

## 10W

The FS Series is an isolated, proportional DC to high voltage DC converter offering stout design and enhanced features for excellent long-term reliability. A proprietary, quasi-sinewave, resonant oscillator produces clean high voltage with inherently low ripple, low EMI/RFI, low input ripple current, and low conducted emissions. The internal transformer temperature and input voltage are actively monitored with supervisory circuits and fed into a shutdown circuit, preventing excessive input voltage or over-temperature failures.

This series features sturdy, galvanic input-to-output high voltage isolation, conservatively rated at  $\pm 2.5\text{kV} + V_{\text{out}}$  with less than 100pF of coupling capacitance and less than 100nA of leakage current. Robustness and high reliability have been designed into each model by incorporating output arc surge current limiting and short circuit protection.

### Features

- Output voltages from 200V to 6kV
- Output voltage proportional to input
- Low turn-on voltage 0.7VDC
- Input to output isolation <2.5kVDC
- Low profile 0.5"
- Dual output option
- Arc and short circuit protected
- Overtemperature and overvoltage protection with auto shutdown
- No minimum load
- 3 year warranty

### Input

| Characteristic | Minimum | Typical | Maximum        | Units | Notes & Conditions         |
|----------------|---------|---------|----------------|-------|----------------------------|
| Input Voltage  | 0.7     |         | 12, 15, 24, 28 | VDC   | See Models & Ratings table |
| Input Current  |         |         | 1.5            | A     | See Models & Ratings table |

### DC-HVDC CONVERTER



### Typical Applications



- Mass Spectrometry
- Electrostatic Chucks
- Electrophoresis
- Capacitor Charging
- Particle Counter
- Isolation Testing
- Medical Laser Treatment

### Dimensions

28.5 x 57.15 x 12.7mm (1.12" x 2.25" x 0.50")

## Output

| Characteristic           | Minimum                                                                          | Typical | Maximum | Units | Notes & Conditions         |
|--------------------------|----------------------------------------------------------------------------------|---------|---------|-------|----------------------------|
| Output Voltage           |                                                                                  |         | 6000    | VDC   | See Models & Ratings table |
| Output Current           |                                                                                  |         | 50      | mA    | See Models & Ratings table |
| Output Voltage Tolerance |                                                                                  | ±5      |         | %     | At Max Vout, Full load     |
| Minimum Load             | No minimum load required                                                         |         |         |       |                            |
| Regulation               | Unregulated, Output is proportional to Input. See Application Notes              |         |         |       |                            |
| Short Circuit Protection | Protected against short circuit conditions indefinitely. B versions not included |         |         |       |                            |
| Ripple and Noise         | 1                                                                                |         | 6       | %     | See Models & Ratings table |

## General

| Characteristic             | Minimum                                                                                                     | Typical | Maximum | Units | Notes & Conditions                                |
|----------------------------|-------------------------------------------------------------------------------------------------------------|---------|---------|-------|---------------------------------------------------|
| Isolation: Input to Output |                                                                                                             |         | 2500    | V     | <±2500VDC Bias on Pin 4                           |
| Leakage Current            |                                                                                                             |         | 100     | nA    |                                                   |
| Switching Frequency        | 25                                                                                                          |         | 125     | kHz   | Stable frequency over entire output voltage range |
| Construction               | Solid vacuum encapsulation, UL 94 V-0 rated. Anodized aluminum heatsink surface, two threaded blind inserts |         |         |       |                                                   |
| Mean Time Between Failure  | 840                                                                                                         |         |         | khrs  | Bellcore TR 332                                   |

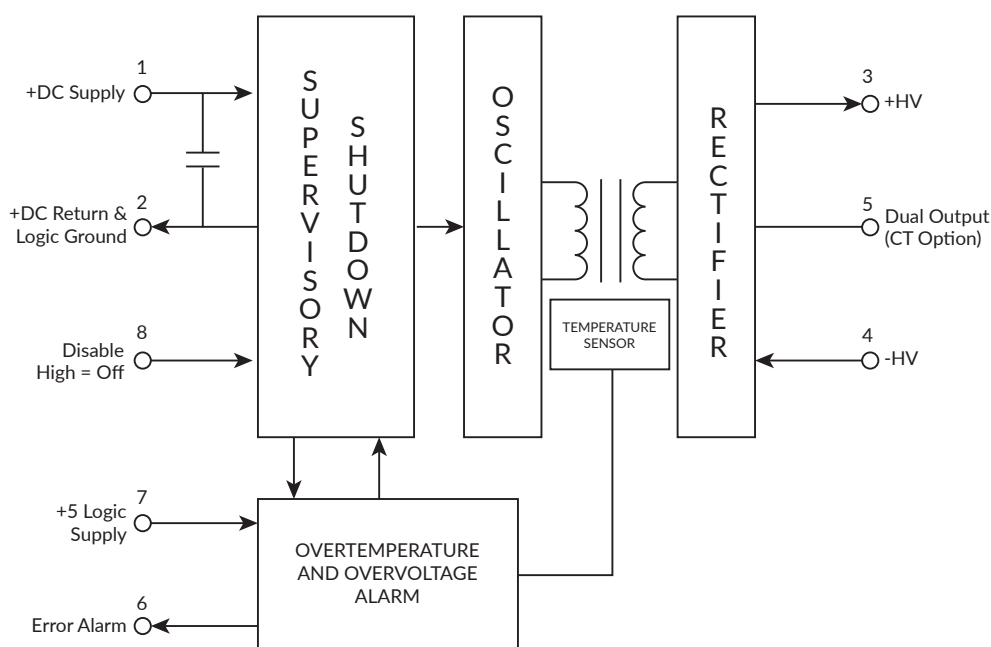
## Environmental

| Characteristic               | Minimum            | Typical | Maximum | Units | Notes & Conditions                        |
|------------------------------|--------------------|---------|---------|-------|-------------------------------------------|
| Operating Temperature (case) | -25                |         | +75     | °C    | Standard operating temperature            |
| Operating Temperature (case) | -55                |         | +85     | °C    | Extended operating temperature, -T models |
| Storage Temperature          | -55                |         | +105    | °C    |                                           |
| Cooling                      | Natural convection |         |         |       |                                           |
| Humidity                     |                    |         | 95      | %RH   | Non-condensing                            |

## Notes:

- Maximum rated output current is available at maximum rated output voltage.
- Output voltage is load dependent. Under light or no-load conditions, reduce the input voltage so maximum rated output voltage is not exceeded.
- Specifications after 1 hour warm-up, full load, at 25°C unless otherwise indicated.
- Maximum output power is typically proportional to input voltage from 40% of input voltage to maximum.
- Short circuit protection not available with -B suffix.
- Proper thermal management techniques are required to maintain safe case temperature at maximum power output.
- Ripple specification for center-tapped units applies to the voltage between the positive and negative output terminals.
- Models FS50 and FS60 do not have the arc protection feature.

## Block Diagram



### SMART Protection Features

The FS Series power supplies are provided with internal input over-voltage and over-temperature protection. The internal transformer temperature and input voltage are actively monitored with supervisory circuits and fed into a shutdown circuit, preventing excessive input voltage or over-temperature failures. Should preset limits be exceeded, the power supply will be temporarily disabled. A TTL-compatible, latching alarm signal on Pin 6 transitions from low to high to indicate an alarm condition has occurred. Sustained presence of an input over-voltage may damage input components. The user should respond to the alarm by removing the potentially damaging input.

If/when the fault condition is removed, the unit will recover and restore itself to normal operation, ensuring maximum reliability in the field. However, the pin 6 error signal will remain high to indicate an alarm event has occurred. To clear the alarm output, the +5V logic input must be toggled low for >250ms, then returned high.

The fault monitor circuits are powered by the +5V logic input voltage and draw <25mA.

SMART Protection features are not included with B suffix.

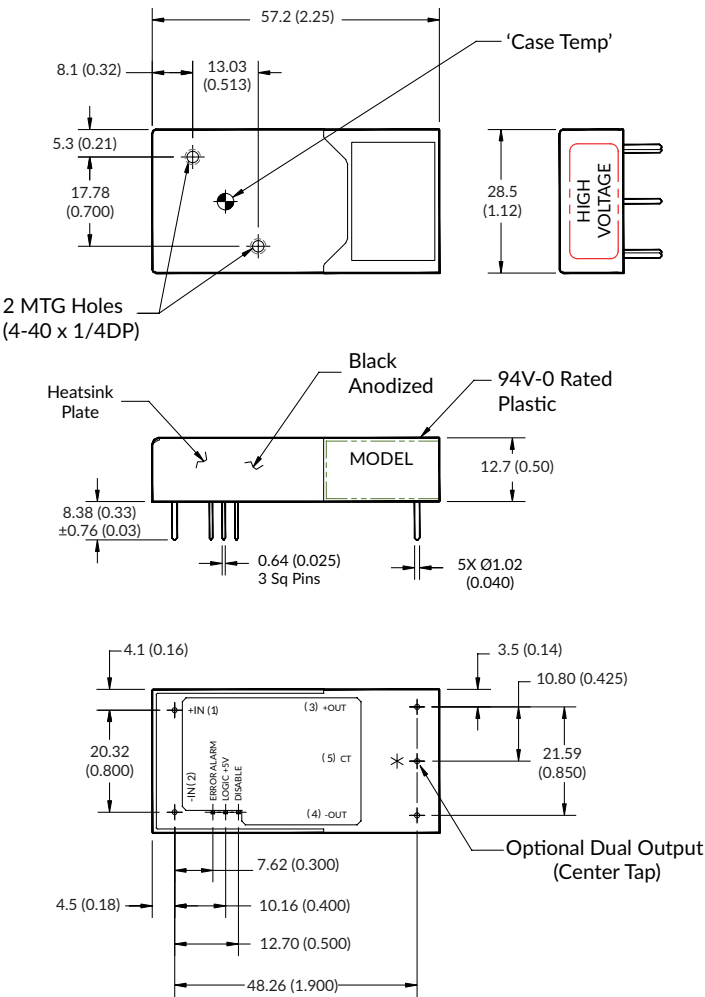
## Models & Ratings

| Model Number | Output Voltage    | Output Current | Ripple | Polarity   | Input Voltage | Input Current, No Load | Input Current, Full Load |
|--------------|-------------------|----------------|--------|------------|---------------|------------------------|--------------------------|
| FS02-12      | 0 to 200V         | 50mA           | <6%    | Reversible | 12V           | <300mA                 | <1.25A                   |
| FS02-24BT    | 0 to 200V         | 50mA           | <6%    | Reversible | 24V           | <150mA                 | <650mA                   |
| FS02CT-15    | 0 to $\pm 100$ V  | 50mA           | <6%    | Bipolar    | 15V           | <250mA                 | <1.15A                   |
| FS03-12      | 0 to 300V         | 33.3mA         | <2%    | Reversible | 12V           | <300mA                 | <1.25A                   |
| FS05-12      | 0 to 500V         | 20mA           | <2%    | Reversible | 12V           | <300mA                 | <1.25A                   |
| FS05-15      | 0 to 500V         | 20mA           | <2%    | Reversible | 15V           | <250mA                 | <1.15A                   |
| FS05-24      | 0 to 500V         | 20mA           | <2%    | Reversible | 24V           | <150mA                 | <650mA                   |
| FS05-24B     | 0 to 500V         | 20mA           | <2%    | Reversible | 24V           | <150mA                 | <650mA                   |
| FS05CT-12    | 0 to $\pm 250$ V  | 20mA           | <2%    | Bipolar    | 12V           | <300mA                 | <1.25A                   |
| FS05CT-24    | 0 to $\pm 250$ V  | 20mA           | <2%    | Bipolar    | 24V           | <150mA                 | <650mA                   |
| FS10-12      | 0 to 1000V        | 10mA           | <1%    | Reversible | 12V           | <300mA                 | <1.25A                   |
| FS10-12B     | 0 to 1000V        | 10mA           | <1%    | Reversible | 12V           | <300mA                 | <1.25A                   |
| FS10-12BT    | 0 to 1000V        | 10mA           | <1%    | Reversible | 12V           | <300mA                 | <1.25A                   |
| FS10-24      | 0 to 1000V        | 10mA           | <1%    | Reversible | 24V           | <150mA                 | <650mA                   |
| FS10CT-12    | 0 to $\pm 500$ V  | 10mA           | <1%    | Bipolar    | 12V           | <300mA                 | <1.25A                   |
| FS20-12      | 0 to 2000V        | 5mA            | <2.5%  | Reversible | 12V           | <300mA                 | <1.25A                   |
| FS20-15      | 0 to 2000V        | 5mA            | <2.5%  | Reversible | 15V           | <250mA                 | <1.15A                   |
| FS20CT-12T   | 0 to $\pm 1000$ V | 5mA            | <2.5%  | Bipolar    | 12V           | <300mA                 | <1.25A                   |
| FS20CT-24    | 0 to $\pm 1000$ V | 5mA            | <2.5%  | Bipolar    | 24V           | <150mA                 | <650mA                   |
| FS30-12      | 0 to 3000V        | 3.33mA         | <2%    | Reversible | 12V           | <300mA                 | <1.25A                   |
| FS30-24B     | 0 to 3000V        | 3.33mA         | <2%    | Reversible | 24V           | <150mA                 | <650mA                   |
| FS40-12      | 0 to 4000V        | 2.5mA          | <1.5%  | Reversible | 12V           | <300mA                 | <1.25A                   |
| FS50P-12     | 0 to +5000V       | 2mA            | <2.5%  | Positive   | 12V           | <400mA                 | <1.5A                    |
| FS50P-24     | 0 to +5000V       | 2mA            | <2.5%  | Positive   | 24V           | <200mA                 | <750mA                   |
| FS50P-24B    | 0 to +5000V       | 2mA            | <2.5%  | Positive   | 24V           | <200mA                 | <750mA                   |
| FS60N-12B    | 0 to -6000V       | 1.67mA         | <2.5%  | Negative   | 12V           | <400mA                 | <1.5A                    |
| FS60P-12     | 0 to +6000V       | 1.67mA         | <2.5%  | Positive   | 12V           | <400mA                 | <1.5A                    |
| FS60P-12B    | 0 to +6000V       | 1.67mA         | <2.5%  | Positive   | 12V           | <400mA                 | <1.5A                    |
| FS60P-24B    | 0 to +6000V       | 1.67mA         | <2.5%  | Positive   | 24V           | <200mA                 | <750mA                   |

### Notes:

- All orderable part numbers are listed above.
- B Suffix is used for models without SMART protection features described on page 2.
- T Suffix indicates extended operating temperature, see page 2 Environmental.
- CT indicates center tap pin for dual output.

Mechanical Details



| Pin | Function                                         |             |
|-----|--------------------------------------------------|-------------|
|     | FS02-FS40                                        | FS50 & FS60 |
| 1   | (+) Input                                        | (+) Input   |
| 2   | (-) Input                                        | (-) Input   |
| 3   | (+) Output                                       | HV Output   |
| 4   | (-) Output                                       | HV Return   |
| 5   | (Center Tap) Optional                            | N/A         |
| 6   | Error Alarm (B Version Not Included)             |             |
| 7   | Logic Input: +5V +/-5% (B Version Not Included)  |             |
| 8   | Disable: TTL High = Off (B Version Not Included) |             |

- Notes:
1. All dimensions are in mm (inches).

2. Weight 45g (1.6oz).

3. Tolerance: X.XX±0.51 (0.02).

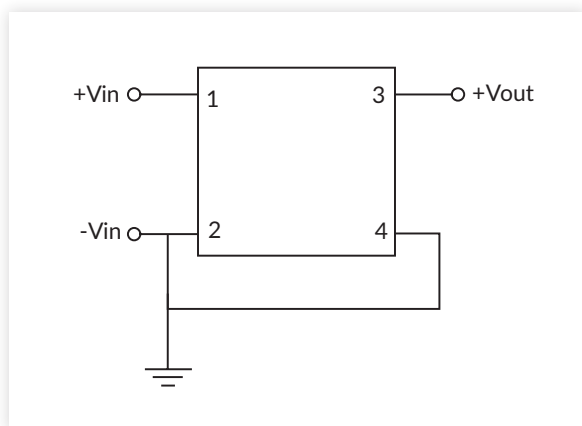
4. Pin Tolerance: ±0.127 (0.005).

5. FS02 - FS40 are floating. FS50 and FS60 must be ordered as positive or negative.

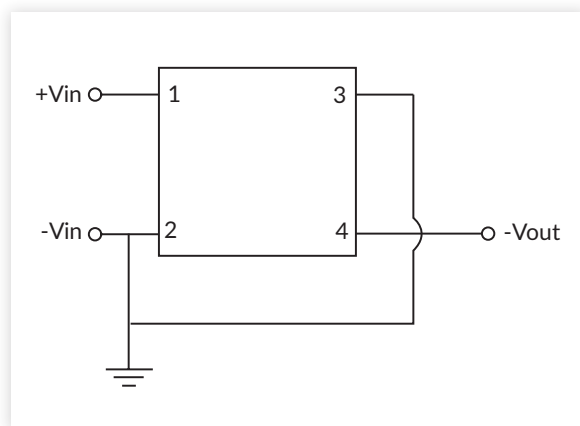
6. Pins 6, 7, and 8 are not included with B suffix models.

## Application Notes

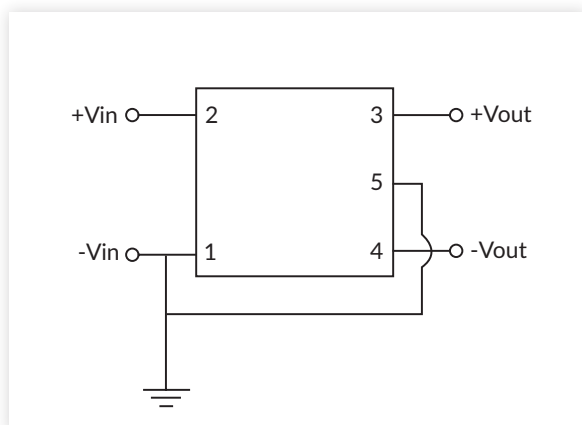
### FS02-FS40 Positive Output for Reversible Models



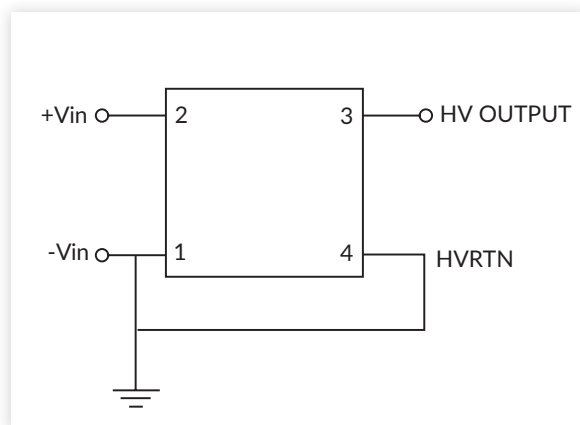
### FS02-FS40 Negative Output for Reversible Models



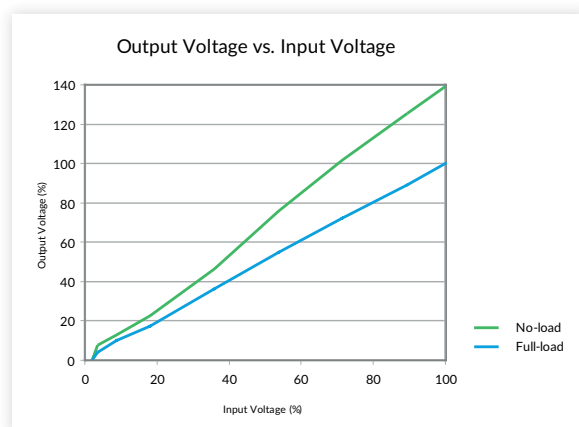
### FS02-FS40CT Dual Output



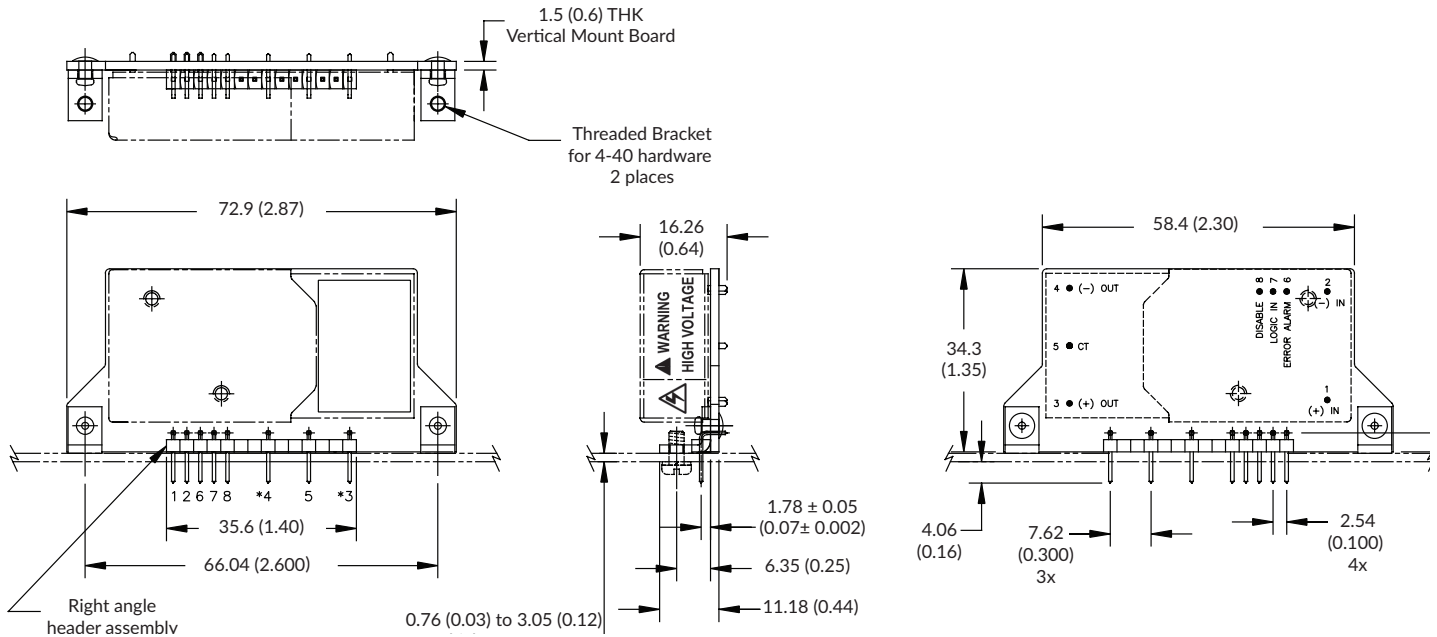
### FS50 - FS60 Order as Positive or Negative Output



### Output Voltage vs. Input Voltage



## FS-VM Vertical Mount Adapter Board



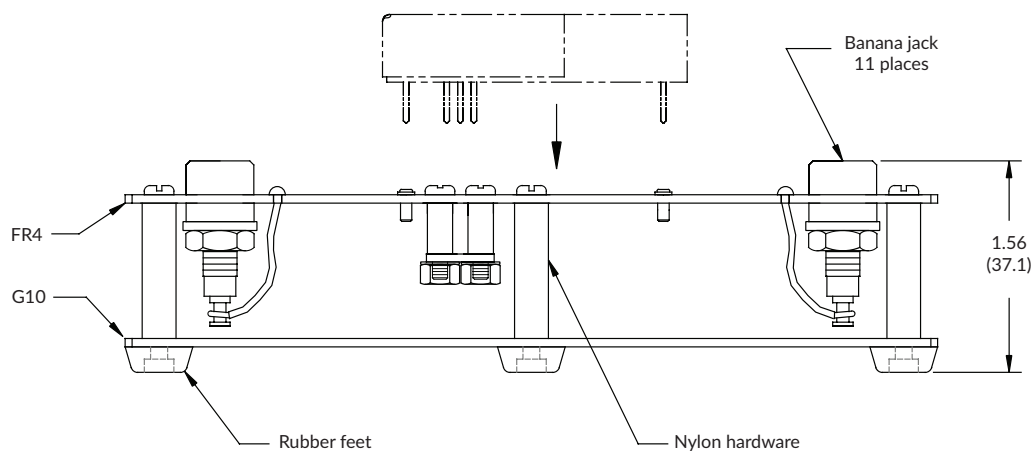
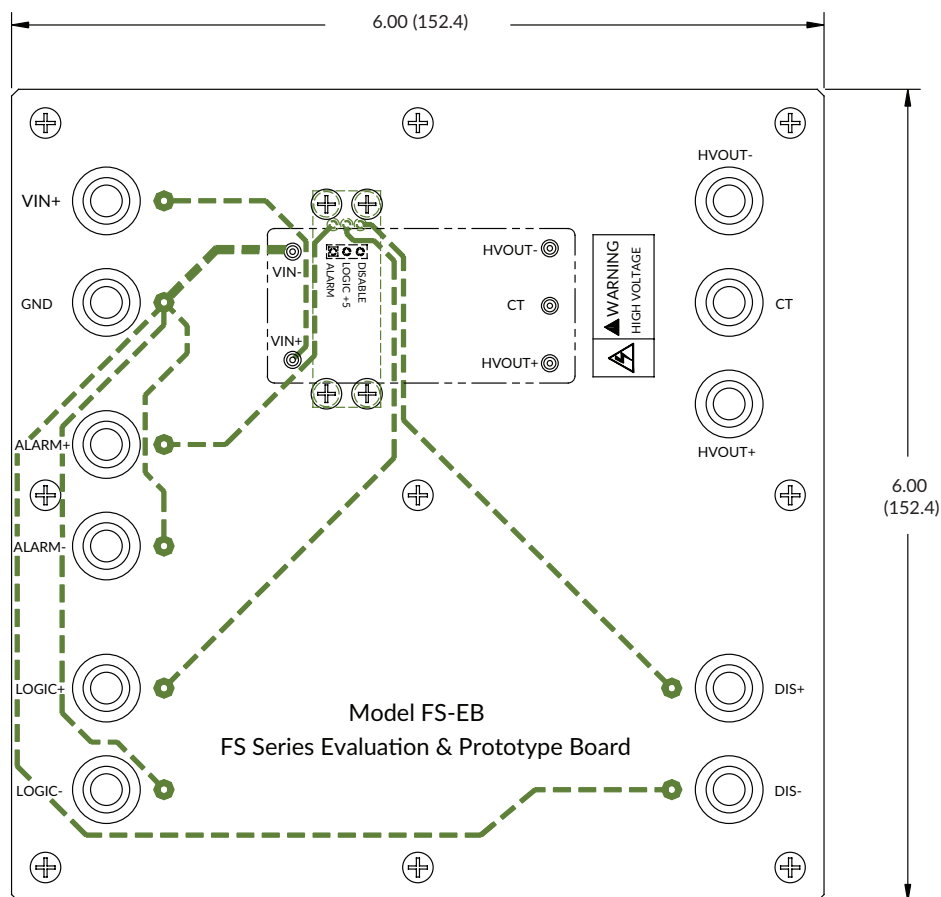
This FS-VM adaptor board provides a convenient way to mount any FS Series high voltage power supply DC to high voltage DC converter on its side, minimizing the X-Y footprint to conserve board real estate. Please note when ordering, the FS Series unit is not included and must be ordered separately.

Weight <28.3g (1oz)

Tolerance: X.XX±0.51 (0.02)

Pin Tolerance: ±0.127 (0.005)

## FS-EB Evaluation Board



This FS-EB evaluation board provides a convenient package to use any FS Series high voltage power supply without having to it onto a PC board. The board provides for easy prototyping and evaluation. Please note when ordering, the FS Series unit is not included and must be ordered separately.

Weight <200g (7oz)

Tolerance: X.XX±0.51 (0.02)

Pin Tolerance: ± 0.127 (0.005)