Iontophoresis involves the ejection of drugs or other ionic compounds through micropipettes by the application of current. Depending on the net charge of the substance to be ejected positive or negative current is applied to the micropipette to cause the ions to flow. npi electronic has designed very accurate current pumps to perform iontophoresis ejection of ionic substances. npi MVCS systems are high-voltage, high-speed current sources for iontophoresis or other applications, where constant currents in the nA or µA range are needed. Some models allow very fast drug applications down to the sub-millisecond range. Therefore, these systems can be used to simulate synaptic events. The unique operating and display elements of the instruments facilitate the application of drugs in physiological, pharmacological, and biochemical studies. The standard version is designed for relatively slow drug applications in the range above 100 milliseconds. With these models the microelectrode is connected via a special cable directly to the front panel of the instrument. The fast version with high-speed capacity compensation is suitable for drug application in the sub-millisecond range. This version includes a special small headstage for each channel as well as an electrode resistance test circuit.

Features:

- One or two channel versions (one channel versions can be upgraded)
- Time resolution: down to 100 µs, spatial resolution: down to 1 µm
- Simulation of synaptic events, suitable for receptor density mapping
- Automated balancing of iontophoretic current (option)
- Currents from tens of pA up to µA
- High-voltage, high-speed current source
- Automated electrode resistance test
- Also available as module for the EPMS-07 system

Kovalschuk et al. (2015). Nat Commun. 6:6349
Müller et al., (2013). J. Vis. Exp. 77: e50701,
Technical Data

Electrode Output:
floating current source
output impedance >10^{12} \Omega

Maximum Current:
\pm 450 \text{nA} \pm (1.5 \text{ } \mu\text{A}) \text{ into } 100 \text{ M} \Omega \text{ load}

Display:
current: XXX \text{nA}, balance: XX.XX \text{ } \mu\text{A},
voltage: XXX.X \text{ V}, R_{\text{i}}, XXX \text{ M}, displayed
value is set by a three position toggle switch, separate displays for each channel

Eject:
ten-turn control, range: \pm 100 \text{nA resp. } \pm 1 \text{ } \mu\text{A},
selected by switch

Minimum pulse duration:
100 \text{ } \mu\text{s}

Retain:
ten-turn control, maximum \pm 100 \text{nA

Capacity compensation:
ten-turn control, range 0-30 \text{ pF

Output current polarity:
selected by INVERTED/NORMAL toggle switch

TTL input (AUTO mode):
LO = RETAIN, HI = EJECT, R_{\text{in}} >5 \text{ k} \Omega

Modes of operation:
set by two toggle switches
EJECT/RETAIN/AUTO switch enables manual or TTL
controlled operation
SET/OPERATE switch connects automatically electrode
outputs to ground (SET position)

Analog input:
sensitivity 100 \text{nA} / \text{V}, R_{\text{i}} >100 \text{ k} \Omega, range \pm 10 \text{ V

Current monitor:
sensitivity 100 \text{nA} / \text{V}, R_{\text{in}} >100 \text{ k} \Omega, range \pm 10 \text{ V

Voltage monitor:
V_{\text{in}} / 10, R_{\text{out}} = 50 \text{ } \Omega

Balance output:
inverted sum of all injection currents, sensitivity 1 \text{ } \mu\text{A} / \text{V

Power requirements:
230 \text{ V / 115 V, 50 Hz / 60 Hz AC, 50 W, fuse 0.4 A / 0.8 A, slow

Dimensions:
19" rackmount cabinet, 19" (483 mm), 10" (250 mm), 3.5" (88 mm

Headstage: 65x25x25 mm

Capacity compensation:
ten-turn control, range 0-30 \text{ pF

Output current polarity:
selected by INVERTED/NORMAL toggle switch

TTL input (AUTO mode):
LO = RETAIN, HI = EJECT, R_{\text{in}} >5 \text{ k} \Omega

Balance output:
inverted sum of all injection currents, sensitivity 1 \text{ } \mu\text{A} / \text{V

The various configurations of MVCS systems are reflected in the part number

MVCX-C-0YA-V

where
X: S = Iontophoresis System C = Balance channel (Module only)
C: Fast System with Headstage(s)
Y: Number of Channels (1 or 2)
A: C = Iontophoresis System with Balance U = Upgrade M = Module
V: max. Voltage (45 V or 150 V

Examples

MVCS-01C-45 19" instruments, one application channel, one balance channel, slow (>100 ms), 45 V

MVCS-C-02M-150 Module for EPMS-07 system, two application channels, fast (<1 ms), 150 V
### MVCS Series

#### 19" Stand Alone Systems

<table>
<thead>
<tr>
<th>Type</th>
<th>Model</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard (Slow, &gt;100 ms without headstage)</td>
<td>MVCS-01-45 45 V</td>
<td>MVCS-01-150 150 V</td>
</tr>
<tr>
<td></td>
<td>MVCS-01C-45 45 V</td>
<td>MVCS-01C-150 150 V</td>
</tr>
<tr>
<td></td>
<td>MVCS-C-01-45 45 V</td>
<td>MVCS-C-01-150 150 V</td>
</tr>
<tr>
<td>Fast (&lt;1 ms, with cap.comp. and headstage)</td>
<td>MVCS-01U-45 45 V</td>
<td>MVCS-01U-150 150 V</td>
</tr>
<tr>
<td></td>
<td>MVCS-C-01U-45 45 V</td>
<td>MVCS-C-01U-150 150 V</td>
</tr>
<tr>
<td></td>
<td>MVCC-U-45 45 V</td>
<td>MVCC-U-150 150 V</td>
</tr>
<tr>
<td></td>
<td>MVCC-C-U-45 45 V</td>
<td>MVCC-C-U-150 150 V</td>
</tr>
<tr>
<td>Two channels (without balance)</td>
<td>MVCS-02-45 45 V</td>
<td>MVCS-02-150 150 V</td>
</tr>
<tr>
<td></td>
<td>MVCS-02C-45 45 V</td>
<td>MVCS-02C-150 150 V</td>
</tr>
<tr>
<td>Two channels (with balance)</td>
<td>MVCS-02M-45 45 V</td>
<td>MVCS-02M-150 150 V</td>
</tr>
<tr>
<td></td>
<td>MVCC-M-45 45 V</td>
<td>MVCC-M-150 150 V</td>
</tr>
</tbody>
</table>

#### Modules for EPMS-07 System

<table>
<thead>
<tr>
<th>Type</th>
<th>Model</th>
<th>Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard (Slow, &gt;100 ms without headstage)</td>
<td>MVCS-01M-45 45 V</td>
<td>MVCS-01M-150 150 V</td>
</tr>
<tr>
<td></td>
<td>MVCS-C-01M-45 45 V</td>
<td>MVCS-C-01M-150 150 V</td>
</tr>
<tr>
<td>Fast (&lt;1 ms, with cap.comp. and headstage)</td>
<td>MVCS-02M-45 45 V</td>
<td>MVCS-02M-150 150 V</td>
</tr>
<tr>
<td></td>
<td>MVCC-C-M-45 45 V</td>
<td>MVCC-C-M-150 150 V</td>
</tr>
</tbody>
</table>

Standard systems come with a set of cables to connect the electrode directly to the 8-pole connector at the front panel.

Fast systems come with a headstage with BNC connector, capacity compensation and an automated electrode resistance test.
Examples

**MVCS Series**

- **MVCS-C-02C**, two channels, fast, with balance channel (headstages not shown)

- **MVCS-02C**, two channels, slow, with balance channel

- **MVCS-C-02M**, iontophoresis module, fast, two channels for EPMS (headstages not shown)

- **MVCS-01M**, iontophoresis module, slow, one channel for EPMS

- **MVCC-M**, balance modules for EPMS
  - Fast
  - Slow

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**General:**

- npi electronic GmbH
  - Phone: +49-7141-9730230
  - Fax: +49-7141-9730240
  - sales@npielectronic.com
  - www.npielectronic.com

**North America:**

- ALA Scientific Instruments
  - Phone: +1-631-393-6401
  - Fax: +1-631-393-6407
  - sales@alascience.com
  - www.alascience.com

**Switzerland:**

- Science Products Trading AG
  - Phone: +41-43-4880561
  - Fax: +41-43-4880562
  - info@science-products.com
  - www.science-products.ch

**Great Britain:**

- Scientifica Limited
  - Phone: +44-1825-749933
  - Fax: +44-1825-749934
  - info@scientifica.uk.com
  - www.scientifica.uk.com