



- **Integrated Accelerator and Electron Source Supplies**
- **Very Low Ripple and Ultra Stable Outputs**
- **Robust Arc and Short Circuit Protection**
- **Designed to Minimize Micro-discharge Events**
- **Optically Isolated Digital Interface**
- **CE Marked & Designed to Meet SEMI S2**

Spellman's EBM-FEG Series is an integrated multiple output high voltage power supply specifically designed to drive Scanning Electron Microscope (SEM) Columns. Spellman's extensive knowledge in this application has enabled us to develop a range of technology platforms that can be customized to meet the demanding requirements of SEM.

The main Acceleration Voltage is a high stability 30kV supply, with integrated floating Filament, Extractor and Suppressor outputs required to drive Field Emission, Cold Cathode and Schottky Electron Sources in a compact solution with extenders to mount in a 19" rack. All outputs are offered with ultra-low output ripple, excellent regulation, stability, temperature coefficient, drift and accuracy specifications. Isolation and control of the respective floating sources is provided via Spellman's proprietary high voltage isolation techniques.

Customer control of this integrated EBM-FEG power supply system is accomplished via a fiber optic interface. All high voltage safety interlocks are of a failsafe hardware based design and the EBM-FEG is CE marked and is designed to be compliant with applicable IEC, UL and SEMI standards. Spellman's EBM-FEG offers exceptional performance with low ripple, micro-discharge, and ppm level stability for unprecedented image quality and resolution.

TYPICAL APPLICATIONS

Scanning Electron Microscopes (SEM)
Electron Beam Controller

SPECIFICATIONS

Input Voltage:

+24Vdc, $\pm 5\%$ @ 4 amps maximum.
Inrush is <6 amps for 1 second.

Safety Fuse:

A 5 x 20mm ceramic fuse changeable from the outside and marked with the fuse value.

Leakage Current:

<200 μ A to case

Power Switch:

A shielded rocker switch allows the unit to be switched ON and OFF from the front panel.

Environmental:

Operating Temperature:

+10°C to +45°C ambient for normal operation.
The unit will operate from 0°C but will require an extended warm up period.

Storage Temperature:

-20°C to +60°C

Humidity:

0 to 80% RH, non-condensing

Altitude:

2000 meters ASL at full power. For altitudes above 2000 meters the maximum ambient operating temperature is linearly derated by 1.1°C per 300 meter interval.

Mechanical:

The unit is provided with a pair of removable mounting flanges; these allow the unit to mount in a 19" rack system. The unit can be operated in any orientation. An M5 x 23mm protective ground stud is mounted in the vicinity of the HV connector

Weight:

<48.5 lbs. (<22kg)

Regulatory Approvals:

IEC61010:2010 Safety requirements for electrical equipment for measurement, control and laboratory use. UL61010-1:2012 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements and CAN/CSA-C22.2 No.61010-1-12:2015. The unit is CE marked against EN61010:2010 and EN61326-2-1:2013 and RoHS compliant.

Beam Energy Supply

Output Voltage:

20V to 30kV, negative polarity. A conditioning voltage of 32.5kV with no load current is settable. The output will not exceed 35kV under any condition. The output can be set to OFF which disables the Beam Energy converter, in this case the output will be <60 volts.

Output Current:

200 μ A maximum, 20kV to 30kV

Output Current Trip Level:

250 μ A $\pm 10\%$ The output is disabled and latched off with a delay of approximately 1 second. The program voltage is set to zero.

Accuracy (Voltage Program):

<1% or $\pm 10V$ (whichever is greater) over control range

Voltage Control:

16 bit, resolution 0.5V, full scale = 32,768 volts

Linearity:

-20 to -30kV $\leq \pm 25V$

Load Regulation:

<±100mV for a 30µA to 200µA load change

Line Regulation:

<±10ppm from 22.8V to 26.4V line change

Ripple:

<50mVp-p @ 0uA to 200uA, 0.1Hz to 20MHz

Temperature Coefficient:

<10ppm/°C from +10°C to +45°C,

<5ppm/°C from +20°C to +30°C

Stability:

<200mV/15 minute period after 1 hour warm up under constant operating conditions.

Voltage Monitor:

16 bit, resolution 0.5V. Accuracy with respect to actual output voltage is ±2% or ±10V.

Current Monitor:

12 bit, resolution 100nA, accuracy is ±2% or ±1µA.

Wobble Amplitude:

0 to 100% modulation in steps of 1%, where 100% is defined

as ±5% of the Beam Energy output with a minimum value of ±50V. The peak to peak value is twice the amplitude.

Wobble Period:

666 to 2000 milliseconds. Adjustable in 1 millisecond steps. A sinusoidal output with 16 points per period. The wobble always starts and stops at a zero crossing.

Stored Energy:

<850mJ

Filament Supply**Connection:**

The center of the filament is connected to the Beam Energy output. The output can be set to off which disables the filament converter.

Voltage:

Nominally 1.8V, maximum 3V

Maximum Current:

3A, control range 0.5A to 3A

Load Resistance:

Nominal at 0.6Ω

Accuracy:

± 5mA between 2 and 3 Amperes

Current Control:

12 bit, resolution 1mA. Full scale = 4.096 Amperes

Linearity:

± 10mA between 0.5A and 3A

Load Regulation:

<5mA for 0.4Ω to 1.0Ω change at 3A. (Including output lead)

Line Regulation:

<1mA for 5% change in supply voltage.

Ripple:

<1mA p-p, 20Hz to 10 kHz and <30mV p-p at approximately 100kHz both across 0.6Ω @ 3.0A

Temperature Coefficient:

<50ppm/°C

Stability:

<0.5mA/60 minutes. After one hour warm up under constant operating conditions.

Voltage Monitor:

12 bit, resolution 2.5V, full scale = 10.24V. Accuracy with respect to actual output voltage: ±5% or ±25mV

Current Monitor:

12 bit, resolution +/-1mA, full scale = 4.096 Amperes. Accuracy with respect to actual output current ±10mA.

Trip OC:

Open circuit detection, $V_{out} > 5.2 \pm 0.1$ Volts. All outputs will be disabled and programs set to zero.

Trip Current:

Over current detected if the output current exceeds 3.15A for ten seconds. All outputs will be disabled and programs set to zero.

Extractor Supply**Voltage:**

0V to 10kV (positive with respect to Beam Energy).

Control range +100V to +10kV. The output can be set to OFF which disables the extractor converter.

Current:

700µA over control range.

Current Trip Level:

Programmable 0 to 735µA resolution 0.25µA. Accuracy ±2% or 2µA. All outputs shall be disabled and programs set to zero

Accuracy (Voltage Program):

<1% or ±20V (whichever is greater) over control range

Voltage Control:

12 bit, resolution 2.5V, full scale = 10.24kV

Linearity:

±20V over the control range

Load Regulation:

<±1V (10µA – 700µA output current change)

<100mV @ 40µA 0.1Hz to 20MHz

Line Regulation:

<±5ppm for a +/-5% line change

Ripple:

<100mVp-p at 10kV, 700µA, 0.1Hz – 20MHz

Temperature Coefficient:

<25ppm/°C

Stability:

<0.3V/15 minutes; after one hour warm up under constant operating conditions

Ramp Rate:

10V/s to 1000V/s

Voltage Monitor:

12 bit, resolution 2.5V, full scale = 10.24kV. Accuracy with respect to actual output voltage: ±1% or ±20V

Current Monitor:

12 bit, resolution 0.25µA, full scale = 1.024mA. Accuracy with respect to actual output current: ±2% or ±2µA

Protection:

Continuous/intermittent arcs to the Beam Energy supply and ground.

Stored Energy:

<150mJ

Suppressor Supply

Voltage:

0V to 1000V (negative with respect to Beam Energy).
Control range 100V to 1000V. The output can be set to OFF which disables the extractor converter.

Current:

<100µA over control range.

Current Trip Level:

100µA ±10% with a nominal five second delay. All outputs will be disabled and programs set to zero.

Accuracy (Voltage Program):

<2% or ±6V (whichever is greater) over control range

Voltage Control:

12 bit, resolution 0.25V, full scale = 1024V

Linearity:

±5V over the control range

Load Regulation:

<120mV for a 10µA to 100µA load current change.

Line Regulation:

<±5ppm for a +/-5% line change

Ripple:

<20mV p-p over control range, 0.1Hz to 20 MHz.

Temperature Coefficient:

<50ppm/°C

Stability:

<0.3V/15 minutes; after one hour warm up under constant operating conditions

Voltage Monitor:

12 bit, resolution 0.25V, full scale = 1.024kV. Accuracy with respect to actual output voltage: ±2% or ±250mV

Current Monitor:

12 bit, resolution 0.25µA, full scale = 1.024mA. Accuracy with respect to actual output current: ±10%

Protection:

Continuous/intermittent arcs to the Beam Energy or extractor

Stored Energy:

<2.5mJ

Vacuum Interlock:

The vacuum interlock is an optical interlock which is made when light is present on the fiber. When no light is present the interlock is broken and the unit shuts down all of the outputs.

Indicators:

Power On (front panel):

A green LED will be illuminated to indicate that +24V power is present. This LED will be illuminated over the range 22.8 to 25.2 volts and will flash with a 1 second period when out of range.

Vacuum Interlock (front panel):

A yellow LED will be illuminated to indicate that all the vacuum interlock is closed. The vacuum interlock LED must be illuminated for the unit to be able to generate high voltage.

Protection:

All outputs are protected from arcs in the load and continuous short circuit. Dielectric strength test voltage capability of outputs to be 36kV however no output is capable of exceeding this voltage.

All low voltage inputs are protected against over voltages of ±30 Volts. The power input is protected against over voltage and reversed connection.

Over Temperature:

Any semiconductor device exceeding an over temperature condition for greater than ten seconds will initiate a shut down and send an error message.

Shutdown Requirements:

Beam Energy output can be shut down independently. Filament, Suppressor and Extractor outputs (Emission) should be shut down together.

INPUT POWER CONNECTOR

PIN	SIGNAL	PARAMETER
1	+24Vdc	+24Vdc @ 4A
2	Power Ground	Power Ground

VACUUM INTERLOCK CONNECTOR

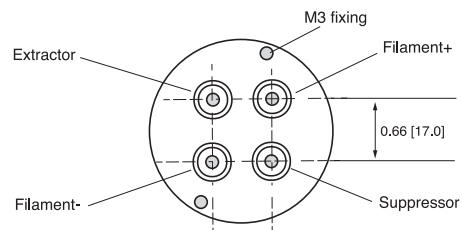
The vacuum interlock connector is a dual channel Avago HFBR- 2524z/1524z connector.

OPTICAL COMMUNICATIONS CONNECTOR

The fiber optics communications connector is a dual channel Avago HFBR- 2524z/1524z connector.

HIGH VOLTAGE OUTPUT CONNECTOR

The main high voltage output will be fitted with a custom 4 pole receptacle:

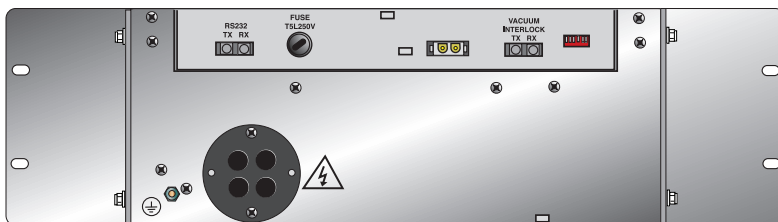


Mating cable can either be supplied by Spellman or Spellman will provide manufacturing drawings such that the customer can manufacture the cable assembly.

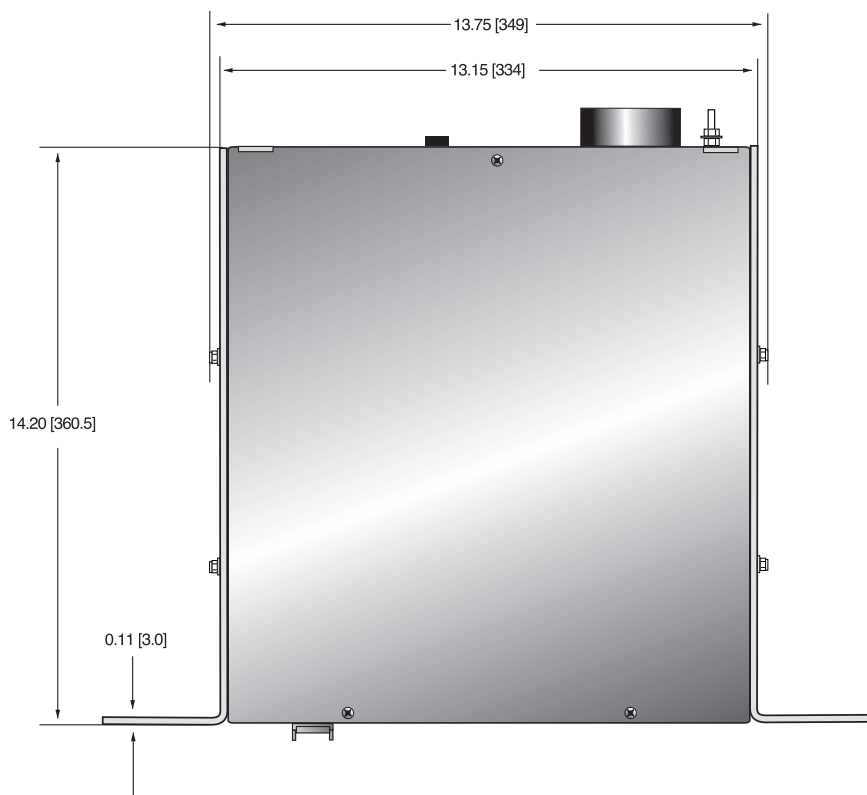
How To Order:
PART NUMBER: EBM30N6/FEG

DIMENSIONS: in.[mm]

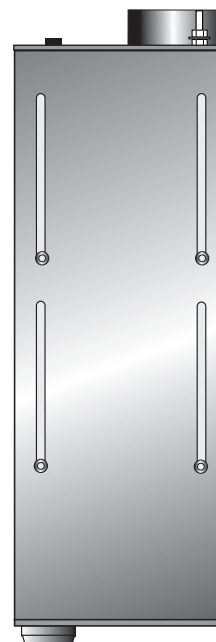
REAR VIEW



TOP VIEW



SIDE VIEW



FRONT VIEW

