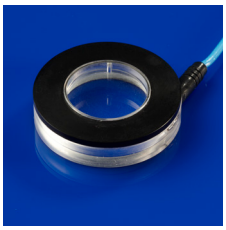
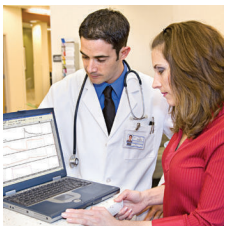
Transdermal drug delivery

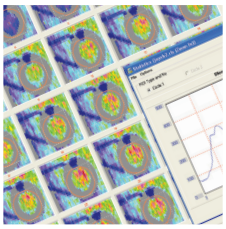
with MIC2™



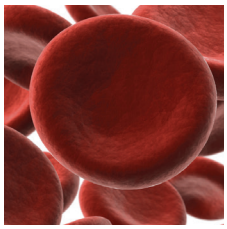












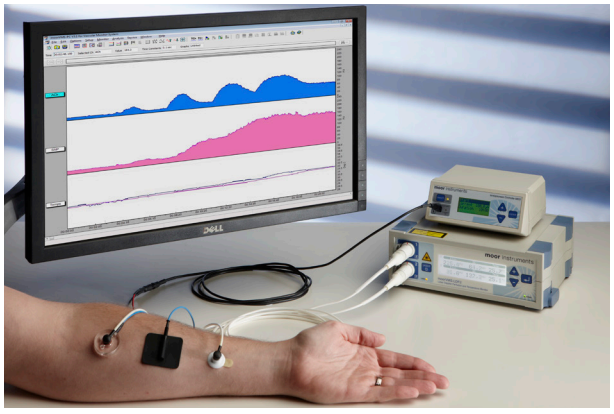
moor instruments

innovation in microvascular assessment

MIC2™ - Iontophoresis Controller

A low current Iontophoresis Power supply for use in combination with Laser Doppler assessment of blood flow changes stimulated by the transdermal delivery of vaso-active drugs. The features include;

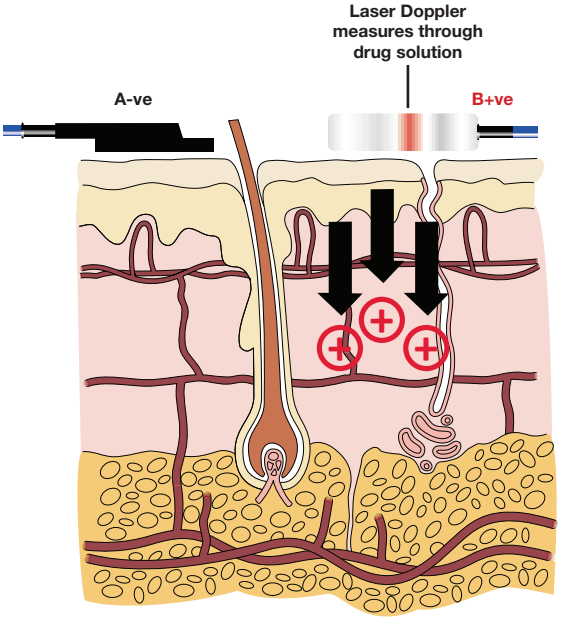
- **Programmable:** current levels and delivery periods can be controlled via the serial port (RS232 or USB) of a PC.
- **Stand Alone mode:** current levels and delivery periods can be set via a soft key user interface. The MIC2 can be used with any laser Doppler instrument and when ever low current (0 to 250 microAmps) drug delivery by iontophoresis is called for.
- **Skin Resistance Measurement:** both voltage and current are measured and recorded for assessment of skin resistance changes.
- **Tests of microvascular responses:** these include endothelial function, smooth muscle function, peripheral neuropathy and irritancy.
- **Re-usable drug chambers:** Perspex 'ION' chambers with platinum electrodes. These drug chambers are compatible with Moor Instruments laser Doppler optic and heater probes. The large area ION6 chamber allows imaging of blood flow changes through a transparent window.
- **Full compatibility:** with other moorVMS™ family products (laser Doppler, tissue oygenation, skin heating and pressure cuff control options).
- **Advanced Windows™ PC software:** with extensive analytical features and automatic report generation.
- **Convenient connections:** Analogue (0-5V, BNC) for external monitoring of current and voltage.
- **Reliability:** 2 year manufacturers warranty as standard – no servicing requirement.



moorVMS-LDF2 and MIC2 – Experimental set-up with enhanced image of responses to simultaneous iontophoresis of Acetylcholine and Sodium Nitroprusside.

The Technique

Iontophoresis is a method of delivering ionic drugs into the skin. Normally non-lipophylic drugs, e.g. acetylcholine chloride, would remain on the skin surface and very little would diffuse into the skin. By applying a low voltage to a drug solution, the ions of the drug conduct electricity as they pass into the skin. Changes in skin blood flow can be assessed by laser Doppler monitoring or imaging.



A. Negatively charged reference electrode.
B. ION chamber containing **positively** charged drug ions and the laser Doppler probe.

The electric field at the ION chamber (electrode B) repels the drug ions which are forced through the surface of the skin. For negatively charged drugs, the ION chamber is attached to the negative terminal of the supply.

Multiple dose-response

In some studies, cumulative dose responses have been found to be more reproducible than a single dose response. The moorVMS-PC and moorLDI PC software allows up to 25 time periods to be programmed to control the drug delivery automatically whilst measuring blood flow. This allows the use of protocols that would be difficult to perform manually thus improving experimental accuracy. Automation is carried through to analysis of the measurement.

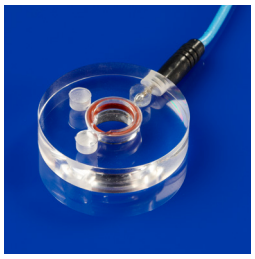
Galvanic Effect

Use of low current doses (usually less than 50 microamps) has been shown to help eliminate non-drug related vasodilation due to the galvanic effect, that is vasodilation resulting from the passage of current through the skin. The current range of the MIC2 has been specifically designed to operate at low micro amp settings with an accuracy of 0.1 microamps.

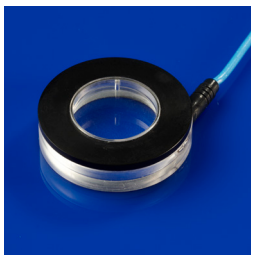
Skin Resistance

Galvanic effect has been shown to be related to skin resistance. The MIC2 is a constant current system – i.e. the applied voltage varies according to the skin resistance to keep current delivery as programmed. The MIC2 measures both current and applied voltage from which skin resistance can be assessed.

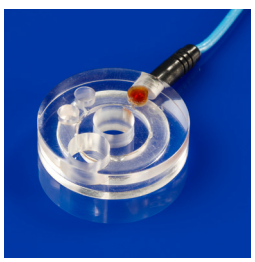
Ion Chambers



ION1r - perspex drug chamber which accepts Moor optic and skin heater probes. Drug chamber 9.5mm, overall diameter 36mm.



ION6 - is a drug chamber with a sealed cap to prevent drug spillage and a transparent window for LDI imaging. Drug chamber 22mm, overall diameter 36mm.



ION3-P2 - direct and indirect (axon reflex) assessment with moorVMS-LDF. For use with P2 optic probes. Drug chamber annulus internal diameter 14mm, outside diameter 22mm, overall diameter 30mm.

Response Monitoring with the moorVMS-LDF

An ION chamber containing an ionic drug solution and a laser Doppler probe is attached to the forearm with a double sided adhesive disc. The ION chamber, together with a reference electrode (or second ion chamber) to complete the circuit, is connected to the MIC2. The MIC2 is controlled either manually, or automatically with the moorVMS-PC software. The user defined protocol delivers the programmed drug doses to the skin. The laser Doppler monitor (usually with two probes) measures the response to the drug both at the delivery site and at a reference site, typically a few centimeters from the chamber. Results are displayed graphically and are easily analysed post measurement with moorVMS-PC software.

Reproducible Imaging

The procedure is similar to that of the moorVMS-LDF except larger ION6 chambers are normally used. Current and delivery periods are software controlled by the moorLDI software. The current protocol is easily defined within the dedicated software via a set-up table, allowing the user to precisely control charge doses.

In repeat-scan mode, moorLDI scanning builds a series of colour-coded maps of the skin response. Full analysis of the changes in blood flow is available post scan.



moorFLPI-2 and MIC2 – Experimental set-up displaying skin blood flow response to Acetylcholine.

About Moor Instruments

Moor Instruments, established in 1987, is a world leader in the design, manufacture and distribution of monitoring and imaging systems for micro-vascular assessments. We are proud now to include tissue oxygenation assessments within this portfolio.

Firsthand experience of laser Doppler research and development within Moor dates back to 1978 and with this we have the breadth of knowledge to help with your application and the enthusiasm to try and find answers to any of your questions.

By giving priority to performance, quality and service, we strive to ensure the highest levels of customer satisfaction.

Our dedicated design team is involved with a number of development projects for other partners and manufacturers. Whatever your needs, as a researcher, clinician or manufacturer, Moor will work harder for you.



MIC2™ – front and back panels.

Specifications:

Quality Control
Moor Instruments is certified to ISO 13485: 2003.
The MIC2™ is CE marked.

Output Current Range
0.1 – 250µA stand alone mode.
4µA – 250µA analogue remote control mode.

Output Current Accuracy
Set current ± 0.1µA.

Output Current Step
0.1µA For RS232 control.
0.1µA (<10µA), 1µA (>10µA) stand alone mode.
1µA For analogue control (i.e. DRT4).

Output Voltage (Maximum)
27V ± 1V open circuit.

Current Measurement Range
0 – 250µA.

Current Measurement Resolution
0.1µA.

Current Measurement Accuracy
± 0.1µA.

Voltage Measurement Range
0 – 27V.

Voltage Measurement Resolution
10mV Analogue output and serial outputs, 10mV (<10V), 100mV (>10V) on front panel display.

Voltage Measurement Accuracy
± 100mV

Resistance Measurement Range
1.2kΩ – 20MΩ

Resistance Measurement Accuracy
±5% 1.2kΩ – 20MΩ, output voltage > 0.3V or when high resistance warning is displayed. ±2% 2kΩ – 10MΩ, output voltage > 0.5V.

Analogue Control Input
0-2.5V, 1V = 100µA*, 40mV minimum input for activation of analogue remote control.

Current Monitor Analogue Output
0-2.5V, 1V = 100µA*.

Voltage Monitor Output
0-2.7V, 1V = 10V*.

Sample Rate
40Hz all parameters.

General
Power source: internal battery, 4 x AA cells (4 x 1.5V).
Battery life (typical): 80 hours continuous.
Dimensions: W x H x D mm, 70 x 150 x 140, 0.55kg (including batteries).
Operating environment: Clinic or laboratory, excluding domestic.
Operating temperature: 15-30ºC.

Classification
Medical devices directive 93/42/EEC: Class IIa, Active device for diagnosis.
Type of protection against electric shock: internally powered equipment.
Degree of protection against electric shock: Type BF applied parts.
Protection against harmful ingress of water: IPX0 (not protected).
Mode of operation: continuous.
Not suitable for use in an oxygen rich atmosphere.
Not suitable for use in the presence of flammable anaesthetics.

Safety Standards
Complies with: IEC 60601-1:2005, IEC 60601-1-2:2007.

Moor Instruments reserves the right to change specifications without notice.

*External equipment interfaces are electrically isolated from iontophoresis output.

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innovation in microvascular assessment

Moor Instruments Ltd Millwey Axminster Devon EX13 5HU UK tel +44 (0)1297 35715 fax +44 (0)1297 35716 email sales@moor.co.uk website www.moor.co.uk