

made to measure

OPERATING INSTRUCTIONS AND SYSTEM DESCRIPTION FOR THE

ELP-01D

ELECTROPORATOR FOR TISSUE AND CULTURED CELLS



VERSION 1.1
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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) **GENERAL:** This system is designed for use in scientific laboratories and must be operated by trained staff only. General safety regulations for operating electrical devices should be followed.
- 2) **AC MAINS CONNECTION:** While working with the npi systems, always adhere to the appropriate safety measures for handling electronic devices. Before using any device please read manuals and instructions carefully.
The device is to be operated only at 115/230 Volt 60/50 Hz AC. Please check for appropriate line voltage before connecting any system to mains.
Always use a three-wire line cord and a mains power-plug with a protection contact connected to ground (protective earth).
Before opening the cabinet, unplug the instrument.
Unplug the instrument when replacing the fuse or changing line voltage. Replace fuse only with an appropriate specified type.
- 3) **STATIC ELECTRICITY:** Electronic equipment is sensitive to static discharges. Some devices such as sensor inputs are equipped with very sensitive FET amplifiers, which can be damaged by electrostatic charge and must therefore be handled with care. Electrostatic discharge can be avoided by touching a grounded metal surface when changing or adjusting sensors. **Always turn power off when adding or removing modules, connecting or disconnecting sensors, headstages or other components from the instrument or 19" cabinet.**
- 4) **TEMPERATURE DRIFT / WARM-UP TIME:** All analog electronic systems are sensitive to temperature changes. Therefore, all electronic instruments containing analog circuits should be used only in a warmed-up condition (i.e. after internal temperature has reached steady-state values). In most cases a warm-up period of 20-30 minutes is sufficient.
- 5) **HANDLING:** Please protect the device from moisture, heat, radiation and corrosive chemicals.

2. Special Safety Notice for High Voltage Instruments



**HIGH VOLTAGE!!
RISK OF ELECTROCUTION!!**

Observe extreme caution when working with this instrument!!!

- 1) Always connect high voltage power supplies to protective earth!!
- 2) Do not touch connections unless the instrument is turned off and the capacitance of both the load and power supply are earthed!!
- 3) Allow adequate time for discharge of internal capacitance of the power supply!!
- 4) Do not ground yourself or work under wet or damp conditions!!
- 5) Servicing should be only done by qualified personnel aware of the hazards!!
- 6) If in doubt, return to supplier for servicing!!

3. ELP-01D

3.1. System Description

The ELP-01D was designed as an easy-to-use device for electroporating tissue and cultured cells using square wave voltage pulses of up to 110 V.

The ELP-01D has two digital switches for setting PULSE duration and DELAY time. The ELP-01D can be used continuously, or for a selectable number of cycles. A switch allows manual start (and stop while cycling), but the timing unit can also be operated using an external TRIGGER. ELP-01D can also be used independently from the internal timing unit using a TTL INPUT for gating the PULSE.

The AMPLITUDE is set by a digital switch in 1 V steps. An electrode resistance test unit allows to measure the electrode resistance up to 10 k Ω .

3.2. Description of the Front Panel

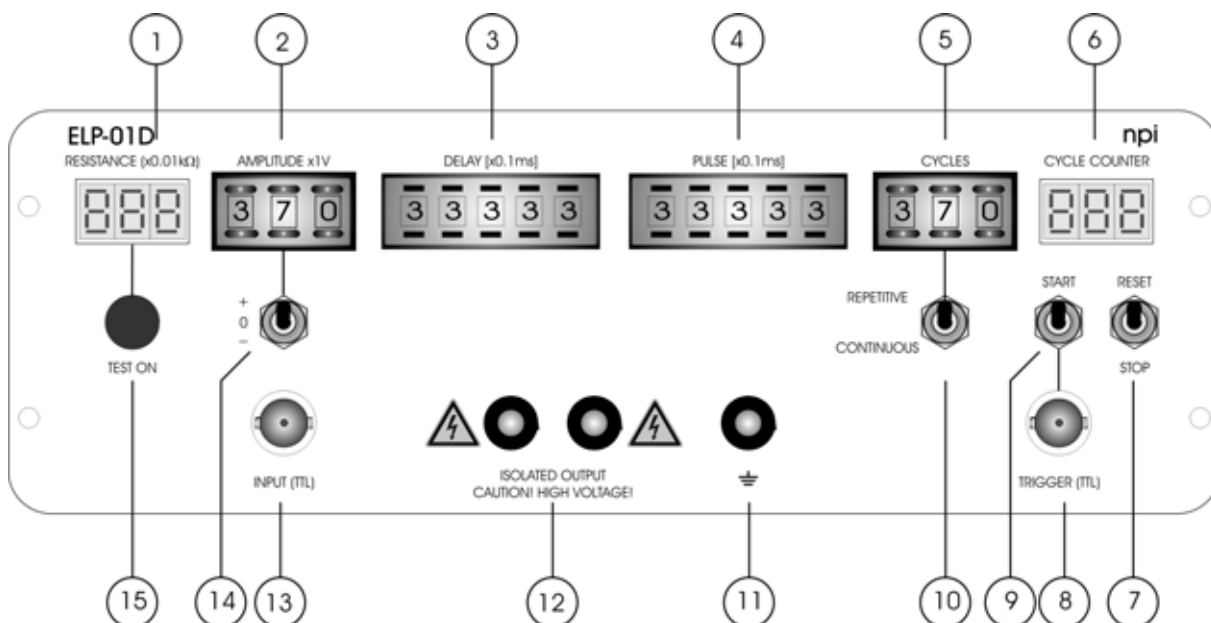


Figure 1: ELP-01D front panel view

(1) RESISTANCE (x0.01 k Ω) display

LED indicating the resistance of the electrode when operating the electrodes resistance test using button #15.

(2) AMPLITUDE x1V switch

3-digit thumb wheel switch to set the AMPLITUDE of the electroporation pulse; (range: 0-110 V, resolution: 1 V). The polarity is set by switch #14.

(3) DELAY (x0.1 ms) switch

5-digit thumb wheel switch to set a delay time; minimum delay time 100 μ s, maximum delay time 9999.9 ms. The delay time is the time from the rising edge of the trigger TTL signal to the beginning of the rising edge of the PULSE (see also Figure 2).

Important: A DELAY of 0 is not allowed, and leads to an undefined state of the electroporator!!

(4) PULSE (x0.1 ms) switch

5-digit thumb wheel switch to set the duration (width) of the PULSE; minimum pulse width 100 μ s, maximum pulse width 9999.9 ms.

(5) CYCLES switch

3-digit thumb wheel switch for setting the number of desired cycles (1 to 999).

Note: At the start of each train of cycles a RESET is executed, i.e. the ELP will be reset immediately after a start signal comes, either via manual switch or via TTL signal. For instance, if you preset 10 cycles and you press start or a TTL pulse is applied, the timer is reset to zero, 10 cycles will be executed and the ELP stops still showing "10" at the display. Upon the next start signal (via switch or TTL) the timer is reset again and 10 cycles will be executed.

Important: RESET has to be pressed after setting a new number of cycles

(6) CYCLE COUNTER display

LED indicating the number of cycles which had been carried out since the first start. In CONTINUOUS mode the LED counts continuously.

(7) RESET / STOP switch

Switch for stopping the timer.

RESET: the timer is stopped and the CYCLE COUNTER is set to zero.

STOP: the timer is stopped and the CYCLE COUNTER shows the number of cycles which had been carried out. If started again with switch #9 the CYCLE COUNTER continues to count.

Note: At the start of each train of cycles a RESET is executed, i.e. the ELP will be reset immediately after a start signal comes, either via manual switch or via TTL signal. For instance, if you preset 10 cycles and you press start or a TTL pulse is applied, the timer is reset to zero, 10 cycles will be executed and the ELP stops still showing "10" at the display. Upon the next start signal (via switch or TTL) the timer is reset again and 10 cycles will be executed.

(8) TRIGGER IN (TTL) connector

BNC connector for connecting an external TRIGGER device, minimum length of the TTL signal: 10 μ s.

(9) START switch

Switch for starting the timer (momentary switch to upper position). If the switch is in lower position (permanent) the timer can be started using an external TTL TRIGGER at #8.

(10) REPETITIVE / CONTINUOUS switch

Switch for setting the operation mode of the ELP-01D.

REPETITIVE: The timer cycles repetitively pulses: The number cycles is of set by CYCLES switch #5.

CONTINUOUS: The timer cycles pulses continuously as long as the RESET / STOP switch is used.

(11) Chassis connector

Connector for grounding the cabinet.

(12) ISOLATED OUTPUT plugs

The ISOLATED OUTPUT signal is available at two plugs (red and blue). The polarity of the +,0,- switch (#14) is not changed, i.e. the red plug is positive (+) if the output polarity switch is set to + or the analog input signal is positive. This signal is completely isolated from earth.

Caution: These plugs can provide HIGH VOLTAGE !!!

(13) INPUT (TTL) connector

BNC connector for an external gating signal. If the internal timing unit should not be used, a TTL signal from an external gating unit can be connected to #13 for generating a PULSE with an AMPLITUDE set by #2. The PULSE width is determined by the length of the TTL signal.

(14) +/- switch

Switch to set the polarity of the PULSE for electroporation. In 0 position, the OUTPUT is disabled.

(15) TEST ON button

Push button for the electrode resistance test. The resistance of the electrode is shown at #1 as long as the button is pressed.

4. Operation

The ELP-01D can be operated either by a gate applied to BNC connector #13 (see above) or by using the internal timing unit.

When using the timing unit the ELP-01D can be started either manually by pushing START (#9, Figure 1) or by a TTL HI signal (rising edge) at TRIGGER (TTL) (#8, Figure 1). This signal must be at least 10 μ s.

The time course of the timed ISOLATED OUTPUT is illustrated in Figure 2.

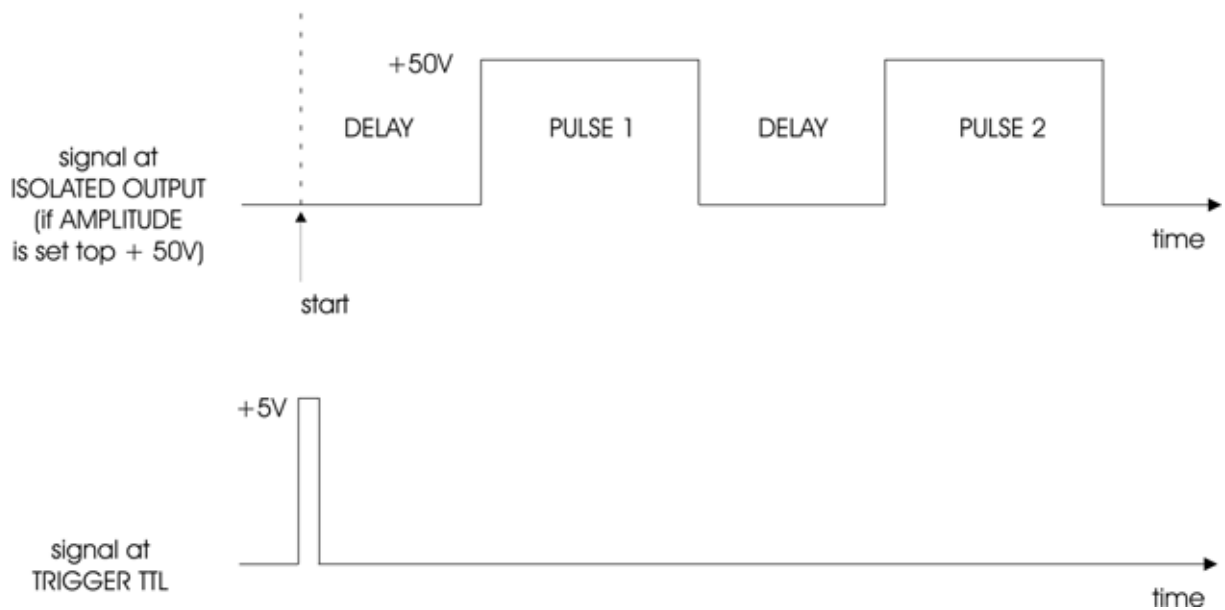


Figure 2: scheme of timed operation

After the DELAY, the PULSE starts immediately. After the end of the PULSE the second cycle begins with the DELAY and so on, i.e. the time-lag between the pulses is determined by the DELAY (x 0.1 ms) switch (#3, Figure 1).

For additional control a BNC connector labeled CURRENT OUTPUT 0.1V/mA is provided at the rear panel. This BNC connector monitors the current that flows during a PULSE. The OUTPUT is not isolated.

5. Literature with Focus on Methods

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- ❑ Murphy RC, Messer A. Gene transfer methods for CNS organotypic cultures: a comparison of three nonviral methods. *Mol Ther*. 2001 Jan;3(1):113-21.
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6. Technical Data

ELP-01D

PULSE (x 0.1 ms) switch:	5 digits thumb wheel, 0.1 ms to 9999.9 ms, digital
DELAY (x 0.1 ms) switch:	5 digits thumb wheel, 0.1 ms to 9999.9 ms, digital
PULSE AMPLITUDE (x1V) switch:	3 digits thumb wheel, 0 V to 110 V, digital
TRIGGER IN:	TTL signal, 10 μ s minimum
ISOLATED OUTPUT:	\pm 110 V max., isolated, set in 1 V steps
CURRENT OUTPUT	BNC connector, 0.1 V / mA
Power Supply:	external, 13.8 V, DC