

## NEW Digitimer Products for 2004

### NEW Four Channel AC Preamplifier for Isolated EMG/EEG Recording

We have recently introduced a new **Four Channel AC Preamplifier (NL844)** as part of the NeuroLog System. The NL844 is designed for research use in combination with the NL820A Four Channel Isolated Amplifier module and replaces the NL822 and NL844. It features four pairs of colour coded 1.5mm DIN "touch-proof" electrode connection sockets as well as a COM input.



NL844 Preamplifier - Perfect for research studies of EEG & EMG

The unit can be operated in one, two, three or four channel modes with unused channels switched off using toggle switches on the rear. This means that unlike the NL822 and NL824, unused inputs do not need to be linked by external jumpers. The NL844 features three decades of gain (x100, x1,000 & x10,000), a low frequency cut off filter (3, 10 or 30 Hz) and an impedance checking function for testing electrode impedance. It is ideal for research studies of EMG, EEG & similar signals.

### New Power Source for the NL800A Stimulus Isolator



NL800A Stimulus Isolator

The NL800, our compact constant current stimulus isolator offered as part of the NeuroLog System, has recently been updated. Existing users of the NL800 will be pleased to learn that the new NL800A is the same compact size as its predecessor and possesses the same simple controls. However, it now uses standard GP23A batteries, which are often found in cameras and car alarm transmitters, which makes battery replacement much more convenient for you. In addition, the NL800A now features an LED near the input socket, allowing you to observe incoming voltage pulses arriving at the stimulus isolator. This LED is of particular use when first setting up a stimulation protocol or when troubleshooting stimulation problems, because it allows you to confirm if the NL800A is receiving an appropriate input.



### Watch Out! There's a Train Coming

The new **DG2A Train/Delay Generator** is a compact, free-standing, battery powered device which can be used to generate trigger pulses necessary for repetitive stimulation. Also featuring DELAY controls, it can be used for determining nerve or axonal Effective Refractory Period (ERP) through the production of a delayed second pulse.



DG2A - a colourful addition to the Digitimer family

Various modes allow output pulses to be produced singularly (SINGLE), continuously (FREE-RUN & GATED) or in a burst (TRAIN), with the burst/train duration and pulse frequency determined by the front panel controls. In each of the

modes (except FREE-RUN), outputs can be initiated either by the front panel push button, a TTL compatible trigger/gating pulse or a suitable foot switch.

The unit has control of train duration, pulse repetition rate (or frequency) within that train and control of the delay of the second pulse. It has two BNC output sockets (i) the SYNC output produces a pulse to trigger recording devices, stimulators or synchronise other equipment and (ii) the OUT output produces either a delayed version of the same or by toggle switch selection, pairs of delayed and non-delayed pulses (as would be necessary for ERP studies).

The unit is especially suitable for use with our DS2A Isolated Constant Voltage and DS3 Isolated Current Isolated Stimulators which have their own Pulse Duration controls.

A mounting frame (part number D121-11) is available so that two units of either DG2A, DS2A or DS3 can be mounted in 19" rack.

The instrument is powered by an internal 9V battery and replaces our DG2 Trigger Generator.

See Inside for...

Product Focus: DS2A & DS3

Development News

Clinical Update: DS5 Stimulator

News from Our Partners

# DS2A & DS3 Isolated Stimulators

PRODUCT FOCUS

## Compact Sources of Constant Voltage or Constant Current Stimulation

Extremely popular in research laboratories worldwide, our DS2A and DS3 isolated stimulators provide you with compact, reliable and easy to use sources of constant voltage (DS2A, 0-99V) or constant current (DS3, 0-32mA) stimulation. They feature optical isolation between the battery power source and the trigger circuitry making them ideal for use in very low noise electrophysiological recording environments.

Both can be triggered by a front panel button push or by an incoming TTL compatible trigger pulse from your data acquisition interface or other hardware, such as our DG2A Train/Delay Generator. Stimulus amplitude and pulse duration are precisely controlled using front panel dials. In addition, pulse duration can also be determined by the length of the incoming trigger pulse when the duration dial is set to the "Gated" position or by the length of time the single shot push button is held down.

The DS3 was developed from the DS2A in response to many requests for the DS2A to be modified to provide a constant current output. We found that this modification became so popular that it made sense to design a dedicated constant current equivalent of the DS2A. Although similar in appearance, the DS3 contains totally new circuitry, and includes an output clamp circuit which allows the stimulating electrode to be discharged between stimuli, a feature which is invaluable when stimulating with bursts of pulses.



DS3 - Constant Current Unit



DS2A - Constant Voltage Unit

### Some Frequently Asked Questions:

#### QUESTION 1: How do I decide between the constant current DS3 and constant voltage DS2A?

The visible difference between the two units (apart from the colour!) is that the output of the DS2A is defined in Volts while the output of the DS3 is defined in Amps. The actual stimulus passing through your preparation is measured in Amps in both cases and is dependent upon Ohm's Law ( $V = IR$ ). If your preparation has a variable impedance ( $R$ ) and you are using a constant voltage ( $V$ ) source such as the DS2A, then the actual current ( $I$ ) passing through the tissue may vary considerably between each stimulus, which may not be a good idea if you want to apply reproducible stimuli. With the DS3, the constant current circuitry prevents variations in tissue/electrode impedance from altering the size of current applied (within the 90V compliance limit of the unit), leading to the stimulator equivalent of WYSIWYG - "What You Set Is What You Get". Unfortunately there are no well defined rules governing the circumstances under which either stimulator should be used. If you are not sure and feel the need to evaluate either or both please contact us.

#### QUESTION 2: Can the DS2A or DS3 be used to stimulate human subjects?

No, neither the DS2A nor the DS3 have medical device directive (MDD) certification, which means that they do not incorporate safety features legally required for use on human subjects. We offer the MDD compliant DS7A stimulator for human/patient connection.

#### QUESTION 3: What is the purpose & significance of the output clamp circuit on the DS3?

Whenever a high output impedance constant current stimulator is used to deliver a stimulus to a cell, the cell can build up charge between stimuli, forming a capacitive barrier to subsequent stimulation. In turn, the stimulator will attempt to maintain the requested current during a stimulus train by using a higher voltage, however, it will ultimately reach its compliance limit and current will cease to pass to the cell. When activated (by an internal jumper), the DS3 output clamp circuit discharges the electrode tip for 20 microseconds after each stimulus and as a result capacitance is not built up between the stimulating electrode and the cell.

### Recent Publications:

Ruth E. Brooke, Jim Deuchars and Susan A. Deuchars *Input-Specific Modulation of Neurotransmitter Release in the Lateral Horn of the Spinal Cord via Adenosine Receptors.* *J. Neurosci.*, Jan 2004; 24: 127 - 137.

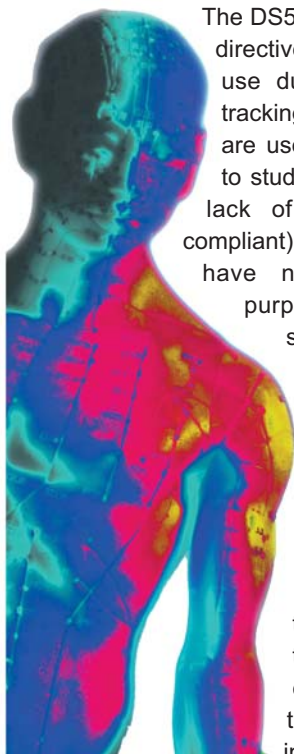
Andrew M. Coney, Mark Bishay and Janice M. Marshall *Influence of endogenous nitric oxide on sympathetic vasoconstriction in normoxia, acute and chronic systemic hypoxia in the rat.* *J. Physiol.*, Mar 2004; 555: 793 - 804.

Linda F. Hayward, Mabelin Castellanos and Paul W. Davenport *Parabrachial neurons mediate dorsal periaqueductal gray evoked respiratory responses in the rat.* *J Appl Physiol*, Mar 2004; 96: 1146 - 1154.

Yanhua H. Huang, Margaret Dykes-Hoberg, Kohichi Tanaka, Jeffrey D. Rothstein and Dwight E. Bergles *Climbing Fiber Activation of EAAT4 Transporters and Kainate Receptors in Cerebellar Purkinje Cells.* *J. Neurosci.*, Jan 2004; 24: 103 - 111.

The above publications are not necessarily endorsements of our products, however, we are extremely grateful to these and other authors who correctly cite our products in their papers.

### Digitimer DS5 - Stimulating New Methods for Peripheral Nerve Diagnostics



The DS5 will be the first MDD (medical devices directive) compliant stimulator designed for use during computer controlled threshold tracking nerve excitability tests. Such tests are used in research laboratories worldwide to study peripheral nerve physiology, but the lack of commercially available (and CE compliant) equipment has meant that such tests have not been adopted for diagnostic purposes. Instead, nerve conduction studies are currently the predominant diagnostic tool for the investigation of peripheral nerve function. Although important, these more traditional tests only provide information on the number of conducting fibres present and the conduction velocity of the fastest ones, shedding more light on the status of axonal myelination rather than on the biophysical properties of the axons themselves. In contrast to conduction studies, nerve excitability testing offers the clinician an insight into the excitability of axons at the point

of stimulation and data collected can indicate disturbances in membrane potential resulting from pathophysiological changes associated with ion channels and/or electrogenic pumps.

Research studies employing a prototype of our DS5 stimulator have indicated that nerve excitability studies can provide a rapid

and convenient method for diagnostic investigation of various peripheral nerve disorders such as diabetic neuropathy, carpal tunnel syndrome and amyotrophic lateral sclerosis. The DS5 provides an isolated, bipolar, constant current output (up to 50mA), controlled by a PC running compatible software, such as QTRAC which has been developed by Prof. Hugh Bostock of the Institute of Neurology (London, UK). In essence, the DS5 operates as a voltage to current amplifier, as it converts a computer controlled analogue voltage waveform into a constant current equivalent which is then applied to the patient. Resultant compound muscle action potentials are compared with a target response by the software and the stimulation amplitude is adjusted via feedback control.

We expect to be shipping the first DS5 stimulators in the last quarter of 2004.

#### Suggested further reading:

*Hugh Bostock, Katia Cikurel & David Burke (1998) Threshold tracking techniques in the study of human peripheral nerve. Muscle & Nerve, 21: 137 - 158.*

*Matthew C. Kiernan, David Burke, Kjeld V. Andersen & Hugh Bostock (2000) Multiple measures of excitability: A new approach in clinical testing. Muscle & Nerve, 23: 399 - 409.*

*Cindy S.-Y. Lin, Jane H. L. Chan, Emmanuel Pierrot-Deseilligny & David Burke (2002) Excitability of human muscle afferents studied using threshold tracking of the H reflex. J. Physiol., 545: 661 - 669.*

### Getting to the Root of a Conduction Problem - A New Application for the D185 MultiPulse Stimulator



Developed for intraoperative monitoring of the spinal cord, the D185 was the first transcranial electrical stimulator cleared by the FDA for this purpose and has now been successfully used in thousands of surgical procedures including scolliosis corrections, spinal tumour re-sections and repairs of thoraco-abdominal aortic aneurysms. In each of these cases, transcranial motor evoked potentials (tceMEPs) have helped surgeons to monitor the viability of the spinal cord throughout the course of the surgery and as a result protected the patients from the small but significant risk of post-operative neurological impairment. Although the D185 was designed with this single, very important application in mind, it is now becoming more widely used as a diagnostic tool for tests of peripheral nerve function.

As with the discontinued Digitimer D180 Stimulator, the high voltage output of the D185 makes it ideally suited to stimulation of deep nerve roots when studying conduction block, as these sites are often difficult to activate with more conventional (lower output) peripheral nerve stimulators. Furthermore, because the D185 uses a very brief pulse duration (50 microseconds), it is less likely to activate C-fibres making stimulation less painful for the patient. Using the D185, peripheral nerve diagnostics can be carried out along the whole length of the nerve, making it possible for clinical neurophysiologists to identify focal sites of motor conduction block, even at very proximal locations.

The ability to identify such sites is crucially important when attempting to differentiate between treatable conditions such as multifocal motor neuropathy (MMN) and motor neuron disease (also known as amyotrophic lateral sclerosis or ALS), which is untreatable and often proves fatal within 5 years of diagnosis. In some cases of MMN the site of conduction block is too proximal for traditional nerve conduction tests to isolate it. This can result in a patient being misdiagnosed with motor neuron disease when they are in fact suffering from a far less serious and recoverable condition. Stimulation more proximally with a high voltage stimulator such as our D185 may reveal these previously unidentified sites of conduction block and allow the clinician to make a correct diagnosis (Arunachalam et al., 2003).

*R Arunachalam, A Osei-Lah and K R Mills Transcutaneous cervical root stimulation in the diagnosis of multifocal motor neuropathy with conduction block J. Neurol. Neurosurg. Psychiatry, Sep 2003; 74: 1329 - 1331.*



### New Electrophysiological Recording Products from Alpha Omega

Alpha Omega Engineering is a biotech company based in Nazareth, Israel that specializes in the design and manufacture of biomedical research and clinical equipment. Their product range includes micro-driving terminals (for skull attachment) and electrode positioning equipment as well as various multi-channel amplification, spike detection and data acquisition hardware & software. Since the 2003 issue of Digitimes, Alpha Omega have made some notable additions to their product line up.

#### Tungsten micro-electrodes for extracellular recording.

Electrodes are available in packs of 10 with custom specifications relating to length (up to 130mm), impedance (500kohm to 2000kohm) and tip taper angle (60 or 90 degrees). Electrodes can be supplied with or without a 0.5mm pin connection.

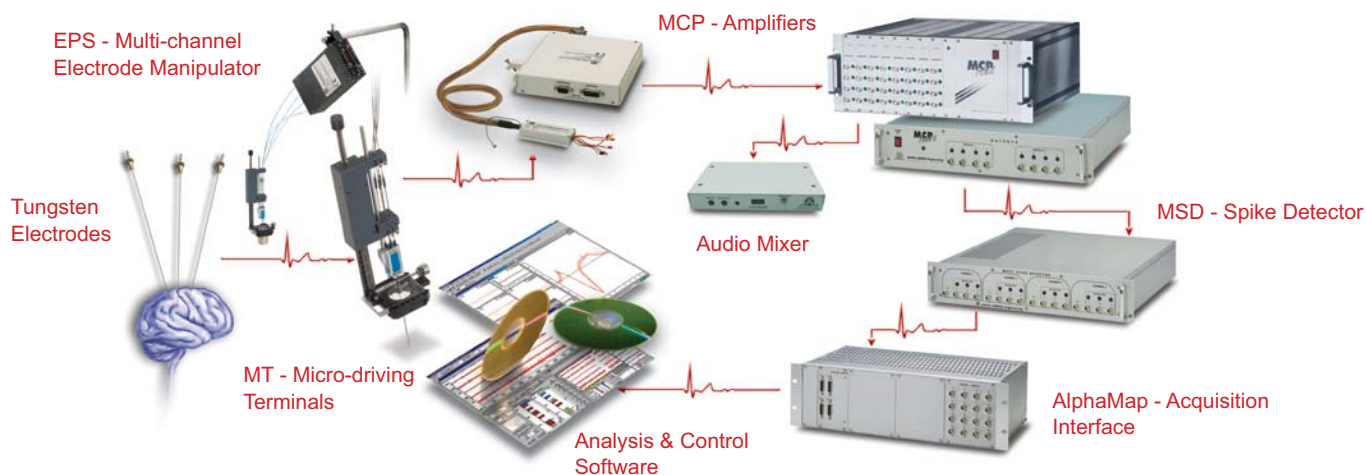
**32 Channel micro-driving terminal (MT).** Control the vertical position of up to 32 electrodes independently during *in vivo* extracellular recording from the brain. When connected to the electrode positioning system (EPS), up to 40mm of depth

movement is possible with a resolution of 1 micron.

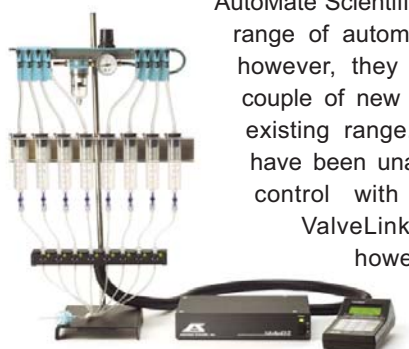
**Version II Electrode Positioning System (EPS).** This latest version of the Alpha Omega EPS now provides a variable speed control so that electrodes can be moved at speeds of 5 to 400 microns per second. In addition, the EPS interface card is now PCI-based making it simpler to source an EPS compatible computer.

#### AlphaLab - The AlphaLab is a complete electrode recording system integrated into a single workstation.

AlphaLab includes the following: Electrode micropositioning, signal amplification and conditioning, data acquisition, real time and offline spike sorting and offline data analysis. The unique hardware architecture and innovative software design allow the user to customize the system to fit the researcher's unique experimental requirements. Furthermore, the software gives the user complete control over the entire experiment from a single computer interface.



### Perfusion Systems & Accessories from AutoMate



A typical AutoMate ValveBank Perfusion System

AutoMate Scientific are well known for their range of automated perfusion systems, however, they are about to launch a couple of new products to add to their existing range. Previously, Automate have been unable to offer temperature control with their ValveBank and ValveLink perfusion systems, however, they will soon be able to provide a new heated perfusion pencil

which will allow you to perfuse your preparations/cells with pre-heated solutions.

For those of you needing to perfuse your preparations with very expensive drugs and peptides, AutoMate are developing the SmartSquirt8 which is a low volume air powered delivery system for microperfusion. The SmartSquirt8 will allow you to make up expensive solutions in much lower volumes and uses air pressure to apply them to your preparation. As we go to press, further details on both these products are unavailable, so please contact us or visit our website for up to date information.

Don't forget, we also represent the following companies:

**Bruxton**  
Software

**Medical Systems**  
Incubators  
Cell Injectors  
Drug Application Systems

**NARISHIGE**  
Micromanipulators  
Cell Injectors  
Pipette Pullers & Polishers

**InstruTECH**  
Data Acquisition



## PULSE Users - Have you considered upgrading to PATCHMASTER?



PatchMaster is the newest acquisition & online analysis package from Heka and has been developed to meet the increasing demands of today's patch-clamp experiments, as well as to exploit advances in hardware technology, such as their latest computer controlled

patch clamp amplifier, the EPC 10 (pictured below). Although at first glance the user interface of PatchMaster resembles that of Pulse, the program itself is totally new. As a result, PatchMaster avoids some of the limitations inherent in the architecture of Pulse and provides new functions and features which were previously impossible to offer. Heka have decided to focus their attention on PatchMaster for future developments, however, the Pulse family is being maintained for those who wish to continue using it at this time. PatchMaster is available in Windows and MacOS compatible versions. For those of you at commercial establishments with an interest in Good Laboratory Practice (GLP) standards, Heka are developing PatchMaster PRO (currently at the Beta testing stage). PatchMaster PRO addresses issues such as electronic signature of users, an audit trail of commands, access control, data integrity and hardware validation.



If you currently use Pulse and the features of PatchMaster are of interest to you, then you can download a manual/tutorial and demonstration copy of the software from the Heka website ([www.heka.com](http://www.heka.com)). You can now purchase a Pulse to PatchMaster upgrade from Digitimer at a special reduced rate. Please contact us for further details.

Some of the new features available in PatchMaster include:

- A greater number of acquisition and stimulation channels;**
- Enhanced trigger features**
- Individual timing for different channels**
- Support for multiple telegraphing amplifiers**
- Simultaneous capacitance measurements from multiple headstages**
- Extended online analysis capabilities**
- Protocol editor, extending automation possibilities**

**Other NEW products from Heka:**

**EPC10 Plus** - A modified EPC 10 which allows simultaneous cophasic acquisition of ALL 4 analogue inputs due to the integrated ITC-18 interface.

**PROBE SELECTOR** - Headstage Multiplexer controlled by PatchMaster which turns a single EPC 10 into an 8 or 12 channel serial/sequential patch clamp device.

**MIM4** - New evolution of the PatchMan motorized manipulator manufactured by Eppendorf.

**LIH1600** - NEW Acquisition Interface based on the InstruTECH ITC-1600, featuring full compatibility with Heka software packages.

**EVA8** - Voltammetric Amplifier.

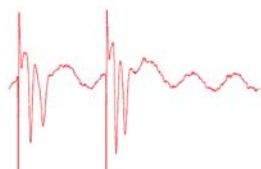
## Free Standing or Bench Mounted Anti-vibration Solutions from TMC



Digitimer continue to supply the TMC range of anti-vibration tables, Faraday cages and associated accessories. If you are setting up an electrophysiology rig that uses other equipment from Digitimer, why don't you ask us for a quote? We can arrange for an experienced installation engineer to deliver and setup tables at your convenience.

Standard tables are available in sizes from 25" x 36" to 36" x 60" with stainless steel laminate, plastic laminate or drilled top plates designed to suit your particular applications. The variety of optional accessories includes casters, arm rests and sliding shelves. Changes to the design of the Type II Faraday cages include the provision of an optional hanging shelf, rubber lined holes for cable passage in and out of the screened environment and a "roller blind style" front panel which is more convenient to operate than hinged doors. For those of you needing a bench top-based isolation solution, TMC now offer the 68 Series TableTop high performance isolation system, which features passive anti-vibration technology. The passive TableTop can be upgraded with the new Q-Damp active (electro-magnetic) damping modules.

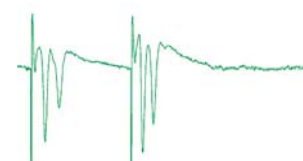
### Still Having Problems with 50Hz Noise?



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Too good to be true... No, just a *Hum Bug*

## Other Digitimer Products



*NeuroLog*  
SYSTEM

### *The NeuroLog System: Modular Electrophysiology*

The NeuroLog System is a compact, versatile & modular instrument which can be used for a variety of purposes including: intracellular, extracellular, transducer and multi-channel isolated amplification; pulse generation and electrical stimulation; signal processing and conditioning. In many cases a researcher will use a single NeuroLog system to carry out several of these functions simultaneously. With over thirty years of use in laboratories worldwide, no other device can evolve with your research needs quite like a NeuroLog System.

### *D330 MultiStim: Multi-channel Laboratory Stimulator*

The D330 MultiStim System is a modular and versatile multi-channel stimulator for biomedical scientists requiring accurate *in vitro* stimulation of multiple low impedance tissue preparations with different stimulating voltages or currents. Timing modules are available to generate pulses, variable in frequency and duration, which can be controlled as trains using a gating waveform, variable in repetition rate and duration or pulse count. Sockets are fitted to allow full external control and synchronisation if required. The D330 MultiStim System comes as a 19" rack-mountable unit that can house up to ten stimulation channels - along with the pulse train generator, gating and meter modules. In order to help with module selection, a number of application diagrams are downloadable from the Support section of our website.



### *D360 8-Channel Isolated Amplifier*

The D360 is a computer controlled isolated amplifier. It can be used for multi-channel AC coupled amplification of electro-encephalography (EEG), evoked potential (EP) or electromyography (EMG) signals. The control software provides gain, filter, impedance checking and deblock functions. Analogue output to your acquisition interface is via connectors on the rear of the unit or from 8 BNC sockets on the front. The D360 has been designed according to the medical devices directive through implementation of the EN60601 Standard.

### *DS7A/DS7AH Human Nerve & Muscle Stimulators*

The DS7A High Voltage Constant Current Stimulator is a very popular product for percutaneous stimulation within clinical or research environments. The stimulator uses mains power to provide a variable compliance of up to 400V, allowing a maximum stimulation current of 100mA, or 1A with the DS7AH variant. The stimulator has a built in "single-shot" trigger button, but also accepts TTL trigger input via a BNC socket on the rear of the unit or triggering from a contact closure footswitch. In addition, a TTL output, also on the rear, allows triggering of recording equipment. The DS7A has 6 selectable stimulus durations of between 50µs and 2000µs (restricted to 50-200µs with the DS7AH). Electrodes (not supplied) are connected to the stimulator via touch-proof safety sockets. Electrode extension cables or plugs are available from Digitimer.



## *Register Your Digitimer Product & Extend Your Warranty - FOR FREE!*



*Our D380 Dye Marker - just one of the products you can register with us*

All products manufactured by Digitimer include a standard 12 month warranty against defects in materials or workmanship, however, by registering your purchase with us, you can extend this warranty to two years, **free of charge**. Currently, you can register your purchase online at [www.digitimer.com/support](http://www.digitimer.com/support), however, in the future we will be including product registration leaflets along with despatched orders of Digitimer and NeuroLog products. This offer is only available for purchases of products manufactured by Digitimer and your registration details must reach us within 28 days of purchase in order to qualify.

In addition, and as part of our ongoing commitment to the ISO 9001:2000 quality standard, we are actively seeking feedback from our customers relating to customer satisfaction. A brief customer satisfaction questionnaire is included on the product registration forms and we would appreciate your comments and suggestions.

*Please use the enclosed Faxback form, visit our website or contact us directly for further product & pricing information*

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