

Figure 1.1. Top View of AHV24VN4KV2R5MAW



Figure 1.2. Side View



Figure 1.3. Side View



Figure 1.4. Side View

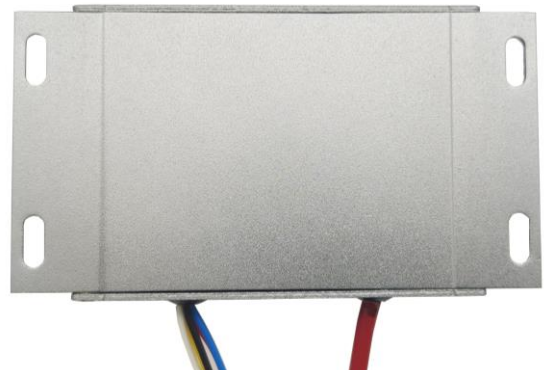


Figure 1.5. Bottom View

### FEATURES

- Input Power Voltage: 24V ± 1V
- Input Current Range: 100mA to 600mA
- Output Voltage: 0 to -4kV@CTRL = 0 to 5V
- Max. Output Current: 2.5mA
- 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, AHV24VN4KV2R5MAW, 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

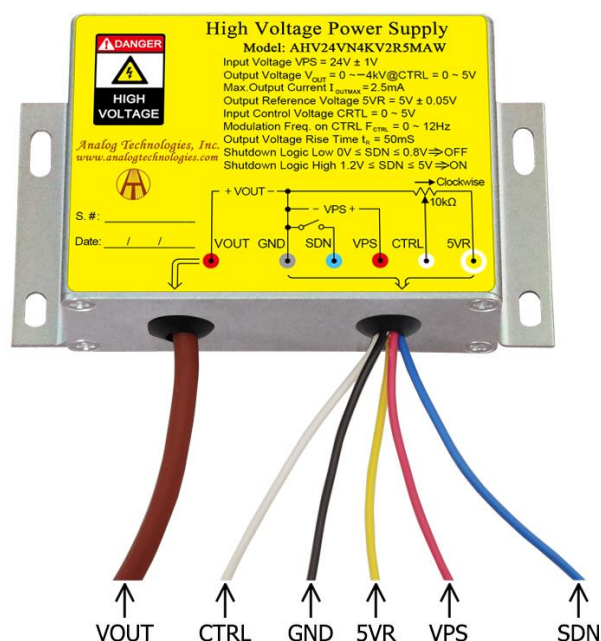








Figure 2. The Connecting Lead Wires of AHV24VN4KV2R5MAW

**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    | 23V  | 24V  | 25V  |
| 5   | GND  | Ground              | Ground for power supply and analog & digital signals |  Black  |      | 0V   |      |
| 6   | VOUT | Output high voltage | Power output   |  Brown  | 0V   |      | -4kV |



DESCRIPTION

Figure 1 shows the actual pictures of AHV24VN4KV2R5MAW. 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 -4kV 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 800 times the input control voltage:  $V_{OUT}=800 \times V_{CTRL}$ .

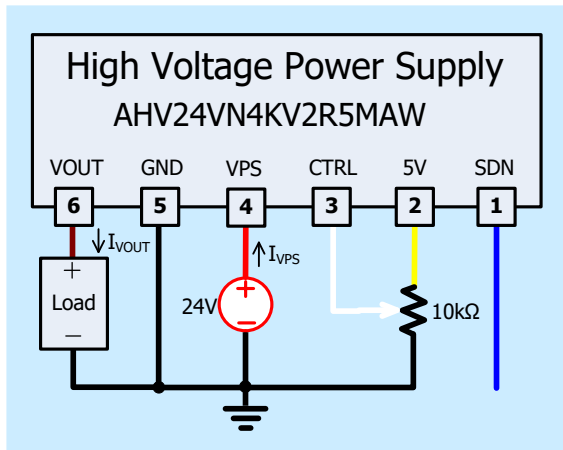


Figure 3. Setting Output to be a Constant Voltage

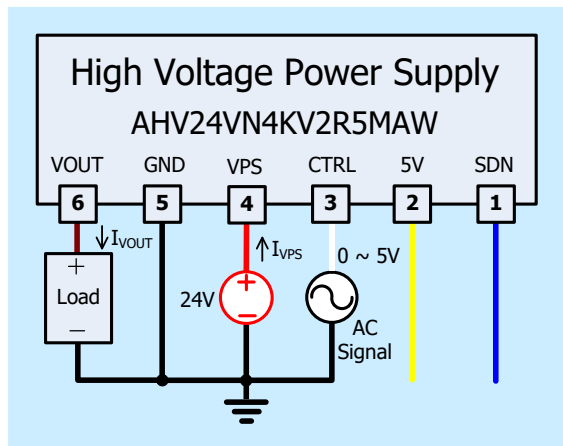


Figure 4. Modulating Output by an AC Signal Source

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.

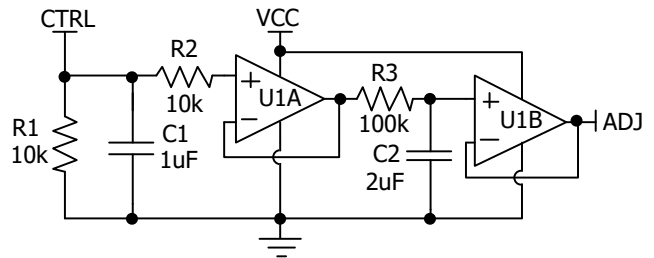


Figure 5. The Equivalent Circuit for CTRL Port

To shutdown AHV24VN4KV2R5MAW, 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.

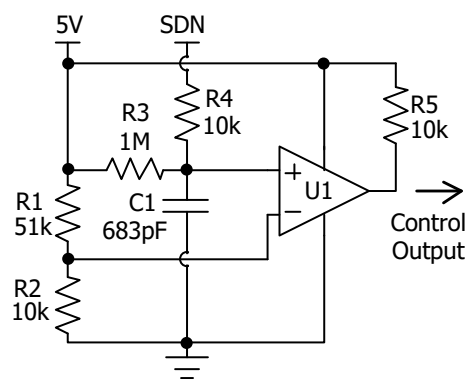


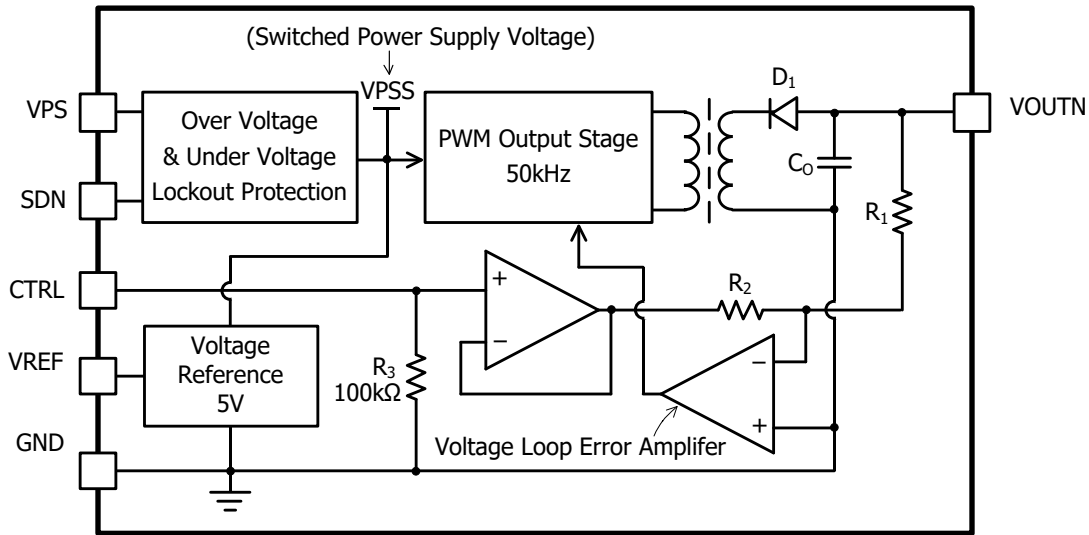
Figure 6. The Equivalent Circuit for SDN Port

USING AHV24VN4KV2R5MAW

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  $55^\circ\text{C}$ .

SAFETY PRECAUTIONS

Although AHV24VN4KV2R5MAW 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              | $V_{VPS}$       |   | 23   | 24   | 25    | V             |
| Input Power Supply Quiescent Current    | $I_{VPS\_QC}$   | $I_{VOUT} = 0\text{mA}$<br>$V_{SDN} = V_{CTRL} = 5\text{V}$                     | 100  | 150  | 200   | mA            |
| Input Power Supply Current at Full Load | $I_{VPS\_FL}$   | $I_{VOUT} = 2.5\text{mA}$   | 550  | 600  | 650   | mA            |
| Input Power Supply Current at Shutdown  | $I_{VPS\_SHDN}$ | $T_A = -10^\circ\text{C} \sim 55^\circ\text{C}$                                 |      | 16   |       | 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  | $\mu\text{A}$ |
|   | $I_{SDNH}$      | $1.2\text{V} < V_{SDNL} < 5\text{V}$  | 0    |      | 3.8   | $\mu\text{A}$ |
| Shutdown Voltage Logic Low              | $V_{SDNL}$      |   | 0    |      | 0.8   | V             |
| Shutdown Voltage Logic High             | $V_{SDNH}$      |   | 1.2  |      | 5     | V             |
| Output Voltage Range                    | $V_{VOUT}$      | $I_{VOUT} = 0 \sim 2.5\text{mA}$  | 0    |      | -4000 | V             |
| Output Current Range                    | $I_{VOUTMAX}$   | $V_{VPS} = 23\text{V} \sim 25\text{V}$  | 0    |      | 2.5   | mA            |
| Reference Output Voltage Range          | $V_{5VR}$       | $T_A = -10^\circ\text{C} \sim 55^\circ\text{C}$<br>$I_{5VR} \leq 1\text{mA}$    | 4.95 | 5    | 5.05  | V             |
| Reference Output Current Range          | $I_{5VR}$       | $T_A = -10^\circ\text{C} \sim 55^\circ\text{C}$<br>$V_{5VR} = 0 \sim 5\text{V}$ | 0    |      | 1     | mA            |



| Parameter   |                  | Symbol   | Test Conditions  | Min.                        | Typ.        | Max.           | Unit/Note      |
|---|------------------|--|--|-----------------------------|-------------|----------------|----------------|
| Output Load Resistance Range                      |                  |  |  | $\frac{V_{VOUT}}{I_{VOUT}}$ |             | $\infty$       | M $\Omega$     |
| Output Voltage Ripple                             |                  | $V_{VOUT\_RP}$                                     | Bandwidth = 1MHz<br>$R_{LOAD} = 1.6M\Omega$<br>$V_{VOUT} = -4000V$   | $\leq 2$                    |             |                | $V_{P-P}$      |
| Output Voltage Temperature Coefficient            |                  | $TCV_{VOUT}$                                       | $V_{VPS} = 24V$<br>$V_{CTRL} = V_{5VR} = 5V$<br>$V_{VOUT} = -4000V$<br>$I_{VOUT} = 2.5mA$<br>$T_A = -10^{\circ}C \sim 55^{\circ}C$ |                             | $\leq 0.01$ |                | %/ $^{\circ}C$ |
| Output Voltage Range v.s. Temperature             |                  | $V_{VOUT}(T)$                                      | $V_{VPS} = 24V$<br>$V_{CTRL} = V_{5VR} = 5V$<br>$V_{VOUT} = -4000V$<br>$I_{VOUT} = 2.5mA$<br>$T_A = -10^{\circ}C \sim 55^{\circ}C$ | $0.99V_{VOUT}$              | $V_{VOUT}$  | $1.01V_{VOUT}$ | V              |
| Output Voltage Drift                              | Short Term Drift | $\frac{\Delta V_{VOUT}/V_{VOUT}}{\Delta t (min)}$  | $V_{VPS} = 24V$<br>$V_{CTRL} = V_{5VR} = 5V$<br>$V_{VOUT} = -4000V$<br>$I_{VOUT} = 2.5mA$<br>$T_A = -10^{\circ}C \sim 55^{\circ}C$ |                             | $\leq 0.5$  |                | %/min          |
|   | Long Term Drift  | $\frac{\Delta V_{VOUT}/V_{VOUT}}{\Delta t (h)}$    |  |                             | $\leq 1$    |                | %/h            |
| Output Voltage Rise Time                          |                  | $t_r$  | $V_{VOUT}(t_1) = -400V$<br>$V_{VOUT}(t_2) = -3600V$<br>$R_{Load} = 1.6M\Omega$   |                             | 50          |                | ms             |
| Output Voltage Fall Time                          |                  | $t_f$  | $V_{VOUT}(t_2) = -3600V$<br>$V_{VOUT}(t_3) = -400V$<br>$R_{Load} = 1.6M\Omega$   |                             | 100         |                | ms             |
| Mean Time Between Failure                         |                  | MTBF   |  |                             | 1M          |                | h              |
| Instantaneous Short Circuit Current at the Output |                  | $I_{VOUT\_SC}$                                     |  |                             | $\leq 250$  |                | mA             |
| Load Regulation                                   |                  | $\frac{\Delta V_{VOUT}/V_{VOUT}}{\Delta I_{VOUT}}$ | $V_{VOUT} = -4000V$<br>$I_{VOUT} = 2.5mA$  |                             | $\leq 0.05$ |                | %/mA           |
| Full Load Efficiency                              |                  | $\eta$   | $V_{VPS} = 24V$<br>$V_{VOUT} = -4000V$<br>$I_{VOUT} = 2.5mA$   |                             | $\geq 70$   |                | %              |
| 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:  $V_{PS} = 24V$ ,  $T_A = 25^\circ C$ ,  $R_{LOAD} = 1.6M\Omega$

#### DC Testing

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

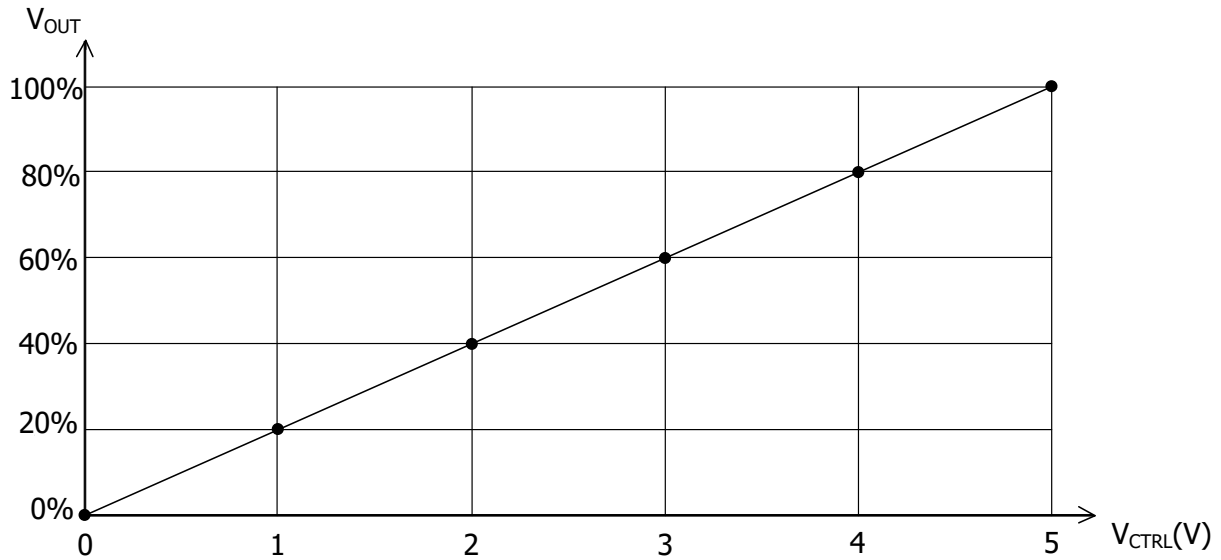


Figure 7.  $V_{CTRL}$  vs.  $V_{OUT}$

#### 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.

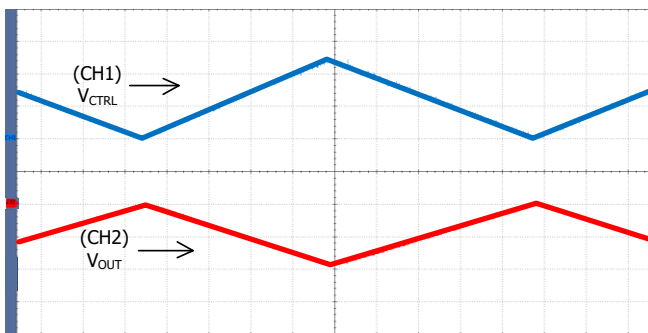


Figure 8. Triangle Wave Modulation

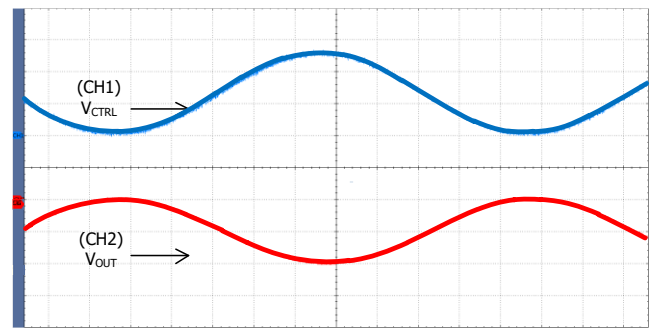


Figure 9. Sine Wave Modulation



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.

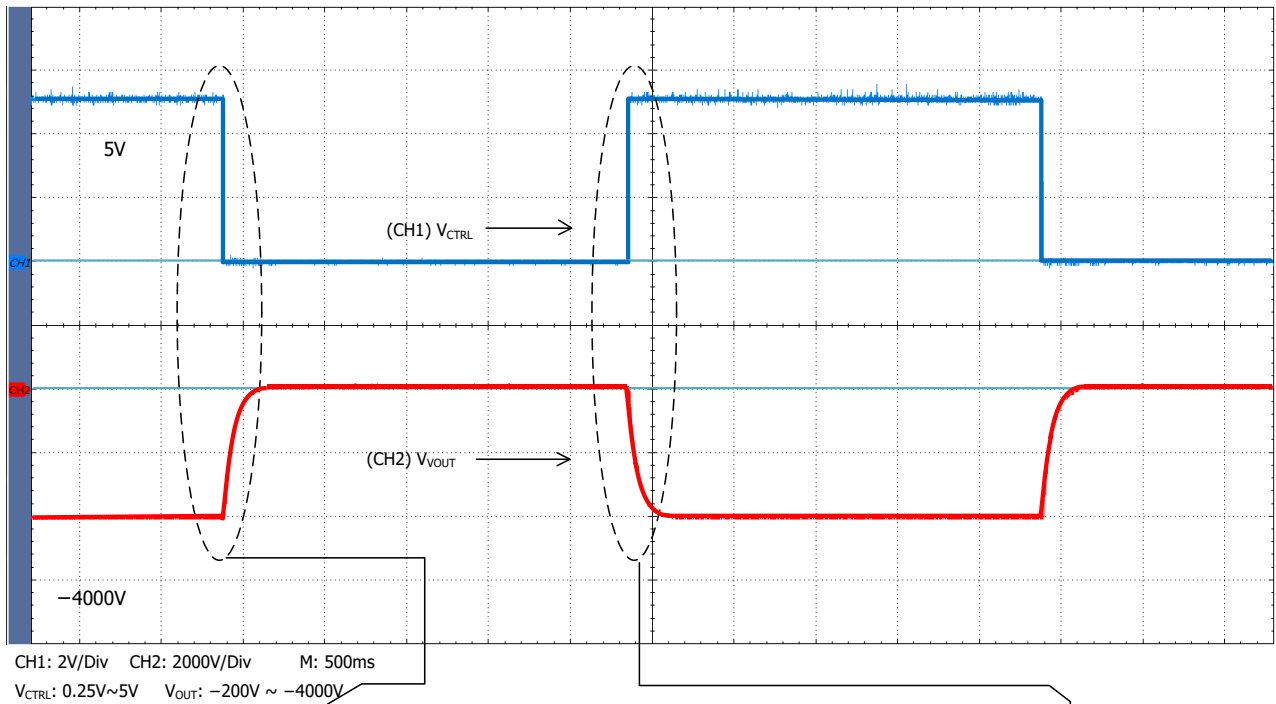


Figure 10. Input vs. Output Waveforms for Square Wave Control

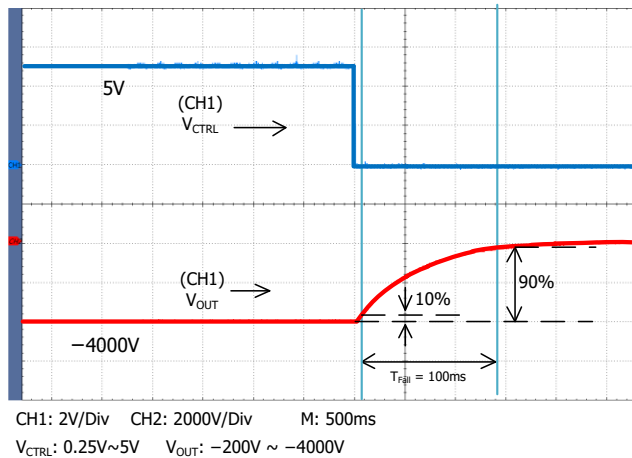


Figure 11. Falling Trail for Large Signal Response

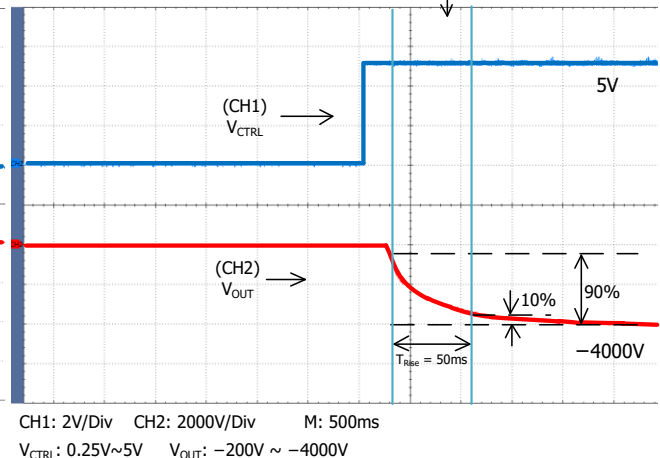
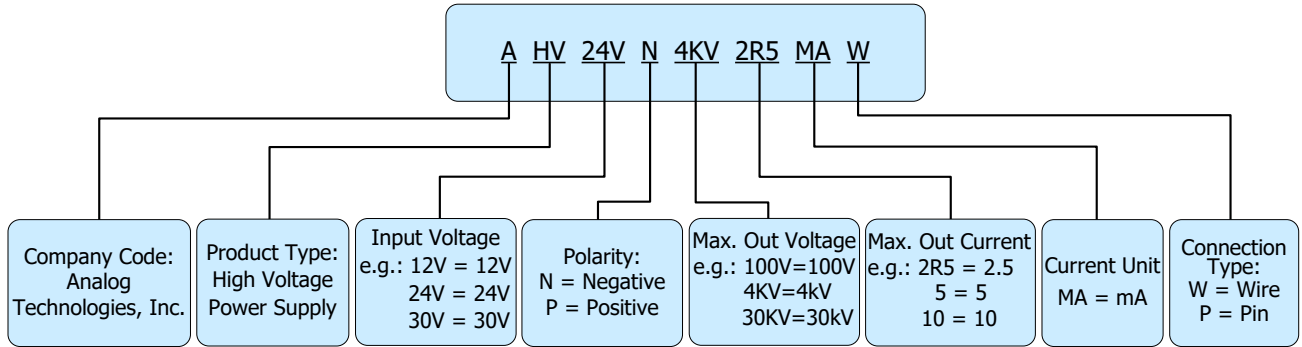


Figure 12. Rising Trail for Large Signal Response



NAMING PRINCIPLE



Naming Principle of AHV24VN4KV2R5MAW

DIMENSIONS

Connecting Lead Wire Sizes and Lengths

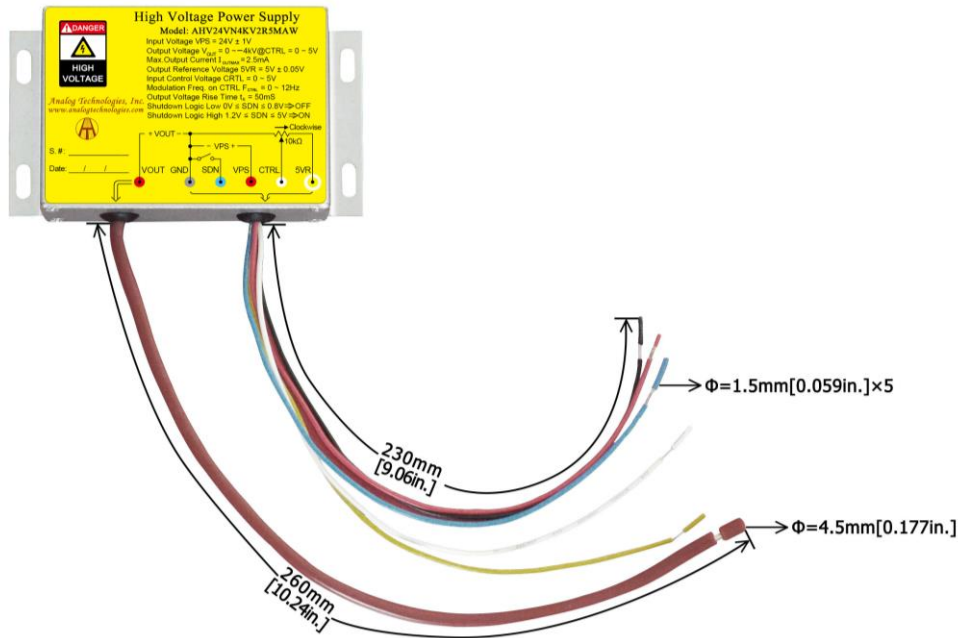


Figure 13. Connecting Lead Wires of AHV24VN4KV2R5MAW

| 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

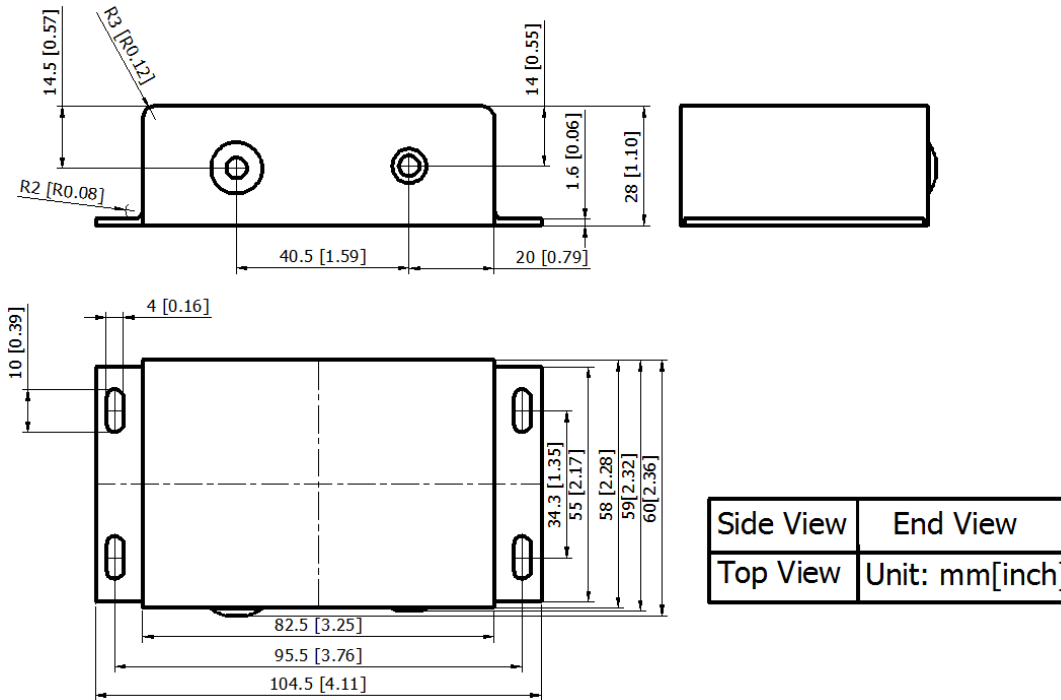


Figure 14. Outline Dimensions

ORDERING INFORMATION

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| AHV24VN4KV2R5MAW | * *     |

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