

Digitimer

IONTOPHORETIC DYE MARKER, MODEL D380



The D380 provides an isolated bipolar constant current output intended for the marking of individual neurons with dyes, such as Lucifer Yellow, via iontophoresis. Holding currents of up to $\pm 6\text{nA}$ and injection currents up to $\pm 12\text{nA}$ are provided and set by single turn panel mounted controls. These tactile controls permit use of the unit whilst using a microscope.

A compliance voltage in excess of $\pm 6\text{V}$ allows the full injection current into electrodes with impedances up to $500\text{M}\Omega$. A large LCD gives a continuous display of the five important injection parameters - requested (set) Injection current, "Inject"; requested Hold current, "Hold"; measured electrode resistance, "Resistance"; measured potential applied to the electrode, "Ve" and the requested electrode current, "Ie".

With this continuous information, the user can easily detect if an electrode is becoming blocked (by a rise in resistance) and simply press the "Deblock" button, reversing the injection current polarity, to unblock the electrode before it is beyond its useful life.

The "Ve" parameter gives the user an indication of how close to the voltage compliance limit they are working. Should the limit be exceeded the resistance reading is replaced by a "COMPLIANCE ERROR" message.

The unit is powered from a single, standard, 9 Volt battery.

Operation:

The Inject / Hold / Inject-Pulse switch will normally be in the "Hold" position when the unit is switched on with the On/Off toggle switch. This "POWER" switch has a shorter 'dolly' to prevent inadvertent 'blind' operation.

The "Hold" current value will be set from experience (or viewing the end of the micro-pipette/electrode) using the left hand control as well as the "POLARITY" switch. The set value is shown on the display.

The required "Inject" current will also be set, using the right hand control, whilst reading the Display.

Next, the electrode will be connected to the BNC "Current Output" socket using low leakage coaxial cable.

At this time, the electrode impedance can be read from the display as it will be measured using the "Hold" current.

When the user is ready to eject dye, the Inject / Hold / Inject-Pulse switch can be moved to either injection position. The "Inject" current plus the "Hold" current (which are of opposite polarities) is delivered. This means that the amount of dye moving is proportional to the "Inject" current. The toggle switch operation is momentary when pushed to the "Inject-Pulse" position and latched in the "Inject" position. Alternatively, the inject can be controlled via an external TTL input.

The momentary "Deblock" push switch reverses the polarity of the "Inject" current to try to deblock the electrode and is only operational when an Injection is in effect.

Example - If the Holding current is set at -3.2nA and Injection current at $+7.4\text{nA}$, the electrode current will be $+4.2\text{nA}$. If the "Deblock" switch is pressed, the "Inject" current will be reversed giving an electrode current of -10.6nA .

The LCD display shows the magnitude of the requested "Inject" and "Hold" currents, the electrode resistance and the voltage applied to the electrode. If the electrode resistance is so high that the full current can not be applied, a "COMPLIANCE ERROR" message is displayed. The LCD will also flash a "LOW BATTERY" warning to indicate when the battery is nearing the end of its useful life.

Technical Data:

Output Current:

- Holding range - $0 - \pm 6.3\text{nA}$ in 0.1nA (100pA) steps
- Injection range - $0 - \pm 12.7\text{nA}$ in 0.1nA (100pA) steps
- Compliance voltage range - $> \pm 6\text{Volts}$

LCD display:

- Inject - The Injection current requested, with 100pA resolution.
- Hold - The Holding current requested, with 100pA resolution.
- Resistance - The computed electrode resistance, with 10M resolution.
- Ve - The voltage applied to the electrode, with 100mV resolution.
- Ie - The requested electrode current, with 100pA resolution.
- Out of compliance - The "Resistance" display will be replaced by a "COMPLIANCE ERROR" message.

Gate In:

- Connection - A TTL 'high' ($> +3\text{V}$) places the unit in Inject mode for its duration.
- A standard BNC socket which is isolated from the output circuitry.

Electrode connection:

- Standard BNC socket - labelled "Output".

Power Requirements:

- 1 x PP3, IEC - 6R61 (9 Volt) battery. Alkaline type recommended.
- Typical Battery Life: - In excess of 100 hours (continuous operation).
- Size: - $120 \times 175 \times 40\text{ mm}$ (approx.) w x h x d
- Weight: - 400 g including battery.



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