

# OPERATING INSTRUCTIONS AND SYSTEM DESCRIPTION FOR THE

## ACI-01

# AUTOMATIC APPARATUS FOR CHLORINATING AG WIRES BY ELECTROLYSIS



VERSION 3.0  
npi 2014

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### 1. Safety Regulations

**VERY IMPORTANT:** Instruments and components supplied by npi electronic are **NOT** intended for clinical use or medical purposes (e.g. for diagnosis or treatment of humans) or for any other life-supporting system. npi electronic disclaims any warranties for such purpose. Equipment supplied by npi electronic must be operated only by selected, trained and adequately instructed personnel. For details please consult the **GENERAL TERMS OF DELIVERY AND CONDITIONS OF BUSINESS** of npi electronic, D-71732 Tamm, Germany.

1. Any contact with the chlorinating solution must be avoided. Always adhere to the appropriate safety measures for handling toxic or aggressive chemical solutions.
2. Always adhere to the appropriate safety measures for handling electronic mains powered devices. Always use a three-wire line cord and a mains power-plug with a protection contact connected to ground.

## 2. General System Description



Figure 1: view of the *ACI-01* apparatus

The *ACI-01* apparatus is a low-cost, fully automatic system for manufacturing chlorinated silver wires, which are widely used in electrophysiology (Ag-AgCl electrodes). The quality of recorded signals relies on a thorough preparation of the Ag-AgCl electrodes.

Non-polarizable reversible electrodes like Ag-AgCl electrodes are used because plain metal/liquid interfaces display junction potentials, and can produce gas (hydrogen and oxygen) if current is passed through them. Silver/silver chloride (Ag/AgCl) electrodes exchange electrons for Cl<sup>-</sup> ions in solution. They are usually provided in the form of silver wire coated with silver chloride or a sintered pellet.

The *ACI-01* apparatus provides all the necessary equipment and an electronic control unit to automatically chlorinate silver wires by electrolysis. The *ACI-01* system is housed in a small plastic enclosure where a glass solution dish can be placed. The recommended solution is 1 to 2 molar KCl.

The currents needed for cleaning and chlorinating the Ag wire are controlled electronically (see Figure 2). The eight minutes chlorinating procedure is electronically timed. Chlorinating of silver wires is sufficient for typical electrophysiological recordings, equivalent to several mAh of Ag-AgCl coating. In general, the coating is thicker than conventional chlorinating with chlorinating agents. It is thinner than dipping in hot, liquid AgCl, but the coating is more uniform. Typically silver wires of 0.15 mm to 0.25 mm diameter are used, and these will be coated efficiently.

The *ACI-01* is fully automated. Once the START button is pressed, the ON LED lights and all functions are performed under electronic control. After the chlorinating procedure the system turns off automatically.

### 3. Operation

#### 3.1. External Power Supply

The ACI-01 is powered from an external DC power supply (12 Volt, stabilized, 100 mA). The power supply is connected via a standard connector. The inner (front) pin is connected to plus. The ACI-01 system is protected internally against reverse polarity. First connect ACI-01 system to the power adapter and then power the adapter to mains.

**Caution:** Always adhere to the appropriate safety measures for handling electronic mains powered devices.

#### 3.2. Solution

The 1 to 2 molar KCl solution is held in a small glass dish covered by a plastic lid with a hole for the silver wire which will be chlorinated.

**Caution:** Any contact with the solution must be avoided. Always adhere to the appropriate safety measures for handling toxic or corrosive chemical solutions.

#### 3.3. Operation

First, the silver wire must be cleaned carefully (e.g. with emery paper and alcohol to remove grease or by soaking the wire in conc. ammonium hydroxide. Nitric acid may be used to roughen the silver surface). This is important because a badly cleaned silver wire will result in a non-uniform deposit of chloride.

Then, insert a large silver wire or plate into the solution and connect it to the alligator clip located near the glass dish. This is the „reference“ (= neutral) electrode for the electrolysis circuit. The „active“ electrode (i.e. the silver wire to be chlorinated) is connected to the black connector on top of the gray box by means of a blue wire with an alligator clip. The silver wire is inserted through the hole on top of the protecting lid which covers the solution dish.

**Important:** During operation the solution dish must be covered with the plastic protection lid to avoid accidents.

After immersing the silver wire in the solution, the chlorinating process is started by pressing the switch located on the left side of the box downwards. A red LED indicates that the chlorinating process has been started. At the end of the chlorinating procedure the LED turns off.

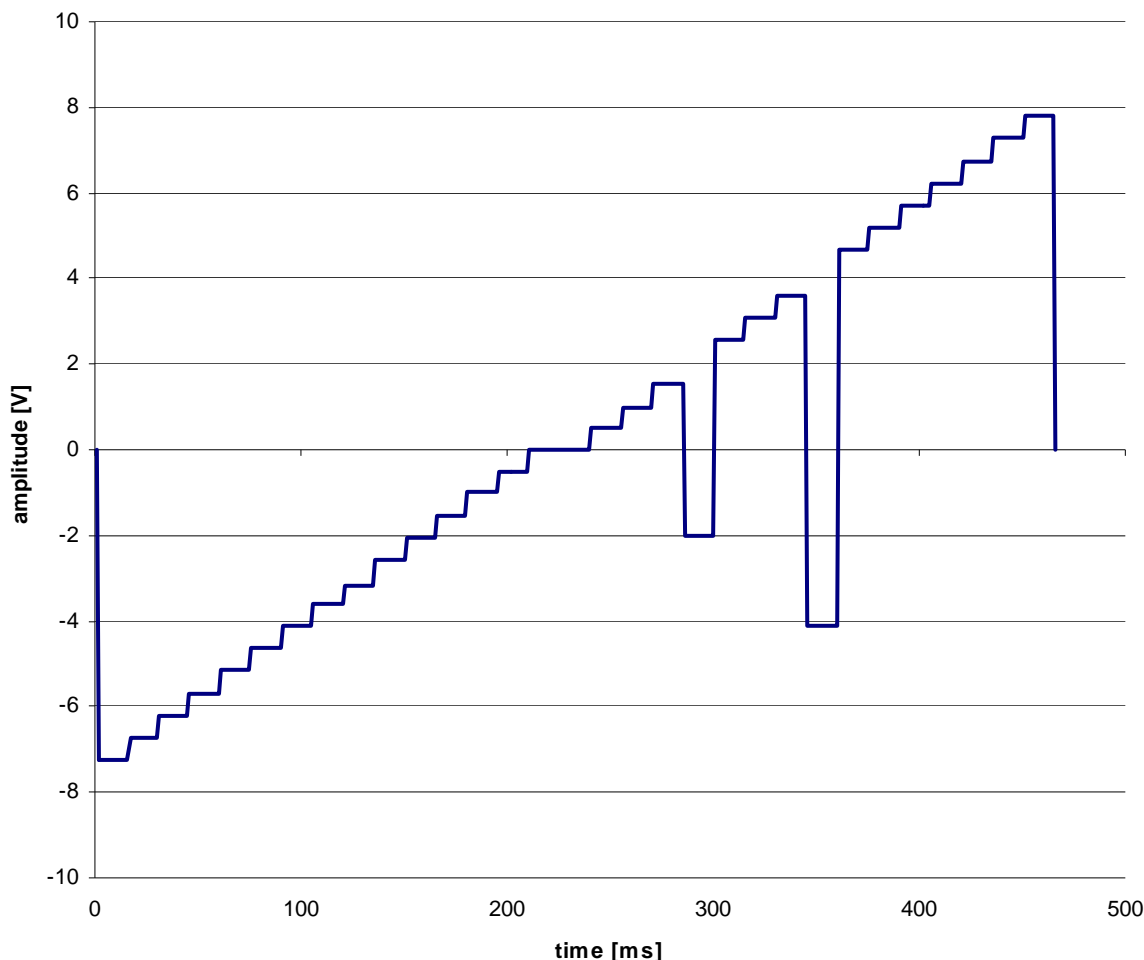


Figure 2: working scheme of the ACI-01

The chlorinating procedure that has been developed at the MPI in Göttingen, Germany, lasts several minutes. The voltage course at the silver wire is shown in Figure 2. The system is shut down automatically by the internal electronics (LED off).

#### 4. Enemies of the Ag/AgCl electrode

**Light:** UV light decomposes AgCl to give silver(0) which gives the electrode a black appearance. Normal lab fluorescent lights are OK, but don't store your electrodes on the window sill!

**Base:** Ag<sub>2</sub>O or AgOH will form if the [OH<sup>-</sup>] is on the order of 0.1 M and the electrode potential will be a mixed Ag/AgCl/Ag<sub>2</sub>O potential and will depend on the pH. Ag<sub>2</sub>O will also form in the pores of the frit used.

**NH<sub>3</sub> Buffers:** NH<sub>3</sub> will complex silver and will dissolve AgCl.

**Sulfide:** Silver sulfide is quite insoluble.

## 5. Literature

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