KIMBALL PHYSICS
Excellence in Electron and Ion Optics

EMG-4210/ EGPS-4210
ELECTRON SOURCE / POWER SUPPLY

1 keV to 30 keV
Focusable, High Energy Electron Beams, Small Spot Size to 100 µm

FOR USE IN:

- General Vacuum Physics
- Radiation Studies
- Surface Bombardment
- Semiconductor Research
- X-ray Generation
- Plasma Excitation
- Fluorescence Studies
- Surface Physics Studies

FEATURES / OPTIONS:

- Spot Size down to 100 µm
- Beam Currents up to 5 mA
- Magnetostatic Focusing
- Optional Magnetostatic Beam Shaping
- Magnetostatic Deflection
- Pulse Capability
- Internal Alignment During Operation
- 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 (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, with the energy from 1 keV to 30 keV and the current from 10 µA 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 µm. 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, where both axes of which can be independently compressed or extended. In addition, the cathode to anode spacing is internally adjustable to change perveance.

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 the beam on.

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

The cathode is single-crystal lanthanum hexaboride (LaB_6, small spot high brightness, min. vacuum $1x10^{-7}$ 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 2.75” inch CF flange on the source chamber for attachment for a Turbo pump and a 2.75” inch CF flange for an ionization gauge. The gun is usually mounted on a 2.75” 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 HV (high voltage) Power Supply controlled by the EGPS-4210. The EGPS-4210 features a modular design with miniaturized power supply 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.

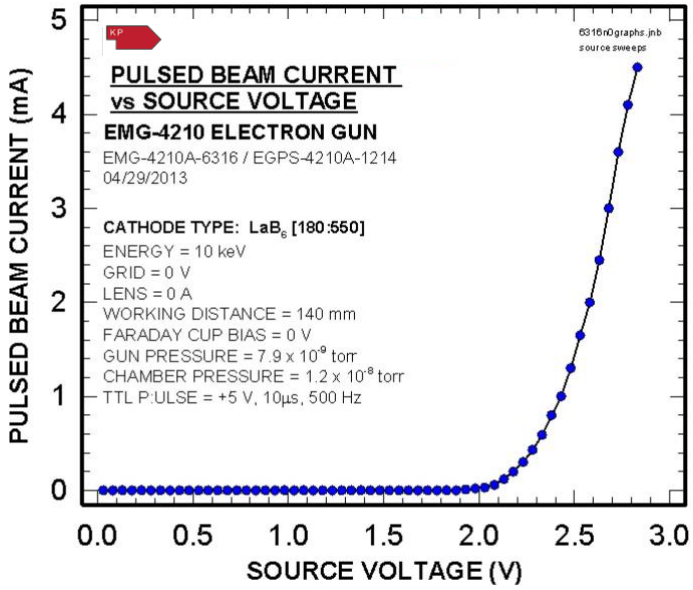
The FlexPanel provides a digital display screen and a keypad controller for programming control on the front panel. Rear panel connectors allow remote /computer control and metering of all gun power supplies. A RS-232 or RS-422/485 and mini-USB serial port and an analog input/output connector are included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

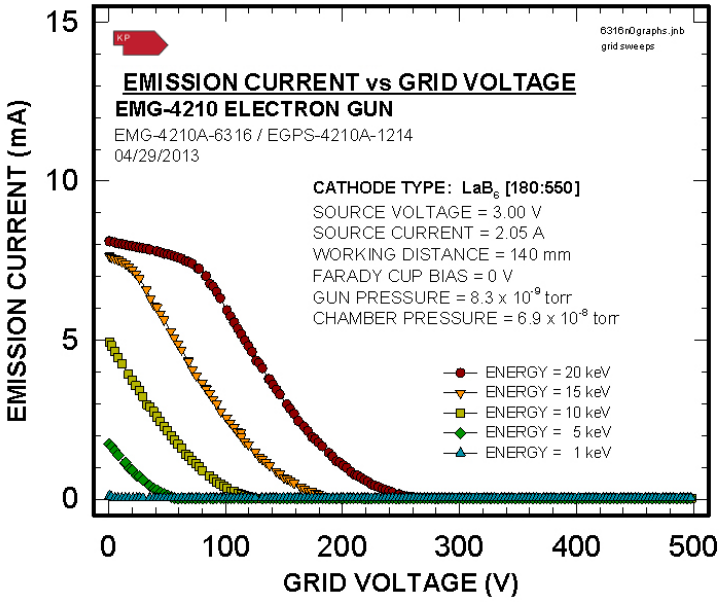
An optional LabVIEW™ computer program designed for the EMG-4210 is available for remote computer control and metering. Software is available in two options: 1) using National Instrument DAQ modules and the 50-pin connector on the EGPS-4210, or 2) via a simple serial connector interface. The program provides a virtual panel of controls and real-time metering on the user’s computer screen.

Front Panel of EGPS-4210 Electron Gun

EMG-4210 ELECTRON GUN SPECIFICATIONS	
BEAM ENERGY	1 keV to 30 keV (Independently adjustable)
BEAM CURRENT	10 µA to 5 mA (Independently adjustable)
ENERGY SPREAD	Approx. cathode thermal spread, calculated: LaB_6 - 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 µm to 10 mm
WORKING DISTANCE	50 mm to 1000 mm
BEAM DEFLECTION	Magnetostatic: ± 5.0° at 30 keV
PULSE CAPABILITY (using appropriate pulse generator, not included)	Optional Dual Grid Power Supply: pulse width 2 µs 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 TYPE	Standard: LaB_6 (180-330). High current option available
BEAM ALIGNMENT	Adjustable Feedthrough for mechanical alignment of firing unit while gun is operating
MOUNTING	Standard: 2¾ inch CF flange
INSERTION LENGTH	Zero mm
GUN DIMENSIONS	Gun length: 364 mm sealing surface to end of cable connector. Gun diameter: 110 mm (without turbo pump and ion gauge).
FEEDTHROUGHS	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 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	±0.1% per hour with Emission Current Control (ECC) or ±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 and mini-USB serial port (RS-232, RS-422 or RS-485 available, if specified at time of order)
SOFTWARE	Standard configuration designed for RS-232 and USB serial connections. Optional: National Instruments LabVIEW™ file, designed to run with NI DAQ modules
INPUT	115 VAC or 230 VAC, (specify on order) 50 to 60 Hz single phase, 250 VA
ENVIRONMENT	Temperature: 0 to 40ºC. 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 20.3 in. x 22 in. excluding handles (432 mm x 516 mm x 560 mm); 19 in. rack mountable





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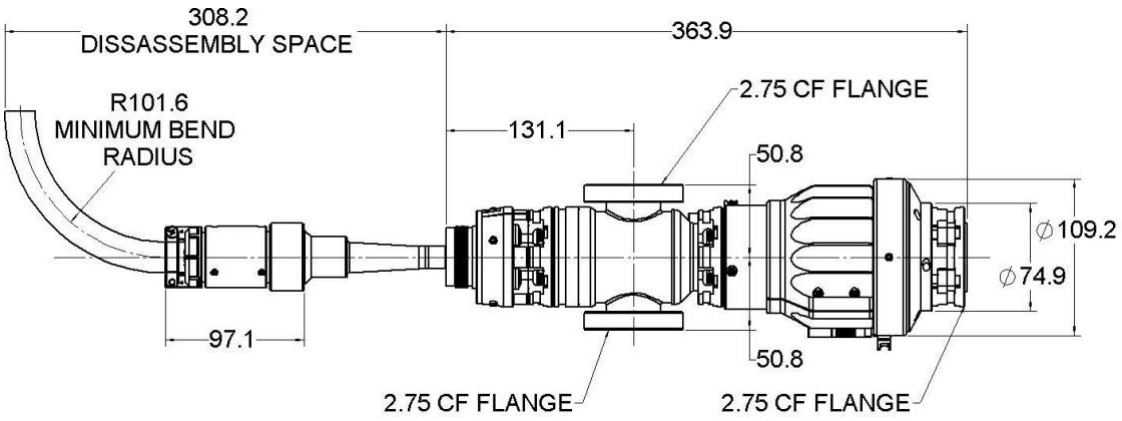

EMG-4210 Electron Gun (Dimensions in mm).

References

For more information on electron sources / gun operations (and the technical bulletins and additional documents listed below), please visit the Resources and Documents section of our website.

General Operating Hints

Operating Instructions, Typical LabVIEW™ Electron Gun Systems

Beam Pulsing Options

Note: A comprehensive custom manual is supplied with each system.

Notes:
1. Charts /graphs show typical performance, data is for guidance only.
2. It is not necessarily possible to achieve all maximum specifications simultaneously.
3. Specifications Subject to Change Without Notice.
4. DE Altobelli, DT Taylor 04/18/2025

Document EMG-4210_EGPS-4210_2025_0418