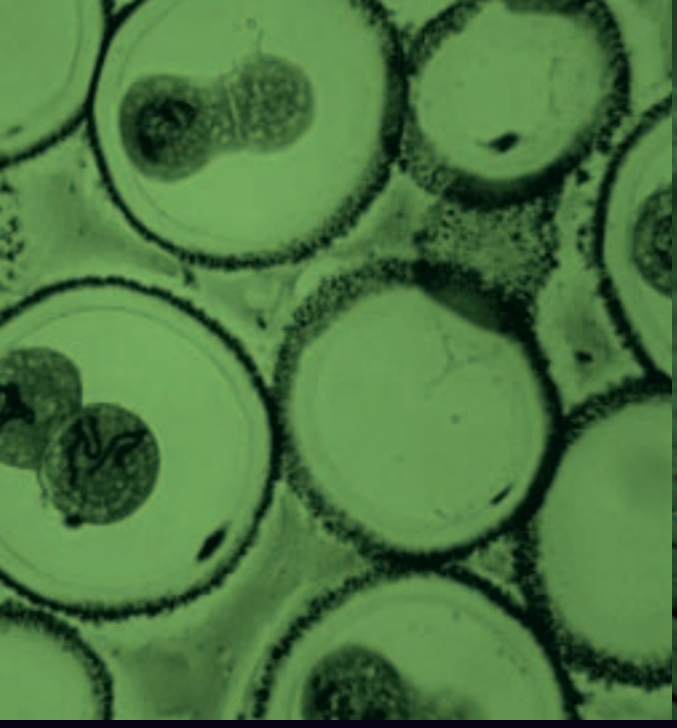

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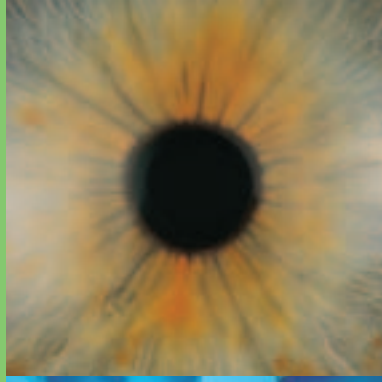
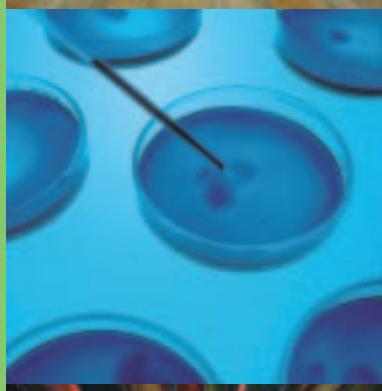
Gene Pulser Xcell™ System

BIO-RAD

An exceptional system for excellent results

The Gene Pulser Xcell is a flexible, modular pulse delivery system that uses exponential or square-wave pulses to deliver the pulses optimal for your cell type.





Innovative Modular Design for Every Cell Type

The modular Gene Pulser Xcell system is built upon the main unit. The CE module contains the low-voltage capacitors required for mammalian cells and plant protoplasts. The PC module contains the resistors needed for high-voltage electroporation. The system is available in three combinations.

Gene Pulser Xcell Total System

The total system includes both the PC module and the CE module and provides full capability to electroporate both eukaryotic and prokaryotic cells using either exponential or square-wave pulses.

Gene Pulser Xcell Eukaryotic System

Consisting of the main unit and the CE module, the eukaryotic system enables electroporation of mammalian cells and plant protoplasts. With a range of 25–3,275 µF, the CE module provides a means of controlling the capacitance of the circuit by increasing the time constant of the pulse. For square-wave pulses, the CE module provides the large capacitor necessary for delivering a square-wave pulse into low-resistance media.

Gene Pulser Xcell Microbial System

Consisting of the main unit and the PC module, the microbial system enables electroporation of bacteria and fungi, as well as other applications where high-voltage pulses are applied to samples of small volume and high resistance. By placing resistors in parallel with the sample, the PC module controls the resistance of the circuit, providing a means of reducing the time constant of an exponential decay pulse.

Introducing the Gene Pulser Xcell system

Performance Features

- Provides both exponential and square waveforms
- Supports electroporation of all cell types, prokaryotic and eukaryotic
- Uses Bio-Rad's patented* PulseTrac™ circuitry to ensure reproducible results
- Intuitive user interface allows easy programming
- Modular design offers value and flexibility for changing research needs
- Delivers up to 3,000 V
- Unique ShockPod™ shocking chamber enables one-handed operation

Programming Capabilities

- User-friendly digital interface for easy, intuitive programming and display of all experimental parameters
- Preoptimized programs for frequently used microbial and mammalian cell lines
- Manual programming enables entry or editing of all parameters for exponential or square wave, or assisted programming using the time constant required
- Optimization protocol enables the best conditions to be determined using incremental voltage steps
- Provides delivery parameters of time constant, actual volts given, pulse interval, and pulse time depending on the waveform chosen
- User method storage for 144 programs
- Storage and recall of pulse parameters and results for previous 100 experiments

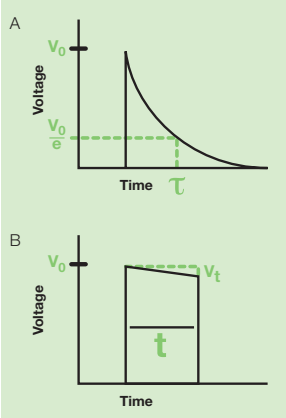
* US patents 4,750,100 and 4,910,140

Exponential and Square-Wave Pulses

Both exponentially decaying and square-wave pulses have been used very effectively for electroporation and electrofusion. The shape of the electroporation wave can have a significant effect on the transformation efficiency of different cell types. The Gene Pulser Xcell system generates both exponential and square waveforms, enabling you to choose the waveform and protocol that will work best for your cells.

Exponential Decay

The chosen voltage is released from the selected capacitor and decays rapidly (exponentially) over time (ms). The delivered pulse is characterized by two parameters, the field strength (E, expressed in kV/cm) and the time constant (τ). The field strength is controlled by adjusting the voltage on the Gene Pulser Xcell system for a known electrode distance. Resistance and capacitance can also be selected using the Gene Pulser Xcell interface. Alternatively, if you specify the time constant and voltage required, the instrument will set these values for you. Following the pulse, the instrument will display values for the actual volts delivered and the time constant.



A, exponential decay pulse from a capacitance discharge system. When a capacitor, charged to an initial voltage V_0, is discharged into cells, the voltage applied to the cells decreases over time according to the equation $V = V_0 e^{-(t/RC)}$, so that at time $t = \tau$, the voltage is V_0/e of the initial value.

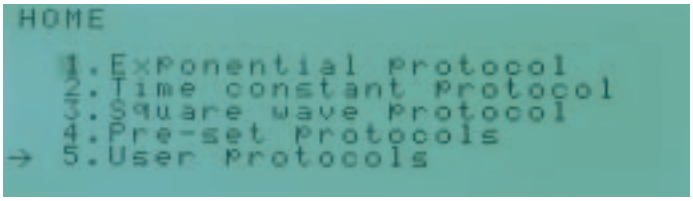
B, square-wave pulse from a capacitance discharge system. The pulse length, t, is the time the cells are subjected to the discharge voltage. The initial voltage, V_0, decreases with time so that at any time t, the voltage to the cells is given by the equation $V_t = V_0 e^{-(t/RC)}$.

Square Wave

For some cell lines, particularly sensitive lines that are easily killed using exponential decay waves, square waves offer increased efficiency and viability. Square-wave pulses are characterized by the voltage delivered, the length of each pulse, the number of pulses, and the length of the interval between pulses. All of these parameters can easily be set using the Gene Pulser Xcell interface. Following the pulse, the instrument will display the actual volts delivered, the pulse time, and the interval time when multiple pulses are used.

User-Friendly Interface

The graphical interface on the main unit controls all functions, including those of any connected accessory modules. The interface consists of a single screen with function keys and an alphanumeric keypad. Programming is simple and intuitive using onscreen prompts. The screen is used for programming, and to display stored and preset protocols, parameters delivered, and a graphic of the pulse waveform. The screen will go into sleep mode after several minutes, and can be restored by touching any key.



All of the programs are easily accessed from the Home screen.

Reliable and Safe Performance With PulseTrac Circuitry

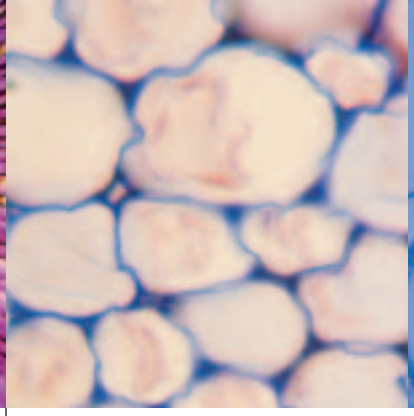
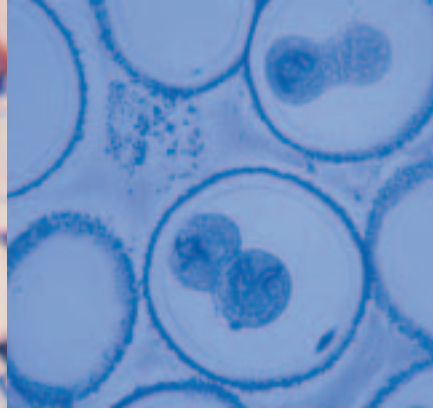
Microprocessor-controlled circuitry ensures that only the highest-quality electroporation pulses are consistently delivered while offering maximum sample protection. The PulseTrac system monitors and adjusts for the total resistance and capacitance of the complete circuit, including the sample in the cuvette, to provide accurate delivery.

The PulseTrac System

- Facilitates capacitor recalibration to maintain accurate pulse specification, correcting for capacitor drift that occurs over time
- Provides prepulse sample resistance measurement
- Reduces the risk of arcing in the high-voltage circuit, protecting both instrument and sample
- Tightens the already rigorous precision of the low-voltage capacitors in the CE module from 20 to 10%
- Enables safe, automatic discharge of current if the pulse or circuit is interrupted
- Provides user-selected calibration and capacitor measurement

User Method Storage

Everybody has favorite methods for electroporating specific cell types. The method storage program enables 12 users to each store 12 programs. The programs can be saved by name using the alphanumeric keypad.

Preset Programs for Commonly Used Microbial and Mammalian Cells

The Gene Pulser Xcell system presents specific preoptimized parameters for the most frequently used cell lines.

Preset programs are available for the following cell lines:

Mammalian Cells	Bacterial Cells	Fungal Cells
CHO	*E. coli*	*S. cerevisiae*
COS7	*A. tumefaciens*	*P. pastoris*
3T3	*P. aeruginosa*	*C. albicans*
293	*S. aureus*	*S. pombe*
HeLa	*B. cereus*	*D. discoideum*
BHK21	*S. pyrogenes*	
A549	*L. plantarum*	
CV1		
K562		
HL60		
Jurkat		
HuT78		

Detailed parameters can be found for each of these cell lines, together with details for the preparation of electrocompetent cells, in the Gene Pulser Xcell instruction manual or on the Bio-Rad web site.

Optimization Protocol

Optimal conditions need to be determined for each new experimental system by using a series of preliminary experiments to determine the optimal pulse parameters. The optimization protocol will enable you to determine the best conditions using incremental voltage steps.

Why Electroporation?

Electroporation is a powerful, highly efficient technique for introducing nucleic acids and other molecules into a wide variety of cells. A high-intensity electrical field transiently permeabilizes the membrane, enabling uptake of exogenous molecules from the surrounding medium. This technique has been used to introduce nucleotides, DNA and RNA, proteins, carbohydrates, dyes, and virus particles into prokaryotic and eukaryotic cells. Electroporation provides a valuable and effective alternative to other physical and chemical methods of transfection.

Bulletins and Electroprotocols

Bulletins describing methods for electroporating a variety of prokaryotic and eukaryotic cell types are available. Electroprotocols provide access to methods from scientists worldwide who use the Gene Pulser® systems in their research. These can be found online at **www.bio-rad.com/genetransfer/**. In addition, protocols described using any other electroporation instrument can be used or adapted for the Gene Pulser Xcell system. For further assistance, please contact your local Bio-Rad representative.

Cuvettes

Reproducible electroporation results require high-quality electroporation cuvettes for consistent pulse delivery to your valuable sample.

Bio-Rad Cuvette Features

- High-quality construction for consistent performance
- Sterility ensured by gamma irradiation
- Color-coded caps for easy identification
- Availability in various package sizes

Electro-Competent Cells

Bio-Rad's EP-Max™10B and EP-Max10B F' cells are perfect for the most demanding applications where consistent, high-efficiency transformations are critical to experimental success. EP-Max10B T1-resistant cells maintain the *ton*A marker, for added protection from T1 and T5 phage infections.

EP-Max Features

- Blue-white screening
- Efficiencies >1 x 10^{10} CFUs/µg DNA
- Accepts methylated DNA
- *rec*A and *end*A mutations for high-quality plasmid preps

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Specifications

Gene Pulser Xcell Total System

For prokaryotic and eukaryotic cells; includes main unit, CE module, PC module

Outputs	Waveform: Exponential decay or square wave Voltage: 10–3,000 V
Capacitance	At 10–500 V: 25–3,275 µF in 25 µF increments At 500–3,000 V: 10, 25, 50 µF
Resistance (parallel)	50–1,000 Ω in 50 Ω increments, plus infinity
Sample resistance	20 Ω minimum at 10–2,500 V 600 Ω minimum at 2,500–3,000 V
Square-wave timing	At 10–500 V: 0.05–100 ms pulse length, 1–10 pulses, 0.1–10 sec pulse interval At 500–3,000 V: 0.05–5 ms pulse length, 1–2 pulses, 5–30 sec pulse interval

Gene Pulser Xcell Eukaryotic System

For mammalian cells and plant protoplasts; includes main unit, CE module; outputs same as total system without the parallel resistance

Gene Pulser Xcell Microbial System

For bacteria and fungi; includes main unit, PC module

Outputs	Waveform: Exponential decay or square wave Voltage: 200–3,000 V
Capacitance	10, 25, 50 µF
Resistance (parallel)	50–1,000 Ω in 50 Ω increments, plus infinity
Sample resistance	20 Ω minimum at 200–2,500 V 600 Ω minimum at 2,500–3,000 V
Square-wave timing	0.05–5 ms pulse length, 1–2 pulses, 5–30 sec pulse interval

Gene Pulser Xcell Main Unit

Outputs	Waveform: Exponential decay or square wave Voltage: 200–3,000 V
Discharge capacitance	10, 25, 50 µF
Sample resistance	20 Ω minimum at 200–2,500 V 600 Ω minimum at 2,500–3,000 V
Square-wave timing	0.05–5 ms pulse length, 1–2 pulses, 5–30 sec pulse interval

General

Input voltage	100–120 VAC or 220–240 VAC, 50/60 Hz
Power	Maximum 240 W (during short charging periods)
Operating environment	Temperature 0–35°C, humidity 0–95% (noncondensing)
Regulatory	Safety EN 61010, EMC EN61326 Class A
Dimensions	Main unit: 31 x 30 x 14 cm, 6.6 kg CE module: 31 x 28 x 9 cm, 3.1 kg PC module: 31 x 28 x 5 cm, 1.9 kg

Ordering Information

Catalog #	Description
165-2660	Gene Pulser Xcell Total System, 100/240 V, 50/60 Hz, includes main unit, CE module, PC module, ShockPod shocking chamber, 15 sterile cuvettes (5 each of 0.1, 0.2, and 0.4 cm gap), instructions
165-2661	Gene Pulser Xcell Eukaryotic System, 100/240 V, 50/60 Hz, includes main unit, CE module, ShockPod, 5 sterile cuvettes (0.4 cm gap), instructions
165-2662	Gene Pulser Xcell Microbial System, 100/240 V, 50/60 Hz, includes main unit, PC module, ShockPod, 10 sterile cuvettes (5 each of 0.1 and 0.2 cm gap), instructions
165-2666	Gene Pulser Xcell Main Unit, 100/240 V, 50/60 Hz, includes instructions
165-2667	Gene Pulser Xcell CE Module, 25–3,275 µF range controlled by main unit, includes integral leads, 5 sterile cuvettes (0.4 cm gap)
165-2668	Gene Pulser Xcell PC Module, 50–1,000 Ω range controlled by main unit, includes integral leads, 10 sterile cuvettes (5 each of 0.1 and 0.2 cm gap)
165-2669	ShockPod Shocking Chamber, includes integral leads for connection to Gene Pulser Xcell, Gene Pulser II, or MicroPulser™ electroporators

Related Products and Information

TransFectin™ Lipid Reagent

Liposomal transfection provides researchers with a powerful yet cost-effective way to introduce nucleic acids to a broad range of mammalian cell lines. This technology uses cationic lipids to bind or "complex" with nucleic acids, producing a condensed macromolecule that is delivered to the cell. TransFectin lipid reagent gives customers the ability to transiently transfect both adherent and suspension cell cultures. TransFectin yields high-efficiency transfections with excellent expression levels.

XenoWorks™ System

XenoWorks is a complete line of instrumentation designed for the rigorous demands of the latest microinjection and micromanipulation techniques. The system features ergonomic height-adjustable joystick controls, micromanipulator position memories, and variable movement radius. Microinjection, whether the delivery of DNA solution to a zygote's pronucleus or insertion of embryonic stem cells into a blastocyst, can be achieved with a level of control previously unattainable with conventional instruments.

Biolistics

Biolistic technology, or particle bombardment, is a direct physical method of delivering nucleic acids or other molecules into cells. The Helios® gene gun and the PDS-1000/He™ systems provide easy-to-use, rapid, versatile gene delivery that is independent of cell type, requires small amounts of DNA, and requires few cells. This technology can be applied in vivo or in vitro to the widest range of targets, including cell cultures, tissues, organs, plants, and animals. These instruments effectively use a helium pulse to accelerate high-density gold or tungsten particles, coated with nucleic acids, directly into the target cells.

Electroporation

Electroporation is a highly efficient technique for introducing nucleic acids, proteins, and other molecules into a wide variety of cells. The Gene Pulser Xcell™ electroporator is a flexible, modular system that delivers exponential or square-wave pulses optimal for your cell type. With an intuitive interface, fully manual setting, preset programs, and "optimize" capability, the Gene Pulser Xcell electroporator provides power and reliability. For more routine high-throughput bacterial or fungal applications, the MicroPulser™ electroporator provides simple, efficient, reproducible delivery.

Competent Cells

The most commonly used competent cells are genetically modified *E. coli* strains. While these cells have genetic characteristics that support routine cloning applications, they do not naturally take up DNA. These cells can be made competent by either chemical/heat shock treatment or by electroporation methods. Bio-Rad's EP-Max electro-competent and C-Max™ chemi-competent cells provide researchers with the highest-efficiency competent cells. EP-Max cells complement Bio-Rad's high-quality electroporation cuvettes and electroporation instruments, ensuring both consistency and high efficiency in bacterial transformations.

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Bio-Rad Laboratories, Inc.

Life Science Group

Web site *www.bio-rad.com* ***USA*** *(800) 4BIORAD* ***Australia*** *02 9914 2800* ***Austria*** *(01)-877 89 01* ***Belgium*** *09-385 55 11* ***Brazil*** *55 21 2527 3454* ***Canada*** *(905) 712-2771* ***China*** *(86-21) 63052255* ***Czech Republic*** *+ 420 2 41 43 05 32* ***Denmark*** *44 52 10 00* ***Finland*** *09 804 22 00* ***France*** *01 47 95 69 65* ***Germany*** *089 318 84-177* ***Hong Kong*** *852-2789-3300* ***Hungary*** *36 1 455 8800* ***India*** *(91-124)-6398112/113/114, 6450092/93* ***Israel*** *03 951 4127* ***Italy*** *39 02 216091* ***Japan*** *03-5811-6270* ***Korea*** *82-2-3473-4460* ***Latin America*** *305-894-5950* ***Mexico*** *55-52-00-05-20* ***The Netherlands*** *0318-540666* ***New Zealand*** *64 9 415 2280* ***Norway*** *23 38 41 30* ***Poland*** *+ 48 22 331 99 99* ***Portugal*** *351-21-472-7700* ***Russia*** *7 095 721 1404* ***Singapore*** *65-6415 3188* ***South Africa*** *00 27 11 4428508* ***Spain*** *34 91 590 5200* ***Sweden*** *08 555 12700* ***Switzerland*** *061 717-9555* ***Taiwan*** *(8862) 2578-7189/2578-7241* ***United Kingdom*** *020 8328 2000*