

Figure 1.1. Top View of AHV24V4KV1MAW



Figure 1.2. Side View



Figure 1.3. Side View

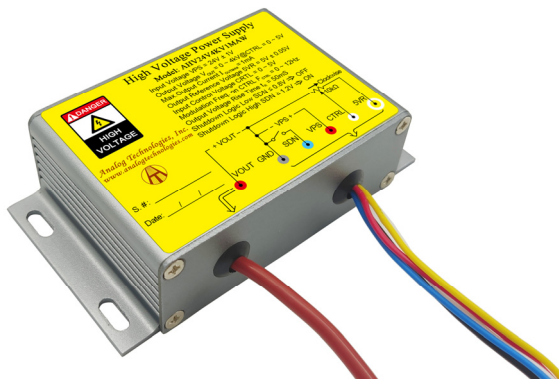


Figure 1.4. Side View

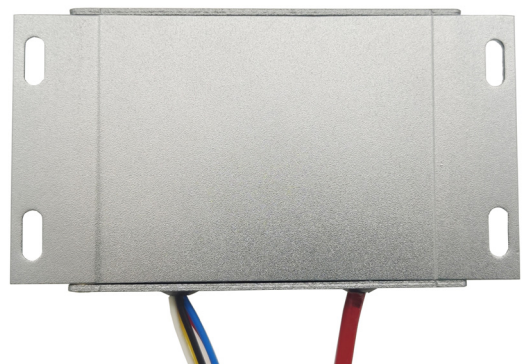


Figure 1.5. Bottom View



FEATURES

- Input Power Voltage: 24V ± 1V
- Input Current Range: 45mA to 225mA
- Output Voltage: 0 to 4kV@CTRL = 0 to 5V
- Max. Output Current: 1mA
- Reference Voltage: 5V ± 0.05V
- Input Control Voltage: 0 to 5V
- Full Span Modulation on Output Voltage
- Electronic Shutdown Control

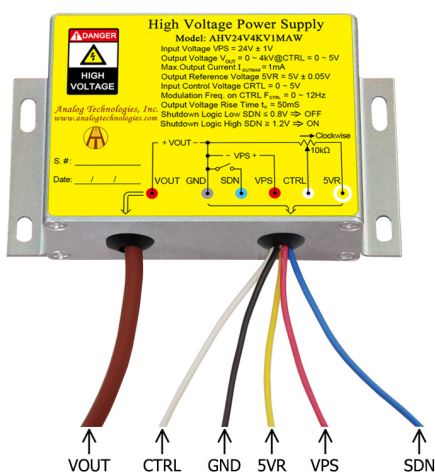


Figure 2. The Connecting Lead Wires of AHV24V4KV1MA

APPLICATIONS

This power module, AHV24V4KV1MAW, is designed for achieving DC-DC conversion from low voltage to high voltage as a power supply source which is widely used in scientific research and other fields including:

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

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

| No. | Name | Color | Type | Description | Min. | Typ. | Max. |
|-----|------|--------|-----------------------------------------------|---------------------|------|------|------|
| 1 | SDN | Blue | Digital input | Shutdown logic low | 0V | | 0.8V |
| | | | | Shutdown logic high | 1.2V | | 5V |
| 2 | 5VR | Yellow | Analog output | Reference voltage | | 5V | |
| 3 | CTRL | White | Analog input | Regulation | 0V | | 5V |
| 4 | VPS | Red | Power input | Input voltage | | 24V | |
| 5 | GND | Black | Ground for analog, digital and power signals. | Ground electrode | | 0V | |
| 6 | VOUT | Brown | Power output | Output high voltage | 0V | | 4kV |



DESCRIPTION

Figure 2 shows the connecting wires of AHV24V4KV1MAW, of which their detail information given in Table 1. The output voltage can be set to a constant value by connecting the CTRL port to the central tap of a POT (Potentiometer) or modulated by an AC signal ranging from 0V to 5V corresponding to 0V to 4kV proportionally at the output VOUT port as shown in Figure 3 and Figure 4 respectively.

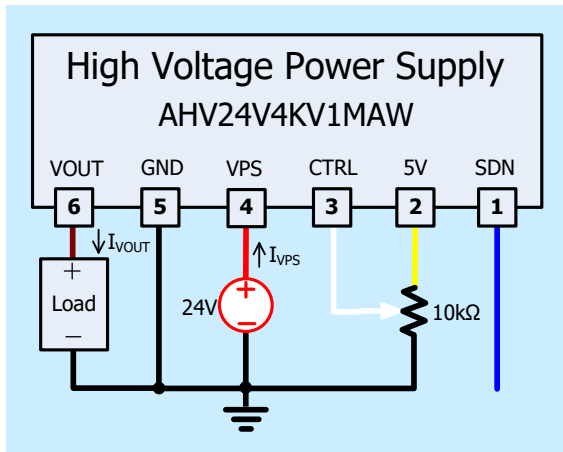


Figure 3. Setting Output to be a Constant Voltage

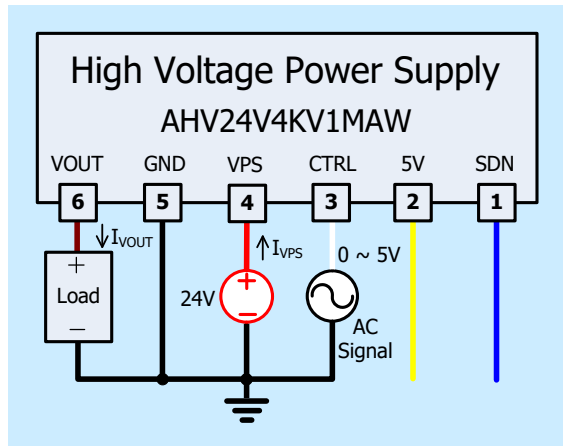


Figure 4. Modulating Output by an AC Signal Source

Please note that the modulation signal must have a low frequency $\leq 10\text{Hz}$ 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.

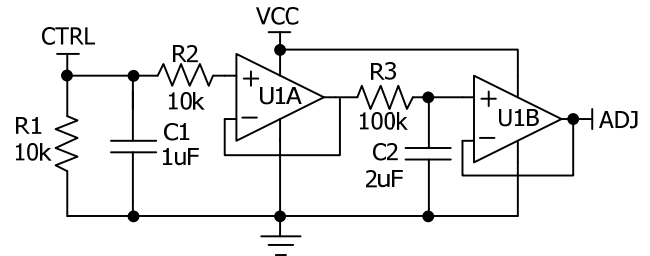


Figure 5. The Equivalent Circuit for CTRL Port

To shutdown AHV24V4KV1MAW, 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.

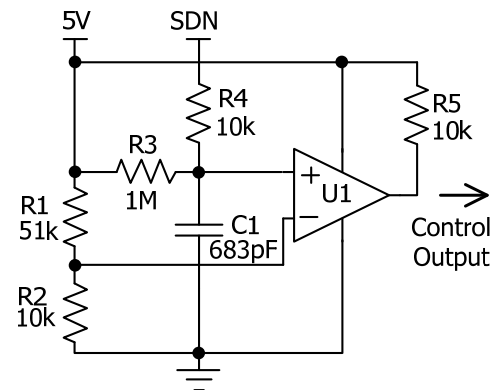


Figure 6. The Equivalent Circuit for SDN Port

USING AHV24V4KV1MAW

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 AHV24V4KV1MAW 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.



SPECIFICATIONS

Table 2. Characteristics. T_A = 25°C, unless otherwise noted.

| Parameter | Symbol | Test Conditions | Min. | Typ. | Max. | Unit/Note |
|--------------------------------------------|------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-------------------|-----------------------|------------------|
| Input Power Voltage | V _{VPS} | | 23 | 24 | 25 | V |
| Input Power Quiescent Current | I _{VPS_QC} | I _{VOUT} = 0mA | 45 | 50 | 55 | mA |
| Input Power Current at Full Load | I _{VPS_FL} | I _{VOUT} = 1.0mA | 200 | 225 | 250 | mA |
| Input Power Current at Shutdown | I _{VPS_SHDN} | T _A = -10°C ~ 55°C | | 18 | | mA |
| Power Supply Rejection Ratio | PSRR ⁽¹⁾ | V _{VPS} = 23V ~ 25V V _{CTRL} = V _{5VR} = 5V V _{VOUT} = 4kV I _{VOUT} = 1.0mA | | TBD | | dB |
| Modulation Voltage Range Frequency on CTRL | f _{CTRL} | | 0 | | 12 | Hz |
| Shutdown Port Current | I _{SDNL} | V _{SDNL} < 0.8V | -5 | | -4.2 | µA |
| | I _{SDNH} | 1.2V < V _{SDNL} < 5V | 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 | V _{VOUT} | I _{VOUT} = 0 ~ 1.0mA | 0 | | 4000 | V |
| Output Current Range | I _{VOUTMAX} | V _{VPS} = 23V ~ 25V | 0 | | 1.0 | mA |
| Reference Voltage Output Range | V _{5VR} | T _A = -10°C ~ 55°C I _{5VR} ≤ 5mA | 4.98 | 5 | 5.02 | V |
| Output Load Range | | | 4 | | ∞ | MΩ |
| Output Voltage Ripple | V _{VOUT_RP} | Bandwidth = 1MHz R _{LOAD} = 4 MΩ | ≤2.0 | | | V _{P-P} |
| Output Voltage Ripple Frequency | f _{VOUT_RP} | | TBD | | | Hz |
| Output Voltage Temperature Coefficient | TCV _{VOUT} ⁽²⁾ | V _{VPS} = 24V V _{CTRL} = V _{5VR} = 5V V _{VOUT} = 4kV I _{VOUT} = 1mA T _A = -10°C ~ 55°C | | ≤0.01 | | %/°C |
| Output Voltage Range v.s. Temperature | V _{VOUT(T)} | V _{VPS} = 24V V _{CTRL} = V _{5VR} = 5V V _{VOUT} = 4kV I _{VOUT} = 1mA T _A = -10°C ~ 55°C | 0.99V _{VOUT} | V _{VOUT} | 1.01V _{VOUT} | V |
| Output Voltage Drift | Short Term Drift | $\frac{ \Delta V_{VOUT} }{V_{VOUT}}$ Δt (min) | ≤0.5 | | | %/min |
| | Long Term Drift | $\frac{ \Delta V_{VOUT} }{V_{VOUT}}$ Δt (h) | ≤1 | | | %/h |



| | | | | | |
|---------------------------------------------------|------------------------------------------------------|--------------------------------------------------------------------------------------|----------------|----------|------|
| Output Voltage Rise Time | t_r | $V_{VOUT}(t_1) = 400V$ $V_{VOUT}(t_2) = 3600V$ No-Load | 30 | ms | |
| | | $V_{VOUT}(t_1) = 400V$ $V_{VOUT}(t_2) = 3600V$ $R_{Load} = 4 M\Omega$ | TBD | ms | |
| Output Voltage Fall Time | t_f | $V_{VOUT}(t_2) = 3600V$ $V_{VOUT}(t_3) = 400V$ No-Load | 100 | ms | |
| | | $V_{VOUT}(t_2) = 3600V$ $V_{VOUT}(t_3) = 400V$ $R_{Load} = 4 M\Omega$ | TBD | ms | |
| Mean Time Between Failure | MTBF | | TBD | h | |
| Instantaneous Short Circuit Current at the Output | I_{VOUT_SC} | | ≤ 500 | mA | |
| Load Regulation | $\frac{ \Delta V_{VOUT}/V_{VOUT} }{\Delta I_{VOUT}}$ | $V_{VOUT} = 4kV$ $I_{VOUT} = 1mA$ | ≤ 0.05 | %/mA | |
| Full Load Efficiency | $\eta^{(3)}$ | $V_{VPS} = 24V$ $V_{VOUT} = 4kV$ $I_{VOUT} = 1mA$ | ≥ 70 | % | |
| Operating Temperature Range | T_{opr} | | -10 | 55 °C | |
| Storage Temperature Range | T_{stg} | | -20 | 85 °C | |
| Thermal resistance housing-ambient | $\theta_{HA}^{(4)}$ | $V_{VPS} = 24V$ $V_{CTRL} = V_{SVR} = 5V$ $V_{VOUT} = 4kV$ $I_{VOUT} = 1mA$ | TBD | °C/W | |
| External Dimensions | | | 82×55×28 | | mm |
| | | | 3.23×2.17×1.10 | | inch |
| Weight | | | 210 | g | |
| | | | 0.46 | lbs | |
| | | | 7.4 | Oz | |

Note 1: $PSRR = 20 \log_{10} \frac{\Delta V_{VOUT}/V_{VOUT}}{\Delta V_{VPS}/V_{VPS}}$ (dB)

$\Delta V_{VOUT} = V_{VOUT}(V_{VPS} = 24.5V) - V_{VOUT}(V_{VPS} = 23.5V)$, $V_{VOUT}(V_{VPS} = 24.5V) = V_{VOUT}(V_{VPS} = 24V)$
 $\Delta V_{VPS} = 24.5V - 23.5V$, $V_{VPS} = 24V$

Note 2: $TCV_{VOUT} = \frac{|\Delta V_{VOUT}|}{V_{VOUT} \times \Delta T}$

Note 3: $\eta = \frac{V_{VOUT} \times I_{VOUT}}{V_{VPS} \times I_{VPS}}$



TESTING DATA

Test conditions: $V_{VPS} = 24V$, $T_A = 25^{\circ}C$, $R_{LOAD} = 4M\Omega$

DC Testing

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

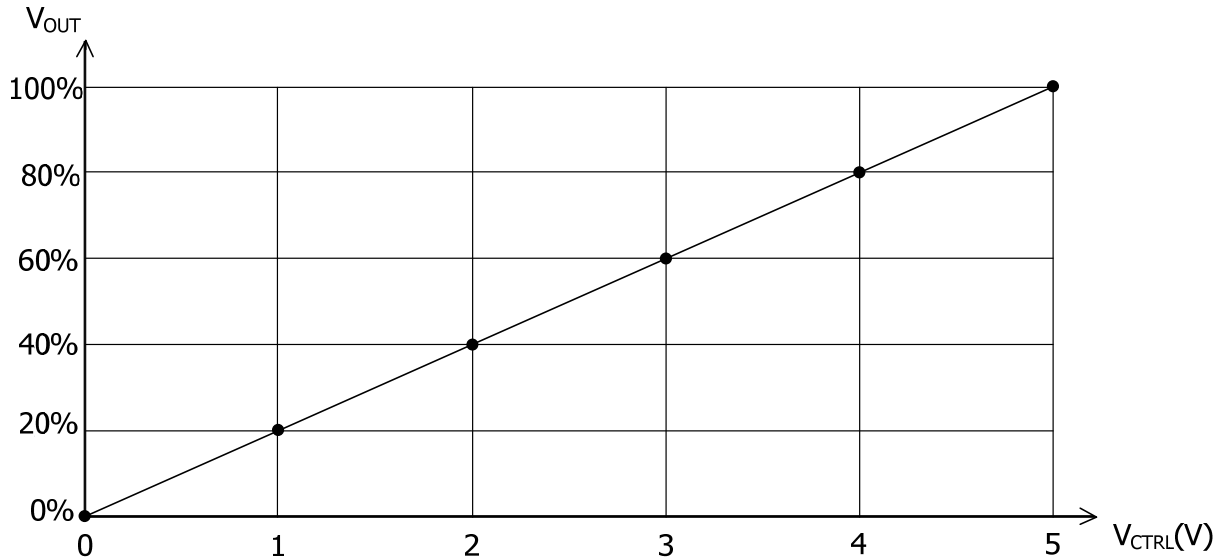


Figure 7. V_{CTRL} vs. V_{VOUT}

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.

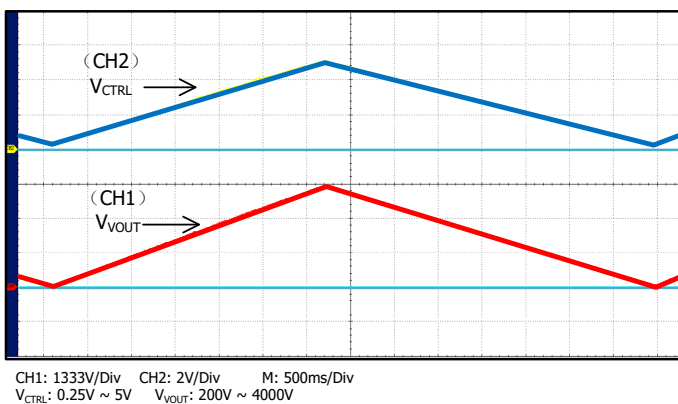


Figure 8. Input vs. Output Waveforms for Triangle Wave Control

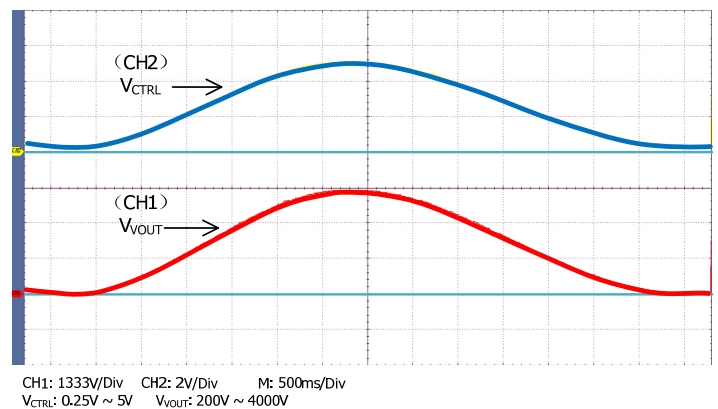


Figure 9. Input vs. Output Waveforms for Sine Wave Control



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 30ms. 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.

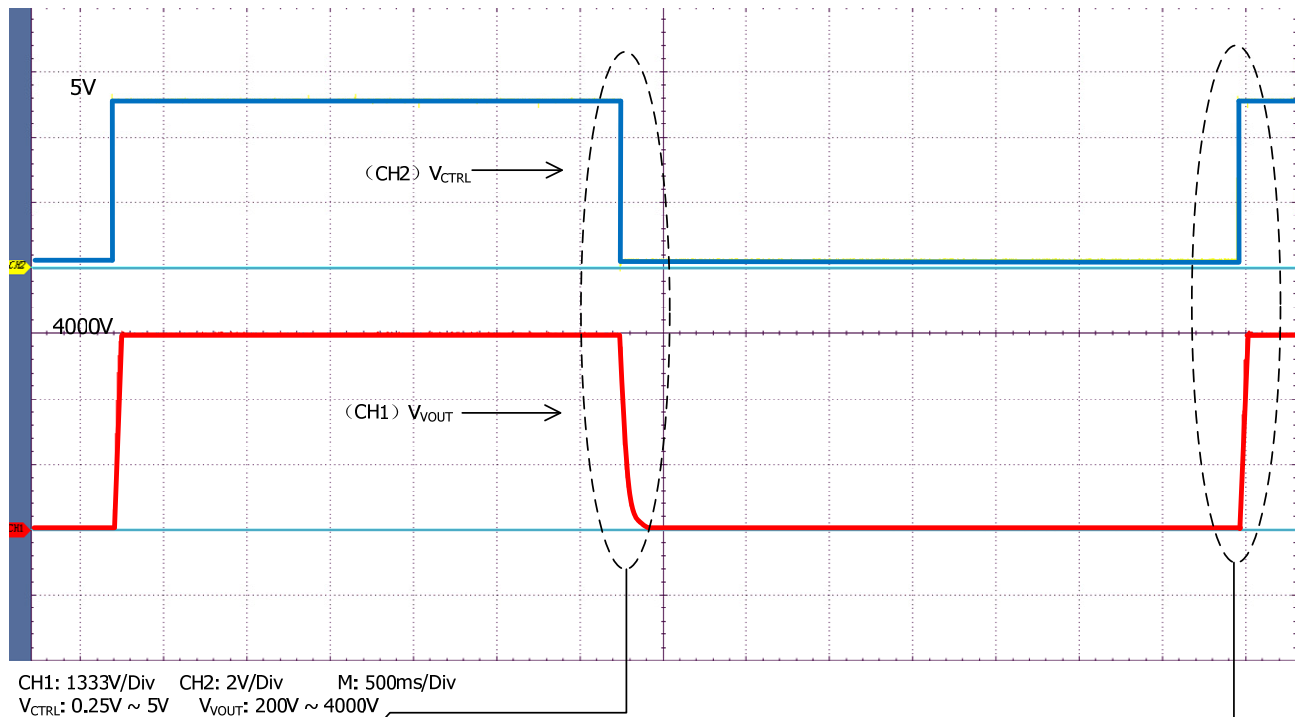


Figure 10. Input vs. Output Waveforms for Square Wave Control

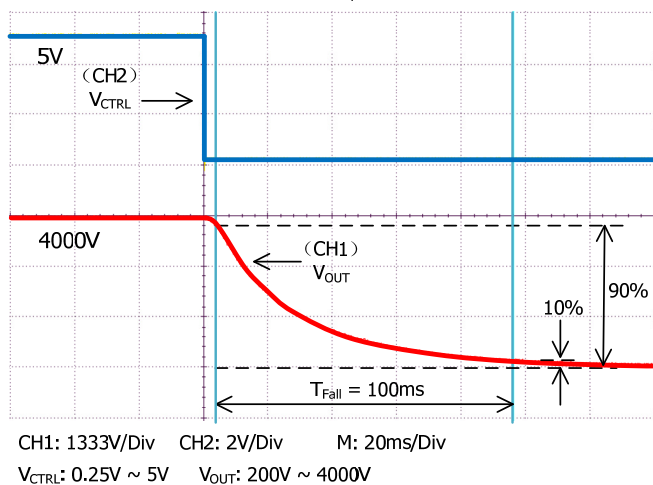


Figure 11. Falling Trail for Large Signal Response

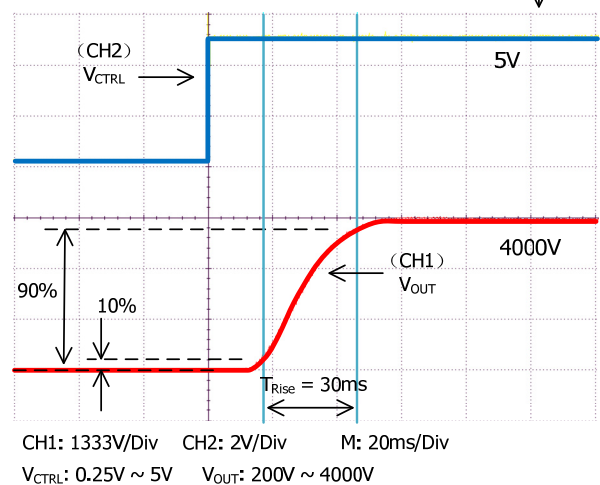
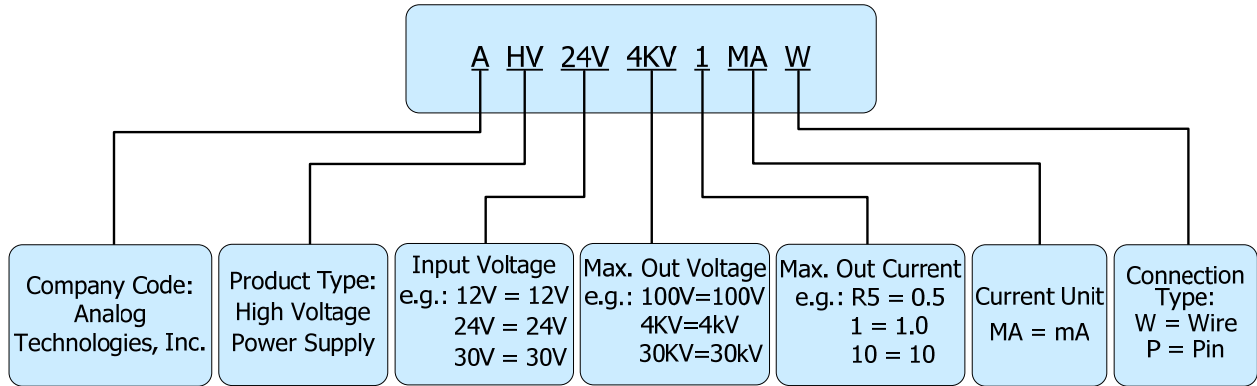


Figure 12. Rising Trail for Large Signal Response



NAMING PRINCIPLE



Naming Principle of AHV24V4KV1MAW

DIMENSIONS

Connecting Lead Wire Sizes and Lengths

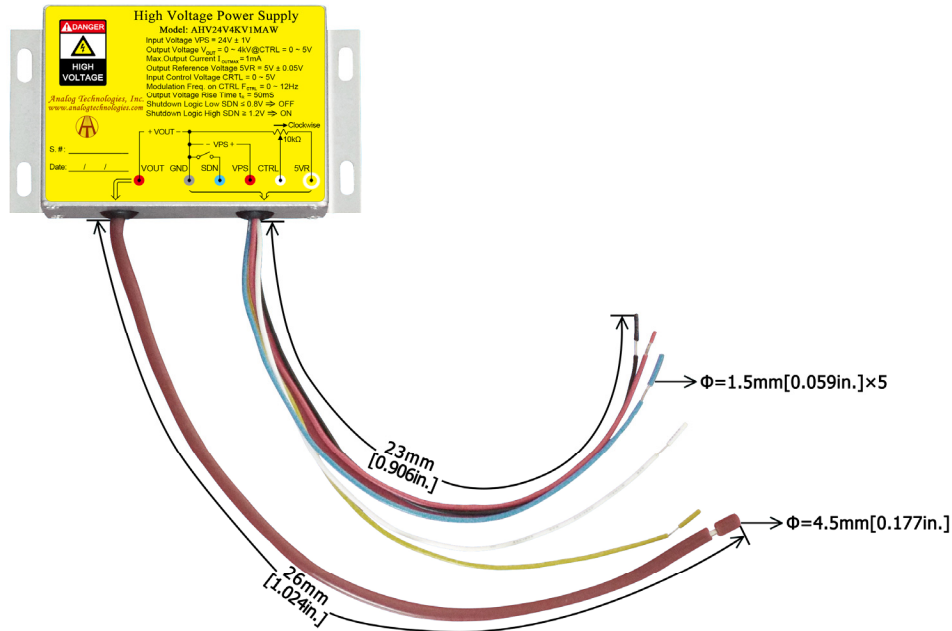


Figure 13. Connecting Lead Wires of AHV24V4KV1MAW

| Lead Wires | Diameter | | Length | |
|-----------------------------------------------|----------|-------|--------|---------------|
| | mm | inch | mm | inch |
| Thick brown lead wire | 4.5 | 0.177 | 26 ± 1 | 1.024 ± 0.039 |
| Yellow, red, blue, black and white lead wires | 1.5 | 0.059 | 23 ± 1 | 0.906 ± 0.039 |



Outline Dimensions

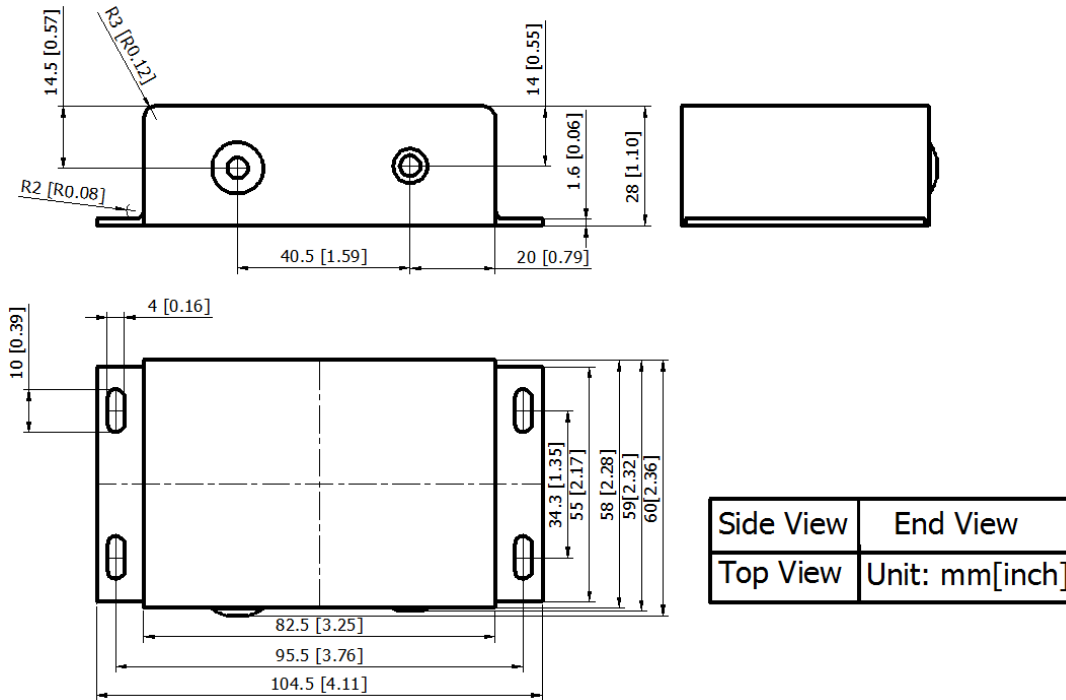


Figure 14. Outline Dimensions

ORDERING INFORMATION

| Quantity | 1~9pcs | 10~49pcs | 50~99pcs | ≥100pcs |
|---------------|--------|----------|----------|---------|
| AHV24V4KV1MAW | \$130 | \$120 | \$110 | \$100 |



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