

Figure 1.1. Top View of AHV12VN2KV3MAW

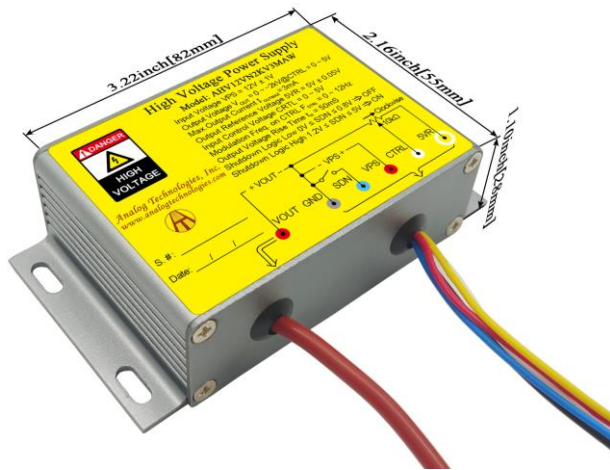


Figure 1.2. Side View



Figure 1.3. Side View



Figure 1.4. Side View

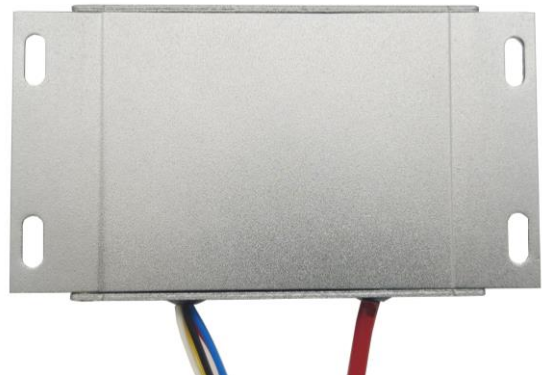


Figure 1.5. Bottom View



FEATURES

- Input Power Voltage: 12V ± 1V
- Input Current Range: 120mA to 710mA
- Output Voltage: 0 to -2kV@CTRL = 0 to 5V
- Max. Output Current: 3mA
- Reference Voltage: 5V ± 0.05V
- Input Control Voltage: 0 to 5V
- Electronic Shutdown Control Available
- Zero EMIs and Good Heat Sinking by Metal Enclosure

APPLICATIONS

This power module, AHV12VN2KV3MAW, is designed for achieving DC-DC conversion from low voltage to high voltage as a power supply source. It can be used for:

- X-ray Machine
- Spectral Analysis
- Nondestructive Inspection
- Semiconductor Manufacturing Equipment
- Particle Accelerator
- Capillary Electrophoresis
- Particles Injection
- Physical Vapor Phase Deposition
- Electrospinning Preparation of Nanofiber
- Glass/ Fabric Coating
- DC Reactive Magnetron Sputtering

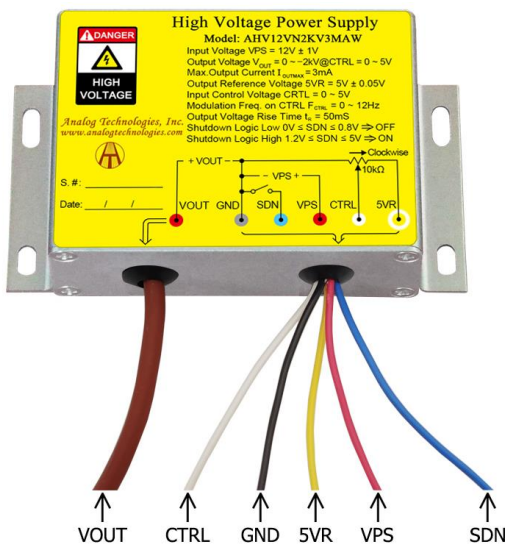


Figure 2. The Connecting Lead Wires of AHV12VN2KV3MAW

Table 1. Pin Names, Colors, Functions and Specifications.

| No. | Name | Description | Type | Color | | Min. | Typ. | Max. |
|-----|------|---------------------|--|-------|--------|------|------|------|
| 1 | SDN | Shutdown logic low | Digital input | ● | Blue | 0V | | 0.8V |
| | | Shutdown logic high | | | | 1.2V | | 5V |
| 2 | 5VR | Reference voltage | Analog output | ● | Yellow | | 5V | |
| 3 | CTRL | Regulation | Analog input | ○ | White | 0V | | 5V |
| 4 | VPS | Input voltage | Power supply input | ● | Red | 11V | 12V | 13V |
| 5 | GND | Ground | Ground for power supply and analog & digital signals | ● | Black | | 0V | |
| 6 | VOUT | Output high voltage | Power output | ● | Brown | 0V | | -2kV |



DESCRIPTION

Figure 1 shows the actual pictures of AHV12VN2KV3MAW. Figure 2 shows its connecting wires. More detail information is given in Table 1. The high voltage output can be set to a constant value between 0V to -2kV by connecting the CTRL port to the central tap of a POT (Potentiometer) or modulated by an AC signal ranging from 0V to 5V, as see Figure 3 and Figure 4 respectively. The output voltage equals to 400 times the input control voltage: $V_{OUT} = 400 \times V_{CTRL}$.

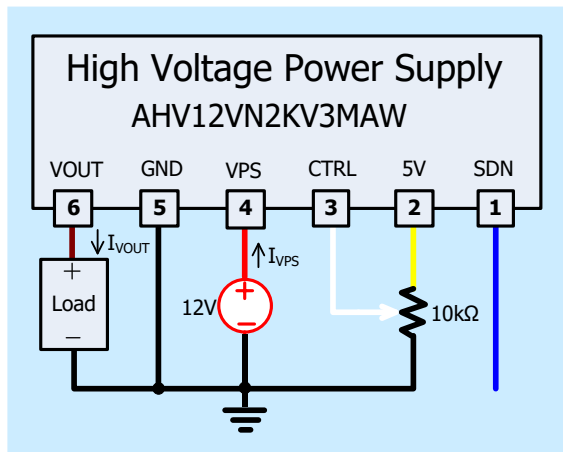


Figure 3. Setting Output to be a Constant Voltage

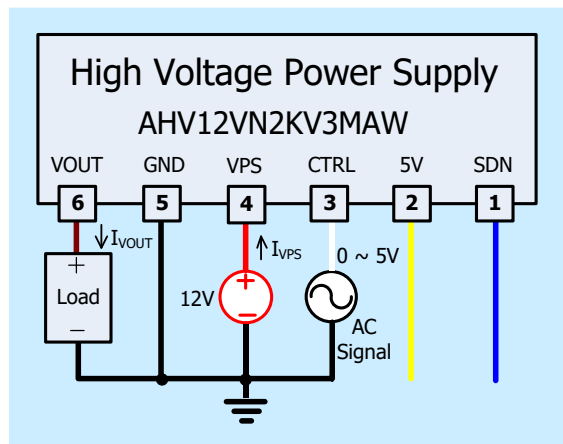


Figure 4. Modulating Output by an AC Signal Source

Please note that the modulation signal must have a low frequency $\leq 12\text{Hz}$ and the value range must be $0\text{V} \leq V_{CTRL} \leq 5\text{V}$. The equivalent input circuit for the CTRL is shown in Figure 5.

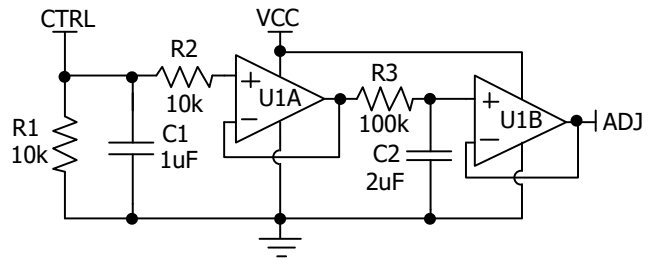


Figure 5. The Equivalent Circuit for CTRL Port

To shutdown AHV12VN2KV3MAW, pull down SDN pin to $< 0.8\text{V}$; to turn it on, leave SDN pin unconnected or pull it $> 1.2\text{V}$. The maximum voltage allowed on the SDN pin is 5V. The equivalent circuit for SDN port is shown in Figure 6.

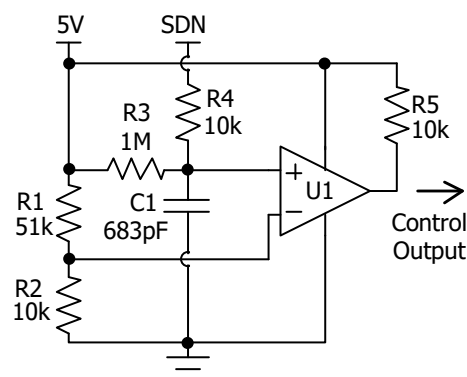


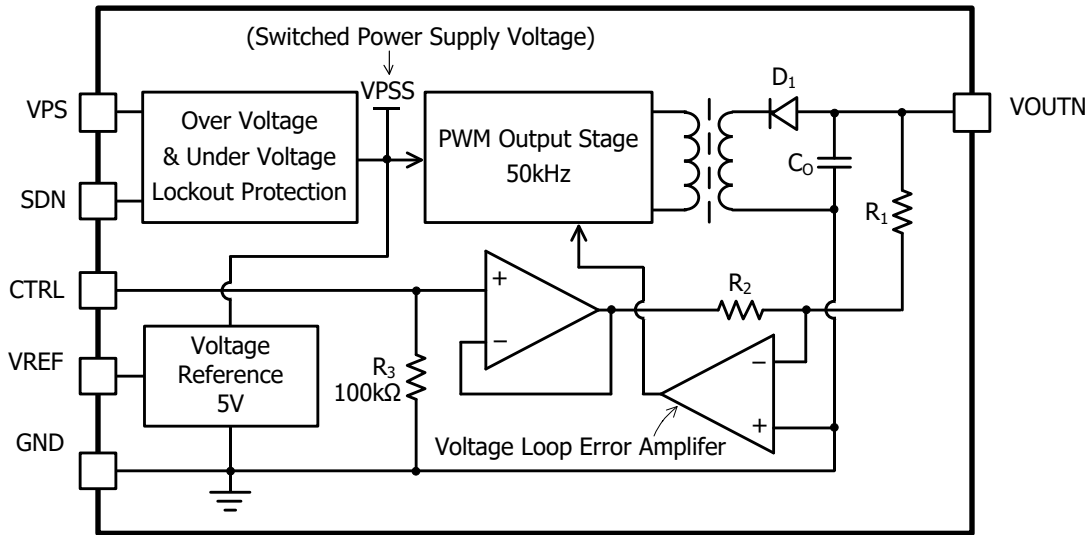
Figure 6. The Equivalent Circuit for SDN Port

USING AHV12VN2KV3MAW

This high voltage power supply must be mounted tightly onto a metal plate, ideally, thus expanding its heating sinking capacity of the metal enclosure. Sufficient ventilation must be provided to keep the power supply surface temperature under 55°C .

SAFETY PRECAUTIONS

Although AHV12VN2KV3MAW high voltage power supply comes with an over current protection circuit, a short circuit at the output should always be avoided. Make sure the high voltage wire for connecting VOUT node has sufficient insulation capability with its surrounding objects.



$V_{OUTN} = -N \times V_{CTRL}$, where N is the amplification factor: $N = R_1/R_2$.

High Voltage Power Supply Function Block Diagram

SPECIFICATIONS

Table 2. Characteristics. $T_A = 25^\circ\text{C}$, unless otherwise noted.

| Parameter | Symbol | Test Conditions | Min. | Typ. | Max. | Unit/Note |
|---|-----------------|---|------|------|-------|---------------|
| Input Power Supply Voltage | V_{VPS} | | 11 | 12 | 13 | V |
| Input Power Supply Quiescent Current | I_{VPS_QC} | $I_{VOUT} = 0\text{mA}$ $V_{SDN} = V_{CTRL} = 5\text{V}$ | 120 | 170 | 220 | mA |
| Input Power Supply Current at Full Load | I_{VPS_FL} | $I_{VOUT} = 3.0\text{mA}$ | 660 | 710 | 760 | mA |
| Input Power Supply Current at Shutdown | I_{VPS_SHDN} | $T_A = -10^\circ\text{C} \sim 55^\circ\text{C}$ | | 13 | | mA |
| Modulation Voltage Range on CTRL | V_{CTRL} | | 0 | | 5 | V |
| Modulation Frequency Range on CTRL | f_{CTRL} | | 0 | | 12 | Hz |
| Shutdown Port Current | I_{SDNL} | $0 \leq V_{SDNL} < 0.8\text{V}$ | -5 | | -4.2 | μA |
| | I_{SDNH} | $1.2\text{V} < V_{SDNL} < 5\text{V}$ | 0 | | 3.8 | μA |
| Shutdown Voltage Logic Low | V_{SDNL} | | 0 | | 0.8 | V |
| Shutdown Voltage Logic High | V_{SDNH} | | 1.2 | | 5 | V |
| Output Voltage Range | V_{VOUT} | $I_{VOUT} = 0 \sim 3.0\text{mA}$ | 0 | | -2000 | V |
| Output Current Range | $I_{VOUTMAX}$ | $V_{VPS} = 11\text{V} \sim 13\text{V}$ | 0 | | 3.0 | mA |
| Reference Output Voltage Range | V_{5VR} | $T_A = -10^\circ\text{C} \sim 55^\circ\text{C}$ $I_{5VR} \leq 1\text{mA}$ | 4.95 | 5 | 5.05 | V |
| Reference Output Current Range | I_{5VR} | $T_A = -10^\circ\text{C} \sim 55^\circ\text{C}$ $V_{5VR} = 0 \sim 5\text{V}$ | 0 | | 1 | mA |



| Parameter | | Symbol | Test Conditions | Min. | Typ. | Max. | Unit/Note |
|---|------------------|---|--|-----------------------------|-------------|----------------|----------------|
| Output Load Resistance Range | | | | $\frac{V_{VOUT}}{I_{VOUT}}$ | | ∞ | M Ω |
| Output Voltage Ripple | | V_{VOUT_RP} | Bandwidth = 1MHz $R_{LOAD} = 670k\Omega$ $V_{VOUT} = -2kV$ | ≤ 1.0 | | | V_{P-P} |
| Output Voltage Temperature Coefficient | | TCV_{VOUT} | $V_{VPS} = 12V$ $V_{CTRL} = V_{5VR} = 5V$ $V_{VOUT} = -2kV$ $I_{VOUT} = 3mA$ $T_A = -10^{\circ}C \sim 55^{\circ}C$ | | ≤ 0.01 | | %/ $^{\circ}C$ |
| Output Voltage Range v.s. Temperature | | $V_{VOUT}(T)$ | $V_{VPS} = 12V$ $V_{CTRL} = V_{5VR} = 5V$ $V_{VOUT} = -2kV$ $I_{VOUT} = 3mA$ $T_A = -10^{\circ}C \sim 55^{\circ}C$ | $0.99V_{VOUT}$ | V_{VOUT} | $1.01V_{VOUT}$ | V |
| Output Voltage Drift | Short Term Drift | $\frac{ \Delta V_{VOUT} }{V_{VOUT}}$ Δt (min) | $V_{VPS} = 12V$ $V_{CTRL} = V_{5VR} = 5V$ $V_{VOUT} = -2kV$ $I_{VOUT} = 3mA$ $T_A = -10^{\circ}C \sim 55^{\circ}C$ | | ≤ 0.5 | | %/min |
| | Long Term Drift | $\frac{ \Delta V_{VOUT} }{V_{VOUT}}$ Δt (h) | | | ≤ 1 | | %/h |
| Output Voltage Rise Time | | t_r | $V_{VOUT}(t_1) = -200V$ $V_{VOUT}(t_2) = -1800V$ $R_{Load} = 670k\Omega$ | | 50 | | ms |
| Output Voltage Fall Time | | t_f | $V_{VOUT}(t_2) = -1800V$ $V_{VOUT}(t_3) = -200V$ $R_{Load} = 670k\Omega$ | | 100 | | ms |
| Mean Time Between Failure | | MTBF | | | 1M | | h |
| Instantaneous Short Circuit Current at the Output | | I_{VOUT_SC} | | | ≤ 300 | | mA |
| Load Regulation | | $\frac{ \Delta V_{VOUT} }{V_{VOUT}}$ ΔI_{VOUT} | $V_{VOUT} = -2kV$ $I_{VOUT} = 3mA$ | | ≤ 0.05 | | %/mA |
| Full Load Efficiency | | η | $V_{VPS} = 12V$ $V_{VOUT} = -2kV$ $I_{VOUT} = 3mA$ | | ≥ 70 | | % |
| Operating Temperature Range | | T_{opr} | | -10 | | 55 | $^{\circ}C$ |
| Storage Temperature Range | | T_{stg} | | -20 | | 85 | $^{\circ}C$ |
| External Dimensions | | | | 82×55×28 | | | mm |
| | | | | 3.23×2.17×1.10 | | | inch |
| Weight | | | | | 210 | | g |
| | | | | | 0.46 | | lbs |
| | | | | | 7.4 | | Oz |



TESTING DATA

Test conditions: $V_{PS} = 12V$, $T_A = 25^{\circ}C$, $R_{LOAD} = 670k\Omega$

DC Testing

The measured output voltage, V_{OUT} , corresponding to the control port input voltage, V_{CTRL} , is shown in Figure 7.

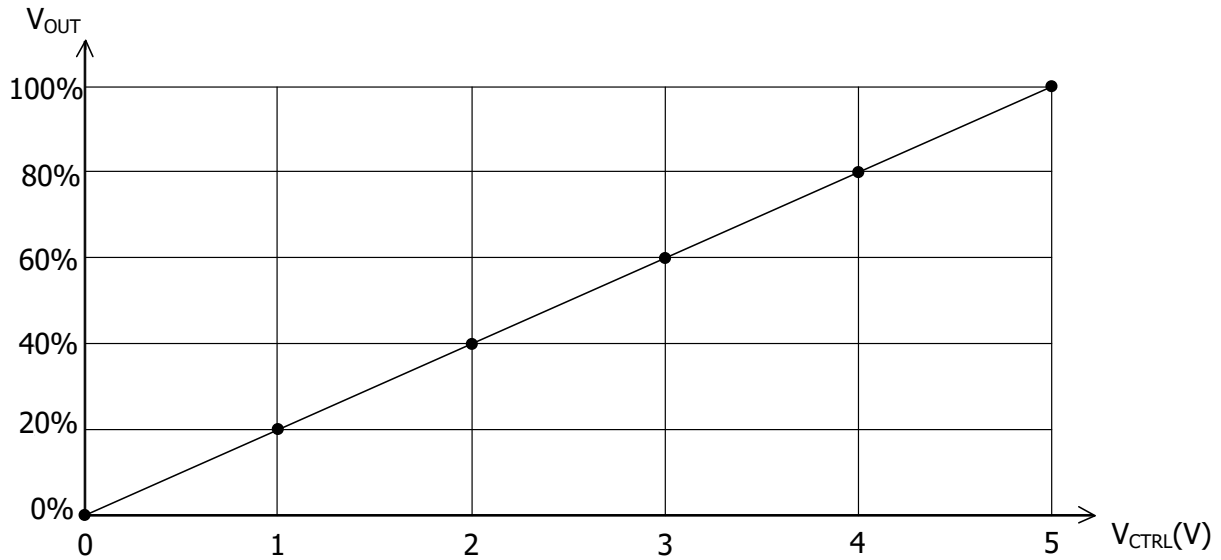


Figure 7. V_{CTRL} vs. V_{OUT}

AC Testing

To test the analog modulation function, a triangle and sine-wave voltage signals are applied to the CTRL port as the input source signal respectively. Figure 8 and 9 show both the input signal and the output signal waveforms when using the triangle and sine-wave signals at the CTRL port respectively.

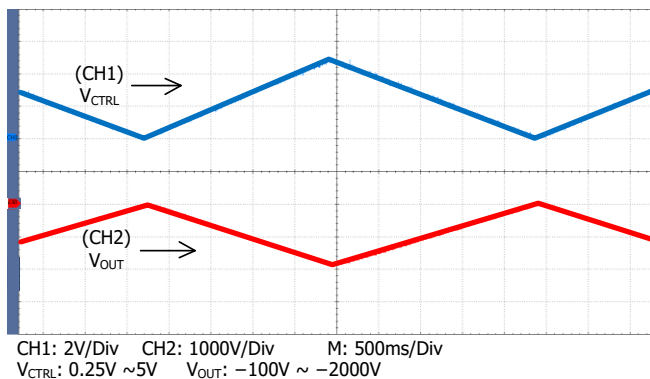


Figure 8. Triangle Wave Modulation

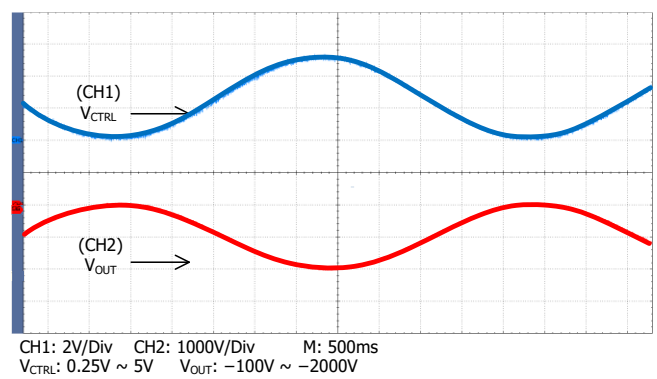


Figure 9. Sine Wave Modulation



To test the rise and fall times at the output, a step function signal is applied to the CTRL port. The testing results are shown in Figure 10, Figure 11, and Figure 12. As shown in Figure 11 and Figure 12, a square wave of 0.25V ~ 5V, f = 0.10Hz, is applied to CTRL port, the output waveform fall time is measured to be about 100ms and the rise time is about 50ms. These two values are not the same, that is because on the rising trail, the power supply injects a current to the load; while on the falling trail, the best the power supply can do is to stop its output current and let the load resistor drain the output filtering capacitor to a lower voltage, and the draining current is much smaller than the injection current.

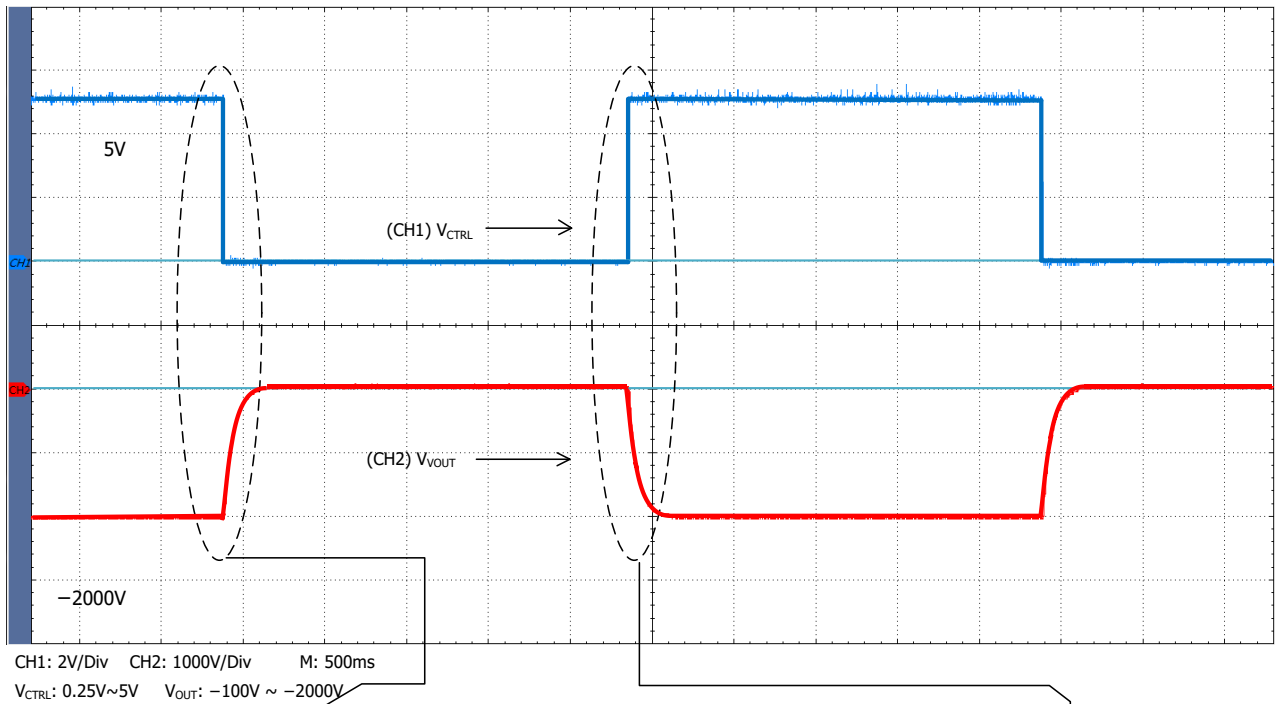


Figure 10. Input vs. Output Waveforms for Square Wave Control

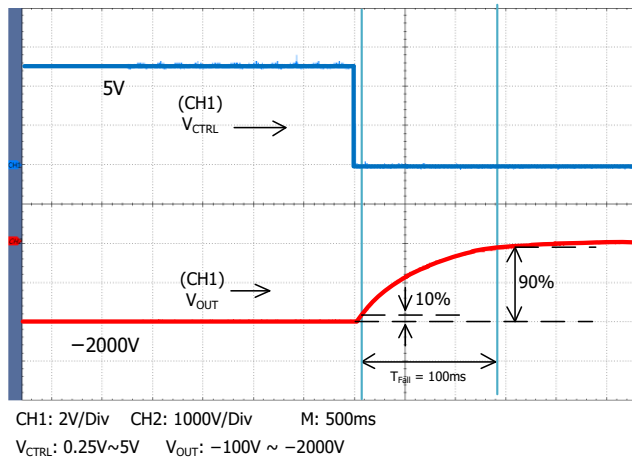


Figure 11. Falling Trail for Large Signal Response

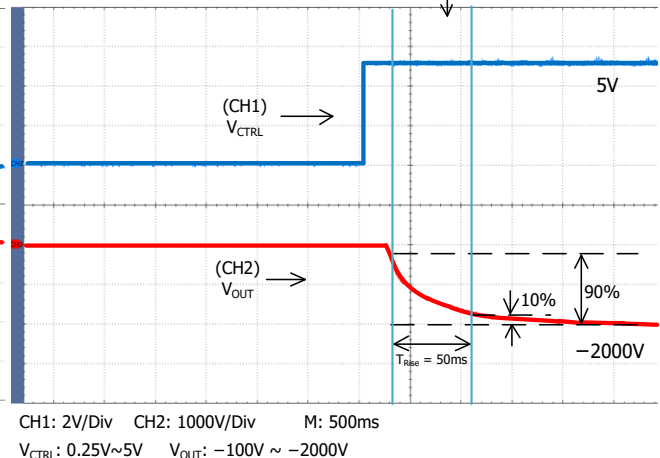
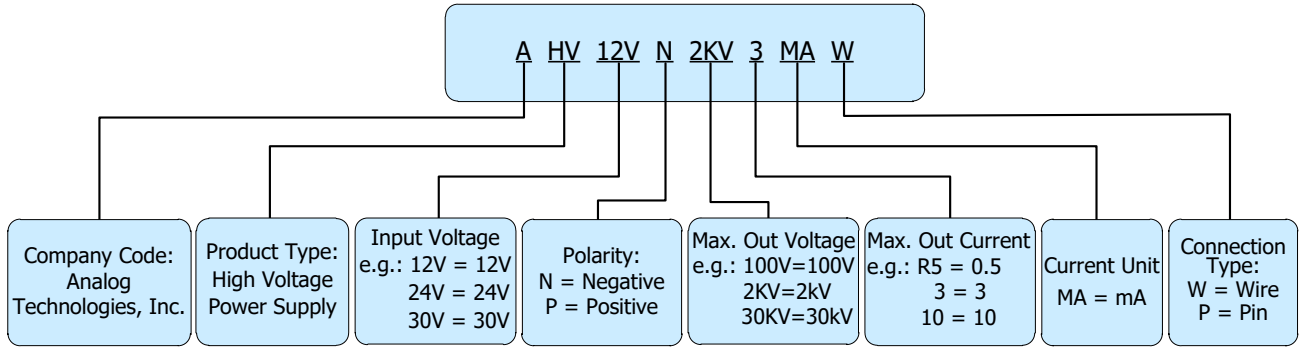


Figure 12. Rising Trail for Large Signal Response



NAMING PRINCIPLE



Naming Principle of AHV12VN2KV3MAW

DIMENSIONS

Connecting Lead Wire Sizes and Lengths

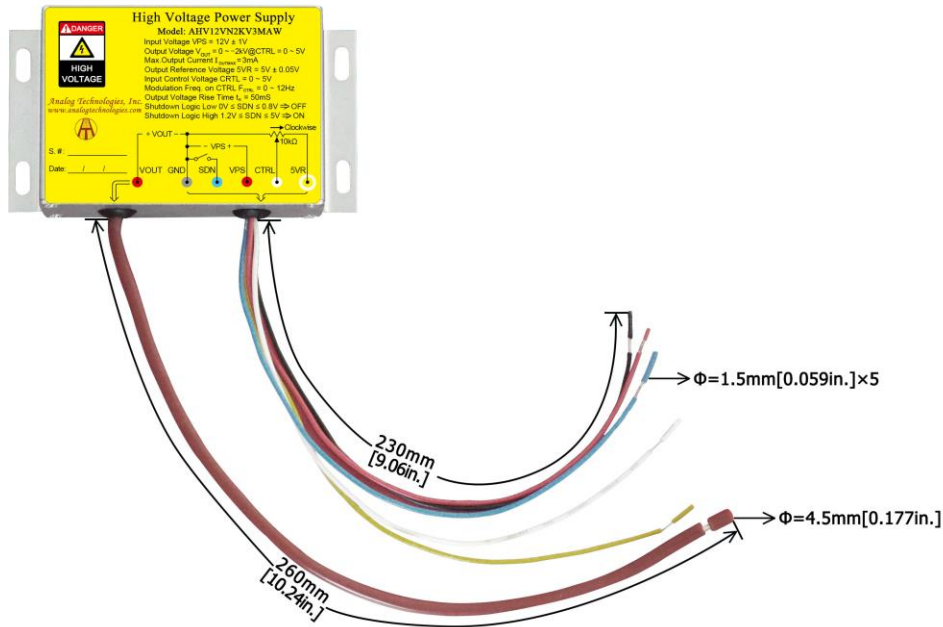


Figure 13. Connecting Lead Wires of AHV12VN2KV3MAW

| Lead Wires | Diameter | | Length | |
|---|----------|-------|---------|---------------|
| | mm | inch | mm | inch |
| Thick brown lead wire | 4.5 | 0.177 | 260 ± 1 | 10.24 ± 0.039 |
| Yellow, red, blue, black and white lead wires | 1.5 | 0.059 | 230 ± 1 | 9.06 ± 0.039 |



Outline Dimensions

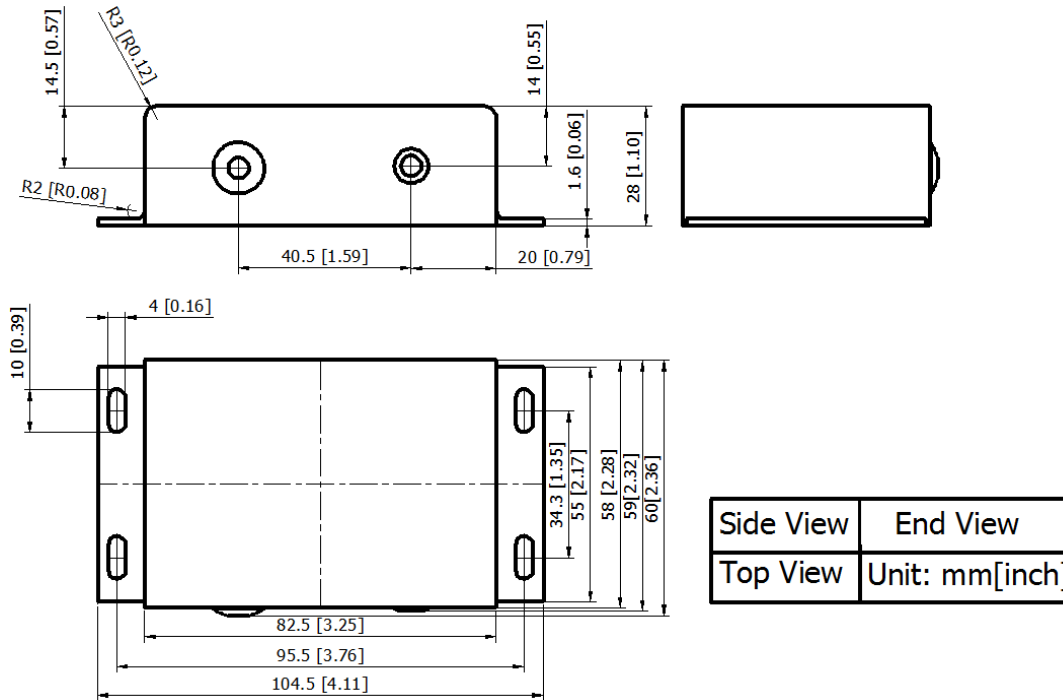


Figure 14. Outline Dimensions

ORDERING INFORMATION

| Part Number | Buy Now |
|----------------|---------|
| AHV12VN2KV3MAW | * * |

RELATED PRODUCTS

Input Voltage: 12V, Input Control Voltage: 0 to 5V, Efficiency: 70%.

| Part # | Datasheet | Output Voltage (V) | Output Current (mA) | Description | Buy Now* |
|-----------------|-----------|--------------------|---------------------|---|----------|
| AHV12V500V1MAW | | 500 | 1 | Positive 500V 1mA module with lead wires | * * |
| AHV12V500V2MAW | | 500 | 2 | Positive 500V 2mA module with lead wires | * * |
| AHV12V500V5MAW | | 500 | 5 | Positive 500V 5mA module with lead wires | * * |
| AHV12V500V10MAW | | 500 | 10 | Positive 500V 10mA module with lead wires | * * |
| AHV12V500V20MAW | | 500 | 20 | Positive 500V 20mA module with lead wires | * * |
| AHV12V500V50MAW | | 500 | 50 | Positive 500V 50mA module with lead wires | * * |



| Part # | Datasheet | Output Voltage (V) | Output Current (mA) | Description | Buy Now* |
|------------------|-----------|--------------------|---------------------|--|----------|
| AHV12V1KV1MAW | | 1000 | 1 | Positive 1kV 1mA module with lead wires | |
| AHV12V1KV2MAW | | 1000 | 2 | Positive 1kV 2mA module with lead wires | |
| AHV12V1KV3MAW | | 1000 | 3 | Positive 1kV 3mA module with lead wires | |
| AHV12V1KV5MAW | | 1000 | 5 | Positive 1kV 5mA module with lead wires | |
| AHV12V1KV10MAW | | 1000 | 10 | Positive 1kV 10mA module with lead wires | |
| AHV12V1KV20MAW | | 1000 | 20 | Positive 1kV 20mA module with lead wires | |
| AHV12V1500V1MAW | | 1500 | 1 | Positive 1.5kV 1mA module with lead wires | |
| AHV12V1500V2MAW | | 1500 | 2 | Positive 1.5kV 2mA module with lead wires | |
| AHV12V1500V3MAW | | 1500 | 3 | Positive 1.5kV 3mA module with lead wires | |
| AHV12V1500V5MAW | | 1500 | 5 | Positive 1.5kV 5mA module with lead wires | |
| AHV12V1500V10MAW | | 1500 | 10 | Positive 1.5kV 10mA module with lead wires | |
| AHV12V2KV1MAW | | 2000 | 1 | Positive 2kV 1mA module with lead wires | |
| AHV12V2KV3MAW | | 2000 | 3 | Positive 2kV 3mA module with lead wires | |
| AHV12V2KV5MAW | | 2000 | 5 | Positive 2kV 5mA module with lead wires | |
| AHV12V2KV10MAW | | 2000 | 10 | Positive 2kV 10mA module with lead wires | |
| AHV12V2500V1MAW | | 2500 | 1 | Positive 2.5kV 1mA module with lead wires | |
| AHV12V2500V3MAW | | 2500 | 3 | Positive 2.5kV 3mA module with lead wires | |
| AHV12V2500V5MAW | | 2500 | 5 | Positive 2.5kV 5mA module with lead wires | |
| AHV12V3KV1MAW | | 3000 | 1 | Positive 3kV 1mA module with lead wires | |
| AHV12V3KV2MAW | | 3000 | 2 | Positive 3kV 2mA module with lead wires | |
| AHV12V3KV3MAW | | 3000 | 3 | Positive 3kV 3mA module with lead wires | |
| AHV12V3KV5MAW | | 3000 | 5 | Positive 3kV 5mA module with lead wires | |
| AHV12V3KV10MAW | | 3000 | 10 | Positive 3kV 10mA module with lead wires | |
| AHV12V4KV1MAW | | 4000 | 1 | Positive 4kV 1mA module with lead wires | |
| AHV12V4KV2R5MAW | | 4000 | 2.5 | Positive 4kV 2.5mA module with lead wires | |
| AHV12V4KV5MAW | | 4000 | 5 | Positive 4kV 5mA module with lead wires | |
| AHV12V5KV1MAW | | 5000 | 1 | Positive 5kV 1mA module with lead wires | |
| AHV12V5KV2MAW | | 5000 | 2 | Positive 5kV 2mA module with lead wires | |
| AHV12V5KV4MAW | | 5000 | 4 | Positive 5kV 4mA module with lead wires | |
| AHV12V6KV1MAW | | 6000 | 1 | Positive 6kV 1mA module with lead wires | |



| Part # | Datasheet | Output Voltage (V) | Output Current (mA) | Description | Buy Now* |
|-------------------|-----------|--------------------|---------------------|--|----------|
| AHV12V6KV3MAW | | 6000 | 3 | Positive 6kV 3mA module with lead wires | * * |
| AHV12V7KV1MAW | | 7000 | 1 | Positive 7kV 1mA module with lead wires | * * |
| AHV12V7KV2MAW | | 7000 | 2 | Positive 7kV 2mA module with lead wires | * * |
| AHV12V8KV1MAW | | 8000 | 1 | Positive 8kV 1mA module with lead wires | * * |
| AHV12V8KV2R5MAW | | 8000 | 2.5 | Positive 8kV 2.5mA module with lead wires | * * |
| AHV12V9KV1MAW | | 9000 | 1 | Positive 9kV 1mA module with lead wires | * * |
| AHV12V10KV1MAW | | 10,000 | 1 | Positive 10kV 1mA module with lead wires | * * |
| AHV12V25KV1MAW | | 25,000 | 1 | Positive 30kV 0.7mA module with lead wires | * * |
| AHV12V30KVR5MAW | | 30,000 | 0.5 | Positive 30kV 0.7mA module with lead wires | * * |
| AHV12VN500V1MAW | | -500 | 1 | Negative 500V 1mA module with lead wires | * * |
| AHV12VN500V2MAW | | -500 | 2 | Negative 500V 2mA module with lead wires | * * |
| AHV12VN500V5MAW | | -500 | 5 | Negative 500V 5mA module with lead wires | * * |
| AHV12VN500V10MAW | | -500 | 10 | Negative 500V 10mA module with lead wires | * * |
| AHV12VN500V20MAW | | -500 | 20 | Negative 500V 20mA module with lead wires | * * |
| AHV12VN500V50MAW | | -500 | 50 | Negative 500V 50mA module with lead wires | * * |
| AHV12VN1KV1MAW | | -1000 | 1 | Negative 1kV 1mA module with lead wires | * * |
| AHV12VN1KV2MAW | | -1000 | 2 | Negative 1kV 2mA module with lead wires | * * |
| AHV12VN1KV3MAW | | -1000 | 3 | Negative 1kV 3mA module with lead wires | * * |
| AHV12VN1KV5MAW | | -1000 | 5 | Negative 1kV 5mA module with lead wires | * * |
| AHV12VN1KV10MAW | | -1000 | 10 | Negative 1kV 10mA module with lead wires | * * |
| AHV12VN1KV20MAW | | -1000 | 20 | Negative 1kV 20mA module with lead wires | * * |
| AHV12VN1500V1MAW | | -1500 | 1 | Negative 1.5kV 1mA module with lead wires | * * |
| AHV12VN1500V2MAW | | -1500 | 2 | Negative 1.5kV 2mA module with lead wires | * * |
| AHV12VN1500V3MAW | | -1500 | 3 | Negative 1.5kV 3mA module with lead wires | * * |
| AHV12VN1500V5MAW | | -1500 | 5 | Negative 1.5kV 5mA module with lead wires | * * |
| AHV12VN1500V10MAW | | -1500 | 10 | Negative 1.5kV 10mA module with lead wires | * * |
| AHV12VN2KV1MAW | | -2000 | 1 | Negative 2kV 1mA module with lead wires | * * |
| AHV12VN2KV3MAW | | -2000 | 3 | Negative 2kV 3mA module with lead wires | * * |
| AHV12VN2KV5MAW | | -2000 | 5 | Negative 2kV 5mA module with lead wires | * * |
| AHV12VN2KV10MAW | | -2000 | 10 | Negative 2kV 10mA module with lead wires | * * |



| Part # | Datasheet | Output Voltage (V) | Output Current (mA) | Description | Buy Now* |
|------------------|-----------|--------------------|---------------------|--|----------|
| AHV12VN2500V1MAW | | -2500 | 1 | Negative 2.5kV 1mA module with lead wires | * * |
| AHV12VN2500V3MAW | | -2500 | 3 | Negative 2.5kV 3mA module with lead wires | * * |
| AHV12VN2500V5MAW | | -2500 | 5 | Negative 2.5kV 5mA module with lead wires | * * |
| AHV12VN3KV1MAW | | -3000 | 1 | Negative 3kV 1mA module with lead wires | * * |
| AHV12VN3KV2MAW | | -3000 | 2 | Negative 3kV 2mA module with lead wires | * * |
| AHV12VN3KV3MAW | | -3000 | 3 | Negative 3kV 3mA module with lead wires | * * |
| AHV12VN3KV5MAW | | -3000 | 5 | Negative 3kV 5mA module with lead wires | * * |
| AHV12VN3KV10MAW | | -3000 | 10 | Negative 3kV 10mA module with lead wires | * * |
| AHV12VN4KV1MAW | | -4000 | 1 | Negative 4kV 1mA module with lead wires | * * |
| AHV12VN4KV2R5MAW | | -4000 | 2.5 | Negative 4kV 2.5mA module with lead wires | * * |
| AHV12VN4KV5MAW | | -4000 | 5 | Negative 4kV 5mA module with lead wires | * * |
| AHV12VN5KV1MAW | | -5000 | 1 | Negative 5kV 1mA module with lead wires | * * |
| AHV12VN5KV2MAW | | -5000 | 2 | Negative 5kV 2mA module with lead wires | * * |
| AHV12VN5KV4MAW | | -5000 | 4 | Negative 5kV 4mA module with lead wires | * * |
| AHV12VN6KV1MAW | | -6000 | 1 | Negative 6kV 1mA module with lead wires | * * |
| AHV12VN6KV3MAW | | -6000 | 3 | Negative 6kV 3mA module with lead wires | * * |
| AHV12VN7KV1MAW | | -7000 | 1 | Negative 7kV 1mA module with lead wires | * * |
| AHV12VN7KV2MAW | | -7000 | 2 | Negative 7kV 2mA module with lead wires | * * |
| AHV12VN8KV1MAW | | -8000 | 1 | Negative 8kV 1mA module with lead wires | * * |
| AHV12VN8KV2R5MAW | | -8000 | 2.5 | Negative 8kV 2.5mA module with lead wires | * * |
| AHV12VN9KV1MAW | | -9000 | 1 | Negative 9kV 1mA module with lead wires | * * |
| AHV12VN10KV1MAW | | -10000 | 1 | Negative 10kV 1mA module with lead wires | * * |
| AHV12VN25KV1MAW | | -25000 | 1 | Negative 25kV 1mA module with lead wires | * * |
| AHV12VN30KVR5MAW | | -30000 | 0.5 | Negative 30kV 0.5mA module with lead wires | * * |

*: both and are our online store icons. Our products can be ordered from either one of them with the same pricing and delivery time.

NOTICE

1. It is important to carefully read and follow the warnings, cautions, and product-specific notes provided with electronic components. These instructions are designed to ensure the safe and proper use of the component



and to prevent damage to the component or surrounding equipment. Failure to follow these instructions could result in malfunction or failure of the component, damage to surrounding equipment, or even injury or harm to individuals. Always take the necessary precautions and seek professional assistance if unsure about proper use or handling of electronic components.

2. Please note that the products and specifications described in this publication are subject to change without prior notice as we continuously improve our products. Therefore, we recommend checking the product descriptions and specifications before placing an order to ensure that they are still applicable. We also reserve the right to discontinue the production and delivery of certain products, which means that not all products named in this publication may always be available.
3. This means that while ATI may provide information about the typical requirements and applications of their products, they cannot guarantee that their products will be suitable for all customer applications. It is the responsibility of the customer to evaluate whether an ATI product with the specified properties is appropriate for their particular application.
4. ATI warrants its products to perform according to specifications for one year from the date of sale, except when damaged due to excessive abuse. If a product fails to meet specifications within one year of the sale, it can be exchanged free of charge.
5. ATI reserves the right to make changes or discontinue products or services without notice. Customers are advised to obtain the latest information before placing orders.
6. All products are sold subject to terms and conditions of sale, including those pertaining to warranty, patent infringement, and limitation of liability. Customers are responsible for their applications using ATI products, and ATI assumes no liability for applications assistance or customer product design.
7. ATI does not grant any license, either express or implied, under any patent right, copyright, mask work right, or other intellectual property right of ATI.
8. ATI's publication of information regarding third-party products or services does not constitute approval, warranty, or endorsement.
9. ATI retains ownership of all rights for special technologies, techniques, and designs for its products and projects, as well as any modifications, improvements, and inventions made by ATI.
10. Despite operating the electronic modules as specified, malfunctions or failures may occur before the end of their usual service life due to the current state of technology. Therefore, it is crucial for customer applications that require a high level of operational safety, especially in accident prevention or life-saving systems where the malfunction or failure of electronic modules could pose a risk to human life or health, to ensure that suitable measures are taken. The customer should design their application or implement protective circuitry or redundancy to prevent injury or damage to third parties in the event of an electronic module malfunction or failure.