

**1 keV to 30 keV**  
**Medium Energy, Small Spot Size Electron Beams**

**FOR USE IN:**

- Surface Physics
- Vacuum Physics Experiments

**FEATURES / OPTIONS:**

- New Modular Design
- Photo Emission Option
- Internal Alignment while in Operation
- Electrostatic Focusing
- Quadrupole Alignment
- Octopole Deflection / Raster / Stigmator
- Beam Blanking
- Inline Faraday Cup
- Internal Magnetic Shielding
- Differential Pumping
- Small Spot Down to 25  $\mu\text{m}$
- Beam Current 1 nA to 10  $\mu\text{A}$
- UHV Compatible / Bakeable
- Computer / Remote Control
- User-Replaceable Firing Units



*EMG-4193 Electron Gun, 4.5" CF Mounting Flange*

The Kimball Physics EMG-4193 Electron Gun, with its matching EGPS-4190 Power Supply and COPS-4190 Column Optics unit is a medium power Electron Gun for surface physics applications and general vacuum physics research. It is a complete subsystem ready to attach to the user's vacuum system and turn on.

Both beam current and beam energy are independently adjustable over wide ranges; the energy from 1 keV to 30 keV and current from 1 nA to 10  $\mu\text{A}$ . The beam divergence is also directly controllable.

The gun uses a lanthanum hexaboride ( $\text{LaB}_6$ ) cathode to provide a small spot size, down to 25  $\mu\text{m}$ . A constant emission can be maintained by a control grid which is varied by electronic feedback. The  $\text{LaB}_6$  cathode can have a lifetime in the thousands of hours. The beam can be rastered for imaging of the target.

The gun's adjustable optics include two

focusing lenses as well as three quadrupole alignment and two octupole deflection elements. The gun also features an adjustable feedthrough assembly that allows mechanical alignment of the firing unit while the gun is in operation.

The gun has a blander element which diverts the electron beam into an in-line Faraday cup. This system is used to measure the beam current in the column. The blander provides a means of cutting off the beam while the gun is running and could also be used for pulsing.

UHV technology is used throughout. The gun may be completely disassembled for cleaning and repair. The cathode firing unit assembly (including the cathode, cathode-mount, and Wehnelt aperture) is user replaceable. The cathode is not damaged by repeated exposure to atmospheric gases or water vapor when cold. The gun can be run in vacuums from  $10^{-11}$  torr to  $10^{-7}$  torr. The system is bakable, with

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details provided in the specification table.

The EGPS-4190/COPS-4190 Electron Gun Power Supply system features a modular design with miniaturized power supply clusters, optically isolated signals, and the FlexPanel digital interface controller. The EGPS-4190 and COPS-4190 Column Optics units contains all power supplies necessary to generate the required voltages to run an EMG-4193 Electron Gun.

The power supplies present in the EGPS-4190 and COPS-4190 units include Beam Energy, Condenser Lens 1, Objective Lens 2, and Blanker, as well as the supplies that float at the negative high voltage, including Source and Grid, Aperture Alignment Quadrupole X & Y, Lens Alignment Quadrupole 1 X & Y, Lens Alignment Quadrupole 2 X & Y, Deflection Octupole 1 X & Y, Deflection Octupole 2 X & Y. For rastering, the octupole deflection is varied by computer-generated cyclical signals.

The FlexPanel provides a digital display screen and a keypad for programming control on the front panel. Rear panel connectors allow remote /computer control and metering of all gun power supplies. A RS-232 or RS-422/485 and mini-USB serial port and an analog input/output connector are included on standard power supply units. All common computer interface bus types can be considered by use of appropriate digital to analog converters.

An optional LabVIEW™ computer program designed for the EMG-4193 is available for remote computer control and metering.

Software is available in two options: 1) National Instrument DAQ modules and the 50-pin connector on the EGPS-4190, or 2) via a simple serial connector interface. The program provides a virtual graphic user interface panel of controls and real-time metering on the user's computer screen.



*A typical lab set-up of a complete Kimball Physics system with power supplies, electron gun, and optional computer control system.*

EMG-4193 ELECTRON GUN SPECIFICATIONS	
BEAM ENERGY	1 keV to 30 keV (Independently adjustable)
BEAM CURRENT	1 nA to 10 $\mu$ A (Independently adjustable) *See Notes 2.
ENERGY SPREAD	0.4 eV cathode thermal spread, calculated
SPOT SIZE	25 $\mu$ m to 500 $\mu$ m
WORKING DISTANCE	30 mm to 200 mm
BEAM DEFLECTION	Two octupole deflection elements: $\pm$ 1 mm max deflection at 30 mm working distance at 30 keV (scales larger at lower energies)
RASTER	Deflection raster size: $\pm$ 1 mm by 1 mm area at 30 mm working distance, raster frequency up to 10 kHz
PULSE CAPABILITY (using appropriate pulse generator, not included)	Optional Dual Grid Power Supply: pulse width 2 $\mu$ s to DC, rise/ fall 500 ns, rep rates to 5 kHz (TTL required)
BEAM BLANKING	Optional: Pulse width 2 $\mu$ sec to DC at rep rate to 5 kHz Capacitive pulsing - pulse width to 20 ns
BEAM UNIFORMITY	Gaussian
FIRING UNIT	Customer-replaceable Firing Unit includes precision-aligned cathode and Wehnelt (G-1) assembly
CATHODE TYPE	Custom Lanthanum hexaboride (LaB <sub>6</sub> ) ES-423 25 $\mu$ m flat. Cathodes not harmed by repeated exposure to atmospheric gases while cold
FARADAY CUP	Faraday cup detector in-line, used with blanker
SHIELDING	Full internal mu-metal magnetic shielding
INTERNAL GUN ALIGNMENT	Adjustable Feedthrough for mechanical alignment of firing unit while gun is operating
MOUNTING	4½ inch CF flange, optional conversion adaptor for mounting to larger flanges
DIFFERENTIAL PUMPING	4½ inch port for pump and 2¼ for ionization gauge Optional pump: Varial Turbo-V81 M with controller Optional gauge: Granville-Phillips 356 Micro-Ion Module
INSERTION LENGTH	156 mm standard; varies with mounting adaptor
GUN DIMENSIONS	Gun length: 396 mm outside vacuum, sealing surface to end of cable connector Gun diameter: 144 mm at pumping ports, 180 mm across quad connectors.
FEEDTHROUGHS	Multi-pin brazed ceramic, threaded stainless steel shell
CABLES / CONNECTORS	Multi-conductor 30 kV high voltage fully ground-shielded cable, 25 kV lens cables, and low voltage deflection cables, coaxial blanker cable, with mating aluminum connectors, to connect gun and power supply. Standard lengths: 3 m, Optional: 5 m
MAXIMUM BAKEOUT	350°C with cables removed Exceptions: 65°C with Faraday Cup (unless removed)

EGPS-4190 / COPS-4190 POWER SUPPLY SPECIFICATIONS	
OUTPUT	All necessary voltages to drive the EMG-4193 Electron Gun
ENERGY SUPPLY STABILITY	<0.01% per hour with 0.05% RMS ripple at full output
BEAM STABILITY	$\pm$ 0.1% per hour with Emission Current Control or $\pm$ 10% per hour after warm-up without ECC
CONTROLS	FlexPanel controls: Energy, Source, Grid, Emission Current Control, Lens1 (condenser), Lens2 (objective), Blanker, Aperture Align Quad X&Y, Lens Align Quad1 X&Y, Lens Align Quad2 X&Y, Deflection Octopole1 X&Y, Deflection Octopole2 X&Y, Raster Frequency, Raster Size, Raster Duty Cycle, Stigmator V1, Stigmator V2
METERING	FlexPanel digital meters: Energy, Source Voltage, Source Current, Emission Current, Grid, Lens 1 (condenser), Lens2 (objective), Aperture Align Quad X & Y, Lens Align Quad 1 X & Y, Lens Align Quad 2 X & Y, Faraday Cup Current, Beam Stop Current, Blanker Optional Ionization Gauge meter
COMPUTER/REMOTE CONTROL & METER	Power supplies: 0 to +10 V (-10 V to +10 V, quadrupoles and octupoles) Metering: 0 to +2 V (-2 V to +2 V, quadrupoles and octupoles) Standard 50-pin connector for analog input/output and RS-232 and USB serial port (RS-422 or RS-485 available, if specified at time of order)
SOFTWARE	National Instruments LabVIEW™ file, designed to run with RS-232 and USB serial connections and NI DAQ modules.
INPUT	115 VAC or 230 VAC, 50 to 60 Hz single phase, 250 VA
ENVIRONMENT	Temperature: 0 to 40°C, Relative humidity: 0 to 75% RH non-condensing, Classified as a pollution degree 2, installation category (overvoltage category) II environment unit
DIMENSIONS (width x height x depth)	Two units, total approximately: 17 in. x 14 in. x 22 in. excluding handles (432 mm x 356 mm x 559 mm); 19 in. rack mountable



