

## 1 keV to 30 keV

### Focusable, High Energy Electron Beams, Small Spot to 100 $\mu\text{m}$

#### FOR USE IN:

- ▶ General vacuum physics
- ▶ Radiation studies
- ▶ Surface bombardment
- ▶ Semiconductor research
- ▶ Biological specimen irradiation
- ▶ X-Ray generation
- ▶ Plasma excitation
- ▶ Fluorescence studies
- ▶ Surface physics studies

#### FEATURES / OPTIONS:

- ▶ Small spots, down to 100  $\mu\text{m}$
- ▶ Beam currents, up to 5 mA
- ▶ Magnetostatic focusing
- ▶ Optional magnetostatic beam shaping
- ▶ Magnetostatic deflection
- ▶ Pulse capability
- ▶ Internal alignment while operating
- ▶ User-replaceable firing units



*EMG-4210 Electron Gun Mounted on 2.75 inch CF.  
Optional Turbo Pump and Ion Gauge not shown*

The Kimball Physics EMG-4210 Electron Gun with its matching EGPS-4210 Power Supply is a complete subsystem ready to attach to the user's vacuum system and turn on. It can deliver electrons over a very broad range of energies, currents and power. The EMG-4210 has applications in space materials testing, radiation studies, semiconductor research, x-ray generation and plasma excitation.

The gun uses a single-crystal lanthanum hexaboride ( $\text{LaB}_6$ ) cathode to generate a high energy, focusable, small spot electron beam. Both beam energy and beam current are independently adjustable over wide ranges, the energy from 1 keV to 30 keV, and current from 10  $\mu\text{A}$  to 5 mA. The electron beam can be pulsed by an input signal to the control grid.

The adjustable optics of the gun can adapt to different divergences and a range of working distances, suitable to a variety of applications. The magnetic focusing lens can vary the spot size from 10 mm down to 100  $\mu\text{m}$ . The magnetic centering and optional shaping coils provide additional beam control, allowing the user to deflect and shape the electron beam. Shaping typically results in an elliptical beam, both axes of which can be independently compressed or extended. In addition, the cathode to anode spacing is internally adjustable to change permeance.

The gun features an adjustable cathode feedthrough assembly that allows the mechanical alignment of the firing unit with respect to the anode and the column. This alignment can be done in real time while the gun is operating with beam on.

UHV technology is used throughout, and the gun can be run in vacuums from  $10^{-11}$  torr to  $10^{-7}$  torr. The electron gun is bakeable to 200°C with cables removed; bakeout is limited by the magnetic focus and deflection coils.

The cathode is single-crystal lanthanum hexaboride ( $\text{LaB}_6$ , small spot, high brightness, min. vacuum  $1 \times 10^{-7}$  torr). The cathode is not damaged by repeated exposure to atmospheric gases or water vapor when cold.

The gun design provides for differential pumping of the Source region with a 2 3/4 inch CF flange on the source chamber for attachment for a Turbo pump and a 2 3/4 inch CF flange for an ionization gauge. The gun is usually mounted on a 2 3/4 inch CF flange and has zero insertion distance, i.e. does not extend into the vacuum chamber. Due to the high power beam produced by the EMG-4210, X-ray shielding is essential.

Firing units are user-replaceable without removing the entire gun from the vacuum chamber; spare firing units can be purchased new, and used firing units may be returned to the factory for rebuild. Alternatively, the entire electron gun can be sent back to the factory for complete cleaning, rebuild, cathode replacement, and optional in-vacuum testing. Various stand-alone Faraday cups designs are available.

The Power Supply System for the EMG-4210 is composed of two separate units: the EGPS-4210 Electron Gun Power Supply and a separate H.V. Power Supply controlled by the EGPS-4210. The EGPS-4210 features a modular design with miniaturized power supply clusters, optically isolated signals, and the FlexPanel digital interface controller. The included power supplies are Beam Energy, magnetic Lens, and magnetic X, Y Deflection, as well as the floating Source/ ECC, and Grid supplies.

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

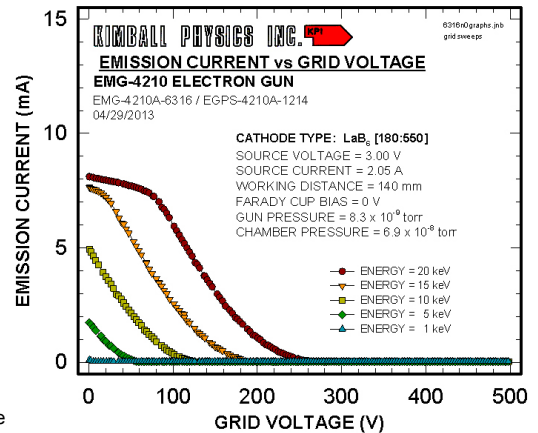
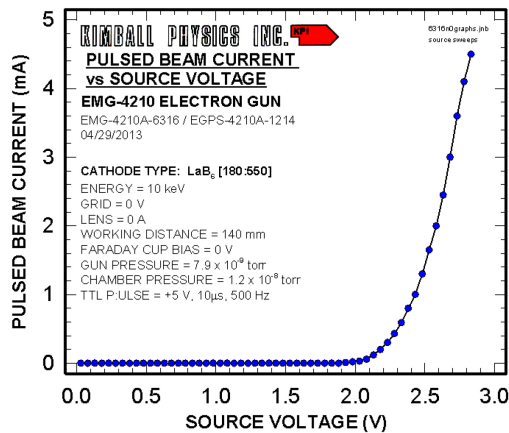
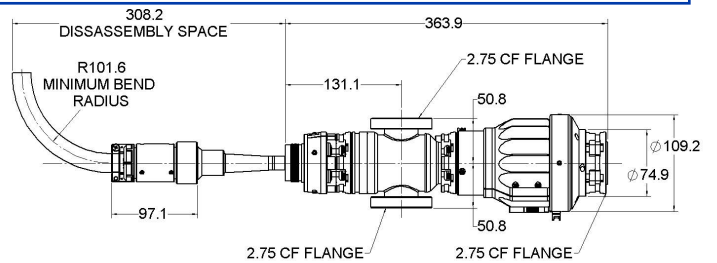
An optional LabVIEW™ computer program designed for the EMG-4210 is available for remote computer control and metering. Software is available in two types: Using National Instrument DAQ boards and SCSI connectors on the EGPS-4210, or via a simple serial connector interface. The program provides a virtual panel of controls and real-time metering on the user's computer screen.



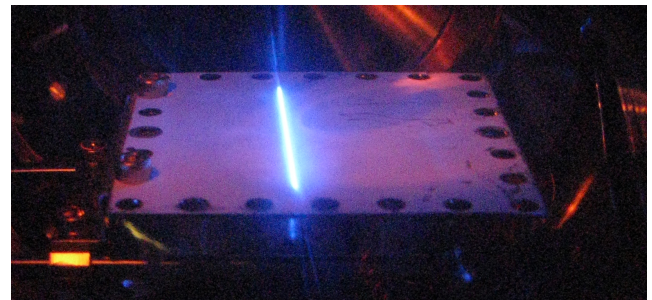
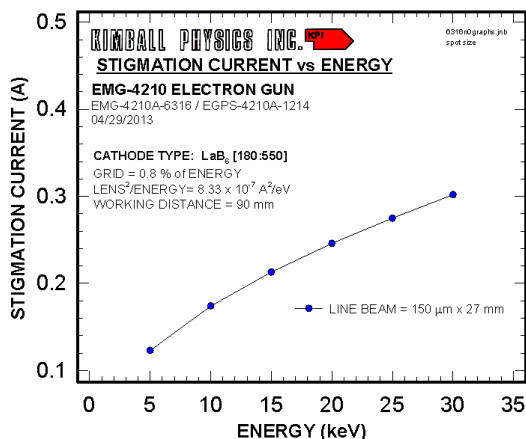
*EGPS-4210A Electron Gun Power Supply with FlexPanel controller*

EMG-4210 ELECTRON GUN SPECIFICATIONS	
BEAM ENERGY	1 keV to 30 keV (Independently adjustable)
BEAM CURRENT	10 $\mu$ A to 5 mA (Independently adjustable)
ENERGY SPREAD	Approx. cathode thermal spread, calculated: LaB <sub>6</sub> - 0.4eV
BEAM FOCUSING	Magnetostatic Lens Optional: Magnetostatic beam shaping
BEAM DIVERGENCE	Variable. Adjustable optics to adapt to different divergences and different working distances
SPOT SIZE	100 $\mu$ m to 10 mm
WORKING DISTANCE	50 mm to 1000 mm
BEAM DEFLECTION	Magnetostatic: $\pm 5.0^\circ$ at 30 keV
PULSE CAPABILITY	Optional Dual Grid Power Supply: pulse width 2 $\mu$ s to DC, rise/ fall 500 ns, rep rates to 5 kHz with optional LabVIEW™ program pulse generator or user's TTL pulser.
BEAM UNIFORMITY	Gaussian
FIRING UNIT	Customer-replaceable Firing Unit Cartridge includes precision-aligned cathode, and Wehnelt (G-1) assembly
CATHODE TYPES	Standard: LaB <sub>6</sub> (180-330). High current option available
INTERNAL GUN ALIGNMENT	Adjustable Feedthrough for mechanical alignment of firing unit while gun is operating
MOUNTING	Standard: 2 3/4 inch CF flange
DIFFERENTIAL PUMPING	Source chamber with 2 3/4 inch CF ports for small pump and ionization gauge. Optional pump: Varian Turbo-V81-M with controller. Optional gauge: Granville-Phillips 356 Micro-Ion Module
INSERTION LENGTH	Zero mm
GUN DIMENSIONS (outside vacuum)	Gun length: 364 mm sealing surface to end of cable connector. Gun diameter: 110 mm (without turbo pump and ion gauge).
FEEDTHROUGH	Multi-pin brazed ceramic
CABLES / CONNECTORS	All high voltage fully ground-shielded cables with mating metal to metal connectors, to connect gun and power supply. Standard lengths: 3 m, Optional: longer available
MAXIMUM BAKEOUT	200°C with cables removed (200°C for magnetic Lens and Deflection coils, 350°C for Source chamber region)

EGPS-4210 ELECTRON GUN POWER SUPPLY SPECIFICATIONS	
OUTPUT	All necessary voltages to drive the EMG-4210 Electron Gun (in combination with H.V. Power Supply)
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, Lens, X and Y Deflection, Emission Current Control (ECC)
METERING	FlexPanel digital meters: Energy, Source Voltage, Source Current, Emission Current, Grid, Lens Current, X and Y Deflection Currents
COMPUTER/REMOTE CONTROL & METER	Power supplies: 0 to +10 V (-10 V to +10 V, deflection) Metering: 0 to +2 V (-2 V to +2 V, deflection) Standard 50-pin connector for analog input/output and RS-232 serial port (RS-232, RS-422 or RS-485 available, if specified at time of order) Optional: SCSI metering and programming connectors
INPUT	115 VAC or 230 VAC, (specify on order) 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
SOFTWARE	Standard configuration designed for RS-232 connections. Optional: National Instruments LabVIEW™ file, designed to run with computer DAQ boards NI PCI-6733 and PCIe-6341. SCSI interface
DIMENSIONS (width x height x depth)	Two units, total approx: 17 in. x 20.3 in. x 22 in. excluding handles (432 mm x 516 mm x 560 mm); 19 in. rack mountable



Typical performance data for guidance only.



Line beam imaged on phosphor screen