal of interest, even if it overlaps with the mains frequency.

Available in 2, 4 and 8 channel versions, the D400 is unique as a multi-channel, standalone mains noise eliminator, which is not incorporated within and does not have to be used in conjunction with any specific electrophysiology data acquisition system. While the method of noise removal follows the principles of the Hum Bug Noise Eliminator, the hardware and software algorithms used by the D400 have been developed by Digitimer and are unique to this device. For those unfamiliar with the concept of operation, the D400 receives amplified analogue voltage signals (AC or DC coupled) from an amplifier via its inputs and as these signals pass through the D400 noise eliminator remaining in the analogue domain, it rapidly constructs a phase-locked "mains noise template" and subtracts this from the original signal. Noise removal occurs in real-time and the noise template evolves constantly, so that any changes in the amplitude or other characteristics of the noise are corrected for.

Global control is via the Clear, Hold and Bypass buttons located on the front panel, however, the D400 is supplied with virtual front panel software (for Windows), which adds some functionality and permits control of individual channels.

## Features

- Multi-channel 50/60Hz noise elimination
- 2, 4 and 8 channel versions
- Analogue path with no waveform distortion
- Independent noise template for each channel
- Control via front panel or software
- BNC or multi-way signal connections



# FILTERS, SIGNAL CONDITIONERS & NOISE ELIMINATORS

## NeuroLog System (filters & conditioners)

Our range of single and multi-channel filters and signal conditioning modules allow precise identification of signals of interest against a background of unrelated frequencies. The single channel NL125/6 features variable high and low cut settings and a 50/60Hz notch filter. Our four channel filters

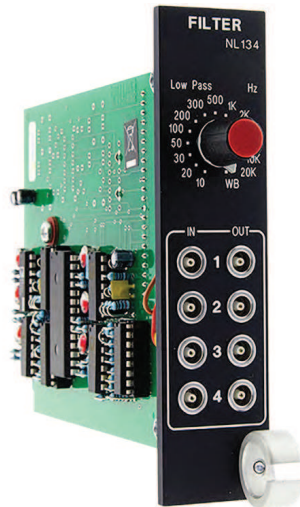
operate with our NL844/NL820A isolated amplifier in multi-channel EEG and EMG applications. **Please refer to our website for details relating to the other specialist conditioner modules available.**



### NL125/6 Band Pass Filter (with Notch)

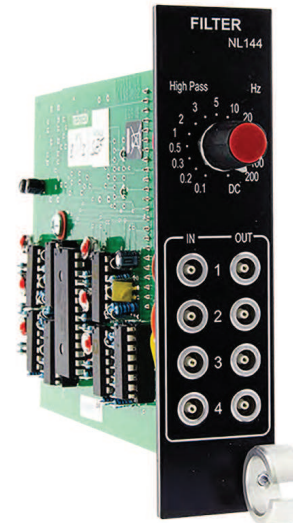
The NL125/6 BAND PASS FILTER module employs two active sections to control the variable high-pass and low-pass characteristics along with a mains frequency Notch filter (jumper selectable for 50Hz or 60Hz).

The NL125/6 is often used in combination with our NL100AK/NL104A AC Preamplifier headstage and module for band-pass filtering of signals from extracellular recordings.



### NL134/5/6 Four Channel Low Pass Filters

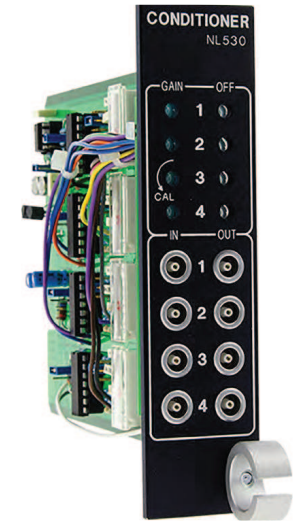
The NL134/5/6 LOW PASS FILTERS provide second order (two-pole) low-pass filtering with mains frequency Notch reject (NL135/6 only). They are ideal partners for the NL820 Isolated Amplifier system. A rotary switch selects the 14 frequency settings giving repeatability over a wide range with 12dB/octave [40dB/decade] attenuation above the selected frequency value. The 'WB' (wide-band) switch position bypasses the filter sections completely (both LP and Notch).



### NL144 Four Channel High Pass Filter

The NL144 HIGH PASS FILTER is a 4-channel, second order (two-pole) high-pass filter module. It is an ideal partner for the NL820A Isolated Amplifier system with its 4-channel NL844 AC pre-amplifier and the NL530 4-channel Conditioner module.

In combination with one of the NL134/5/6 filters, it is possible to configure a full 4 channel low and high frequency cut-off system.



### NL530 Signal Conditioner

The NL530 SIGNAL CONDITIONER from Digitimer is a single width module designed to give gain and offset set-up controls when interfacing signals to the analog-to-digital converters (ADCs) of PCs. The NL530 module contains four channels each with independently adjustable filter settings and front panel gain and offset presets.

There is also a master ADC offset control to allow unipolar ADCs to be used with bipolar signals. As ADC boards have a precise input range (outside of which damage may occur) the NL530 Signal Conditioner Module features on-board preset controls to set all channels to 'CLIP' (or limit) at independently set positive and negative (or zero) levels.

**OUR RANGE OF SINGLE AND MULTI-CHANNEL  
FILTERS AND SIGNAL CONDITIONING  
MODULES ALLOW PRECISE IDENTIFICATION  
OF SIGNALS OF INTEREST AGAINST A  
BACKGROUND OF UNRELATED FREQUENCIES.**





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