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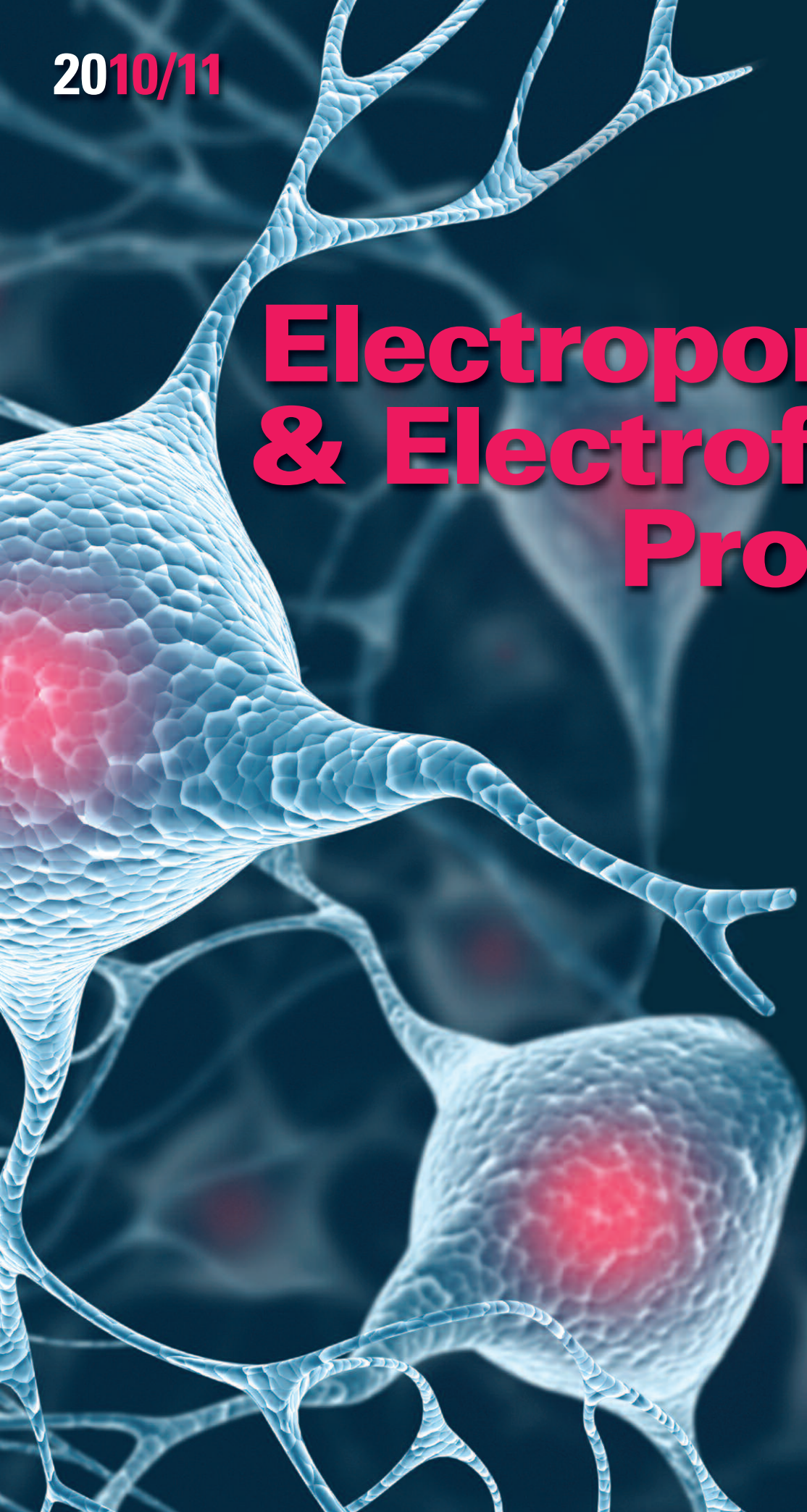
Electroporation & Electrofusion Products



Bacteria & Yeast

Plants & Insects

Mammalian Cell Transfections

In Vitro, In Utero, In Ovo

Electrofusion

Microinjection

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The Electroporation Experts

The Complete Electroporation & Electrofusion Catalog

BTX has been at the forefront of electroporation technology since we introduced the first commercially available electroporator in 1983. For the past 26 years we have made it our priority to focus only on Electroporation and Electrofusion. This focus allowed us to develop the experience and expertise to supply you, the researchers, with the broadest selection of innovative in vivo or in vitro tools. These tools allow you to advance your research.

BTX offers a diverse number of possible solutions, putting you in control. From the introduction of our specialty line of electrodes for in vivo work, to our contribution to the high throughput market and now the addition of BTXpress™ High Performance Electroporation Solution, we strive to broaden the line of available products for electroporation.

The BTX Advantage...

BTX offers exceptional applications support and service before, during and after your purchase to assure your success. Our library of protocols and publications, along with the expertise of our technical staff, will make solving your application easier. Our thousands of users have published papers on: mammals, bacteria, fruit flies, nematodes, chickens, frogs, muscles, liver, brains, embryos, muscles in vivo and in vitro.

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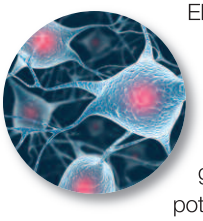
- The BTX Team

Technology

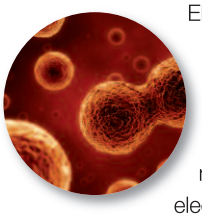
Electroporation



Electroporation is the application of controlled electrical pulses to living cells in order to permeabilize the cell membrane for the purposes of transfection or transformation. These pulses are delivered to a pair of electrodes by a pulse generator. The pulse induces a transmembrane potential which causes the reversible breakdown of the cellular membrane. This action results in the formation of pores that allow molecules, such as DNA, proteins or antibodies, to enter the cell. The process involves two variables, field strength and pulse length. These variables are manipulated in order to maximize the efficiency of gene transfer. A third variable, pulse shape, is dependent upon the type of pulse generator used. In this catalog, we have included an optimization guide to help you achieve the best results.

Due to it's ease of use, reproducibility, high efficiency and low toxicity, electroporation has become the method of choice for introducing many types of molecules into cells such as mammalian, bacterial, yeast, plant and insect.

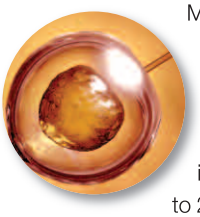
Electrofusion



Electrofusion is characterized by the presence of two membranes, in close contact, that can be joined by the application of a pulsed electrical field. The electrofusion procedures are very similar to those of electroporation. When neighboring cells are brought into contact during electroporation, these cells can be induced to fuse. The key to electrofusion is that the cells must be brought into contact first. This is accomplished by the application of an AC pulse which causes dielectrophoresis resulting in a pearl-chain (dimer) formation. The DC square pulse is then applied resulting in the integration of cell membranes. This is followed by another application of an AC pulse which causes cell compression to stabilize the cell hybrid. This method is especially useful for hybridoma work.

Researchers can also use chemical or manual methods of aligning the cells prior to electrofusion. Though these alternative methods can be time consuming and potentially toxic, they are useful for nuclear transfer and other fusion application.

Microinjection



Microinjection is a well established technique used routinely in animal cells and embryos to insert genetic material such as DNA or RNA directly into a cells cytoplasm or in to the nucleus. Injection of the genetic material is inserted via a needle varying in size from 0.5uM to 20uM in diameter that penetrates the cell membrane and/or the nuclear envelope to deliver the desired amount of molecule. Microinjection is performed, observed and controlled under a microscope.

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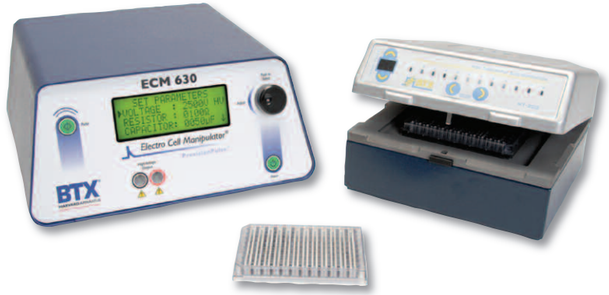

ECM® 630 High Throughput
HT Multi-Well Electroporation System
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NEW! MicroJect 1000 Max System
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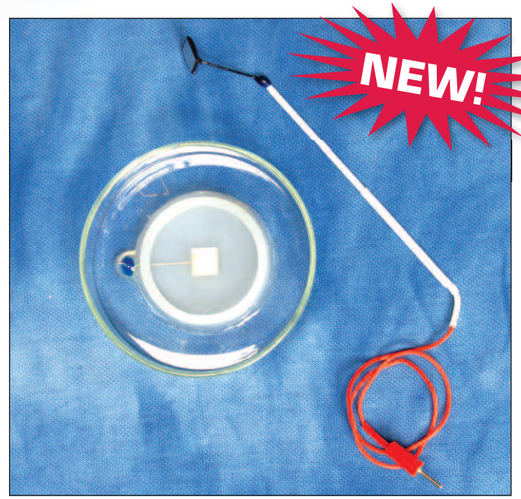

NEW! Petri Dish Platinum Electrode for Tissue Slices
See page 42 for details.

Bacteria & Yeast

Electroporation has long been recognized as one of the most efficient methods of transforming human genes into prokaryotic cell lines. Researchers use this technique to express recombinant proteins to study gene function and for the therapeutic treatment of human diseases. Typically, the most commonly transformed cell lines are bacteria and yeast, such as *Escheria coli, Agrobacterium Tumerfaciens, Pichia Pastoris* and Saccharomyces *Cerevisiae.* Electroporation of these gram-negative bacterial strains can achieve transformation success rates in the range of $1X10^{10}$ transformants/ug DNA. Gram-positive bacteria such as *Streptococcus pneumoniae* and *Lactobacillus* strains present more of a challenge in achieving transformation success due to their cell wall composition. Electroporation as a technique is able to achieve exceptional results in gram-positive strains in the range of $1X10^{7}$ transfromants/ug DNA.

Other more difficult or less utilized prokaryotic cell lines have also achieved significant positive transformation results with this method. These cell lines include anaerobic bacteria such as *Desulfovibro vulgaris*, *Dictyosteliida*, a celluar slime mold, proprietary modified bacteria lines produced for Biofuels, Mycoplasma, Bacillus genera and parasites such as *Leishmania*.

Electrical transformation has proven to be highly efficient and easily performed in single cuvettes or multi-well electroporation plates (25 or 96 well options) for greater sample quantities.

High Field Strength

High field strengths (voltage applied between electrode gap measured as kV/cm) are critical to achieve high efficiency transformations in prokaryotic cell lines. The ECM 399 and ECM 630 can attain the optimal voltage ranges up to 2500V to provide field strengths of 12-25kV/cm which are essential for prokaryotic applications.

Optimized Time Constants

The time constant or pulse duration is a crucial factor in achieving high efficiency transformations. In an exponential decay wave pulse generators such as the ECM 399 and the ECM 630 the time constant is determined by the values of the resistance and capacitance (RC) settings in the generator. The ECM 399 has fixed RC values which are pre-optimized to provide the standard time constant range of 5-6 msec for efficient transformation of gram-negative bacteria and yeast. The ECM 630 has adjustable RC settings to span the range of time constants needed for gram-positive bacteria, requiring a range from 5 - 10 msec time constants. Other prokaryotic cell lines need the advantage of adjust able RC values due to the need of even higher ranges of time constants to achieve efficient transformation.

Economical Solution

The ECM 399 provides the voltage range needed to achieve the field strengths of 12-25 kV/cm essential for efficient transformation. The fixed internal resistance and capacitance settings which deliver the pre-optimized time constants of 5-6msec in high voltage (HV) is ideal for the transformation of gram-negative bacteria. This system offers the best low cost solution for simple transformation needs.

Prokaryotes and Eukaryotes Solution

Labs working with a variety of bacterial and yeast strains often need to transfect mammalian cells as well. This requires more flexibility and control over the electrical parameters such as the voltage range and time constant for successful transfection. The ECM 630 has been found to be efficient and the best instrument for select mammalian cell lines such as mouse stem cells.

High Throughput (HT)

Not only is the ECM 630 a powerful stand-alone system for transformation and transfection applications but is capable of supporting a High throughput (HT) plate handler. The HT plate handler is an accessory which easily connects to the ECM 630, the delivery of the powerful exponential wave pulse to electroporating 25 or 96 well electroporation plates in seconds. The HT multi well system is an effective and affordable tool for optimizing electrical or biological parameters quickly and simply.

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applications

equipment

The ECM 399 is an exponential decay wave electroporation generator which allows simple transformation of Gram-negative bacteria and yeast.

ECM® 399
Exponential Decay Wave Electroporation System

See page 20 for details.

ECM® 630
Exponential Decay Wave Electroporation System

See page 21 for details.

The ECM 630 is an exponential decay wave electroporation generator which allows the researcher full flexibility in choosing a wide range of voltages and time constants for bacteria, yeast, insect, plant and mammalian cells.

results

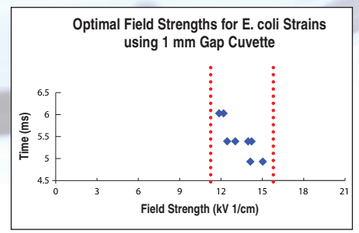
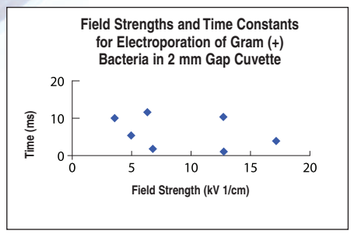


Figure 1: *Field strength and time constants for gram (-) bacteria in 1mm gap cuvettes using the ECM 630 and 399 models. Field strengths and time constants remain grouped around discrete values making the ECM 399 and 630 ideal for the lab that is performing simple transformations. The ECM 630 would be a good choice for labs that are currently doing simple transformations now, but plan on working with other cell lines in the future, while the ECM 399 would be ideal for the lab that is only interested in simple transformations of bacteria and yeast where the pulse duration is no longer than 5-6 ms.*



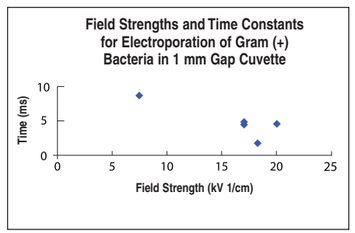


Figure 2 and 3: *Shows Field Strength and pulse duration values for gram positive bacteria in 1 mm and 2 mm cuvettes. Unlike the gram (-) bacteria the field strengths and time constants are more variable with gram (+). The ECM 630 is flexible and settings can be adjusted for optimizing multiple cell lines.*

Plants & Insects

plants & insects

For many years, Agriculture and Horticulture labs have used electroporation to transform plants in order to generate transgenic crops (GMO). Electroporation offers a an alternative method for the delivery of genes directly into plant cells, plant tissues and plant protoplasts. Electrofusion allows for the fusion of plant protoplasts for transgenic modified plant applications.

Transformation of plants can be successfully accomplished without prior removal of the cell wall, allowing for greater genetic manipulation potential of the plant cells. Whether performing a stable transformation to generate crops with better traits, enhance productivity or developing transient transformations for gene expression, electroporation has obtained high efficiencies and cell viabilities. BTX offers protocols for successful transformations of many plant cell lines such as rice, sweet potatoes, wheat, barley, tobacco leaf, cotton and root protoplasts using the ECM 630, ECM 830 and ECM 2001.

There are few techniques available that are powerful enough to transfect insect cells and tissues. Electroporation is one of those methods. It has been widely used for successfully transecting insect cells, such as Drosophila, Bombyx mori embryos and larval tissues. Using electroporation on insect cells has proven extremely useful for invertebrate genetic manipulation and genome function analysis.

Plants

Electroporation offers an alternative method for the delivery of genes directly into plant cells with out prior removal of the cell walls allowing for greater genetic manipulation potential of plant cells. The stable or transient integration of genes into plant protoplast cells is efficiently performed with high cell viability using the ECM 830 square wave system. It has been reported that wheat, barley leaf, and root protoplasts have been successfully transformed and electroporation parameters optimized using the BTX line of generators. The BTX ECM 630 exponential decay wave system provides a wide scope of voltage settings (10-2500V) resulting in field strengths up to 25kV/cm and an array of possible time constants (pulse durations) critical for highly efficient electro-transformations. The ECM 630 system enables transformation of Agrobacterium for gene transfer with efficiencies of $1x10^8$ transformants/ug DNA.

Field Strengths and Time Constants

The ECM 630 exponential decay wave pulse generator has the voltage range needed to reach the high field strengths (kV/cm) these cells require. The adjustable resistance and capacitance combinations create a wide range of time constant options to ensure efficient transformations of difficult cell types including plant tissues and Agrobacterium cells producing efficiencies of 1×10^8 pfu/ugs.

Powerful Exponential Decay Wave Pulse

The diverse combination of settings joined with the power of the exponential decay wave pulse generator provides the permeation of cell membrane for efficient transformation of Drosophila, SF9 cells, and many other insect cells.

Square Wave Gentle Strength

Transformation of plant protoplasts, insect embryos and various tissues including delicate brain tissues require the gentle strength of the square wave pulse generator, the ECM 830. The square wave pulse generator provides the voltage ranges and multiple pulsing capabilities needed for efficient membrane permeation with out sacrificing cell viability critical to these applications.

Protoplast Fusion

Plant protoplast fusion is used to generate genetically modified hybrids to improve traits or enhance production. The use of electrofusion allows for fusion of plant protoplast and the transfer of genes more effectively compared to standard cDNA transformations. The ECM 2001 system is a multi-purpose system for both electrofusion and electroporation. It employs both AC and DC wave forms to align cells for better membrane contact, fuses cells together and with post AC alignment continues to maintain compression of cells during the rounding off period. The span of voltages, pulse lengths and multiple pulsing up to 9 pulses, allow this system to function solely as an electroporator for plant protoplast and mammalian cell transfections.

Insects

Electroporation has been widely used for successfully transfecting insect cells and tissues. Jean-Luc Thomas et al. 2003, found that working with a BTX ECM 830 square wave generator to transfect Bombyx mori embryos and larval tissue was efficient, simple and reliable. The BTX generators can be used with our specialty electrodes for tissue specific transfection in insects or BTX microslides can be utilized for the transformation of large numbers of insect eggs.

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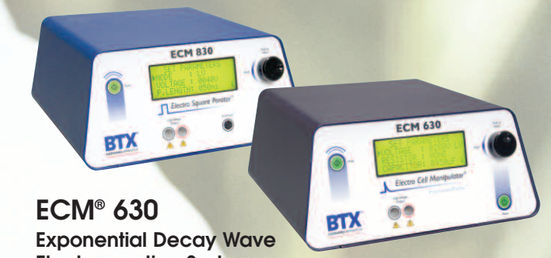
applications

equipment



ECM® 630

Exponential Decay Wave Electroporation System

See page 21 for details.

The ECM 630 is an exponential decay wave electroporation generator which allows the researcher full flexibility in choosing a wide range of voltages and time constants.

ECM® 830

Square Wave Electroporation System

See page 22 for details.

The ECM 830 is a highly flexible square wave electroporation generator that may be used for in vitro and in vivo transfections and plant transformations.

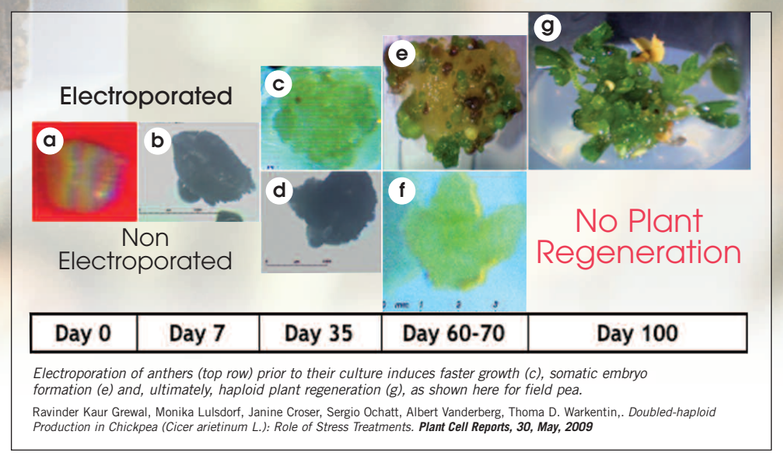
ECM® 2001

Square Wave Electrofusion Electroporation System

See page 23 for details.

The ECM 2001 is a multifunctional square wave electro cell fusion and electroporation generator capable of AC/DC wave pulses. The CE/ETL marked ECM 2001 is used for a variety of applications from embryo manipulation to Hybridoma production to plant tissue transformation.

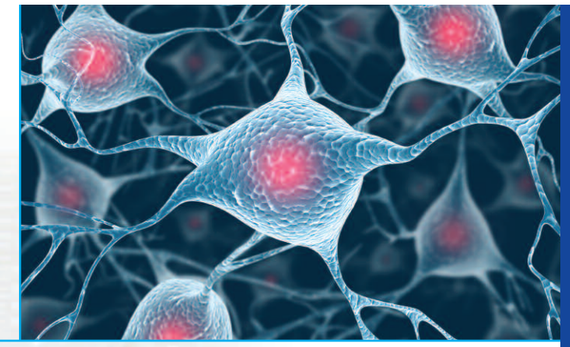
results



Electroporation of anthers (top row) prior to their culture induces faster growth (c), somatic embryo formation (e) and, ultimately, haploid plant regeneration (g), as shown here for field pea.

Ravinder Kaur Grewal, Monika Lulsdorf, Janine Croser, Sergio Ochatt, Albert Vanderberg, Thoma D. Warkentin,. *Doubled-haploid Production in Chickpea (Cicer arietinum L.): Role of Stress Treatments.* ***Plant Cell Reports, 30, May, 2009***

Mammalian Cell Tra nsfections



mammalian cells

Electroporation is an efficient non-viral method used to transfect genes and other molecules into mammalian cell lines. This technology is commonly used to study gene targeting, function and to understand protein regulation. Electroporation is a standard method used to transfect mammalian cell lines to express recombinant human proteins which are used for therapeutic purposes. Gene delivery by this method is typically used to create a transient transfection in order to study protein expression or to temporarily knockout or "silence" these genes using siRNA; which is used to study gene targeting and function. Alternatively the stable transfection integrates the gene into the genome of the cell for long term expression of a human protein. The use of the BTX square wave pulse generator ECM 830 offers the control needed to adjust electrical settings for optimization of parameters. This system is powerful enough to yield high transfection efficiencies for cell lines and difficult to transfect cell types including stem cells and primary cells. The gentle square wave pulse allows for high cell viability of these cell types.

Mammalian Cell Transfections – "The Advantage"

The advantage of the square wave lies in its superior ability to introduce genes, proteins and other molecules into mammalian cells efficiently. Mammalian cells respond exceptionally better to the gentle strength of the square wave pulse to allow for both high transfection efficiencies while maintaining cell viability. With the ECM 830, users have control over their parameters, including voltage, pulse length, number of pulses and pulse intervals for more accurate optimization of conditions. BTX developed a system that provides the versatility a researcher needs to transfect single samples in cuvettes or scale up to 96 wells quickly and simply with the addition of a High Throughput plate handler for 96 and 25 well electroporation. Other transfection applications include in vivo, in utero, ex vivo tissues and in ovo transfections using our array of specialty electrodes from BTX.

Wide Voltage and Pulse Length Range

With the ability to achieve a wide range of field strengths with voltage settings up to 3000 V and pulse lengths as low as 10 µs, the researcher can set parameters to allow for molecules of various sizes to be delivered into the cells efficiently while maintaining high cell viability.

Multiple Pulsing

Many cell types can be difficult to transfect due to the delicate nature of the cell line. Multiple pulsing and the ability to set intervals between pulses allow cells the opportunity to recover between pulses resulting in higher cell viability and efficient transfections.

High Throughput (HT)

The ECM 830 can be coupled with our specially designed HT plate handler, which can transfect up to 96 or 25 well samples quickly and efficiently. This greatly reduces the time to optimize experiments and process large number of samples.

Gene Silencing

The use of siRNA to analyze gene function is fundamental for research. The ECM 830 has been used successfully for this application with inhibition and cell viabilities of up to 90%. It has been reported recently that single cell expression of miRNA in a mouse brain was successfully achieved with the ECM 830.

NEW! BTXpress™ High Performance Electroporation Solution

The BTXpress™ is the NEW solution in High Performance Electroporation buffers. A single buffer developed to quickly and efficiently deliver genes into mammalian cells that were previously recalcitrant to chemical and non-viral methods. BTXpress™ supports high efficiency transfection in numerous cell types while maintaining critical cell viability. This high performance electroporation buffer is equally effective at delivering DNA as well as siRNA into mammalian cells. This buffer is not restricted to use in just BTX electroporation systems. As a universal solution, the BTXpress™ electroporation buffer can be used in other systems including the Amaxa™ Nucleofector™, achieving similar results. The BTXpress™ High Performance Electroporation Solution is offered as a kit including the BTX plus cuvettes with transfer pipette or as a buffer alone.

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Please note: *Amaxa™ Nucleofector™ are a registered trademarks.*

equipment

ECM® 830

Square Wave Electroporation System

See page 22 for details.

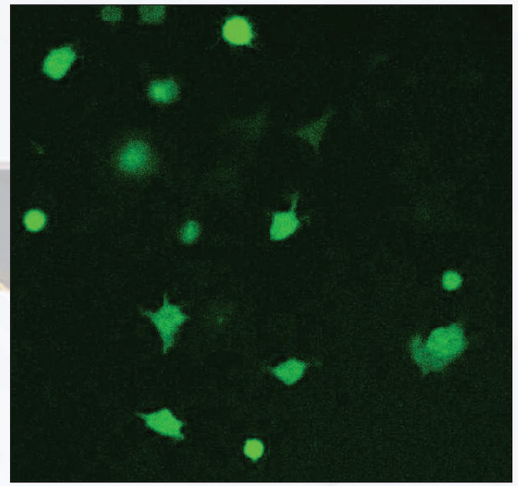
The ECM 830 is a highly flexible square wave electroporation generator that may be used for in vitro and in vivo transfections.

NEW! BTXpress™

High Performance Electroporation Solution

See page 30-31 for details.

results



PC12 cells were transfected with hGFP using the ECM 830 system. GFP expression was observed 48hrs. post transfection. ***Anne Chiaramello, Ph.D Associate Professor, George Washington University Medical Center***

In Vivo, In Utero & In Ovo Applications

The delivery of genes and drugs directly into living tissues has significant implications in gene therapy applications, cancer treatments, vaccine development and transgenic animal production. Tissues and whole embryos can be transfected with the use of specialty electrodes for the following methods; in vivo, in ovo, in utero and ex vivo tissues. Electroporation mediated gene and drug delivery has been shown to substantially increase intracellular uptake and expression of DNA, siRNA and miRNA in a variety of tissue such as muscle, skin, liver, retina, testis and kidney.

The use of our square wave technology provides the gentle power needed to efficiently deliver the genes and molecules to the various tissues while still maintaining the viability critical for the survival of tissue. Other more delicate in vivo tissues that are successfully electroporated include in utero embryos, brain tissue in both embryo and adult animal and marine species such as zebra fish.

In Vivo

BTX offers researchers a wide selection of specialty electrodes to deliver molecules such as DNA, siRNA, miRNA and various drugs into tissues of living animals. This technique is a valuable tool which assists in the evaluation of a gene function and cell development. Depending on the research application, BTX offers both invasive and non-invasive electrodes. BTX provides the tools for efficient, easy and reproducible transfections into specific tissues, embryos and ex vivo samples.

In Utero

Tweezertrodes™ and Genepaddles™ are ideally shaped to electroporate into rat or mouse embryos allowing the user to study the postulated roles that genes play during embryonic development.

In Ovo

The use of electrodes such as the L-shaped Genetrodes™ have been established as an effective method for introducing molecules such as DNA, siRNA and miRNA into embryos for the study of development, gene function and protein expression.

Oocytes

Studies of gene function through gene silencing is a powerful technique that is not limited to cultured cells. BTX has an entire line of electrodes that make siRNA delivery possible into intact blastocysts. Soares et al. 2005 used BTX ECM 2001 generator and flat electrodes to introduce RNA to study the signaling pathways in the developing mouse embryo.

Zebra Fish

Zebrafish have shown to be a very useful model for studying vertebrate development given the transparency of the fingerlings during early stages of development. Rambabu et al. 2005 used a BTX ECM 830 and Tweezertrodes™ in conjunction with microinjection of naked DNA to study the effect of electroporation as a method for gene delivery into adult zebrafish.

Mouse Embryonic Brain

With the help of BTX electroporation generators Tonelli et al. 2007 were able to transfect a dual-fluorescence reporter/sensor plasmid into the mouse embryonic brain. They developed a technique to detect expression at the single cell level making it possible to monitor miRNA appearance and disappearance in defined cell lineages during vertebrate development.

Transgenic Animal Development

Development of transgenic animals using standard methods is highly time consuming and is costly. With the help of BTX square wave electroporation Majumdar et al. 2008 was able to in vivo transfection to deliver genes directly into undifferentiated germ cells in mouse testis to establish a stably transfected spermatogonial cells. These mice were then mated to wild type females and sired transgenic offspring for up to a year following transfection.

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Miguel L. Soares, et al. *Functional Studies of Signaling Pathways in Peri-Implantation Development of the Mouse Embryo by RNAi.* ***BMC Developmental Biology, 5:28, 2005***

equipment

ECM® 830

Square Wave Electroporation System

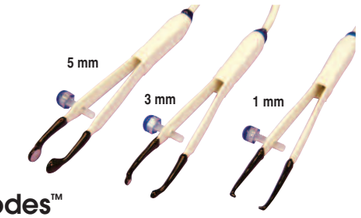
See page 22 for details.

The ECM 830 is a highly flexible square wave electroporation generator that may be used for in vitro and in vivo transfections.

ECM® 2001

Square Wave Electrofusion Electroporation System

See page 23 for details.



Platinum Tweezertrodes™

See page 34 for details.

results

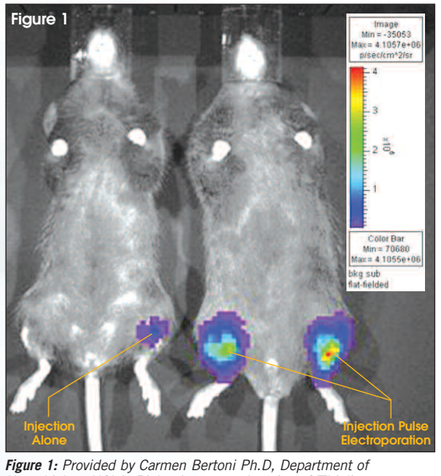


Figure 1: *Provided by Carmen Bertoni Ph.D, Department of Neurobiology UCLA. Bioluminescence Imaging of Tibialis anterior muscles injected with a luciferase plasmid and electroporated compared to injection alone.*

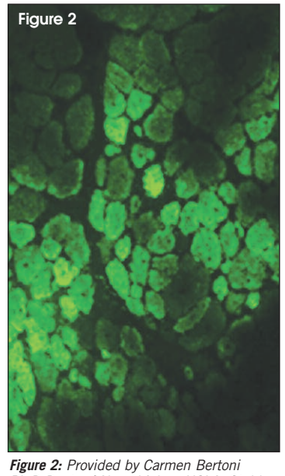


Figure 2: *Provided by Carmen Bertoni Ph.D Dept. of Neurobiology UCLA. Stable long term expression obtained after intramuscular injection of a PhiC31 plasmid encoding the green fluorescence protein (GFP) under the control of a muscle specific promoter followed by electroporation.*

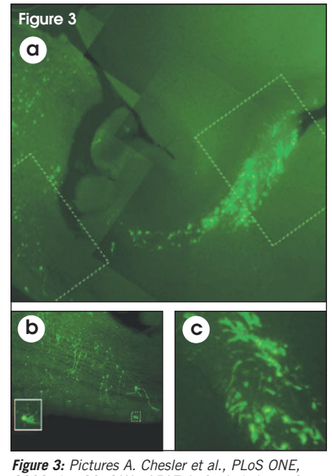
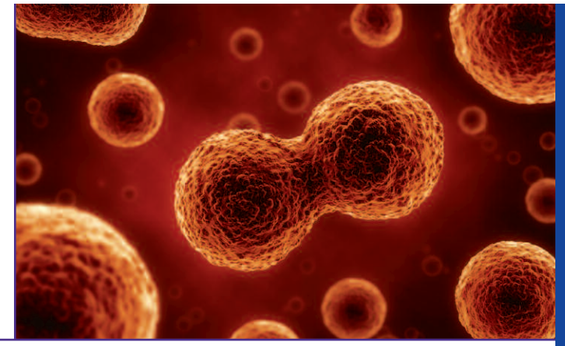


Figure 3: *Pictures A. Chesler et al., PLoS ONE, 2008, Jan 30; 3(1):e1517 A. Sagital views of a P15 mouse 2 weeks post electroporation; 60 µm sections. In addition to the RMS, GFP-positive cells can be found throughout the olfactory bulb. B/C. Enlarged views of the boxed regions in (a) showing olfactory bulb (b), and the RMS (c). Inset in B highlights a periglomerular cell*

Electrofusion, Mam malian, Oocyte & Plant



electrofusion

Electrofusion is a highly efficient, reproducible and non-toxic technique used in a wide variety of applications. The number of applications requiring the use of electrofusion has greatly increased in the past decade and include; hybridoma productions for antibody expression, stem cell development, genetically modified plant protoplast, tetraploid fusion and nuclear transfer for transgenic development. Many applications have clinical significance in diagnostic testing, therapeutics and vaccine development.

The ECM® 2001 is a versatile system for both Electrofusion and Electroporation. It incorporates both AC and DC square wave pulsing capabilities to allow for plant protoplast fusion, embryo manipulation and mammalian cell transfections. Cells are easily manipulated under the microscope using specially designed BTX microslide fusion chambers. These chambers help to deliver a gentle, low intensity, high frequency AC pulse to align the cells while the DC square wave pulse fuses the cells for higher fusion rates when compared to other chemical methods. The ECM 2001 is a multi-purpose system which can function as the highly efficient AC/DC electrofusion system or to transfect a variety of mammalian cells, including direct gene delivery into oocytes or in vivo tissues by simply turning off the AC features and utilizing the DC square wave pulsing capabilities.

Applications

- Hybridoma Production
- Nuclear Transfer
- Stem Cell Production
- Mammalian Cell Fusion
- Oocyte Transfection
- Mammalian Cell Transfection
- In Vivo Applications

AC/DC

The 1 MHz AC frequency feature of the ECM 2001 results in quick and simple alignment of cells. The post fusion AC pulse option maintains alignment during cell recovery resulting in a higher number of fusion couplets. Voltage settings of 10V up to 3000V pulse lengths of 0.01 - 0.99 msec and multiple pulsing upto 9 pulses can be selected in the DC mode for unmatched fusion capabilities.

Dual System

The ECM 2001 is not only an efficient stand alone electrofusion system capable of a broad variety of fusion applications, this system is equally as powerful as an electroporator. The wide range of user controlled parameters includes voltage, pulse lengths and multiple pulsing capabilities making this system an effective tool for efficient mammalian cell transfections.

Plant Fusion

Electrofusion can be used to fuse plant protoplasts to generate hybrids and create crops with desirable traits. Fusion of the plant protoplast is easily carried out by using the AC feature of the ECM 2001 to align the protoplast while the gentle square wave DC pulse is applied with moments of the alignment resulting in successful fusion. This method is performed with no cyto-toxic effects common with comparable chemical methods.

Hybridoma and Cell Fusion

Electrofusion using the ECM 2001 is an extremely efficient, highly reproducible and non-toxic method for the fusion of mammalian cells. Hybridoma development for monoclonal antibody production and cell fusion for cancer vaccine development are some of the most common applications for electrofusion. It has been reported that significantly higher rates of genuine dendritic and tumor cell hybrids were produced. These hybridomas are multinuclear and dually fluorescent for individual cell-specific markers and shown to be therapeutic in murine tumor models compared to PEG (Parkhurst et al. 2003).

Other electrofusion applications include two cell embryo hybrids for tetraploid productions, nuclear transfer for transgenic animal and stem cells development. Increased cell fusion rates of 90% were reported, as well as post fusion viability when compared to chemical fusions (Orentas et. al. 2001).

Nuclear Transfer Electroporation

Nuclear Transfer Electrofusion is a method utilized for introducing a nucleus from a donor cell (fetal cell or adult cells) into an un-fertilized recipient oocyte via the use of AC/DC electrical pulses to fuse the cell membranes. This technique is often used to generate transgenic animals producing therapeutic proteins which can be expressed in various species including Bovine, Caprine, Porcine and Ovine. Transgenic development is also widely used to study gene function and to develop stem cells for therapeutic research.

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Hui Liu, Chia-Woei Wang, James A. Grifo, Lewis C. Krey and John Zhang; *Reconstruction of Mouse Oocytes by Germinal Vesicle Transfer: Maturity of Host Oocyte Cytoplasm Determines Meiosis.* ***Human reproduction vol. 14, no 9 pp. 2357-2361, 1999***

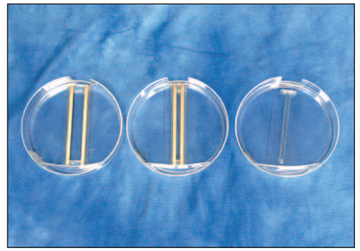
equipment

ECM® 2001

Square Wave Electrofusion Electroporation System

See page 23 for details.

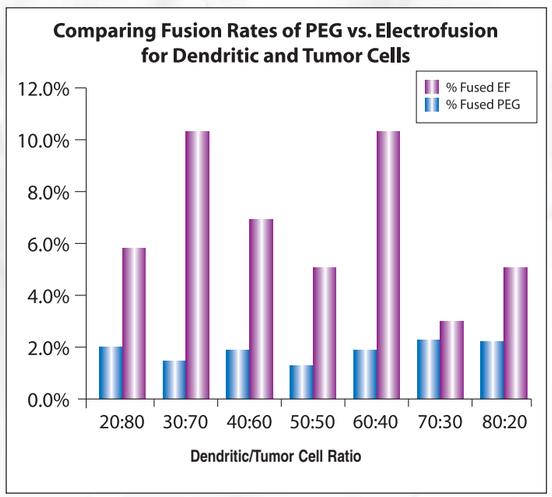
The ECM 2001 is a multifunctional square wave electro cell fusion and electroporation generator capable of AC and DC square wave pulses. The CE/ETL marked ECM 2001 is used for a variety of applications from embryo manipulation to hybridoma production to plant tissue transformation.



Microslides

See page 39 for details.

results



Fusion of dendritic cells to tumor cells was determined by loading either CMFDA or CMTMR fluorescent labels into cells. Fusion was carried out by using PEG-mediated fusion and Electrofusion methods. The cells wereanalysed by flow cytometry. Cells expressing both fluorescent labels were considered fused. Electrofusion resulted in significantly higher numbers of fused cells in comparison to PEG.

Rimas J.Orentas, Dennis Schauer, Qian Bin, and Bryon D. Johnson; *Electrofusion of a weakly Immunogenic Neuroblastoma with Dendritic Cells Produces a Tumor Vaccine.* ***Cellular Immunology 213, 4-13, 2001***

Microinjection

Microinjection is a well established technique used routinely for injection of animal cells, tissues and embryos to insert genetic material such as DNA, RNA, proteins and macromolecules directly into animal cells or embryos a cell cytoplasm or nucleus. Genetic material is inserted via a needle varying in size from 0.5uM to 20uM in diameter. The needle penetrates the cell membrane and/or the nuclear envelope. The process is performed, observed and controlled by using a micromanipulator specialized microscope set up. This technique is widely used by researchers for genetic engineering of cells by modifying, silencing or creating knockouts to study gene targeting and function. Microinjection and electroporation can be combined for the transfection of mammalian cells and tissues for gene therapy applications. This highly effective method is routinely used to insert genes into early stage pronuclear embryos for transgenic development applications for therapeutics. Microinjection is routinely used for nuclear transfer applications, cell biology and viral studies.

Pressure Control

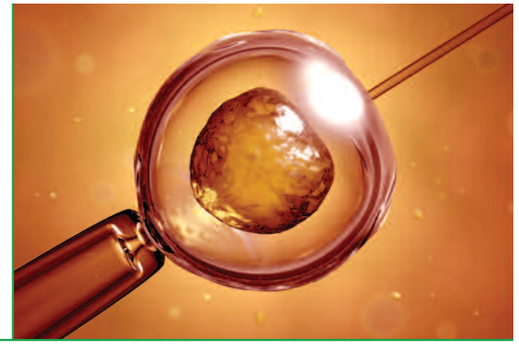
• Fill/Clear/Hold

The MicroJect 1000 is a versatile injection system, providing the consistency and reliability to deliver precise volumes ranging from femtoliter to microliters through a stable compressed gas pressure mechanism for a set duration of time. The MicroJect 1000 Max provides key pressure features designed to maximize the researchers injection potential with two negative and three positive pneumatic features. The negative pressure or vacuum functions provides convenient filling functions, holding and clearing function critical for efficient microinjection applications.

- **Fill:** This feature reduces waste of valuable injection material using the negative pressure feature to conveniently fill the microinjection needles from the tip.
- **Hold:** The negative pressure and vacuum functions provides the means to immobilize and manipulate a cell or oocytes using a micropipette.
- **Clear:** The high pressure pulse feature allows quick clearing of the pipette to remove potential clogs when working with smaller diameter pipette sizes for small volumes.

Balance Pressure

It is all about the balance of pressure with our Microject 1000 system. The unique “Balance” feature provides a secondary balance pressure to maintain positive pressure on the injection pipette, this prevents sample dilution by capillary action and reduces clogging of the injection needle.



equipment

MicroJect 1000 Max System

See page 27 for details.

Crossover Guide

BTX generally recommends a square waveform for mammalian cell work, and an exponential decay waveform for bacteria and yeast applications. However, there are some exceptions, and crossover in the use of our electroporation generators. We highly recommend that you contact BTX regarding your application prior to purchasing a generator system to ensure that you are getting the best possible system for your needs.

For BTX Technical Support go to **www.btxonline.com** or call **800-272-2775** within the U.S.

ECM® 2001

This square wave pulse electroporator and electrofusion generator is primarily used for cell fusion work and mammalian cell transfection. It can also be used for transforming bacteria, but with lower efficiencies than with an exponential decay waveform, **see page 23**.

ECM® 830

This square wave unit is engineered mainly for mammalian cell transfection. The 830 is also capable of performing certain cell fusion applications which will require the use of a manual cell alignment method. The basic transformation of bacteria to generate plasmids can be accomplished with 830 but with lower efficiencies compared to our exponential decay wave system (830/107-108 pfu/ug. vs. 630/108-1010 pfu/ug), **see page 22**.

ECM® 630

This exponential decay wave pulse generator is primarily used for bacteria and yeast transformation applications. The exponential decay wave system is used for efficient transfection of mammalian cells but much lower cell viabilities compared to square wave pulse system, with the exception of mouse embryonic stem cells. Excellent transfection is achieved with the ECM 630, **see page 21**.

ECM® 399

This exponential decay wave generator is our most economical unit for a lab doing mainly gram (-) bacteria and yeast applications. This unit is not recommended for mammalian transfection, **see page 20**.

Decision Guide

Application	Cell/Tissue	Instrument	Electrode	Field of Study	Comments
Ex Vivo	Brain Tissue or Brain Slice	ECM 830, ECM 2001	Tissue Slice Chamber/Tissue Chamber/ L-Shaped Needle	Neurobiology	Transfection of delicate brain tissue and tissues with unique morphologies are more easily transfected with our new tissue slice chamber, L-shaped platinum needles or other BTX electrodes.
	Retina/Cornea	ECM 830, ECM 2001	Tissue Slice Chamber/Tissue Chamber/ Genepaddles	Developmental Biology	
	Tumor/Skin	ECM 830, ECM 2001	Tissue Chamber/Tweezertrodes/ Genetrodes	Cell Biology Ophthalmology Cancer Research Gene Therapy	
In Utero	Embryos	ECM 830, ECM 2001	Tweezertrodes and Genepaddles	Developmental Biology Neuroscience Neurology Embryology	The new smaller size Platinum Tweezertrodes for use with early stage embryos.
In Vivo	Muscle	ECM 830, ECM 2001	2-Needle Array/Genetrodes/ Tweezertrodes	Ophthalmology	The numerous electrodes offered by BTX can be used for multiple tissues type depending on the specific application the researcher is trying to perform. To the left are some of the most common recommendations. For more assistance please contact BTX technical support.
	Brain	ECM 830, ECM 2001	L-Shaped Needle/Tweezertrodes/ Genepaddles	Cancer Research	
	Skin	ECM 830, ECM 2001	2-Needel Array/Calipers/Tweezertrodes/ Genetrodes	Vaccine Development	
	Retina	ECM 830, ECM 2001	Tweezertrodes/Genepaddles	Gene Therapy	
	Cornea	ECM 830, ECM 2001	Tweezertrodes/Genetrodes	Immunology	
	Tumors	ECM 830, ECM 2001	2-Needle Array/Calipers/Tweezertrodes/ Genetrodes	Developmental Biology	
	Other Soft Tissue	ECM 830, ECM 2001	2-Needle Array/Calipers/Tweezertrodes/ Genetrodes/Genepaddles/ L-Shaped Needles	Cell Biology Neurology Biological Sciences	
In Ovo	Chick Embryo	ECM 830, ECM 2001	L-Shaped Genetrodes/L-Shaped Needle	Neurobiology	The Genetrodes are available in 3 different sizes and the New L-Shaped Needle electrodes provides a finer diameter needle in various length tips to best suit the dimensions of your target tissue.
	Zebra Fish	ECM 830, ECM 2001	L-Shaped Genetrodes/Tissue Chamber/ Genepaddles/Tweezertrodes	Developmental Biology	
	Xenopus	ECM 830, ECM 2001	L-Shaped Genetrodes/Tweezertrodes/ Genepaddles	Ophthalmology Regenerative medicine Embryology	
In Tact Plant	Plant Fragments	ECM 630	Tissue Chambers/Microslides/ Tweezertrodes/Cuvettes	Cellular Physiology	The electrodes can vary for plant applications depending on the target tissue.
	Seeds	ECM 630	Tissue Chambers/Microslides/ Tweezertrodes/Cuvettes	Food and Agriculture	
	Anthers	ECM 630	Tissue Chambers/Microslides/ Tweezertrodes/Cuvettes	Plant Biology	
	Pollen	ECM 630	Tissue Chambers/Microslides/ Tweezertrodes/Cuvettes		

Electroporation Definitions Guide

AC
Abbreviation for “alternating current” which is an oscillating dielectrophoretic current in which an electrical current rises to a maximum point in one direction and falls to zero and then rises in the opposite direction and then repeats.

AC Alignment
Refers to the use of AC current to align cells prior to electrofusion.

Anode
Positive electrode or terminal of a device from which electrons flow outwards.

Arc
Discharge of electrical current in a sample in which the conductivity is too great.

Capacitor
A device capable of holding an electrostatic charge between two conducting surfaces.

Capacitance
The quantity of electric charge (usually measured in Farads) which a capacitor is capable of receiving with an applied voltage.

Cathode
Negative electrode or terminal of a device to which electrons flow towards.

DC
Abbreviation for “direct current”, which is defined by the constant flow of electrons in a single direction from low to high potential.

DC Pulsing
The application of a DC pulse that is used in electroporation and the fusion step in electrofusion.

Electroporation
Applying an electrical pulse inducing a transmembrane potential which causes a reversible breakdown of the cellular membrane. This results in the formation of pores in the membrane of cells and tissues allowing exogenous molecules such as DNA, siRNA, proteins, or antibodies to enter the cell.

Electrofusion
Using electrical pulses to destabilize cell membranes to create pores and fuse cell membranes together to create a hybrid cell.

Exponential Decay
A wave in which the decay is 1/3 of the maximum peak amplitude of the pulse.

Field Strength
The voltage delivered across the electrode gap. It is expressed as kV/cm. Field strength relates to the potential difference experienced by the cell membrane in the electric field.

Pulse Length
The length of time the cell is exposed to the electrical field. Pulse length is generally believed to be related to the length of time during which the electroporation membrane pores remain open.

RC Time Constant
Product of resistance and capacitance in seconds

Resistance
Opposition to current flow and dissipation of energy in the form of heat, typically measured in Ohms.

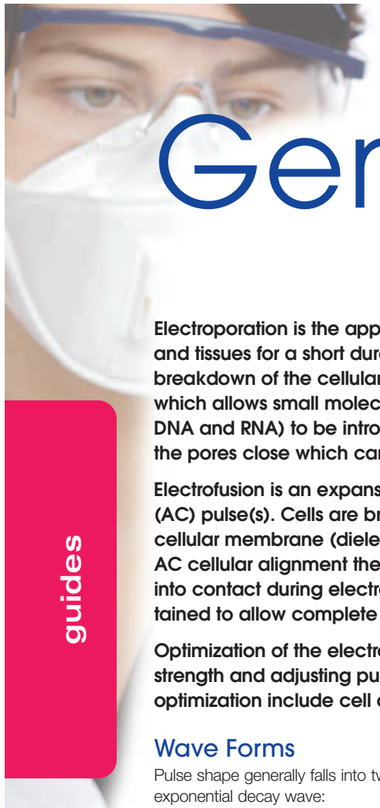
Stable Transfection
Integration of nucleic acids into the host chromosomes and the inheritance of associated traits in progeny cells.

Square Wave
A wave form that alternates between two fixed values for an equal amount of time.

Transfection
The introduction of nucleic acids into animal cells either as a stable or transient transfection.

Transformation
The introduction of nucleic acids into bacteria, yeast and plants.

Transient Transfections
Temporary expression of exogenous nucleic acids.



General Optimiza tion Guide

guides

Electroporation is the application of controlled direct current (DC) electrical pulses which are applied to living cells and tissues for a short duration of time. The pulse induces a transmembrane potential which causes the reversible breakdown of the cellular membrane. This action results in the permeation or "pore formation" of the cell membrane which allows small molecules (such as dye, oligonucleotides or peptides) and large molecules (such as proteins, DNA and RNA) to be introduced into the cell. During this process the cellular uptake of the molecules continue until the pores close which can take milliseconds to minutes.

Electrofusion is an expansion of electroporation using different buffers and one or more proprietory alternating current (AC) pulse(s). Cells are brought together or "aligned" by the use of an AC pulse which causes charges to form on the cellular membrane (dielectrophoresis) resulting in alignment of cells or pearl-chain (dimer) formation. Following the AC cellular alignment the DC pulse is applied to induce permeation of the cell membrane. When cells are brought into contact during electroporation, these cells are induced to fuse. Following this DC pulse the AC pulse is maintained to allow complete cell membrane fusion during the recovery period.

Optimization of the electroporation process involves several factors. Choosing the wave form, determining field strength and adjusting pulse length are just a few critical variables. Other parameters which play a crucial role in optimization include cell diameter, DNA concentrations, temperature and electroporation buffer.

Wave Forms

Pulse shape generally falls into two categories, square wave or exponential decay wave:

Square wave pulse: Square wave pulses rise quickly to a set voltage level, maintains this level during the duration of the set pulse length and quickly turns off. This square wave system yields higher efficiencies and viabilities in mammalian cells. Square wave EP in in vivo and ex vivo tissues, embryo's, cell fusions and plant protoplast applications yield better results in comparison to an exponential decay wave system.

Exponential decay wave pulse: Exponential decay waves generate an electrical pulse by allowing a capacitor to completely discharge. A pulse is discharged into a sample the voltage rises rapidly to the peak voltage set then declines over time. The powerful exponential decay wave pulse is routinely used for transformation of gram-negative and gram-positive, bacterial, yeast, plant tissues, insect cells and some mammalian cells.

Field Strength

The field strength is measured as the voltage delivered across an electrode gap and is expressed as kV/cm. Field strength is critical to surpassing the electrical potential of the cell membrane to allow the temporary reversible permeation or "pore formation" to occur in the cell membrane. Three factors should be considered for optimizing field strength:

1. Cuvette Gap Size
2. Cell Diameter
3. Temperature

Cell Types	Field Strength Ranges
Bacteria/Yeast	3-24 kV/cm
Mammalian	0.25-3 kV/cm
Plant	3-12 kV/cm

1. Cuvette Gap Size

The distance between electrodes, or "gap size" is important when optimizing your electroporation experiment. Field strength is calculated using voltage divided by gap size. For example, using a 4mm gap cuvette with 500V would provide a field strength of 1.25kV/cm. If instead of a 4mm gap cuvette, a 2mm gap cuvette was used, the voltage would have to be reduced by half or 250V in order to maintain the same field strength of 1.25kV/cm. It is possible to derive the voltage needed to accomplish electroporation if the desired field strength and gap size are known. The calculation for this is Field strength (kV) multiplied by gap size (cm) equals voltage. For example, if a user was certain that a 1.25 kV/cm field strength was required in a 1mm gap cuvette the calculation would be: 1.25kV x 0.1cm= 0.125kV or 125volts.

Example: A field strength of 1.25 kV/cm
4mm gap cuvette = 500 volts
2mm gap cuvette = 250 volts
1mm gap cuvette = 125 volts

2. Cell Diameter

Generally, smaller cell sizes require higher voltages while larger cell diameters require lower voltages for successful cell membrane permeation.

Cell Diameter	Cuvette 4mm Room Temp. (Volt)	Cuvette 4mm 4ºC
10	500 Volts	1000 V
15	350 Volts	700 V
20	250 Volts	500 V
30	180 Volts	360 V
40	130 Volts	250 V
50	100 Volts	200 V

3. Temperature

The temperature at which cells are maintained during electroporation effects the efficiency of the electroporation for several reasons. For a majority of mammalian cell lines are effectively electroporated at room temperature. Samples which are pulsed at high voltage or exposed to multiple pulses and long pulse durations can cause the sample to heat up. These conditions cause increased cell death and lowers the transfection efficiency. Maintaining the sample at lower temperatures can diminish the heating effects on cell viability and efficiency. Since electroporation causes the transient formation of pores, keeping the cells at lower temperature following the pulse may allow the pores to remain open longer to allow more uptake of the exogenous molecule. Yet lower temperatures on other cell lines can be damaging and cause high cell mortality. This effect is specific to each cell line and should be considered during optimization studies. The standard pulse voltage used for cells at room temperature will need to be approximately doubled for electroporation at 4°C in order to effectively permeate the cell membrane.

Pulse Length

The pulse length is the duration of time the sample is exposed to the pulse. This is measured as time in micro to milliseconds ranges. Adjusting this parameter is dependent on the pulse generator in use square wave or exponential decay wave. The pulse length in a square wave system can be inputted directly. The pulse length in an exponential decay wave system is called the "time constant" which is characterized by the rate at which the pulsed energy (e) or voltage is decayed to 1/3 the original set voltage. This time constant is modified by adjusting the resistance and capacitance (RC) values in an exponential decay. Time constant calculation T=RC, where T is time and R is resistance and C is capacitance.

The pulse length works indirectly with the field strength to increase pore formation and therefore the uptake of target molecules. Generally, during optimization of parameters an increase in voltage should be followed by an incremental decrease in pulse length. Decreasing the voltage, the reverse is true. Pulse length is a key variable that works hand in hand along with voltage and needs to be considered when optimizing electrical parameters to maximize the results for a given cell type.

Number of Pulses

Electroporation is typically carried out as a single pulse for most cell types. However, other cell lines may require multiple pulses to achieve maximum transfection efficiencies. Usually lower voltages are used when applying multiple pulses in order to gradually permeate the cell membranes. This allows the transfer of molecules while avoiding damage to delicate or whole tissue samples. This method of multiple pulsing is critical for maximum gene delivery without causing tissue damage to in vivo, in utero and ex-plant tissue environments. The use of multiple pulsing will require the optimization of key electrical parameters including voltage and pulse length. Typically, for in vivo applications the use of lower voltages between 10-100 volts with pulse lengths ranging 30-50msec provides efficient transfection. The optimal voltage, pulse length and number of pulses will vary depending on the cell type and molecule (DNA or RNA) transfected.

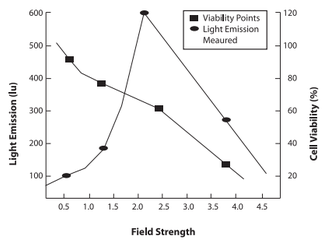
Electroporation Buffer

The buffers used for electroporation can vary depending on the cell type. Many applications use highly conductive buffers such as PBS (Phosphate Buffered Saline <30 ohms) and HBSS (Hepes Buffer <30 ohms) or standard culture media which may contain serum. Other recommended buffers are hypoosmolar buffers in which cells absorbs water shortly before pulse. This swelling of the cells results in lowering the optimal permeation voltage while ensuring the membrane is more easily permeable for many cells but can be damaging to others. Prokaryotic cells such as bacteria require the use of high resistance buffers (>3000 ohms) for this reason proper preparation and washing of the cells is essential to remove excess salt ions to reduce the chance of arcing. Ionic strength of an electroporation buffer has a direct affect on the resistance of the sample which in turn will affect the pulse length or time constant of the pulse. The volume of liquid in a cuvette has significant effect on sample resistance for ionic solutions, the resistance of the sample is inversely proportional to the volume of solution and pH. As the volumes are increased resistance decreases which increases the chance of arcing, while lowering the volume will increase the resistance and decrease the arc potential.

BTX now offers BTXpress™ High Performance Electroporation Solution, a low conductance buffer that achieves higher transfection efficiencies with minimal cell toxicity. The BTXpress buffer is a single buffer developed to facilitate high efficiency gene delivery into mammalian cells.

DNA/RNA Concentrations

Electroporation is typically thought of as a nucleic acid (DNA, mRNA, siRNA and miRNA) transfer method into prokaryotic and eukaryotic cells. Electroporation is not limited to just nucleic acid delivery, it can introduce proteins, antibodies, small molecules and fluorescent dyes. The standard range of DNA used for transfections is 5-20µg/ml for most cell types; however in some instances increasing the DNA concentration as high as 50µg/ml improves transfection efficiency without changing other parameters. Determining the optimal DNA concentration through a DNA titration can be beneficial. The size of a molecule will have an effect on the electrical parameters used to transfect the cell. Smaller molecules (siRNA or miRNA) may need higher voltage with microsecond pulse lengths and larger molecules (DNA) may need lower voltages with longer pulse lengths. Buffers such as EDTA or Tris can drastically reduce the transfection efficiency. Therefore, we recommend resuspending DNA in distilled water. Finally, electroporating ligation mixtures into E.coli can cause arcing and reduced transformations. Diluting the ligation mixture a minimum of 1:5 with diH_2O, dialysis, or ethanol precipitation can significantly improve transformation efficiencies and reduce the potential for arcing.



ECM® 399

Exponential Decay Wave Electroporation System

45-0212 PEP™ (Personal Electroporation Pak) Cuvette Module

Applications

The ECM 399 is an exponential decay wave electroporation system specifically designed to deliver the field strengths and pulse lengths required for the simple transformation of bacteria and yeast cells. In low voltage mode the ECM 399 has a limited capability for transfecting some mammalian cell lines. The ECM® 399 is ideal for basic transformation in research and academic environments. It is easy to operate, cost effective, compact in size and portable.

Combination System

BTX provides a combination system which has the power of both its exponential decay and square wave technologies for labs involved in multiple applications. These labs need the versatility of the BTX systems to range from prokaryotes to eukaryotes with the ability to transfect delicate in vivo tissues efficiently. This combo system includes the power of the ECM 399 exponential decay wave generator to provide the highest transformation efficiencies of basic bacteria and yeast strains. This package option also includes the gentle strength and versatility of the ECM 830 Square Wave System to provide high transfection efficiencies with equally high cell viabilities in mammalian cells and in vivo tissues. BTX offers the ECM 399/ECM 830 Combo System complete with a PEP and a safety stand for cuvettes. These systems can be used together or separate as independent systems for operation in different labs with no extra components needed.

Specifications

Operational Status	Internal self test upon start-up
Interface	Digital User Interface
Charge Time	5 sec maximum
Voltage Range:	
LV Mode	2 – 500 V HV Mode/ 2 V resolution
HV Mode	10 – 2,500 V HV Mode/10 V resolution
Capacitance:	
LV Mode	1,050 µF Fixed
HV Mode	36 µF Fixed
Resistance:	
LV Mode	150 ohm Fixed
HV Mode	150 ohm Fixed

Item #	Description
45-0000	Electroporation System includes ECM 399 Generator, PEP, Cuvettes 1 mm, 2 mm, 4 mm, pkg. of 30 (10 each) and Cuvette Rack 660
45-0050	ECM 399 Generator Only
45-0060	Combination package includes ECM 830 Generator, ECM 399 Generator, Safety Stand, PEP, 30 Cuvettes, (10 each: 1mm, 2mm and 4mm) and Cuvette Rack

To order these products, please contact BTX at **800-272-2775** (US) or **508-893-8999** (outside the US) or **techsupport.btx@harvardapparatus.com** or visit **www.btxonline.com** to get complete list of distributors in your area.

ECM® 630

Exponential Decay Wave Electroporation System

Applications

- **Transformation of Bacteria and Yeast**
- **Transfection of Mammalian Cells**
- **Transfection of Plant Tissue and Plant Protoplast**
- **High Throughput 96 & 25 Well Electroporation**

The ECM 630 is an exponential decay wave electroporation generator providing a broad range of voltage and time constant for full flexibility in varying applications. The ability to select the resistance and capacitance values and adjust the range of voltages is the key to achieving the optimal time constants and field strengths needed for efficient transformation of prokaryotes and eukaryote transfection. This system is an outstanding value for researchers working with bacteria, yeast, stem cell transfection, plant transformation and insect transfection. Flexibility is important to a researcher, so BTX has designed a plug and play system for our ECM 630 system to transition between standard cuvettes and to a 96 well electroporation plate using our High Throughput plate handler.

96-Multi-Well Electroporation

Transition from standard cuvette work using the safety stand to multi-well electroporation is quick and simple with the addition of the High Throughput (HT) plate handler and plates. The HT plate handler accommodates either 96 & 25 well electroporation plates and it operates with an existing ECM 630 generator or is offered as an ECM 630 HT System for easy scale up. The HT System offers the researcher the advantage of multi-well technology. High Throughput electroporation permits for large numbers of samples to be quickly processed or easy optimization of electroporation conditions for the highest possible efficiencies.

Monitoring Option

The ENHANCER 3000 allows the researcher to monitor and track key electrical parameters used in electroporation applications. The electrical pulse data is captured as both a graphic display of the wave form and electrical output values following each experiment. This data can be stored on a memory stick or downloaded to a computer easily by using the USB port for potential analysis, documentation and validation purposes.

Combination System

This combo system includes the power and flexibility of the ECM 630 Exponential Decay Wave Generator to provide the highest transformation efficiencies for a wide range of bacteria and yeast strains. This combo also contains the gentle strength and versatility of the ECM 830 Square Wave System to provide high transfection efficiencies with equally high cell viabilities in mammalian cells and in vivo tissues. BTX offers the ECM 630/ECM 830 Combo System complete with two safety stands and sample cuvettes. These systems may be used together or separate as independent systems for operation in different labs with no extra components needed.

Specifications

Operational Status	Internal self test upon start-up
Interface	Digital User Interface
Input	110 V/220 V Universal
Charge Time	5 sec maximum
Arc Control	Arc Quenching™
Voltage Range	10 – 500 V LV Mode/ 1 V resolution 50 – 2500 V HV Mode/ 5 V resolution
Capacitance Range	1 µF, 25 µF to 3,275 µF LV Mode 25 µF, 50 µF HV Mode
Resistance Range	25 ohm – 1,575 ohm/ 25 ohm resolution HV & LV Modes “None” setting to simulate alternative systems lacking resistance control LV Mode

Item #	Description
45-0001	Electroporation System includes ECM 630 Generator, 630B Safety Stand, Cuvettes 1 mm, 2 mm, 4 mm pkg. of 30 (10 each) and Cuvette Rack 660
45-0051	Generator Only
45-0422	Includes ECM 630 Generator, 2 x 96-Well Plates (2 mm), Plate Seals and HT-100 Plate Handler
45-0412	Includes ECM 630 Generator, 6 x 25-Well Plates (2 mm), Plate Seals, and HT-100 Plate Handler
45-0061	Combination package includes ECM 830 Generator, ECM 630 Generator, 2 x Safety Stands, 30 Cuvettes (10 each: 1mm, 2mm and 4mm) and Cuvette Rack
45-0071	ENHANCER 3000 Probe, ENHANCER Interface Box,Oscilloscope, Communications Module, ECM 630 Generator, Safety Stand, 30 Cuvettes (10 each 1 mm, 2 mm and 4 mm) and Cables

Visit the BTX website for hundreds of protocols and publications

www.btxonline.com

ECM® 830

Square Wave Electroporation System

Applications

- Transfection of Mammalian Cells
- In Vitro, In Vivo, Ex Vivo & In Ovo Tissue Transfection
- Nuclear Transfer
- Plant Protoplast Transfection
- High Throughput 96 and 25 well Electroporation

The ECM 830 is a square wave pulse generator designed for In Vitro and In Vivo electroporation applications. BTX square wave technology provides the advantage of efficient cell transfer and high cell viability for numerous applications. The versatility of the ECM 830 applications for gene, drug and protein delivery include; mammalian cells, in vivo and ex-vivo tissues, zebra fish tissue and embryos, nuclear transfer, embryo manipulation, plant protoplast and basic bacteria and yeast transformations. The ECM 830 possesses key features including a wide range of voltages from 5 to 3000 volts, fine voltage discrimination, pulse durations from 10µsec to 10sec, user control of pulse intervals, Arc Quenching™, digital display of output of voltage and pulse length for precise optimization of experiments. It is a true laboratory work-horse with a 2-year warranty. The ECM 830 can be used in combination with a wide array of BTX specialty electrodes and accessories to enhance your molecular and drug delivery for In Vivo and Ex Vivo experiments. Flexibility is important to a researcher, so BTX has designed a plug and play system for our ECM 830 system to transition between standard cuvettes and 96 or 25 well electroporation plates using our High Throughput plate handler.

96-Well Electroporation

The High Throughput (HT) 96 & 25 well systems offer the researcher the advantage of multi-well technology. This permits a large number of samples to be quickly processed for routine applications or easy optimization of electrical and biological conditions. Simplify discovering the conditions needed to obtain the best possible efficiencies using the BTX ECM 830 pulse generator and HT plate handler.

Monitoring Option

The ENHANCER 3000 allows the researcher to monitor and track key electrical parameters used in electroporation applications. The electrical pulse data is captured as both a graphic display of the wave form and electrical output values following each experiment. This data can be stored on a memory stick or downloaded to a computer easily by using the USB port for potential analysis, documentation and validation purposes.

Combination System Options

This combo system includes the power and flexibility of the ECM 630 exponential decay wave generator to provide the highest transformation efficiencies for a wide range of bacteria and yeast strains. The gentle strength and versatility of the ECM 830 square wave system provides high transfection efficiencies with equally high cell viabilities in mammalian cells and in vivo tissues. BTX offers the ECM 630/ECM 830 combo system complete with two safety stands and sample cuvettes. These systems may be used together or separate as independent systems for operation in different labs with no extra components needed.

Specifications

Operational Status	Internal self test upon start-up
Interface	Digital User Interface
Input	110 V/220 V Universal
Charge Time	5 sec maximum (without delay)
Pulse Length Range	10 µs – 999 µs LV Mode/ 1 µs resolution 1 msec – 999 msec LV Mode/ 1 msec resolution 1 sec – 10 sec LV Mode/ 0.1 sec resolution 10 µs – 600 µs HV Mode/ 1 µs resolution
Voltage Range	5 – 500 V LV Mode/ 1 V resolution 505 – 3000 V HV Mode/ 5 V resolution
Multiple Pulsing	1 – 99
Pulse Interval	100 msec – 10 sec
Programmability	Storage for 3 protocol setups (V,t,n,interval)
Arc Control	Arc Quenching™
Safety	Generator short circuit proof
Capacitance	4000 µF LV, 111 µF HV
Amperage	500 A limit at 100 µs
Remote Operation	Footswitch available. Please contact BTX Technical Services at 1-800-272-2775 or techsupport.btx@harvardapparatus.com for assistance.

Item #	Description
45-0002	ECM 830 Electroporation System includes, ECM 830 Generator, 630B Safety Stand, Cuvettes 1 mm, 2 mm, 4 mm pkg. of 30 (10 each) and Cuvette Rack 660
45-0052	ECM 830 Generator Only
45-0421	HT 96/200 includes ECM 830 Generator, 2 x 96-Well Plates (4 mm), Plate Seals and HT-200 Plate Handler
45-0411	HT 25/200 includes ECM 830 Generator, 6 x 25-Well Plates (4 mm), Plate Seals and HT-200 Plate Handler
45-0061	ECM 830 / ECM 630 Combination Package includes ECM 830 Generator, ECM 630 Generator, 2 x Safety Stands, Sample Package of Cuvettes and Cuvette Rack
45-0060	ECM 830 / ECM 399 Combination Package includes ECM 830 Generator, ECM 399 Generator, Safety Stand, PEP, Sample Package of Cuvettes and Cuvette Rack
45-0072	ECM 830 / ENHANCER 3000 System: ENHANCER 3000 Probe, ENHANCER Interface Box, Oscilloscope, Communications Module, ECM 830 Generator, Safety Stand, 30 Cuvettes (10 each 1 mm, 2 mm and 4 mm) and Cables

ECM® 2001

Electro Cell Fusion & Electroporation System

Applications

- Cell Fusion
- Nuclear Transfer
- Embryo Manipulation
- Hybridoma Production
- Mammalian Cell Transfection
- Plant Protoplast Fusion
- Stem Cell Production

The ECM 2001 is a multipurpose pulse generator. This system offers AC/DC pulsing and a variety of pulse lengths with multiple pulsing features. This generator has the capability of performing electrofusion as well as electroporation.

Fusion

Electrofusion is carried out by applying both AC and DC waves. Fusion is achieved by the generation of a proprietary AC wave form for benign dielectrophoretic alignment of cells. Microsecond switchover time from AC to DC creates efficient fusion results. After fusion, the AC pulse reapplication maintains compression of the cells following the DC pulse for the rounding off process, resulting in a higher number of hybrids. The 1 MHz AC pulse aligns cells together in “real time”, saving time (seconds vs. hours) in comparison to PEG methods. Blastomeres and Oocytes can also be aligned to the correct position for better fusion accuracy during nuclear transfer and embryo manipulation.

Electroporation

The ECM 2001 can function as a powerful stand alone electroporation system for efficient cell transfection or for in vivo tissue transfection applications. Using the ECM 2001 for standard mammalian cell transfections the AC feature is turned off and the DC mode can now be set as a square wave electroporation device. The range of voltages and pulse lengths that can be set coupled with the ability to carry out up to 9 pulses per experiment make this an all around flexible system for any lab.

Monitoring Option

The ENHANCER 3000 allows the researcher to monitor and track key electrical parameters used in electroporation and electrofusion applications. The electrical pulse data is captured as both a graphic display of the wave form and electrical output values following each experiment. This data can be stored on a memory stick or downloaded to a computer easily by using the USB port for potential analysis, documentation and validation purposes.

Specifications

AC Parameters (Alignment)

Proprietary nonsinusoidal wave shape

Frequency	1 MHz
Voltage	0 – 75 V RMS (zero to peak)
Duration	0 – 99 sec
Post fusion AC	1/10 of pre fusion amplitude
Post fusion ramp	1 – 9 sec
Pause between AC/DC	50 µsec

DC Pulse Parameters (Fusion) (Electroporation)

High Voltage Mode

Voltage	10 – 3000 V
Pulse Length	1 – 99 µsec/ 1 µsec resolution

Low Voltage Mode:

Voltage	10 – 500 V
Pulse Length	1 – 9 pulses
Number of Pulses	0.01 – 0.99 msec/ 0.01 msec res 1 – 99 msec/ 1 msec res

Item #	Description
45-0011	Electroporation System includes ECM 2001 Generator, Safety Stand 630B , Cuvettes 1 mm, 2 mm, 4 mm, pkg. of 30 (10 each), Cuvette Rack 660
45-0012	Embryo Manipulation System includes ECM 2001 Generator Micro-Slides 450, 450-1, 453 and Connection Cable
45-0010	Electro Cell Fusion System includes ECM 2001 Generator, Micro-Slides 450, 453, Meander Fusion Chamber 454, Flat Electrode/Divergent Field 484, Electrode Adapter, Connection Cable, Safety Stand 630B Cuvettes 1 mm, 2 mm, 4 mm, pkg. of 30 (10 each), Cuvette Rack 660
45-0080	ECM 2001 Generator Only
45-0013	ENHANCER 3000 Probe, ENHANCER Interface Box, Oscilloscope with USB communications, ECM 2001 Generator, Safety Stand, Cuvettes 1 mm, 2 mm, 4 mm, pkg. of 30 (10 each) and Cables

Cables*

Item #	Description
45-0216	Micrograbber Cables
45-0217	Banana to Banana Plug, 10 ft.
45-0089	Adapter Set Banana to Square Post
45-0088	Adapter Set F/F Banana to Square Splice
45-0087	Adapter Micrograbber

** For full selection of cables see page 43.*

ECM® 830 High Throughput

HT Multi-Well Electroporation System

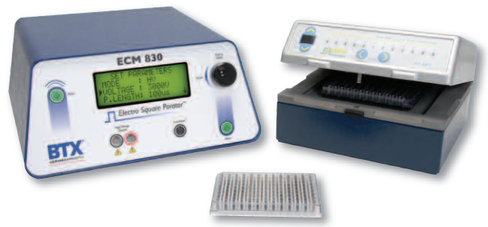


Plate Handler

The key to the HT system is the combination of the Plate Handler and Multi-Well Plates. The Plate Handler holds the HT Multi-Well Plates; much like the safety stand holds the cuvettes. It delivers the pulse(s) to the wells using parameters set in the ECM 830 generator. Specifically, the HT 200 plate handler offers the option of the delivery of multiple pulses column by column automatically.

Generator

The final component of the HT System is a BTX ECM 830 Square Wave Electroporation Generator.

Applications

- Mammalian Cells
- Primary Cells
- Stem Cells
- siRNA Libraries

The BTX High Throughput (HT) System, offers a multi-well electroporation technology for processing multiple samples in seconds. Using the HT Multi-Well plates instead of traditional cuvettes, the researcher can transition from a single cuvette to either a 96 well or 25 well electroporation plate by using one simple plate handler. This increases yields and the number of experiments runs in a single day. Experiments take seconds to run, allowing for quick and efficient optimization of the electrical and biological parameters. Once optimized, samples are rapidly processed increasing yields and saving valuable time and money.

The HT plate handler is compatible with the ECM 830 and some older ECM 830 generators (for more details regarding compatibility of your ECM 830 systems please contact BTX tech support).

The HT System is comprised of 3 components: The HT Multi-Well Plates, an HT Plate Handler and the BTX ECM 830 Generator.

HT Plates

Each HT Plate consists of either 96 or 25 individual wells with integrated electrodes. The 96-well plate assumes a traditional 96 well format i.e., 12 columns of 8 wells each. The 25-well format has 5 columns of 5 well each. Four different Multi-Well Plates are available: 96-well with 4mm gap, 96-well 2mm gap, 25-well 4mm gap and 25-well 2mm gap.

Rapid protocol optimization of transfection parameters can be obtained by loading a plate with unique experimental samples. Optimization of electrical parameters can be achieved by pulsing each column within the plate with variable electrical settings. **The same electrical settings are applied to each well within a column.**

Item #	Description
45-0421	Includes ECM 830 Generator, 4 mm gap, 2 x 96-Well Plates, Plate Seals and HT-200 Plate Handler
45-0411	Includes ECM 830 Generator, 4 mm gap, 6 x 25-Well Plates, Plate Seals and HT-200 Plate Handler
45-0452	96-Well Disposable Electroporation Plates, 4 mm gap, 250 µl, 1 plate
45-0450	96-Well Disposable Electroporation Plate, 2 mm gap, 125 µl, 1 plate
45-0462	25-Well Disposable Electroporation Plate, 4 mm gap, 250 µl, 1 plate
45-0466	25-Well Disposable Electroporation Plate, 2 mm gap, 125 µl, 1 plate
45-0463	25-Well Disposable Electroporation Plate, 4 mm, 250 µl, pkg. of 6 plates
45-0467	25-Well Disposable Electroporation Plates, 2 mm, 125 µl, pkg. of 6 plates
45-0401	HT-200 Plate Handler, Automatic Column Switching

To order these products, please contact BTX at **800-272-2775** (US) or **508-893-8999** (outside the US) or **techsupport.btx@harvardapparatus.com** or visit **www.btxonline.com** to get complete list of distributors in your area.

bacteria, yeast & fungus | plants & insects | mammalian cells | in vivo, in utero & in ovo | electrofusion | microinjection

ECM® 630 High Throughput

HT Multi-Well Electroporation System

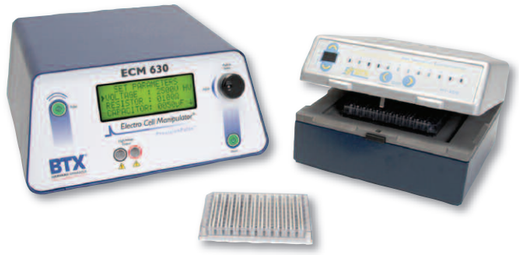


Plate Handler

The key to the HT system is the combination of the Plate Handler and Multi-Well Plates. The Plate Handler holds the HT Multi-Well Plates; much like the safety stand holds the cuvettes. It delivers a single pulse to the wells using parameters set in the ECM 630 generator. Specifically, the HT 100 plate handler applies a single pulse to each column of a plate while switching through columns is performed manually.

Generator

The final component of the HT System is a BTX ECM 630 Exponential Decay Wave Electroporation Generator.

Applications

- Bacteria
- Yeast
- Insect Cells
- cDNA Libraries

The BTX High Throughput (HT) System, offers a multi-well electroporation technology for processing multiple samples in seconds. Using the HT Multi-Well plates instead of traditional cuvettes, the researcher can transition from a single cuvette to either a 96 well or 25 well electroporation by using one simple plate handler. This increases yields and the number of experiments runs in a single day. Experiments take seconds to run, allowing for quick and efficient optimization of the electrical and biological parameters. Once optimized, samples are rapidly processed increasing yields and saving valuable time and money.

The HT plate handler is compatible with the ECM 630 including older ECM 630 generators.

The HT System is comprised of 3 components: The HT Muli-Well Plates, an HT Plate Handler and the BTX ECM 630 Generator.

HT Plates

Each HT plate consists of either 96 or 25 individual wells with integrated electrodes. The 96-well plate assumes a traditional 96 well format i.e., 12 columns of 8 wells each. The 25-well format has 5 columns of 5 well each. Four different Multi-Well Plates are available: 96-well with 4mm gap, 96-well 2mm gap, 25-well 4mm gap and 25-well 2mm gap.

Rapid protocol optimization of transformation and transfection parameters can be obtained by loading a plate with unique experimental samples. Optimization of electrical parameters can be achieved by pulsing each column within the plate with variable electrical settings. **The same electrical settings are applied to each well within a column.**

Item #	Description
45-0423	Includes ECM 630 Generator, 2 mm gap, 2 x 96-Well Plates, Plate Seals and HT-200 Plate Handler
45-0413	Includes ECM 630 Generator, 2 mm gap, 6 x 25-Well Plates, Plate Seals and HT-200 Plate Handler
45-0452	96-Well Disposable Electroporation Plates, 4 mm gap, 250 µl, 1 plate
45-0450	96-Well Disposable Electroporation Plate, 2 mm gap, 125 µl, 1 plate
45-0462	25-Well Disposable Electroporation Plate, 4 mm gap, 250 µl, 1 plate
45-0466	25-Well Disposable Electroporation Plate, 2 mm gap, 125 µl, 1 plate
45-0463	25-Well Disposable Electroporation Plate, 4 mm, 250 µl, pkg. of 6 plates
45-0467	25-Well Disposable Electroporation Plates, 2 mm, 125 µl, pkg. of 6 plates
45-0400	HT-100 Plate Handler, Manual Column Switching
45-0401	HT-200 Plate Handler, Automatic Column Switching

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systems

Enhancer 3000

Monitoring System

ECM / ENHANCER 3000 Monitoring Systems

These Systems pair electroporation methods with the advanced monitoring capabilities of the ENHANCER 3000 System. They allow complete documentation and storage of data for further review and analysis. This system is available separately for use with your existing electroporation equipment.

Specifications

Input Voltage

Common Mode:

Range	±7000 V (DC+Peak AC) or 2500 V rms at 1/100 & 1/1000

Output Voltage:

Maximum Amplitude	±7 V (into 50 kΩ load)
Offset (typical)	±5 mV
Power Requirements	4 AA batteries and AC plug adapter
Length of BNC Cable	88.9 cm (35 in)
Length of Input Leads	30.5 cm (12 in)

ENHANCER 3000 High Voltage Interface Box Specifications

Input, Output, Probe Connections:

Type	4 mm Banana Jack
Voltage	2500 V rms, 3500 V pk CAT II
Current	15 A, maximum continuous
Current (Peak)	1000 A for 100 µsec

Applications

- **Optimize and Troubleshoot Electroporation Settings**
- **Capture and Print Results for Documentation Purposes**
- **Track & Download Images to Computer for Analysis**

The BTX Enhancer 3000 offers a novel approach to monitoring critical parameters while performing electroporation applications.

The system allows researchers to maintain efficiencies, optimize both electrical and biological parameters, view sample runs, troubleshoot possible problems and easily perform routine quality control. Communications using the USB data port permits storage and documentation of data for further analysis.

The ENHANCER 3000 Monitoring System can monitor all key electroporation parameters including:

- Wave Form
- Peak Amplitude
- Field Strength
- Pulse Lengths
- Pulse Intervals
- AC duration

The electrical pulse data is captured as both a graphic display of the waveform and electrical output values following each electroporation experiment from generators w/ external pulse capability.

The ENHANCER 3000 System is comprised of three components: a Voltage Probe, an Interface Box and a digital Oscilloscope. The Voltage Probe and Interface Box together comprise the voltage monitor, while the Oscilloscope displays waveform images from the actual electrical pulse. This system offers a solution for evaluating critical electroporation settings and USB for storage and input to a computer.

Item #	Description
45-0059	Interface Box, ENHANCER 3000 Probe, Digital Oscilloscope, Communications Module and Cables
45-0057*	Interface Box, ENHANCER 3000 Probe and Cables

** Requires a digital Oscilloscope for readout of waveforms and electrical parameters.*

To order these products, please contact BTX at **800-272-2775** (US) or **508-893-8999** (outside the US) or **techsupport.btx@harvardapparatus.com** or visit **www.btxonline.com** to get complete list of distributors in your area.

bacteria, yeast & fungus | plants & insects | mammalian cells | in vivo, in utero & in ovo | electrofusion | microinjection

MicroJect 1000 Max System

Applications

- **Nuclear Transfer Applications**
- **Transgenic Animal Development**
- **Injection of Mouse, Xenopus, Zebrafish and other oocytes**
- **Intra-cytoplasmic sperm injection**
- **Cell injection**
- **Extracellular brain injections**
- **Injection of DNA, mRNA, microbeads neurotransmitters, kinases and other proteins**

The NEW! MicroJect 1000 MAX (MJ 1000) is the newest addition to our the family of BTX transfection products. The MJ 1000 MAX micro-injector is an alternative method to deliver genes, proteins, macromolecules and micro-beads by direct injection into cells, tissues and oocytes simply and efficiently. This microinjection system provides a reliable, consistent and precise delivery of volumes through stable pressure regulation maintaining this pressure for a set duration of time, controlled digitally. The compressed gas internally controlled pressure system, allows the precise delivery of desired volumes ranging from femtoliters to microliter volumes. The MJ 1000 MAX is capable of holding a cell, oocyte or early stage embryo stationary while simultaneously using a separate pressure channel for injections. The MJ 1000 MAX is versatile enough to provide the same consistent performance needed to inject large volumes into tissue such as capillaries, or pico volumes, for nuclear injections. It is also ideal for the gentle transfer of delicate fetal or stem cells into oocytes.

Pressure Control Features

- Fill/Clear/Hold

The MicroJect 1000 Max provides key pressure features designed to maximize your injection potential with two negative and three positive pneumatic capabilities. The negative pressure feature or vacuum function allows researchers the ability to fill the micropipettes from their tips. The "Fill" feature reduces waste of valuable injection material. The "Hold" feature provides the means to immobilize and manipulate a cell or oocyte using a micropipette. The positive pressure allows for the precise discharge of fluids by simply using the "Clear" function of the system.

Balance Pressure

It's all about the balance of pressure with our MicroJect 1000 MAX system. The unique "Balance" feature provides a secondary balance pressure to maintain positive pressure on the injection pipette. This is important before and after injections to avoid the chance of dilution of sample due to capillary action. It also prevents clogging of your injection needle.

Accessories

The MicroJect 1000 MAX system provides the "MAX"imum potential for your microinjection applications. The durability and precision of the MJ 1000 is coupled with two footswitches for easy operation of the Clear/Fill features. The system also includes two pipette holders and the appropriate adaptors.

Specifications

Input Gas Pressure	70 to 105 p.s.i. (480 to 720 kPa)
Injection Pressure	0.2 to 60 p.s.i. (413 kPa), regulated, multi-turn control
Balance Pressure	0.1 to 3.5 p.s.i. (68.9 kPa), regulated, multi-turn control, other ranges available upon request
Fill Vacuum	Internally produced, -12.0 p.s.i. (-82 kPa), unregulated
Holding Vacuum	Internally produced, 0 to 3 in H_2O (0 to 0.75 kPa or 0 to 0.1 p.s.i.), regulated
Clearing Pressure	Input gas pressure, unregulated
Injection Timer	0.01 to 0.99 sec in 10 msec steps; 1 to 99 sec in Pulse Width 1 sec steps
Injection Count Display	Digital, 0 through 9999
Duration Mode	Internally timed or externally gated
Time Trigger	Front panel, foot switch, or external TTL pulse (BNC)
Pressure Units	p.s.i./kPa; switch selectable
Pressure Monitor	BNC connector, 10 mV/p.s.i.
Pressure Readout	Inject, balance, clear, output port
Line Voltage	100/110/220/240 VAC
Power Usage	220 W
Meter Accuracy	0.1% full scale
Foot Switches	Inject, fill, hold, and gated; provided in Plus and Deluxe pkgs.
Weight	6.8 kg (15 lb)
Dimensions, H x W x D	11 x 38 x 25.5 cm (5 x 15 x 10 in)
Accessories Supplied	Input, output and holding hoses

Item #	Description
45-0752	MicroJect 1000 Max System includes: MicroJect 1000 pico-injector with Injection, balance, clear/fill and hold pressures. Also included are two footswitches, input/output hoses, holding hose, two pipette holders and input adaptor for hoses, power cord and manual.
45-0751	MicroJect 1000 Plus System; MicroJect 1000 pico-injector with Injection, balance, clear/fill and hold pressure. Includes one footswitch, input/output hoses, holding hose, one pipette holder and input adaptor for hoses, power cord and manual.
45-0750	MicroJect 1000 Basic System: MicroJect 1000 pico-injector with Injection, balance, clear/fill and hold pressure, power cord and manual.

Generator Specifi cations

Applications	ECM® 830 Mammalian Cell Transfection, Intact Plant Tissue and Protoplast Transformation, In Vivo and In Vitro Protein/Drug/ Gene Delivery, In Ovo Nuclear Transfer and Embryo Manipulation, Limited Bacterial and Yeast Transformations	ECM® 2001 Cell Fusion, Nuclear Transfer, Embryo Manipulation, Mammalian Transfection, Hybridoma Production, In Vivo Protein/Drug/Gene Delivery, Plant Protoplast Fusion, Limited Bacteria and Yeast Transformations
Waveform	Square	Square
AC Ranges		
Proprietary Non-Sinusoidal Wave Shape:		
Frequency	N/A	1 MHz
Voltage	N/A	0 to 75 V RMS
Duration	N/A	0 to 99 sec
Amplitude Post Fusion	N/A	1/10 of alignment current
Pause Between AC/DC	N/A	50 µsec
DC Pulse Ranges		
Voltage Range:		
LV Mode	5 to 500 V / 1 V resolution	10 to 500 V / 10 V resolution
HV Mode	505 to 3,000 V / 5 V resolution	10 to 3,000 V / 10 V resolution
Pulse Length Range:		
LV Mode	10 µsec to 999 µsec / 1 µsec resolution	0.01 to 0.99 msec / 0.01 msec resolution
LV Mode	1 msec to 999 msec / 1 msec resolution	1 to 99 msec / 1 msec resolution
LV Mode	1 sec to 10 sec / 0.1 sec resolution	N/A
HV Mode	10 to 600 µsec / 1 µsec resolution	1 to 99 µsec / 1 µsec resolution
Voltage Dependent/Internally Controlled		
Multiple Pulsing	1 to 99	1 to 9
Pulse Interval	100 msec to 10 sec	1 sec fixed
No. Cycle Repeats	N/A	0 to 9 cycles
Programmability	Storage for 3 parameters (V, t, n, interval)	N/A
Arc Control	Arc Quenching™	N/A
Safety	Generator is short circuit proof	Generator is short circuit proof
Capacitance in Micro Farads:		
LV	4,000 µF	3,900 µF
HV	111 µF	108 µF
Internal Resistance (in parallel with load) Ω		
LV	56 Ω	50 Ω
HV	56 Ω	50 Ω
Other Specifications		
Operational Status	Internal self test upon start-up	N/A
Interface	Digital User Interface	Digital Display
Input	100 to 240 VAC, 50/60 Hz	100/115 VAC, 230 VAC, 50/60 Hz
Charge Time	5 sec maximum (without delay)	10 sec maximum
Display	4 line x 20 character LCD	4 characters Digital Display LED
Controls	Single rotary knob with push button toggle to set parameters, On/Off Power and Start switches	Thumb wheel potentiometer and push button control
Electroporation Chamber	Safety Stand or Plate Handler	Microslides or Safety Stand
Monitoring	Monitoring and display of V, t, n, interval	Display of set voltage
HT (High Throughput) Multi-Well 96 or 25	Compatible	N/A
Remote Operation	Footswitch available	Automatic or manually controlled / Footswitch available
CE Marking	Yes	N/A
Dimensions (H x W x D)	14 x 31.8 x 31.1 cm (5.5 x 12.5 x 12.25 in)	27.9 x 43.2 x 39.4 cm (11 x 17 x 15.5 in)
Weight	6.8 kg (15 lbs)	21.3 kg (47 lbs)
Warranty	2 Years	2 Years
See Page	Page 22	Page 23

Applications	ECM® 630 Bacteria and Yeast Transformations, Plant Protoplast and Intact Plant Tissue Transformation, In Vitro Protein/Drug/ Gene Delivery, Mammalian Transfections	ECM® 399 Bacteria and Yeast Transformations, Limited Mammalian Transfections
Waveform	Exponential Decay	Exponential Decay
AC Ranges		
Proprietary Non-Sinusoidal Wave Shape:		
Frequency	N/A	N/A
Voltage	N/A	N/A
Duration	N/A	N/A
Amplitude Post Fusion	N/A	N/A
Pause Between AC/DC	N/A	N/A
DC Pulse Ranges		
Voltage Range:		
LV Mode	10 to 500 V / 1 V resolution	2 to 500 V / 2 V resolution
HV Mode	50 to 2,500 V / 5 V resolution	10 to 2,500 V / 10 V resolution
Pulse Length Range:		
LV Mode	N/A	N/A
LV Mode	N/A	N/A
LV Mode	N/A	N/A
HV Mode	N/A	N/A
Voltage Dependent/Internally Controlled		
Multiple Pulsing	N/A	N/A
Pulse Interval	N/A	N/A
No. Cycle Repeats	N/A	N/A
Programmability	Storage for 2 parameters (V, t, n, interval)	N/A
Arc Control	Arc Quenching™	Arc Quenching™
Safety	Generator is short circuit proof	Generator is short circuit proof
Capacitance in Micro Farads:		
LV	1 µF, 25 µF to 3,275 µF	1,050 µF
HV	25 µF and 50 µF	36 µF
Internal Resistance (in parallel with load) Ω		
LV	25 Ω to 1,575 Ω / 25 Ω resolution "None" setting to simulate alternative systems lacking resistance.	150 Ω
HV	25 Ω to 1,575 Ω / 25 Ω resolution	150 Ω
Other Specifications		
Operational Status	Internal self test upon start-up	Internal self test upon start-up
Interface	Digital User Interface	Digital User Interface
Input	100 to 240 VAC, 50/60 Hz	100 to 240 VAC, 50/60 Hz
Charge Time	5 sec maximum (without delay)	5 sec maximum (without delay)
Display	4 line x 20 character LCD	1 line x 16 character LCD
Controls	Single rotary knob with push button toggle to set parameters, On/Off Power and Start switches	Single rotary knob with push button toggle to set parameters, On/Off Power and Start switches
Electroporation Chamber	Safety Stand	PEP or Safety Stand
Monitoring	Monitoring and display of V, t, n, interval	Monitoring and display of Voltage
HT (High Throughput) Multi-Well 96 or 25	Compatible	N/A
Remote Operation	N/A	N/A
CE Marking	Yes	Yes
Dimensions (H x W x D)	14 x 31.8 x 31.1 cm (5.5 x 12.5 x 12.25 in)	10.9 x 23.1 x 19.6 cm (4.3 x 9.1 x 7.7 in)
Weight	4.5 kg (10 lbs)	3.2 kg (7 lbs)
Warranty	2 Years	2 Years
See Page	Page 21	Page 20

systems

BTXpress™ High Performance Electroporation Solution

NEW!

- **Efficient Electroporation Transfection**
  High efficiency transfection of the cell lines and previously considered "hard to transfect" cells.
- **High Cell Viability**
  Low toxicity resulting in improved cell viability.
- **Single Buffer for all Cell types**
  One buffer used in place of standard electroporation buffers for all mammalian cell types.
- **Control**
  Versatility of choosing your electroporation optimization settings for the highest transfection efficiency with BTX systems.
- **Affordability**
  Choose your size kit to fit your needs, more samples per kit with lower cost compared to competitor.

NEW! BTXpress™ High Performance Electroporation Solution

BTX, the electroporation experts, are introducing the NEW BTXpress™ High Performance Electroporation Solution. The BTXpress™ is THE solution in High Performance Electroporation. A single buffer solution developed to quickly and efficiently deliver genes into mammalian cells that were previously considered "hard to transfect" by chemical and other non-viral methods. This solution, in combination with the BTX electroporation instruments, provides researchers with the versatility and success desired with a broad range of cell types while maintaining critical cell viability. Transfection using this high performance electroporation solution is equally effective in delivering DNA as well as siRNA into mammalian cells. BTXpress™ solution is the first electroporation reagent that meets all of your high performance transfection needs without sacrificing control over your experiment or your budget. The BTXpress™ solution offers increased numbers of transfections per kit compared to our competitors providing higher value to the researcher. As a universal solution, the BTXpress™ electroporation solutions can be used in other electroporators including the Amaxa™ to deliver similar results without the typical high cost associated with these buffer kits. The BTXpress™ High Performance Electroporation Solution is offered as a kit including the BTX plus cuvettes with transfer pipettes or as a buffer alone.

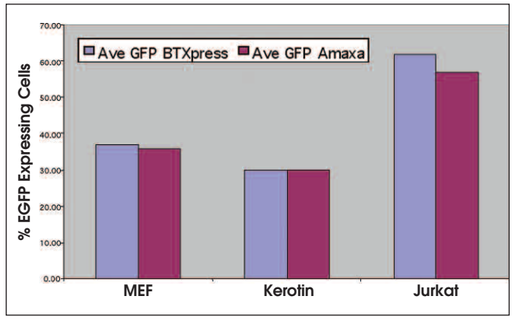


Figure 1: *BTXpress™ High Performance Electroporation Solution vs. Amaxa™ Nucleofector™. Cells were electroporated with an EGFP reporter vector in parallel, using the BTX ECM 830 Square Wave Electroporator with the BTXpress™ High Performance Electroporation Solution or using the Amaxa (Lonza) system. EGFP expressing cells were identified 24hrs post-electroporation by flow cytometery and presented as a percentage of the live cell population.*

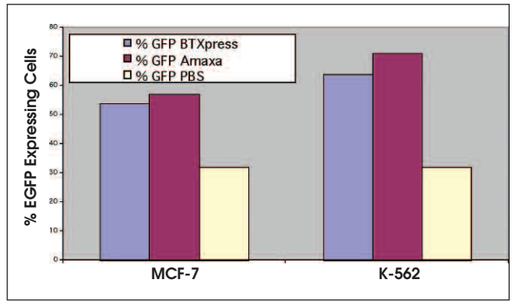
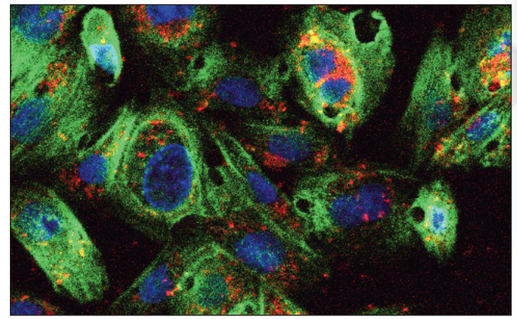


Figure 2: *BTXpress™ Solution Transfection Efficiency vs. Amaxa™: Cells were electroporated in parallel with an EGFP reporter vector using either the BTX electroporation system with BTXpress™ High Performance Electroporation Solution or PBS. In comparison to the same cells transfected in the Amaxa™ (Lonza) system using the Amaxa™ kit V solution. The EGFP expressing cells were identified 24 hrs post-electroporation by flow cytometery and presented as a percentage of the live cell population.*

Storage Conditions

Store BTXpress™ Electroporation Solution at 4°C. Store all other components at room temperature.
Components: Kits contain BTX plus cuvettes either 2mm gap or 4mm gap with transfer pipette.

Please Note: *Amaxa™ Nucleofector™ are a registered trademarks.*



BTXpress™ High Performance Electroporation Solution Efficient siRNA silencing: CHO Cells were transfected by electroporation with BTXpress™ electroporation solution with tracker Cy™ 3 labeled siRNA. Cells were fixed and counterstained to locate the nuclei (blue) and actin (green).

BTXpress™ Kits

Item #	Description
45-0803	BTXpress Solution Kit 50 Reactions in 2mm gap Cuvettes: Includes 5.0ml bottle BTXpress Solution and 5 bags of (10 cuvettes per bag), 2mm gap BTXplus cuvettes with transfer pipette.
45-0804	BTXpress Solution Kit 20 Reactions in 4mm gap Cuvettes: Includes 5.0ml bottle BTXpress Solution and 2 bags of (10 cuvettes per bag) 4mm gap BTXplus cuvettes with transfer pipette.
45-0806	BTXpress Solution Kit 100 Reactions in 2mm gap Cuvettes: Includes a 10ml bottle of BTXpress Solution and 2 bags of 50 cuvettes per bag, 2mm gap BTXplus cuvettes with transfer pipette.
45-0807	BTXpress Solution Kit 40 Reactions in 4mm gap Cuvettes: Includes a 10ml bottle of BTXpress solution and 4 bags of (10 cuvettes per bag) 4mm gap BTXplus cuvettes with transfer pipette.

BTXpress™ Solution Only

Item #	Description
45-0802	BTXpress Solution: 5.0 ml Bottle for up to 50 Reactions
45-0805	BTXpress Solution: 10 ml Bottle for up to 100 Reactions

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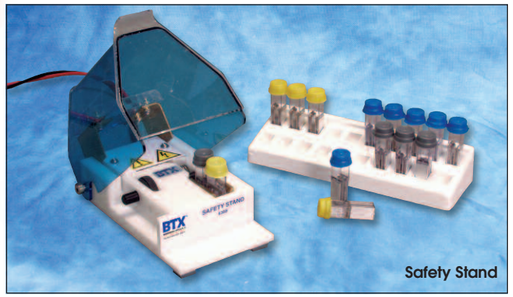
accessories

BTX Cuvette Advantage

Electroporation Accessories



Safety Stand


Cuvettes


BTX Footswitch for ECM 830

BTX Footswitch for ECM 2001

- Safety Stand and Cuvettes protect both the user and sample
- Cuvettes are compatible with most commercially available Electroporators
- Sterile Transfer Pipette included with every cuvette Plus package, allowing quick and easy removal of each sample
- Three cuvette sizes: 1 mm, 2 mm and 4 mm, are available to suit all applications
- Round, cuvette caps allow for single-hand removal and are color coded for easy recognition

Safety Stand and Disposable Cuvettes

The BTX Safety Stand is specially designed to connect to any BTX Generator allowing for the safe delivery of HV electrical pulses to cuvettes. Up to two cuvettes may be electroporated in the safety stand simultaneously. Each BTX Cuvette Plus includes a transfer pipette for the fast and easy removal of samples. The cuvette and pipette are packaged together and are gamma irradiated for sterility.

The cuvette caps are round for easy, one-handed removal and are color coded for quick identification.

The BTX Cuvette Rack holds up to 20 cuvettes in numbered positions.

Footswitch

The Footswitch allows for hands free operation of the ECM 830 and ECM 2001 Generators. This accessory is desirable when conducting in vivo / in ovo gene delivery or nuclear transfer/cloning when both hands are needed for sample manipulation.

The footswitch functions as the start button on the front of the generator.

Two types of Footswitches are available, the 1250SF model for the ECM 830 and the 2001FS model for ECM 2001 generator. Please call BTX technical support for information regardiing compatibility with older models.

BTX Cuvettes Plus

(Individually packaged cuvettes with sterile transfer pipette)

Item #	Gap Size	Package	Volume	Color	Application
45-0124	1 mm	50 each	20 – 90 µl	Gray	Bacterial
45-0125	2 mm	50 each	40 – 400 µl	Blue	Bacterial, Mammalian
45-0126	4 mm	50 each	80 – 800 µl	Yellow	Mammalian

BTX Safety Stand, Cuvette Rack & Footswitch

Item #	Description
45-0207	Safety Stand for use w/BTX Generator and BTX Cuvette Plus (Model 630B)
45-0208	Cuvette Rack, 20 Position (Model 660)
45-0211	Footswitch for ECM 830 (Model 1250FS)
45-0086	Footswitch for ECM 2001 (Model 2001FS)

BTX Bulk Case Cuvettes

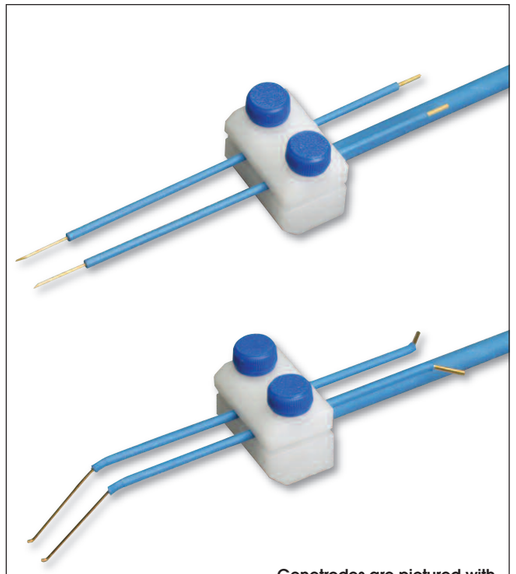
(Case contains 24 packs of 100 Cuvettes each)

Item #	Gap Size	Package	Volume	Color	Application
45-0140	1 mm	2400 each	20 – 90 µl	Gray	Bacterial
45-0141	2 mm	2400 each	40 – 400 µl	Blue	Bacterial, Mammalian
45-0142	4 mm	2400 each	80 – 800 µl	Yellow	Mammalian

accessories

Genetrodes™

In Vivo, Ex Vivo & In Ovo Electroporation


Genetrodes are pictured with Genetrode/Genepaddle Holder

Applications

- In Vivo Gene Delivery
- Ex Vivo Gene Delivery
- In Ovo Gene Delivery

BTX Genetrodes are paired, reusable, needle-style or L-shaped type electrodes that are ideal for in vivo and in ovo electroporation applications, including drug and gene delivery. Genetrodes come in five models to suit the size and shape of the target electroporation area. Each model consists of a pair of electrodes configured as either straight or bent L-shaped electrodes with gold tips.

The Electrodes are placed into target tissue following injection of the molecule of interest. An electroporation pulse is then delivered using a BTX Generator. The electric field introduced by the Genetrodes causes transient pores to form in the cells of the tissue, allowing uptake of the molecules into cells. Genetrodes are positioned in parallel at a predetermined gap in tissue using the Genetrode/Genepaddle Holder.

Specifications

Generator Compatibility	ECM 830, ECM 2001
Voltage Range	0 – 200 V DC
Pulse Length Range	10 µsec – 99 msec
Diameter	Electrode tip 0.5 mm
Genetrode Holder:	
Electrode Gap	1 – 10 mm range
Life Span	Approximately 1500+ pulses

Genetrodes*

Item #	Tip Size	Shape
45-0113*	5 mm	Straight
45-0114*	10 mm	Straight
45-0115*	5 mm	L-Shapped
45-0116*	3 mm	L-Shapped
45-0117*	1 mm	L-Shapped

Genetrode Kits**

Item #	Tip Size	Shape
45-0160**	5 mm	Straight
45-0161**	10 mm	Straight
45-0162**	5 mm	L-Shapped
45-0163**	3 mm	L-Shapped
45-0164**	1 mm	L-Shapped

Genetrode Accessories

Item #	Description
45-0203	Genetrode/Genepaddle Holder (Model 515)
45-0216	Connection Cable, Micrograbber to Banana Plug Cable
45-0217	Banana to Banana Plug, 10ft.
45-0089	Adapter Set Banana to Square Post
45-0087	Adapter Micrograbber for ECM 2001

** Requires 45-0203 Genetrodes/Genepaddle Holder and 45-0216 Connection Cable*

*** Kit Includes Genetrode Electrode, 45-0203 Genetrodes/Genepaddle Holder and 45-0216 Connection Cable*

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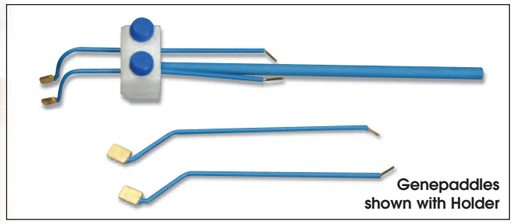
accessories

Genepaddles™

In Vitro Embryo & In Vivo Gene Delivery



Applications

- **In Vivo Gene Delivery**
- **Ex Vivo Gene Delivery**

BTX Genepaddles are designed for in vivo applications such as Gene Delivery in mouse embryo. Genepaddles are non-invasive, paddle-style, reusable electrodes suitable for a variety of applications. These electrodes are gold plated and are available in two models, each model consisting of a pair of electrodes. The electrodes are placed anterior and posterior to the embryo following injection of the molecule of interest, and then an electroporation pulse is delivered using a BTX Generator. The Genepaddles may be positioned in parallel at a predetermined gap in tissue using the Genetrode/Genepaddle Holder.

Specifications

Generator Compatibility	ECM 830, ECM 2001
Voltage Range	0 – 200 V DC (Do not use AC)
Pulse Length Range	10 µsec – 99 msec
Paddle Configuration	Rectangular, 1 mm thick
Gold Plating Thickness	0.04 mm
Genetrode Holder	Electrode gap 1 – 10 mm range, life span (depending on care) approximately 200+ sets of pulses

Genepaddle Electrodes

Item #	Paddle Size
45-0122*	3 x 5 mm
45-0123*	5 x 7 mm

Genepaddle Kits

Item #	Paddle Size
45-0169**	3 x 5 mm
45-0170**	5 x 7 mm

Genetrode Accessories

Item #	Description
45-0203	Genetrode/Genepaddle Holder (Model 515)
45-0216	Connection Cable, Micrograbber to Banana Plug Cable
45-0216	Connection Cable, Micrograbber to Banana Plug Cable
45-0217	Banana to Banana Plug, 10ft.
45-0089	Adapter Set Banana to Square Post
45-0088	Adapter Set F/F Banana to Square Splice
45-0087	Adapter Micrograbber

** Requires 45-0203 Genetrodes/Genepaddle Holder and 45-0216 Connection Cable*

*** Kit Includes Genepaddle Electrode, 45-0203 Genetrodes/Genepaddle Holder and 45-0216 Connection Cable*

Tweezertrodes™

In Vivo Drug/Gene Delivery

Applications

- **In Vivo Drug or Gene Delivery**
- **Ex Vivo Drug or Gene Delivery**
- **In Utero Drug or Gene Delivery**

The Tweezertrodes™ are reusable, tweezer style electrodes for in vivo, and in utero drug or gene delivery. Tweezertrodes™ consist of a standard 12 cm tweezer that has been modified with stainless steel or platinum circular electrodes at the tip. The gap between the electrode disks may be adjusted from under 1 mm to over 2 cm. Stainless Steel Tweezertrodes are available in two sizes 10 mm and 7 mm diameters. Our NEW! Platinum Tweezertrodes™ are available in 7 mm, 5 mm, 3 mm and 1 mm diameters. These electrodes are connected to an electroporator with the Model 524 Connection Cable, and are compatible with the BTX ECM® 830 and ECM® 2001.

Specifications

Generator Compatibility	ECM 830, ECM 2001
Voltage Range	0 – 200 V
Pulse Length Range	10 µsec – 99 msec
Monitoring	Enhancer 3000 Recommended
Autoclave	No

Platinum & Stainless Steel Tweezertrodes™

Item #	Description
45-0118*	Stainless Steel Tweezertrode Electrode, 7 mm Diameter, no Cables (Model 520)
45-0165	Stainless Steel Tweezertrode Kit, 7mm, Includes Cable (Model 520KIT)
45-0119*	Stainless Steel Tweezertrode Electrode, 10 mm Diameter, no Cables (Model 522)
45-0166	Stainless Steel Tweezertrode Kit, 10 mm, Includes Cable
45-0486	Platinum Tweezertrode, 1 mm Diameter, Includes Cables
45-0487	Platinum Tweezertrode, 3 mm Diameter, Includes Cables
45-0489	Platinum Tweezertrode, 5 mm Diameter, Includes Cables
45-0488	Platinum Tweezertrode, 7 mm Diameter, Includes Cables
45-0204	Tweezertrode Cables (Model 524)

** Needs cable 45-0204 to connect to generator*

2-Needle Array™

In Vivo Muscle Gene Therapy

Applications

- **In Vivo Drug or Gene Delivery**
- **Muscle Gene Therapy**

The BTX 2-Needle Array Electrodes are needle-style electrodes designed for in vivo drug or gene delivery applications. The electrode is available in two gap sizes, 5 mm and 10 mm. The 5 mm 2-Needle Array and Handle is recommended for small muscle masses such as mouse tibialis. The 10 mm 2-Needle Array and Handle is recommended for larger muscle masses such as rat gastrocnemius. Among the non-viral techniques for in vivo gene transfer, the direct injection of plasmid DNA into muscle is simple, inexpensive and safe.

These Electrodes are supplied in a convenient kit that includes one 2-Needle Array Handle and six 2-Needle Arrays. Components may also be purchased separately.

Specifications

Generator Compatibility	ECM 830, ECM 2001
Voltage Range	0 – 500 V
Pulse Length Range	10 µsec – 99 msec
Handle Length	8 cm (3.2 in)
Handle Material	Delrin
Needle Length	20 mm
Needle Material	Stainless Steel

2-Needle Array™ Electrode Kits

Item #	Gap Size	Handle	2-Needle Array
45-0168*	5 mm	1 each	Package 6, 5 mm gap
45-0167*	10 mm	1 each	Package 6, 10 mm gap

2-Needle Array™ Electrodes, pkg. of 6

Item #	Gap Size	Package	Sterile
45-0121**	5 mm	pkg 6	Yes
45-0120**	10 mm	pkg 6	Yes

2-Needle Array Handles Only

Item #	For Gap Size	Quantity
45-0206	5 mm	1 each
45-0205	10 mm	1 each

** Kit Includes 2-Needle Array Electrode and Handle with Cable*

*** Requires 2-Needle Array Handle with Cable*

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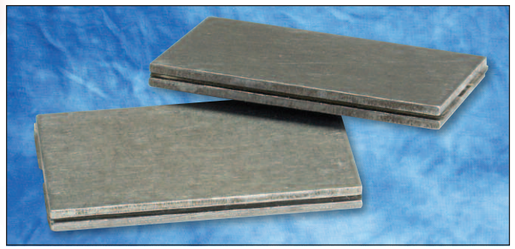
Flatpack Chambers



Applications

- **Bacterial Transformation**
- **Yeast Transformation**
- **Stem Cell Transfection**

Flatpack Chambers are primarily used for prokaryotic applications; however they are used often for high efficiency stem cell transfection as well. The one of a kind flow-through construction of the 0.56 mm gap has a volume capacity from 10 to 85 µl. This design provides the unique combination of small sample volumes with field strengths as high as 40 kV/cm. The Flatpack Chamber 1.83 mm has a three-ply solid sandwich construction of stainless steel and mylar plastic holds a volume of 1.5 ml, ideal for stems cells. Flatpack chambers are gamma sterilized in individual packages. They are provided in sets of 50 and may be used in the Safety Stand.

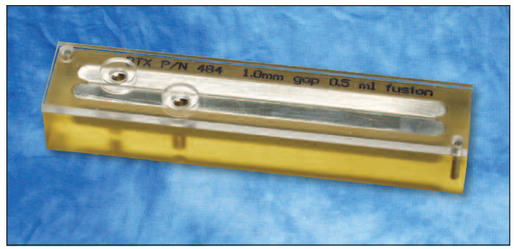
Specifications

Generator Compatibility ECM 830, ECM 2001 and ECM 630

Flatpack Chambers

Item #	Gap Size	Package	Volume
45-0109	1.83 mm	50 each	1.5 ml
45-0110	0.56 mm	50 each	80 µl

Flat Electrode for Cell Fusion



Applications

- **Cell Fusion**
- **Hybridoma Production**
- **Plant Protoplast Fusion**
- **Mammalian Cell Transfection**

The Flat Electrode can be used for both electroporation and electro cell fusion. The Flat Electrode generates either a divergent or homogeneous field depending on the orientation of the grooved electrodes.

The Flat Electrode can be oriented with the grooved sides of the electrode facing one another to generate a divergent field for use in electro cell fusion. Alternatively, it can be oriented with the flat sides facing each other providing a homogeneous field for electroporation.

The Electrode is made of two rectangular, parallel plates of high grade stainless steel that are press-fitted into a polysulfone base.

Specifications

Generator Compatibility ECM 830 and ECM 2001
Field Type Divergent or Homogeneous
Autoclavable No

Flat Electrode*

Item #	Gap	Package	Volume
45-0108*	1 mm	1 each	0.5 ml

Cable

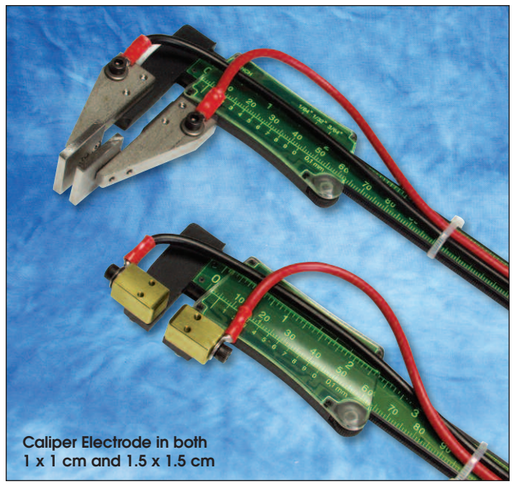
Item #	Description
45-0217	Electrode Connection Cable, Banana to Banana, 10ft.

** Requires 45-0217 Connection Cable*

To order these products, please contact BTX at **800-272-2775** (US) or **508-893-8999** (outside the US) or **techsupport.btx@harvardapparatus.com** or visit **www.btxonline.com** to get complete list of distributors in your area.

Caliper Electrodes

In Vivo Transdermal/Muscle Gene and Drug Delivery



Caliper Electrode in both 1 x 1 cm and 1.5 x 1.5 cm

Applications

- **In Vivo Drug or Gene Delivery**
- **Transdermal Applications**
- **Intact Plant Applications**

BTX Caliper Electrodes are reusable, caliper-style electrodes used for a variety of in vivo applications such as drug or gene delivery into muscle tissue, skin and whole organs. Caliper Electrodes consist of a caliper and a pair of plate electrodes.

Two models are available. The 45-0101 Calipers have 1 x 1 cm brass electrode plates and are used for smaller animals. The 45-0102 Calipers are supplied with two pairs of stainless steel electrode plates, 1.5 x 1.5 cm and 2 x 2 cm, and are used for larger surface areas. The Electrode plates on the caliper may be adjusted by using the roller mounted on the caliper.

The Electrodes clasp the target tissue area following injection of the molecule of interest. Electroporation pulses are then delivered using a BTX 830 or 2001 Generator. The electric field introduced by the Caliper Electrodes causes transient pores to form in the cells of the tissue, allowing uptake of the molecules into cells.

Specifications

Generator Compatibility ECM 830, ECM 2001
Voltage Range 0 – 500 V (depending on electrode gap)
Pulse Length Range 10 µsec – 99 msec (multiple pulsing permitted)
Electrode Gap 0.1 to 13 cm
Electrode Dimensions 1 x 1 cm brass or 1.5 x 1.5 cm and 2 x 2 cm stainless steel

Caliper Electrodes

Item #	Plate Dimensions	Material
45-0101	1 x 1 cm	Brass
45-0102	1.5 x 1.5 cm and 2 x 2 cm	Stainless Steel

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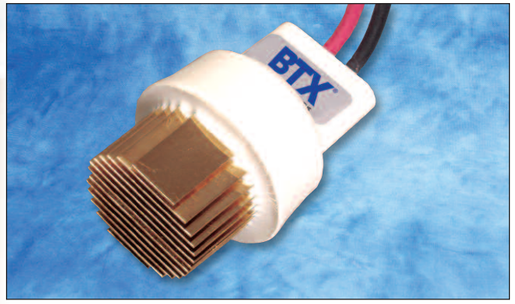
Petri Pulser™



Applications

- **Mammalian Cell Transfections, Gene Therapy, Protein or Drug Delivery**
- **Plant/Yeast Applications**

The Petri Pulser is designed for the electroporation of adherent cells in situ or as an alternative to cuvette electroporation for larger cell suspensions volumes. The electroporation of adherent cells avoids the need for chemical dissociation of cells and eliminates the problems associated with low plating efficiencies following electroporation, interruption of cell cycles and intercellular communications.

To perform electroporation, simply add the exogenous molecule of interest into the electroporation buffer. The buffer can range in volume from 1.0 ml to 3.0 ml and is added to the cells grown in the plate. The electrode is lowered into the well plate containing the sample and then pulsed.

The Petri Pulser is designed to be reusable and fits into a single well of a 6-well plate or in an individual 35 mm dish. It consists of 13 gold plated electrodes spaced 2 mm apart. The Petri Pulser can be used with most BTX Generators.

Specifications

Generator Compatibility	ECM 830, ECM 630, ECM 399 and ECM 2001
Pulse Length Range	1 µsec – 35 msec
Voltage Range	0 – 300 V
Volume Range	0.5 – 3.0 mls
Autoclavable	No
Field Type	Homogeneous
Gap Size	2 mm

Petri Pulser Electrode

Item #	Description	Volume	Electrode Material
45-0130	Petri Pusher, 2 mm gap for 6-well or 35 mm Petri Dish (Model PP35-2P)	0.5 – 3.0 ml	Gold plated

Petri Dish Electrode

Applications

- **Adherent Mammalian Cell Transfections**
- **Plant Tissue Cell Transfections**

The Petri Dish Electrode is designed to be used with a 100 mm petri dish that functions as the electroporation chamber. The Petri Dish Electrode is used to electroporate adherent cells or tissue grown in a petri dish.

To perform electroporation, simply add the exogenous molecule of interest into the electroporation buffer. The buffer can range in volume from 10 ml to 50 ml and is added to the cells grown in the plate. The electrode is lowered into the petri dish containing the sample and pulsed.

The electrode assembly has a 2 mm gap size. It contains parallel stainless steel electrodes which generate a homogeneous field. The Petri Dish Electrode is compatible with most BTX Generators.

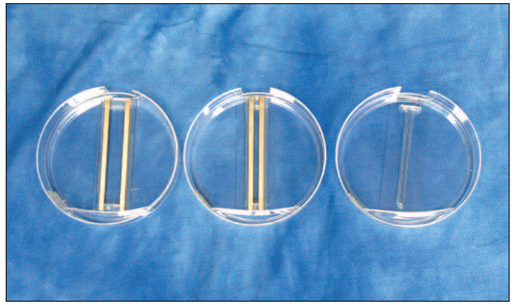
Specifications

Generator Compatibility	ECM 830, ECM 630 and ECM 2001
Voltage Range	0 – 2000 V
Volume Range	10 – 50 ml
Gap Size	2 mm
Autoclavable	No
Field Type	Homogeneous
Pulse Length	10 µsec – 10 msec

Petri Dish Electrode

Item #	Description
45-0100	Petri Dish Electrode, 2 mm Gap, for 100 mm Petri Dish (Model 366)

Microslides



Applications

- **Hybridoma Production**
- **Cell Fusion**
- **Nuclear Transfer**
- **Embryo Manipulation**
- **Plant Protoplast Fusion**
- **Oocyte Transfections**

BTX Microslides are used for cell fusion, plant protplast fusion and embryo manipulation applications. They are available in 4 gap sizes, 0.5, 1.0, 3.2 and 10 mm. The 0.5 and 1.0 mm microslides produce a divergent field of energy ideal for efficient embryo fusion. While the 3.2 and 10 mm slides provide a homogenous field for high fusion rates of hybridoma cells. The Microslides are designed to easily fit on a microscope stage to allow easy observation of the alignment of cells during electrofusion.

The Microslides are composed of a glass slide and two strips of stainless steel (wire or bar) set in a plastic petri dish.

Specifications

Generator Compatibility	ECM 830 and ECM 2001
Field Type:	
45-0103 & 45-0104	Divergent
45-0105 & 45-0106	Homogeneous
Max Voltage	500 V
Autoclavable	No

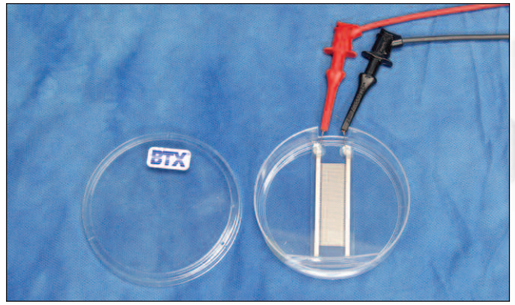
Microslides

Item #	Description
45-0103*†	Microslide*, 0.5 mm Gap, 20 µl, pkg. of 10* (Model 450)
45-0104*†	Microslide*, 1.0 mm Gap, 40 µl, pkg. of 10* (Model 450-1)
45-0105*†	Microslide*, 3.2 mm Gap, 650 µl, pkg. of 1* (Model 453)
45-0106*†	Microslide*, 10 mm Gap, 2.0 ml, pkg. of 1* (Model 453-10)
45-0216	Connection Cable, Micrograbber to Banana Plug Cable

** Requires 45-0216 Micrograbber to Banana Plug Cable for connect on 830*

† Requires 45-0087 Adapter Set to connect with 450216 when connecting to EMC 2001

Meander Fusion Chamber



Applications

- **Cell Fusion**
- **Plant Protoplast Fusion**

The BTX Meander Fusion Chamber is a novel microslide design which is specifically used for electro cell fusion. The Meander Fusion Chamber generates a divergent field and is used for fusion of mammalian cells, plant, yeast, fungi and microorganisms.

This specialty electrode is constructed of a conductive metal alloy. It has two primary bars that are connected by many tiny fingerlike projections. These projections are spaced 0.2 mm apart. This electrode is mounted on a glass slide. It is designed for direct viewing of dimer formation during alignment while under a microscope.

Specifications

Generator Compatibility	ECM 2001
Field Type	Divergent
Max Voltage:	
AC	16 V (0 – peak)
DC	480 V
Gap Size	0.2 mm
Autoclavable	No

Meander Fusion Chamber

Item #	Description
45-0107*†	Meander Fusion Chamber*, 0.2 mm Gap*, pkg. of 4 (Model 454)

** Requires 45-0216 Micrograbber to Banana Plug Cable*

† Requires 45-0087 Adapter Set for Connection to EMC 2001
(See page 43 for cables and cable description)

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Platinum Needle L-Shaped Electrode

Specifications

Generator Compatibility	ECM 830, ECM 2001
Voltage Range	0-100 Volts
Pulse Length Range	10 µsec to 100 msec
Needle Lengths	3 mm
Electrode Length	3 mm
Electrode Material	Platinum

Platinum Needle L-Shaped Electrode

Item #	Description
45-0510*	Platinum Needle L-Shaped Electrode Kit, 3 mm, Includes Cables
45-0509*†	Platinum Needle L-Shaped Electrode, 3 mm, Needle Electrode Only
45-0508	Micrograbber Adapter for Needle Electrode
45-0204	Banana Adapter Cables

** Requires 45-0508 and 45-0204 to Banana Adapter*

† Also requires 45-0088 Adapter Set, female to female for ECM 2001

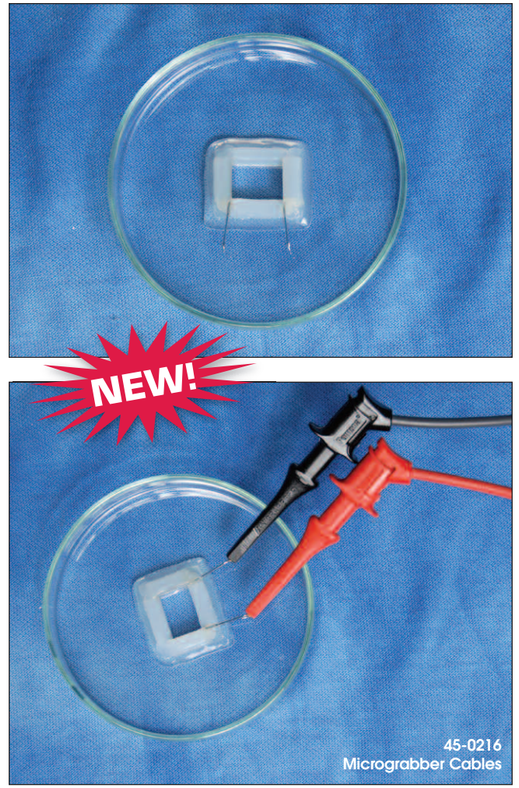
Applications

- **Ex-Vivo Tissues Gene or Drug Delivery**
- **In Vivo Tissues Gene or Drug Delivery**
- **Nuclear Transfer**

These NEW! needle style platinum electrodes are specifically designed for in vivo applications on the most fragile of tissue types, such as brain tissue. In vivo transfection of delicate brain tissue can be difficult to perform with out damage to the tissue. The ultra thin electrode enables pinpoint transfection for greater ease and efficiency in fragile or in accessible tissue. These electrodes are ideal for delivering the electrical pulses directly to oocytes or embryos for nuclear transfer fusion applications. Our L-shaped electrodes are available in 3 mm tip length in order to accommodate the most research needs in small animal models.

To order these products, please contact BTX at **800-272-2775** (US) or **508-893-8999** (outside the US) or **techsupport.btx@harvardapparatus.com** or visit **www.btxonline.com** to get complete list of distributors in your area.

Petri Dish Platinum Electrode for Tissues



Specifications

Generator Compatibility	ECM 830, ECM 2001	
Voltage Range	0-200 Volts	
Pulse Length Range	10 µsec to 100 msec	
Dimensions:		
Chamber 5mm:	**Length**	8 mm
	Width	5 mm
	Depth	3 mm
Chamber 15mm:	**Length**	10 mm
	Width	15 mm
	Depth	5 mm

Petri Dish Platinum Electrode for Tissues Kits

Item #	Description
45-0505	Petri Dish Platinum Electrode for Tissue Chamber Kit, 5 mm Includes Glass Petri Dish with Tissue Chamber 5 mm, Glass Petri Lid and Micrograbber Cables*
45-0507	Petri Dish Platinum Electrode for Tissue Chamber Kit, 15 mm Includes Glass Petri Dish with Tissue Chamber 15 mm, Glass Petri Lid and Micrograbber Cables*

Petri Dish Platinum Tissue Chamber

Item #	Description
45-0504*	Petri Dish Platinum Electrode, Chamber Only, 5 mm gap
45-0506*	Petri Dish Platinum Electrode, Chamber Only, 15 mm gap

Cables

Item #	Description
45-0216*	Micrograbber Cables (positive and negative)

** Cables required are not included*

Applications

- **Ex-Vivo Tissues Gene or Drug Delivery**

This NEW! tissue chamber is specifically designed to handle ex-vivo tissue samples that are either larger than normal or have a unique shape making it difficult to transfect using other standard electrodes. Transfection of ex-vivo tissue samples is an efficient method to deliver genes and drugs to a wide range of tissue types including cornea, muscle and skin. With the use of this chamber, transfection is made simple and easy. The chambers are available in two widths; 15mm and 5mm to accommodate many tissue sample sizes. The reusable chamber is made of a lab grade Pyrex glass petri dish and two platinum electrodes embedded in an inert silicone, creating the rectangular chamber that provides a homogeneous field of energy for high efficiencies.

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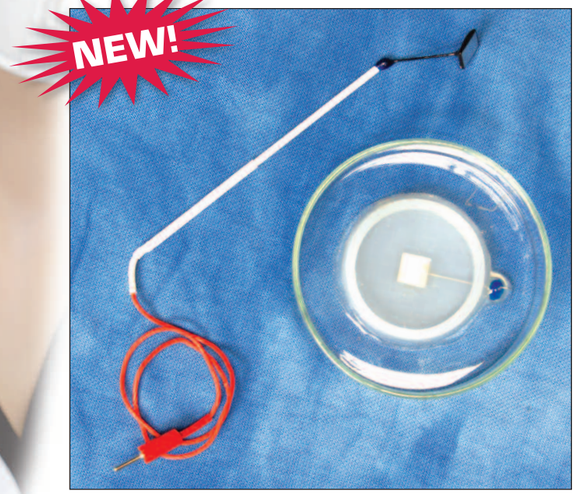
Petri Dish Platinum Electrode for Tissue Slices



Applications

• Ex-Vivo Tissues Gene or Drug Delivery

This NEW! electrode is designed for delicate and/or difficult tissue transfection. Ex vivo electropoartion is an efficient, effective method to introduce genes, drugs or any number of molecules into a tissue. A common application is mouse brain slice for studying neuronal development. This specialty electrode makes transfection quick and simple and is compatible with the BTX ECM 830 and ECM 2001 generators.

The electrode is compromised of two parts, the petri dish and wand. The petri dish contains a platinum electrode chamber to secure the tissue. The wand incorporates an identical shaped platinum electrode, which is placed over the chamber to complete electroporation. This sandwich configuration ensures a homogeneous field of energy for optimum transfection.

Specifications

Generator Compatibility		ECM 830, ECM 2001
Voltage Range		0-100 Volts
Pulse Length Range		10 µsec to 100 msec
Chamber Depth		1mm
Electrode Material		Platinum
Wand Material		Platinum
Dimensions:		
Dish Electrode:	10 mm 7 mm	10 mm x 10 mm x 1 mm 7 mm x 7 mm x 1 mm
Wand Electrode:	10 mm 7 mm	10 mm x 10 mm 7 mm x 7 mm

Petri Dish Platinum Electrode for Tissue Slices Kits

Item #	Description
45-0500*	Petri Dish Platinum Electrode for Tissue Slices Chamber Kit, 10 mm
45-0490*	Petri Dish Platinum Electrode for Tissue Slices Chamber Kit, 7 mm

** Kits include dish chamber, wand and cables*

Petri Dish Platinum Electrode Chambers and Wands

Item #	Description
45-0501**	Petri Dish Platinum Electrode Chamber Only, 10 mm, negative
45-0491**	Petri Dish Platinum Electrode Chamber Only, 7 mm, negative
45-0502***	Platinum Electrode Wand Only, 10 mm, positive
45-0492***	Platinum Electrode Wand Only, 7 mm, positive

*** Requires, 45-0502, 45-0503, 45-0504*

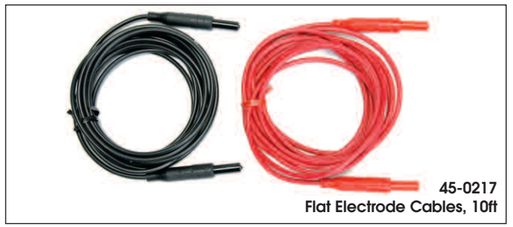
**** Requires, 45-0501, 45-0503, 45-0504*

Cables

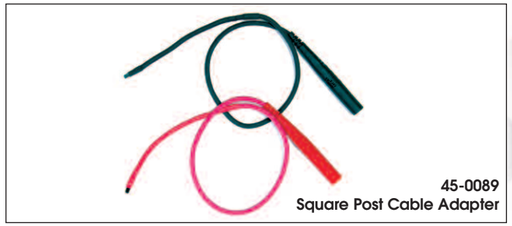
Item #	Description
45-0503	Micro-Grabber Cable for Chamber, negative
45-0511	Single Adaptor Cable for Wand

To order these products, please contact BTX at **800-272-2775** (US) or **508-893-8999** (outside the US) or **techsupport.btx@harvardapparatus.com** or visit **www.btxonline.com** to get complete list of distributors in your area.

Cables & Adapters



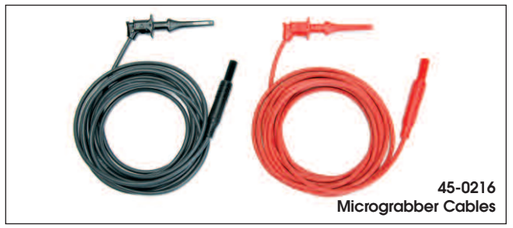
45-0217
Flat Electrode Cables, 10ft



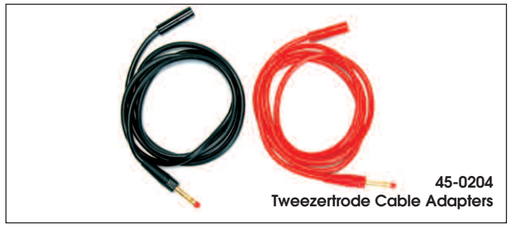
45-0089
Square Post Cable Adapter

45-0465
Well Plate Adapter

45-0083
Coaxial Cables



45-0216
Micrograbber Cables



45-0204
Tweezertrode Cable Adapters

45-0088
Female/Female Adapters

45-0087
Micrograbber Adapters

Item #	Description
45-0217	Black and red banana to banana cables 10ft in length. Used with flat electrode.
45-0465	The 25 well plate adaptor for plate handler HT 200 and HT 100.
45-0216	A pair of black and red micrograbber to banana plugs cables, 10ft length. Used for microslides, genetrodes, genepaddles and tissue petri dish.
45-0088	Black and Red female/female adaptors for banana plug cables.
45-0087	A pair of black and red micrograbber adaptors for banana plug cables. Used with cables 45-0217 and ECM 2001 coaxial banana plug cables for all micrograbber, genetrode, genepaddle and Tissue petri dish.
45-0089	A pair of red and black square post adaptor to banana plugs cables. Used with cable 45-0217 and 45-0052 for connecting to genetrodes and genepaddles.
45-0083	A pair of coaxial to banana plug cables both black and red, 10ft long. Connector cables for the ECM 2001 unit.
45-0204	A pair of red and black adaptor banana plug cables for Tweezertrode electrodes.

Warranty Information

BTX/Harvard Apparatus warranties BTX ECM® Generators, and HT plate handlers for a period of 2 (two) years from the date of purchase, Enhancer 3000 models for a period of 1 (one) year from the date of purchase and all other accessories and electrodes for a period of 90 (ninety) days from the date of purchase. At its option, BTX/Harvard Apparatus will repair or replace the unit if it is found to be defective as to workmanship or materials. This warranty does not extend to any instrumentation which has been (a) subjected to misuse, neglect, accident or abuse, (b) repaired or altered by anyone other than BTX/Harvard Apparatus without BTX/Harvard Apparatus' express and prior approval, (c) used in violation of instructions furnished by BTX/Harvard Apparatus. This warranty extends only to the original customer purchaser. Failure to use the Enhancer 3000 High Voltage Probe to connect a BTX ECM® Generator to an external digital oscilloscope for monitoring will result in the voiding of this warranty; connecting directly to the external monitoring equipment or modified monitoring setup will damage the Generator. **IN NO EVENT SHALL BTX/HARVARD APPARATUS BE LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES.** Some states do not allow exclusion or limitation of incidental or consequential damages so the above limitation or exclusion may not apply to you. THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY, OR FITNESS FOR A PARTICULAR USE, OR OF ANY OTHER NATURE. Some states do not allow this limitation on an implied warranty, so the above limitation may not apply to you. Without limiting the generality of the foregoing, BTX/Harvard Apparatus shall not be liable for any claims of any kind whatsoever, as to the equipment delivered or for non-delivery of equipment, and whether or not based on negligence. Warranty is void if the ECM® Generator is changed in any way from its original factory design or if repairs are attempted without written authorization by BTX/Harvard Apparatus. Warranty is void if parts, connections or cell fusion chambers not manufactured or approved by BTX/Harvard Apparatus are used with the BTX units.

If a defect arises within the warranty period, promptly contact BTX/Harvard Apparatus, 84 October Hill Road, Building 7, Holliston, Massachusetts, USA 01746-1388 using our toll free number **1-800-272-2775** (US Only) or **508-893-8999** (E-mail: **techsupport.btx@harvardapparatus.com**). **Goods will not be accepted for return unless an RMA (Returned Materials Authorization) number has been issued by our customer service department.** The customer is responsible for shipping charges. Please allow a reasonable period of time for completion of repairs or replacement and return. If the unit is replaced, the replacement unit is covered only for the remainder of the original warranty period dating from the purchase of the original device. This warranty gives you specific rights, and you may also have other rights, which vary from state to state.

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