

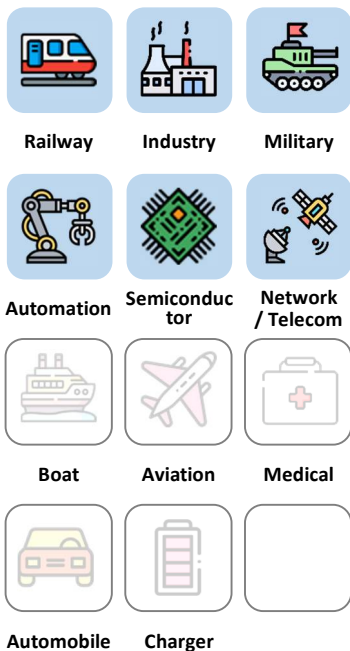


# SHBS Series

## 100W / Half Brick

### DC/DC

#### Applications



**3** Years Warranty



#### Features

|            |                            |               |                    |                     |                               |                     |                 |
|------------|----------------------------|---------------|--------------------|---------------------|-------------------------------|---------------------|-----------------|
| 1/2 Brick  | 2:1 / 4:1 Wide input range | Vicor Pin out | PI FILTER Built-in | 2250 VDC Insulation | MLCC No life-span constrained | 89% High efficiency | ON / OFF REMOTE |
| METAL CASE | UVLO                       | OCP           | OVP                | OTP                 |                               |                     |                 |

#### Model Number Structure

SHBS 110 120 - V - P - B 100

| Series Name    | Input Voltage (VDC) | Output Voltage (VDC) | Pin out   | Remote Control Option                    | Shape          | Watt      |
|----------------|---------------------|----------------------|-----------|------------------------------------------|----------------|-----------|
| Supreme series | 024W : 9-36         | 050 : 5              |           |                                          |                |           |
| Half Brick     | 024 : 18-36         | 120 : 12             |           |                                          |                |           |
|                | 048W : 18-75        | 240 : 24             |           |                                          |                |           |
|                | 110 : 40-160        | 280 : 28             | V : Vicor | P : Positive logic<br>N : Negative logic | B : Base Plate | 50<br>100 |
| Second         | 300 : 180-425       | 480 : 48             |           |                                          |                |           |

**Model Selection Guide**

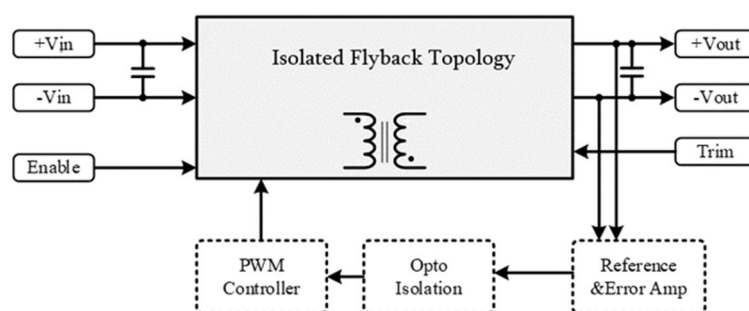
Typical @ Ta=+25 °C under nominal line voltage conditions unless noted

| Model                | Input       |         |             | Output  |         |       | Efficiency |
|----------------------|-------------|---------|-------------|---------|---------|-------|------------|
|                      | Voltage (V) |         | Current (A) | Voltage | Current | Power |            |
|                      | Range       | Nominal | Full load   | (V)     | (A)     | (W)   | Typ.(%)    |
| SHBS024W050-V-□-B50  | 9-36        | 24      | 2.37        | 5       | 10      | 50    | 88         |
| SHBS024W120-V-□-B50  | 9-36        | 24      | 2.34        | 12      | 4.17    | 50    | 89         |
| SHBS024W240-V-□-B50  | 9-36        | 24      | 2.34        | 24      | 2.08    | 50    | 89         |
| SHBS024W280-V-□-B50  | 9-36        | 24      | 2.34        | 28      | 1.79    | 50    | 89         |
| SHBS024W480-V-□-B50  | 9-36        | 24      | 2.34        | 48      | 1.04    | 50    | 89         |
| SHBS024W050-V-□-B100 | 9-36        | 24      | 4.73        | 5       | 20      | 100   | 88         |
| SHBS024W120-V-□-B100 | 9-36        | 24      | 4.68        | 12      | 8.33    | 100   | 89         |
| SHBS024W240-V-□-B100 | 9-36        | 24      | 4.68        | 24      | 4.17    | 100   | 89         |
| SHBS024W280-V-□-B100 | 9-36        | 24      | 4.68        | 28      | 3.57    | 100   | 89         |
| SHBS024W480-V-□-B100 | 9-36        | 24      | 4.68        | 48      | 2.08    | 100   | 89         |
| SHBS024050-V-□-B50   | 18-36       | 24      | 2.37        | 5       | 10      | 50    | 88         |
| SHBS024120-V-□-B50   | 18-36       | 24      | 2.34        | 12      | 4.17    | 50    | 89         |
| SHBS024240-V-□-B50   | 18-36       | 24      | 2.34        | 24      | 2.08    | 50    | 89         |
| SHBS024280-V-□-B50   | 18-36       | 24      | 2.34        | 28      | 1.79    | 50    | 89         |
| SHBS024480-V-□-B50   | 18-36       | 24      | 2.34        | 48      | 1.04    | 50    | 89         |
| SHBS024050-V-□-B100  | 18-36       | 24      | 4.73        | 5       | 20      | 100   | 88         |
| SHBS024120-V-□-B100  | 18-36       | 24      | 4.68        | 12      | 8.33    | 100   | 89         |
| SHBS024240-V-□-B100  | 18-36       | 24      | 4.68        | 24      | 4.17    | 100   | 89         |
| SHBS024280-V-□-B100  | 18-36       | 24      | 4.68        | 28      | 3.57    | 100   | 89         |
| SHBS024480-V-□-B100  | 18-36       | 24      | 4.68        | 48      | 2.08    | 100   | 89         |
| SHBS048W050-V-□-B50  | 18-75       | 48      | 1.18        | 5       | 10      | 50    | 88         |
| SHBS048W120-V-□-B50  | 18-75       | 48      | 1.17        | 12      | 4.17    | 50    | 89         |
| SHBS048W240-V-□-B50  | 18-75       | 48      | 1.17        | 24      | 2.08    | 50    | 89         |
| SHBS048W280-V-□-B50  | 18-75       | 48      | 1.17        | 28      | 1.79    | 50    | 89         |
| SHBS048W480-V-□-B50  | 18-75       | 48      | 1.17        | 48      | 1.04    | 50    | 89         |
| SHBS048W050-V-□-B100 | 18-75       | 48      | 2.37        | 5       | 20      | 100   | 88         |
| SHBS048W120-V-□-B100 | 18-75       | 48      | 2.34        | 12      | 8.33    | 100   | 89         |
| SHBS048W240-V-□-B100 | 18-75       | 48      | 2.34        | 24      | 4.17    | 100   | 89         |
| SHBS048W280-V-□-B100 | 18-75       | 48      | 2.34        | 28      | 3.57    | 100   | 89         |
| SHBS048W480-V-□-B100 | 18-75       | 48      | 2.34        | 48      | 2.08    | 100   | 89         |

| Model               | Input       |         |             | Output  |         |       | Efficiency |
|---------------------|-------------|---------|-------------|---------|---------|-------|------------|
|                     | Voltage (V) |         | Current (A) | Voltage | Current | Power |            |
|                     | Range       | Nominal | Full load   | (V)     | (A)     | (W)   | Typ.(%)    |
| SHBS110050-V-□-B50  | 40-160      | 110     | 0.52        | 5       | 10      | 50    | 88         |
| SHBS110120-V-□-B50  | 40-160      | 110     | 0.51        | 12      | 4.17    | 50    | 89         |
| SHBS110240-V-□-B50  | 40-160      | 110     | 0.51        | 24      | 2.08    | 50    | 89         |
| SHBS110280-V-□-B50  | 40-160      | 110     | 0.51        | 28      | 1.79    | 50    | 89         |
| SHBS110480-V-□-B50  | 40-160      | 110     | 0.51        | 48      | 1.04    | 50    | 89         |
| SHBS110050-V-□-B100 | 40-160      | 110     | 1.03        | 5       | 20      | 100   | 88         |
| SHBS110120-V-□-B100 | 40-160      | 110     | 1.02        | 12      | 8.33    | 100   | 89         |
| SHBS110240-V-□-B100 | 40-160      | 110     | 1.02        | 24      | 4.17    | 100   | 89         |
| SHBS110280-V-□-B100 | 40-160      | 110     | 1.02        | 28      | 3.57    | 100   | 89         |
| SHBS110480-V-□-B100 | 40-160      | 110     | 1.02        | 48      | 2.08    | 100   | 89         |
| SHBS300050-V-□-B50  | 180-425     | 300     | 0.19        | 5       | 10      | 50    | 88         |
| SHBS300120-V-□-B50  | 180-425     | 300     | 0.19        | 12      | 4.17    | 50    | 89         |
| SHBS300240-V-□-B50  | 180-425     | 300     | 0.19        | 24      | 2.08    | 50    | 89         |
| SHBS300280-V-□-B50  | 180-425     | 300     | 0.19        | 28      | 1.79    | 50    | 89         |
| SHBS300480-V-□-B50  | 180-425     | 300     | 0.19        | 48      | 1.04    | 50    | 89         |
| SHBS300050-V-□-B100 | 180-425     | 300     | 0.38        | 5       | 20      | 100   | 88         |
| SHBS300120-V-□-B100 | 180-425     | 300     | 0.37        | 12      | 8.33    | 100   | 89         |
| SHBS300240-V-□-B100 | 180-425     | 300     | 0.37        | 24      | 4.17    | 100   | 89         |
| SHBS300280-V-□-B100 | 180-425     | 300     | 0.37        | 28      | 3.57    | 100   | 89         |
| SHBS300480-V-□-B100 | 180-425     | 300     | 0.37        | 48      | 2.08    | 100   | 89         |

## Description

**Supreme series - Half Brick - Second generation converter** is composed of Isolated, board-mountable, fixed switching frequency DC-DC converters that use synchronous rectification to achieve extremely high-power conversion efficiency. These DC-DC converter modules use advanced power processing, control, and packaging technologies to enhance the performance, flexibility, reliability, and cost effectiveness of mature power components. Each module is six-sided metal case enclosed to provide protection from the harsh environments seen in many industrial and transportation applications.



SHBS Series Block Diagram

## Electrical Specifications

**Input Specifications** (Typical @ Ta=+25 °C under nominal line voltage conditions unless noted.)

| Parameter                                 | Notes and Conditions                                    | Min. | Typ.             | Max. | Unit |
|-------------------------------------------|---------------------------------------------------------|------|------------------|------|------|
| Transient Input Voltage Ranges            | SHBS024W models (100ms Max)                             |      |                  | 50   | VDC  |
|                                           | SHBS024 models (100ms Max)                              |      |                  | 50   |      |
|                                           | SHBS048W models (100ms Max)                             |      |                  | 80   |      |
|                                           | SHBS110 models (100ms Max)                              |      |                  | 250  |      |
|                                           | SHBS300 models (100ms Max)                              |      |                  | 500  |      |
| Operating Input Voltage Ranges            | SHBS024W models                                         | 9    | 24               | 36   | VDC  |
|                                           | SHBS024 models                                          | 18   | 24               | 36   |      |
|                                           | SHBS048W models                                         | 18   | 48               | 75   |      |
|                                           | SHBS110 models                                          | 40   | 110              | 160  |      |
|                                           | SHBS300 models                                          | 180  | 300              | 425  |      |
| Under-Voltage Lockout<br>Start up Voltage | SHBS024W models                                         |      |                  | 9    | VDC  |
|                                           | SHBS024 models                                          |      |                  | 18   |      |
|                                           | SHBS048W models                                         |      |                  | 18   |      |
|                                           | SHBS110 models                                          |      |                  | 40   |      |
|                                           | SHBS300 models                                          |      |                  | 180  |      |
| Under-Voltage Lockout<br>Shutdown Voltage | SHBS024W models                                         |      | 8                |      | VDC  |
|                                           | SHBS024 models                                          |      | 17               |      |      |
|                                           | SHBS048W models                                         |      | 17               |      |      |
|                                           | SHBS110 models                                          |      | 38               |      |      |
|                                           | SHBS300 models                                          |      | 170              |      |      |
| Input Current                             | See model selection guide, Standby mode (OFF, UVLO) 8mA |      |                  |      |      |
| Enable Function Input                     | Positive logic                                          | ON   | Open             |      | VDC  |
|                                           |                                                         | OFF  | Short or 0 ~ 1.2 |      |      |
|                                           | Negative logic                                          | ON   | Short or 0 ~ 1.2 |      | VDC  |
|                                           |                                                         | OFF  | Open             |      |      |

## Output Specifications

| Parameter                     | Notes and Conditions                                | Min. | Typ. | Max.  | Unit                |
|-------------------------------|-----------------------------------------------------|------|------|-------|---------------------|
| Output Voltage Accuracy       | V <sub>NOM</sub> 50% Load                           |      |      | ±1.5  | %                   |
| Line Regulation               | Low Line to High Line                               |      |      | ±0.3  | %                   |
| Load Regulation               | 10% to 100% Load                                    |      |      | ±0.5  | %                   |
| Output Ripple & Noise Voltage | Bandwidth 20MHz and with 10μF MLCC Output Capacitor |      | 1.5  |       | %V <sub>pk-pk</sub> |
| Temperature Coefficient       |                                                     |      |      | ±0.04 | % / °C              |
| Transient Recovery Time       | 25% load step change                                |      | 800  |       | μSec.               |
| Transient Peak Deviation      | ΔIo/Δt=2.5A/us                                      |      | ±2   |       | %Vo                 |
| Start-Up Time                 | When use Enable Function                            |      | 20   |       | mSec.               |
| Trimming Output Voltage       | V <sub>NOM</sub> 10% Load                           |      | ±10  |       | %                   |
| Over Voltage Protection       | V <sub>NOM</sub> 10% Load                           |      | 120  |       | %                   |
| Output Power Protection       | V <sub>NOM</sub>                                    |      | 120  |       | %                   |

## General Specifications &amp; Environmental Specifications

| Parameter                   | Notes and Conditions                            | Min.                                         | Typ. | Max. | Unit    |
|-----------------------------|-------------------------------------------------|----------------------------------------------|------|------|---------|
| Switching Frequency         | V <sub>NOM</sub>                                | 180                                          |      | 300  | kHz     |
| Storage Temperature Range   | All models                                      | -60                                          |      | 125  | °C      |
| Operating Case Temperature  | All models                                      | -40                                          |      | 100  | °C      |
| Over temperature Protection | All models, Auto. Recovery                      |                                              | 105  |      |         |
| Isolation Voltage           | All models, 1 Minute                            | 2250                                         |      |      | VDC     |
| Input to Output             |                                                 |                                              |      |      |         |
| Input & Output to Case      |                                                 | 1500                                         |      |      |         |
| Isolation Resistance        | All models,<br>500VDC, At 70%RH                 | 100                                          |      |      | MΩ      |
| Input to Output             |                                                 |                                              |      |      |         |
| Isolation Capacitance       | All models                                      |                                              | 1500 |      | pF      |
| Input to Output             |                                                 |                                              |      |      |         |
| Humidity (non condensing)   | All models                                      |                                              |      | 95   | %       |
| Calculated MTBF             | BellCore-TR-332@ 50°C G.B                       |                                              | 1.5  |      | M HR    |
| Thermal shock               | Environmental Engineering<br>Experimental Tests | MIL-STD-810F                                 |      |      |         |
| Vibration                   |                                                 | MIL-STD-810F                                 |      |      |         |
| Drop                        |                                                 | MIL-STD-810F                                 |      |      |         |
| Weight                      | Shape-B                                         | 95(3.35)                                     |      |      | g (oz.) |
| Dimensions                  | Shape-B                                         | 2.42" x 2.40" x 0.59" (61.4 x 61.0 x 15.0mm) |      |      |         |
| Case Material               | Aluminum                                        |                                              |      |      |         |
| Potting Material            | Silicone                                        |                                              |      |      |         |

## Standards Compliance

| Parameter                | Standard    | Test Conditions                                | Performance Criteria |
|--------------------------|-------------|------------------------------------------------|----------------------|
| Environmental Compliance | Reach; RoHS |                                                | PASS                 |
| EMI                      | EN55022     |                                                | Class A / Class B    |
| ESD                      | EN61000-4-2 | ±4 kV Air Discharge<br>±4 kV Contact Discharge | Crit. A              |
| Radiated Immunity        | EN61000-4-3 | Level 2, 3 V/m                                 | Crit. A              |
| Fast Transient           | EN61000-4-4 | ±2 kV Applied                                  | Crit. A              |
| Surge                    | EN61000-4-5 | ±2 kV Applied                                  | Crit. A              |
| Conducted Immunity       | EN61000-4-6 | Level 2, 3 V rms                               | Crit. A              |

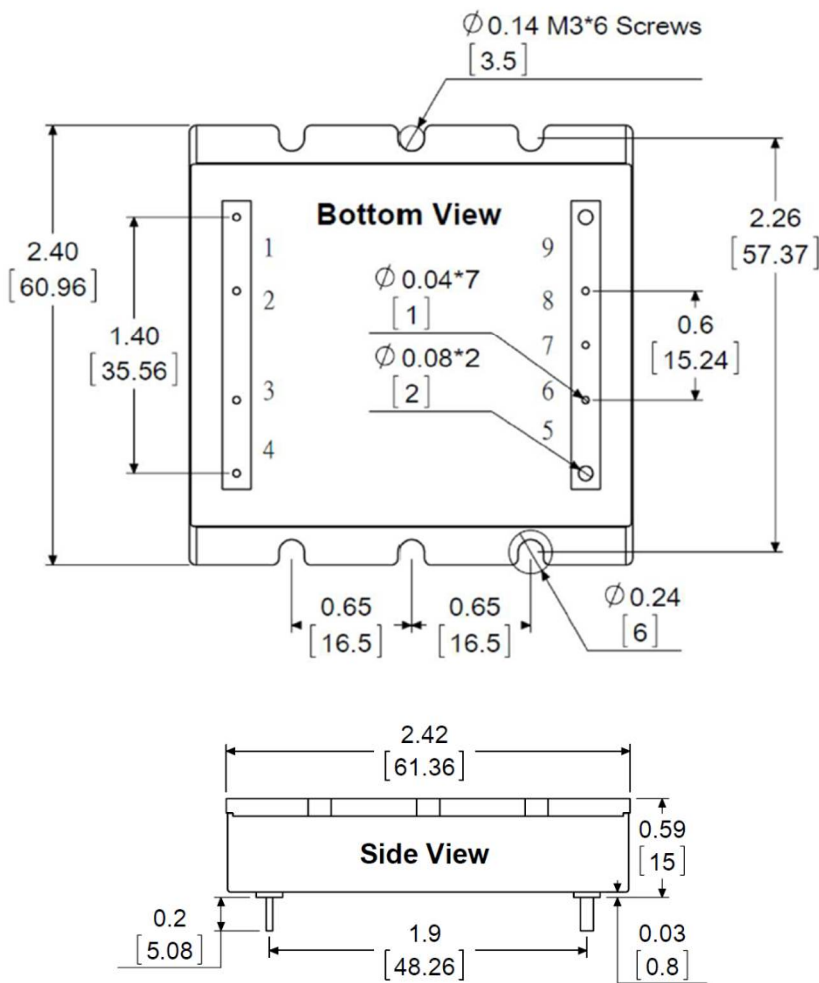
It is recommended to protect the input by fuses or other protection devices.

**Modules could meet EN55022 Class A and Class B standard with external components.**

The information and specifications contained in this data sheet are believed to be correct at time of publication. All specifications are subject to change without notice. No rights under any patent accompany the sale of any such products or information contained herein.

## Mechanical Dimensions & Pin Assignments

### Shape – B



### Pin Assignments:

| Pin# | Function |
|------|----------|
| 1    | -Vin     |
| 2    | NC       |
| 3    | Enable   |
| 4    | +Vin     |
| 5    | +Vout    |
| 6    | +Sense   |
| 7    | Trim     |
| 8    | -Sense   |
| 9    | -Vout    |

### Note:

Pin Material: Copper Alloy

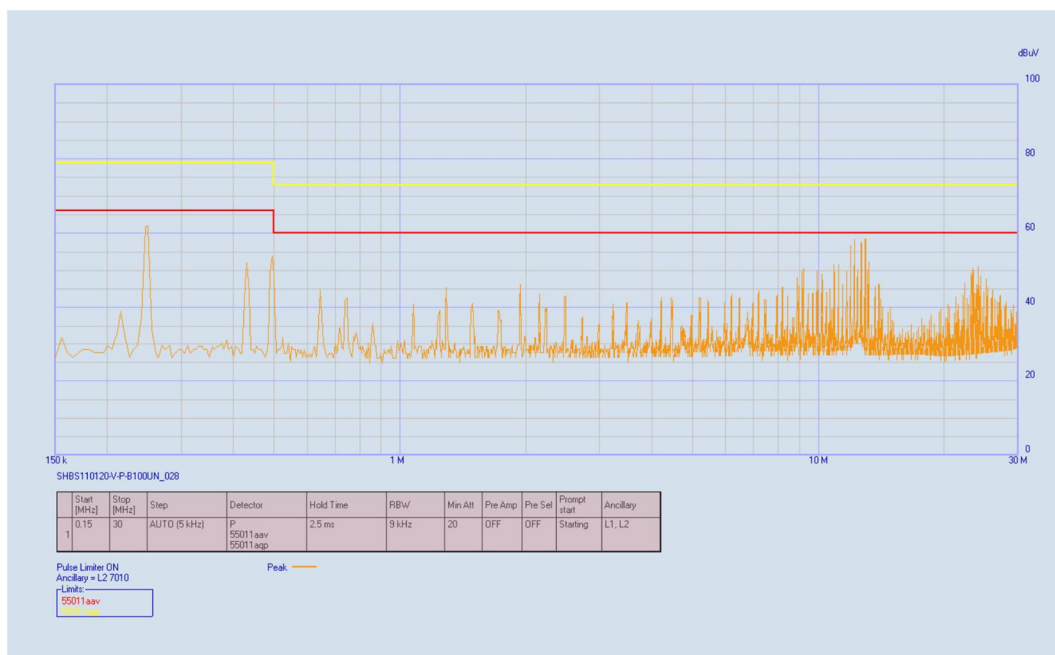
Pin Plating: Gold

Dimensions in inches [mm]

Tolerances: .XX±0.02 [ .X±0.5mm]

## Conducted EMI

Input terminal value (typ.) SHBS110120-V-P-B100 @Vin = 110VDC, Iout = 8.3A



The fundamental switching frequency of the module is 260 kHz.

## Characteristic Curves

Testing conditions are at typical input,  $T_a = +25^\circ\text{C}$ , full load (horizontal mount) Unless otherwise indicated

The figures of SHBS024W240-V-P-B100

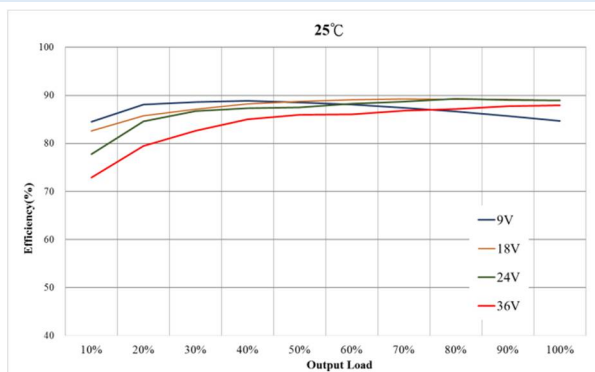


Figure 1 : Efficiency at Minimum, Nominal and Maximum Input Voltages VS. Output Load.

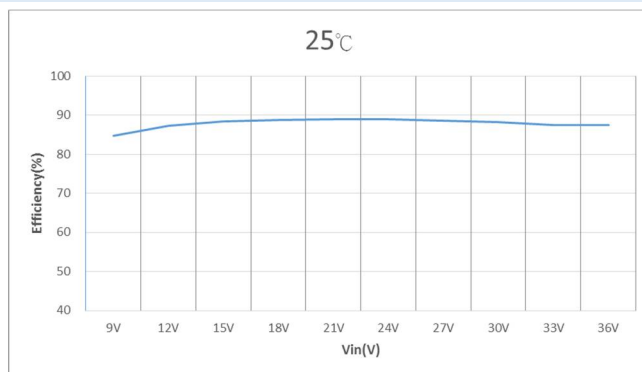


Figure 2 : Efficiency VS. Input Voltages at 100% rated power

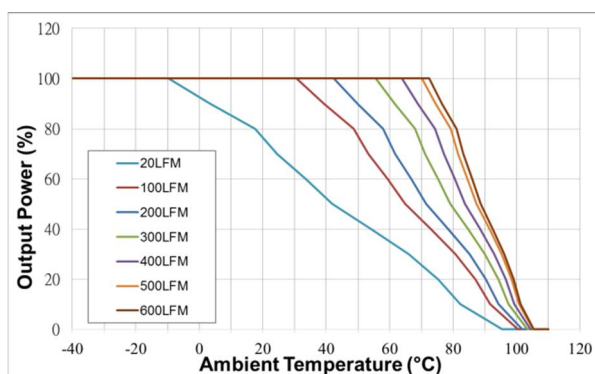


Figure 3 : Ambient Temperature VS. Output Power Derating Curves (Note: 20LFM = Free Air)

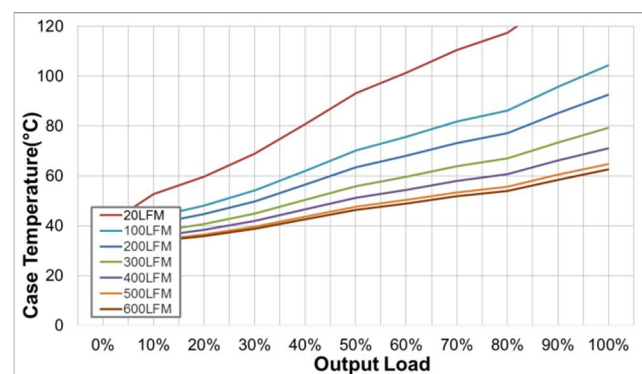


Figure 4 : Case Temperature VS. Output rated Power (Note: 20LFM = Free Air)

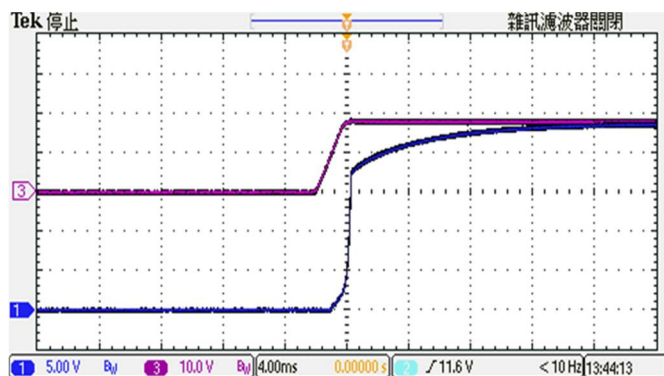


Figure 5 : CH1 = Vout, CH3 = Nominal Input Typical Start-up waveform at Full load.

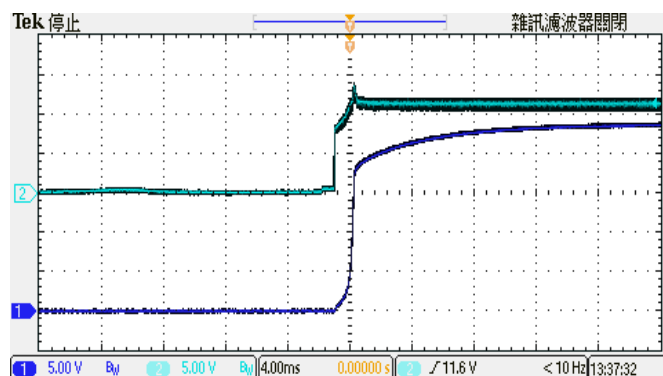


Figure 6 : CH1 = Vout, CH3 = Enable Pin Typical Start-up waveform. Input voltage pre-applied

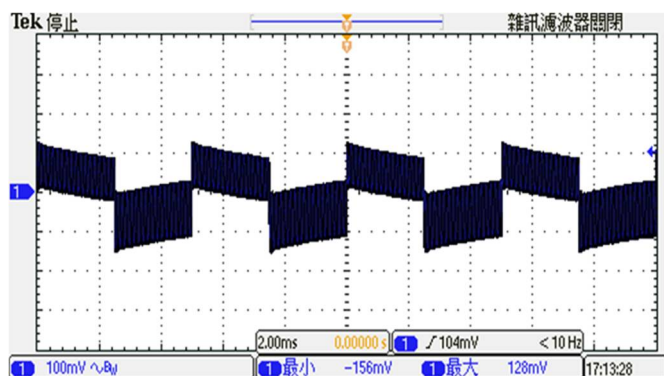


Figure 7 : Transient Response at Output step load ( $V_{in}$ : Typical, 50~75% of output current;  $\Delta I_o/\Delta t = 1\text{A}/\mu\text{s}$ )

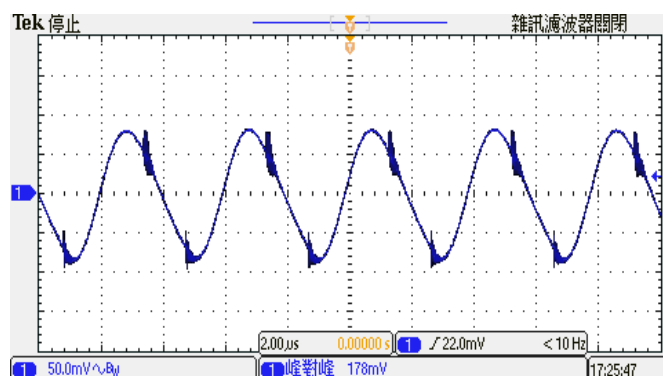


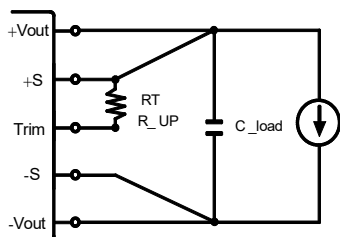
Figure 8 : Output Voltage Ripple & Noise at full load. ( $V_{in}$ : Typical, With Output Capacitor to add 1uF MLCC)

## Trimming Output Voltage – for Single output models

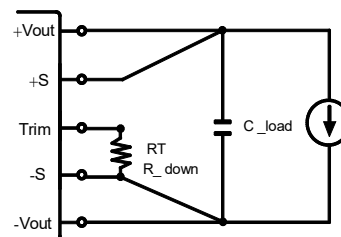
Only the single output converters have a trim function. That allows users to adjust the output voltage from +10% to -10%, please refer to the trim table that follow for details. Adjustments to the output voltage can be used with a simple fixed resistor as shown in Figures 1 and 2. A single fixed resistor can increase or decrease the output voltage depending on its connection.

### Note:

- ✖ Trim adjustments higher than the specified range can have an adverse effect on the converter's performance and are not recommended.
- ✖ If the trim function is not used, leave the trim pin open.



**Figure 1.** Trim Connections To increase Output Voltages Using Fixed Resistors



**Figure 2.** Trim Connections To decrease Output Voltages Using Fixed Resistors

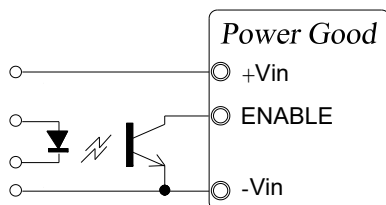
|      | Trim up resistor value(KΩ) |     |     |     |     |    |    |     |     |     |
|------|----------------------------|-----|-----|-----|-----|----|----|-----|-----|-----|
| Vout | 1%                         | 2%  | 3%  | 4%  | 5%  | 6% | 7% | 8%  | 9%  | 10% |
| 5    | 109                        | 50  | 30  | 20  | 14  | 10 | 7  | 5   | 3.3 | 2   |
| 12   | 258                        | 115 | 67  | 44  | 29  | 20 | 13 | 7.8 | 3.8 | 0.6 |
| 24   | 514                        | 232 | 137 | 90  | 62  | 43 | 30 | 20  | 12  | 5.5 |
| 28   | 602                        | 271 | 161 | 105 | 72  | 50 | 34 | 22  | 13  | 5.9 |
| 48   | 1039                       | 464 | 273 | 177 | 120 | 81 | 54 | 34  | 18  | 5   |

|      | Trim down resistor value(KΩ) |     |     |     |     |     |     |     |     |      |
|------|------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|
| Vout | -1%                          | -2% | -3% | -4% | -5% | -6% | -7% | -8% | -9% | -10% |
| 5    | 137                          | 62  | 37  | 25  | 17  | 12  | 9   | 6   | 4   | 2.2  |
| 12   | 358                          | 162 | 96  | 63  | 44  | 31  | 21  | 14  | 8.9 | 4.5  |
| 24   | 769                          | 352 | 213 | 143 | 102 | 74  | 54  | 39  | 28  | 18   |
| 28   | 860                          | 392 | 236 | 158 | 111 | 80  | 57  | 41  | 28  | 17   |
| 48   | 1413                         | 638 | 380 | 251 | 173 | 121 | 85  | 57  | 35  | 18   |

### Enable Control Function

The primary-side, Enable Control function can be specified to operate with either positive or negative polarity. Positive-polarity devices are enabled when the enable pin is left open or is pulled high.

Positive-polarity devices are disabled when the enable pin is pulled low (under +1.0V with respect to -input). Negative-polarity devices are off when the enable pin is high/open and on when the enable pin is pulled low. See Figure 3.



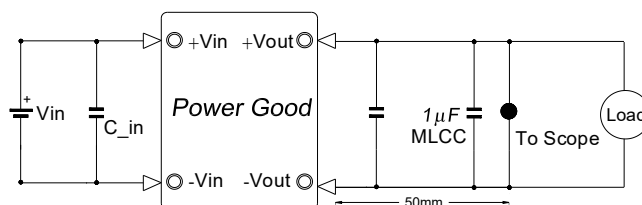
**Figure 3.** Driving the Enable Control pin

### Output Ripple Noise

The two copper strips simulate real-world PCB impedances between the converter and its load. Scope measurements should be made using BNC connectors or the probe ground should be less than 1/2 inch and soldered directly to the fixture.

All external capacitors should have appropriate voltage ratings and be located as close to the converter as possible.

Temperature variations for all relevant parameters should be taken into consideration. The most effective combination of external I/O capacitors will be a function of line voltage and source impedance, as well as particular load and layout conditions. See Figure 4.



**Figure 4.** Measuring Output Ripple/Noise(20MHz bandwidth)

