TRANSDERMAL DRUG DELIVERY
BY IONTOPHORESIS
assessed by Laser Doppler

Moor Instruments
PROTOCOL EQUIPMENT
MIC1-e Iontophoresis Controller

The MIC1-e connects directly to Moor laser Doppler systems. This provides protocol control and measures changes in skin blood flow that occur as a result of drug iontophoresis.

Features

- Variable current range of 0 – 250 microAmps allowing variable iontophoretic transduction
- Flexible control from either DRT4 or MoorLDI.
- ION Chambers are re-usable drug reservoirs with designs for various applications.
- Protocol programming to allow fully reproducible iontophoresis control.

Response Monitoring with DRT4

Real time graphical traces showing changes in skin blood flow, due to iontophoresis, are generated by combining laser Doppler Monitoring (using the DRT4) with the MIC1e.

An ION chamber containing an ionic drug solution, together with an LDF optic probe, is attached to the forearm with double sided adhesive discs. The MIC1e is controlled by a user defined protocol [see illustration] to deliver programmed drug doses to the skin. The two channel laser Doppler monitor measures the response to the drug both at the delivery tissue site and at a reference site, typically a few centimeters from the chamber. Results are displayed graphically and are easily analysed post measurement.

ION Phantom on Opposite Page

Iontophoresis: The Technique

Iontophoresis is a method of inducing ionic drugs to pass into the skin by using a small electrical current. Normally non-lipophytic drugs, e.g. acetylcholine chloride, would remain on the skin surface and very little would diffuse into it. By applying a low voltage to an electrode in contact with the drug and a reference electrode in contact with the skin (or a second ION chamber), the ions of the drug pass into the skin to conduct the electric current.

Responses can be assessed either by Laser Doppler Monitoring (real-time trace of skin blood flow) or Laser Doppler Imaging (colour coded maps of skin blood flow over an area; see repeat scan mode, example on opposite page).
Response Imaging with MoorLDI

Colour coded maps showing changes in skin blood flow, due to Iontophoresis, are generated by combining Laser Doppler Imaging with the MIC1-e.

An ION chamber and reference electrode (or a second ION-chamber) are connected to the MIC1-e and make a complete electrical circuit via the skin. Current flowing through the skin is controlled by the MoorLDI. The Iontophoresis protocols are setup easily by the user to define current applied during each scan period. In repeat scan mode, the LD1 builds a series of colour coded maps of the region of interest. Full analysis is available post scan, including a graphical plot of mean blood flow within the region of interest (below, right).

Example of Iontophoresis of Sodium Nitroprusside.
(Images courtesy of Dr R. Malik, Manchester Royal Infirmary - Department of Medicine)

Reproducible Multi-Period Protocols

The timing is automatically controlled with no user intervention required, during measurement. This allows use of protocols that would be difficult to perform manually leading to greater experimental accuracy. In some studies, cumulative dose responses have been found to be more reproducible than a single dose response. Moor control software allows up to 25 independent periods to be programmed for both current and duration (up to 15 periods with DRT4 control). Automation is carried through to analysis of the trace: including mean, standard deviation, minimum and maximum.
Specifications and Order Codes:

Output current: 0 to 250 microAmps.
MIC1-e control via Moor Instruments MBF3/D, DRT4, MoorLDI systems, or via external 0 to 2.5V power supply. 
Current duration: user selected, single or multiple periods (up to 15 with DRT4, up to 25 with MoorLDI) with protocol software.
Drug Chambers: reusable, perspex body, platinum electrode. (Specifications subject to change without notice)

ION chambers
ION1r-P1 Direct drug assessment
Diameter 9.5mm
Use with P1, P1T, P1T/7 probes
ION1-LDI Direct and Indirect (axon reflex) assessment with MoorLDI diameter 9.5mm
ION3-P1/P2 Direct and Indirect (axon reflex) assessment
Annulus ID=14mm, OD=22mm
For use with P1 and P2 probes
ION6 Direct and Indirect assessments with MoorLDI
Diameter = 22mm
N.B. Diameters given refer to drug chamber. Overall diameters are typically 30mm. Other designs available on request.

Reference Electrode
MIC1-CP Carbon loaded conductive pads

Leads
MIC1-DM1 DRT4 to Mic1e
MIC1-MM1 MBF3 [BNC type] to MIC1e
MIC1-MY1 Mic1e to Y piece
MIC1-Y1 Y – piece
MIC1-GPL Y – piece to CP
MIC1-IONL Y – piece to ION chamber

Consumables
PAD Double sided adhesive discs for ION1r-P1 and ION1-LDI
IAD Double sided adhesive discs for ION3-P1/P2 and ION6
MIC1-GP Gel Pads (20 per pack) for the reference electrode.

References:

For the most recent publications list please consult www.moor.co.uk or contact Moor Instruments directly for your copy.


Brasch J, Hütttemann M, Proksch E. Iontophoresis of nickel elicits a delayed cutaneous response in sensitized individuals that is similar to an allergic patch test reaction. Contact Dermatitis, 42 (1), 36-41, 2000.