# AEH Half-brick Series

# Technical Reference Notes

## 24V Input, 2.5V, 3.3V, 5V Single Output

## 50-150W DC-DC Converter

**(Rev01)**

ASTEC




| | USA | Europe | Asia |
|---|---|---|---|
| **TEL:** | 1-760-930-4600 | 44-(0)1384-842-211 | 852-2437-9662 |
| **FAX:** | 1-760-930-0698 | 44-(0)1384-843-355 | 852-2402-4426 |


Publishing Date: 20020703

# Introduction

The AEH 24Vin series comes in a industry standard half-brick package of **2.4" x 2.28" x 0.5"** and footprint. The AEH 24Vin series is available with 2:1 input range of 18-36V. Outputs of 2.5V, 3.3V, and 5V are fully isolated from input and the isolation voltage is 1500Vdc. **The typical efficiencies are 88% for the 5V output, 87% for the 3.3V output, and 86% for the 2.5V output.**

Designed using a synchronous rectification topology, AEH 24Vin series incorporates simple structure, good electrical performance and high reliability. Standard features include input LVP, OCP, output OVP, short circuit protection, and over-temperature protection. Using aluminum based plate, the maximum case temperature can reach 100 °C.

The AEH 24Vin series is designed to meet CISPR22, FCC Class A, UL, TUV, and CSA certifications.

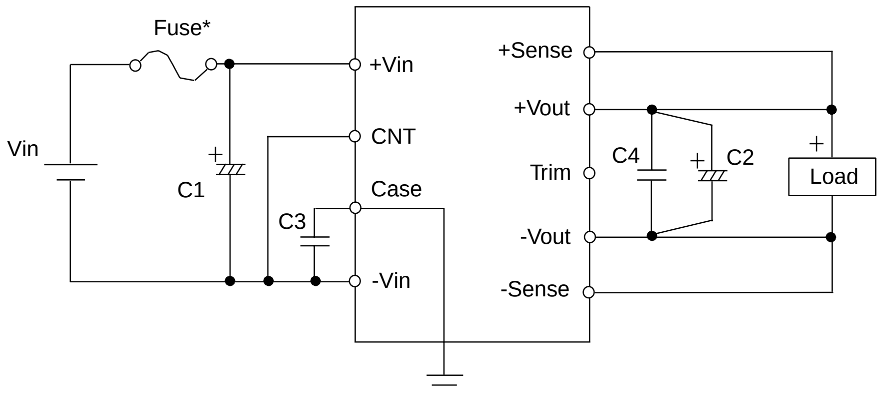
# Design Features

- High Efficiency
- High power density
- Low output noise
- Metal baseplate
- CNT function
- Remote sense
- Trim function
- Input under-voltage lockout
- Output short circuit protection
- Output current limiting
- Output over-voltage protection
- Overtemperature protection
- High input-output isolation voltage

# Options

- Heat sink available for extended operation
- Choice of CNT logic configuration

# Typical Application




**Fuse*:** Use external fuse ( fast blow type ) for each unit.

50W output : 10A fuse

75W output : 15A fuse

100W output : 20A fuse

150W output : 30A fuse

**C1:** Recommended input capacitor C1

-40 °C~ +100 °C: ≥ 47µF/100V electrolytic capacitor.

**C2:** Recommended output capacitor C2

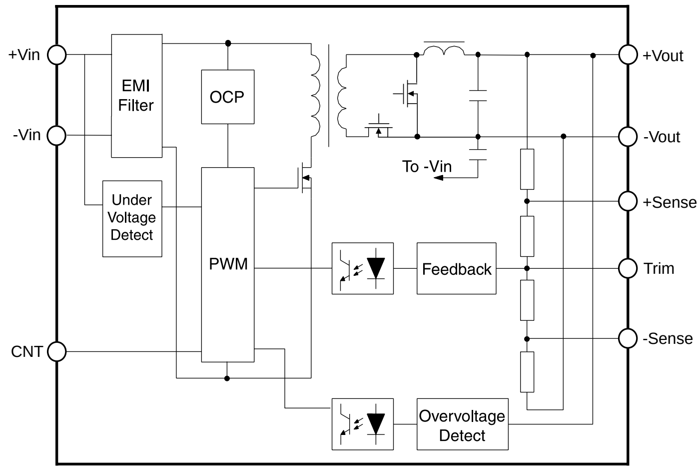
0°C~ +100°C: one 2200 µF/ 6.3V electrolytic capacitor

Below 0°C: use 1 X 220µF tantalum capacitor parallel with a 2200µF/ 6.3V electrolytic capacitor

**C3:** Recommended 4700pF/2000V

**C4:** Recommended 1µF/10V

# Block Diagram




# Ordering Information

| Model Number | Input Voltage | Output Voltage | Output Current | Ripple (mV rms) | Noise (mV pp) | Efficiency min | Efficiency typ |
|---|---|---|---|---|---|---|---|
| AEH10G24(N) | 18-36V | 2.5V | 10A | 40 | 150 | 84% | 86% |
| AEH10F24(N) | 18-36V | 3.3V | 10A | 40 | 150 | 85% | 87% |
| AEH10A24(N) | 18-36V | 5V | 10A | 40 | 150 | 86% | 88% |
| *AEH15G24(N) | 18-36V | 2.5V | 15A | 40 | 150 | 84% | 86% |
| *AEH15F24(N) | 18-36V | 3.3V | 15A | 40 | 150 | 85% | 87% |
| *AEH15A24(N) | 18-36V | 5V | 15A | 40 | 150 | 86% | 88% |
| AEH20G24(N) | 18-36V | 2.5V | 20A | 40 | 150 | 84% | 86% |
| AEH20F24(N) | 18-36V | 3.3V | 20A | 40 | 150 | 85% | 87% |
| AEH20A24(N) | 18-36V | 5V | 20A | 40 | 150 | 86% | 88% |
| *AEH30G24(N) | 18-36V | 2.5V | 30A | 40 | 150 | 84% | 86% |
| *AEH30F24(N) | 18-36V | 3.3V | 30A | 40 | 150 | 84% | 86% |
| *AEH30A24(N) | 18-36V | 5V | 30A | 40 | 150 | 86% | 88% |

*: detailed information referring to the factory

**Absolute Maximum Rating**

| Characteristic | Min | Typ | Max | Units | Notes |
|---|---|---|---|---|---|
| Input Voltage(continuous) | -0.3 | | 40 | Vdc | |
| Input Voltage(peak/surge) | -0.3 | | 50 | Vdc | 100ms non-repetitive |
| Operating temperature | -40 | | 100* | °C | *:case temperature |
| storage temperature | -55 | | 125 | °C | |

**Input Characteristics**

| Characteristic | Min | Typ | Max | Units | Notes |
|---|---|---|---|---|---|
| Input Voltage Range | 18 | 24 | 36 | Vdc | |
| Input Reflected Current | | 25 | 80 | mAp-p | |
| Turn-off Input Voltage | 14 | 15.5 | 17 | V | |
| Turn-on Input Voltage | 15 | 16.5 | 18 | V | |
| Turn On Time | | 15 | 25 | ms | |

**Control Function**

| Characteristic | Min | Typ | Max | Units | Notes |
|---|---|---|---|---|---|
| Logic High | 3 | | 15 | Vdc | |
| Logic Low | -0.7 | | 1.2 | Vdc | |
| Control Current | | | 2 | mA | |

**General Specifications**

| Characteristic | Min | Typ | Max | Units | Notes |
|---|---|---|---|---|---|
| MTBF | | 1880 | | k Hrs | Bellcore TR332, Tc=30°C |
| Isolation | | | 1500 | Vdc | |
| Pin solder temperature | | | 260 | °C | wave solder < 10 s |
| Hand Soldering Time | | | 5 | s | iron temperature 425°C |
| Weight | | 70 | | grams | |

**AEH10G24(N) Output Characteristics**

| Characteristic | Min | Typ | Max | Units | Notes |
|---|---|---|---|---|---|
| Power | | 25 | | W | |
| Output Current | | 10 | | A | |
| Output Setpoint Voltage | 2.45 | 2.5 | 2.55 | Vdc | Vin=24V, Io=10A |
| Line Regulation | | 0.02 | 0.2 | %Vo | Vin=18~36V, Io=10A |
| Load Regulation | | 0.1 | 0.5 | %Vo | Io=0~10A, Vin=24V |
| Dynamic Response | | | | | |
| 50-75% load | | 1.5 | | %Vo | Ta=25°C, di/dt =1A/10µs |
| | | 100 | | µs | Ta=25°C, di/dt =1A/10µs |
| 50-25% load | | 1.5 | | %Vo | Ta=25°C, di/dt =1A/10µs |
| | | 100 | | µs | Ta=25°C, di/dt =1A/10µs |
| Current Limit Threshold | 11 | 12.5 | 14 | A | |
| Short Circuit Current | | 17 | | A | |
| Efficiency | 84 | 86 | | % | Vin=24V, Io=10A |
| Trim Range | 90 | | 110 | %Vo | |
| Over Voltage Protection Setpoint | 3 | | 3.9 | V | |
| Sense Compensation | | | 0.5 | V | 0.25V each leg |
| Temperature Regulation | | | 0.02 | %Vo/°C | |
| Ripple (rms) | | 20 | 40 | mV | ( 0 to 20MHz Bandwidth ) |
| Noise (p-p) | | 100 | 150 | mV | ( 0 to 20MHz Bandwidth ) |
| Over Temperature Protection | | 105 | | °C | |
| Switching Frequency | | 230 | | kHz | |

**AEH10F24(N) Output Characteristics**

| Characteristic | Min | Typ | Max | Units | Notes |
|---|---|---|---|---|---|
| Power | | 33 | | W | |
| Output Current | | 10 | | A | |
| Output Setpoint Voltage | 3.25 | 3.3 | 3.35 | Vdc | Vin=24V, Io=10A |
| Line Regulation | | 0.02 | 0.2 | %Vo | Vin=18~36V, Io=10A |
| Load Regulation | | 0.1 | 0.5 | %Vo | Io=0~10A, Vin=24V |
| Dynamic Response | | | | | |
| 50-75% load | | 1.5 | | %Vo | Ta=25°C, di/dt =1A/10µs |
| | | 100 | | µs | Ta=25°C, di/dt =1A/10µs |
| 50-25% load | | 1.5 | | %Vo | Ta=25°C, di/dt =1A/10µs |
| | | 100 | | µs | Ta=25°C, di/dt =1A/10µs |
| Current Limit Threshold | 11 | 12.5 | 14 | A | |
| Short Circuit Current | | 17 | | A | |
| Efficiency | 85 | 87 | | % | Vin=24V, Io=10A |
| Trim Range | 90 | | 110 | %Vo | |
| Over Voltage Protection Setpoint | 3.9 | | 5.0 | V | |
| Sense Compensation | | | 0.5 | V | 0.25V each leg |
| Temperature Regulation | | | 0.02 | %Vo/°C | |
| Ripple (rms) | | 20 | 40 | mV | ( 0 to 20MHz Bandwidth ) |
| Noise (p-p) | | 100 | 150 | mV | ( 0 to 20MHz Bandwidth ) |
| Over Temperature Protection | | 105 | | °C | |
| Switching Frequency | | 270 | | kHz | |

**AEH10A24(N) Output Characteristics**

| Characteristic | Min | Typ | Max | Units | Notes |
|---|---|---|---|---|---|
| Power | | 50 | | W | |
| Output Current | | 10 | | A | |
| Output Setpoint Voltage | 4.92 | 5.0 | 5.08 | Vdc | Vin=24V, Io=10A |
| Line Regulation | | 0.02 | 0.2 | %Vo | Vin=18~36V, Io=10A |
| Load Regulation | | 0.1 | 0.5 | %Vo | Io=0~10A, Vin=24V |
| Dynamic Response | | | | | |
| 50-75% load | | 1.5 | | %Vo | Ta=25°C, di/dt =1A/10µs |
| | | 100 | | µs | Ta=25°C, di/dt =1A/10µs |
| 50-25% load | | 1.5 | | %Vo | Ta=25°C, di/dt =1A/10µs |
| | | 100 | | µs | Ta=25°C, di/dt =1A/10µs |
| Current Limit Threshold | 11 | 12 | 14 | A | |
| Short Circuit Current | | 17 | | A | |
| Efficiency | 86 | 87 | | % | Vin=24V, Io=10A |
| Trim Range | 90 | | 110 | %Vo | |
| Over Voltage Protection Setpoint | 5.75 | | 7 | V | |
| Sense Compensation | | | 0.5 | V | 0.25V each leg |
| Temperature Regulation | | | 0.02 | %Vo/°C | |
| Ripple (rms) | | 20 | 40 | mV | ( 0 to 20MHz Bandwidth ) |
| Noise (pp) | | 100 | 150 | mV | ( 0 to 20MHz Bandwidth ) |
| Over Temperature Protection | | 105 | | °C | |
| Switching Frequency | | 280 | | kHz | |

**AEH20G24(N) Output Characteristics**

| Characteristic | Min | Typ | Max | Units | Notes |
|---|---|---|---|---|---|
| Power | | 50 | | W | |
| Output Current | | 20 | | A | |
| Output Setpoint Voltage | 2.45 | 2.5 | 2.55 | Vdc | Vin=24V, Io=20A |
| Line Regulation | | 0.02 | 0.2 | %Vo | Vin=18~36V, Io=20A |
| Load Regulation | | 0.1 | 0.5 | %Vo | Io=0~20A, Vin=24V |
| Dynamic Response | | | | | |
| 50-75% load | | 1.5 | | %Vo | Ta=25°C, di/dt =1A/10µs |
| | | 100 | | µs | Ta=25°C, di/dt =1A/10µs |
| 50-25% load | | 1.5 | | %Vo | Ta=25°C, di/dt =1A/10µs |
| | | 100 | | µs | Ta=25°C, di/dt =1A/10µs |
| Current Limit Threshold | 22 | 25 | 28 | A | |
| Short Circuit Current | | 30 | | A | |
| Efficiency | 84 | 86 | | % | Vin=24V, Io=20A |
| Trim Range | 90 | | 110 | %Vo | |
| Over Voltage Protection Setpoint | 3 | | 3.9 | V | |
| Sense Compensation | | | 0.5 | V | 0.25V each leg |
| Temperature Regulation | | | 0.02 | %Vo/°C | |
| Ripple (rms) | | 20 | 40 | mV | ( 0 to 20MHz Bandwidth ) |
| Noise (pp) | | 100 | 150 | mV | ( 0 to 20MHz Bandwidth ) |
| Over Temperature Protection | | 105 | | °C | |
| Switching Frequency | | 230 | | kHz | |

**AEH20F24(N) Output Characteristics**

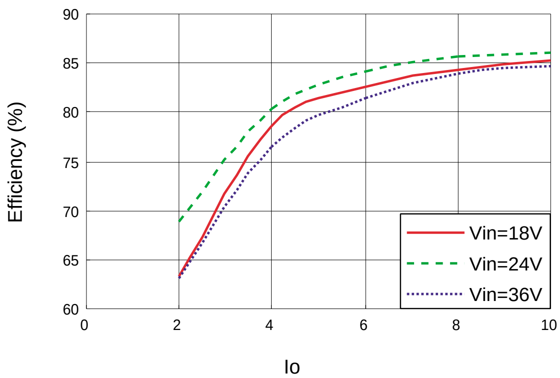
| Characteristic | Min | Typ | Max | Units | Notes |
|---|---|---|---|---|---|
| Power | | 66 | | W | |
| Output Current | | 20 | | A | |
| Output Setpoint Voltage | 3.25 | 3.3 | 3.35 | Vdc | Vin=24V, Io=20A |
| Line Regulation | | 0.02 | 0.2 | %Vo | Vin=18~36V, Io=20A |
| Load Regulation | | 0.1 | 0.5 | %Vo | Io=0~20A, Vin=24V |
| Dynamic Response | | | | | |
| 50-75% load | | 1.5 | | %Vo | Ta=25°C, di/dt =1A/10µs |
| | | 100 | | µs | Ta=25°C, di/dt =1A/10µs |
| 50-25% load | | 1.5 | | %Vo | Ta=25°C, di/dt =1A/10µs |
| | | 100 | | µs | Ta=25°C, di/dt =1A/10µs |
| Current Limit Threshold | 22 | 25 | 28 | A | |
| Short Circuit Current | | 30 | | A | |
| Efficiency | 86 | 87 | | % | Vin=24V, Io=20A |
| Trim Range | 90 | | 110 | %Vo | |
| Over Voltage Protection Setpoint | 3.9 | | 5.0 | V | |
| Sense Compensation | | | 0.5 | V | 0.25V each leg |
| Temperature Regulation | | | 0.02 | %Vo/°C | |
| Ripple (rms) | | 20 | 40 | mV | ( 0 to 20MHz Bandwidth ) |
| Noise (pp) | | 100 | 150 | mV | ( 0 to 20MHz Bandwidth ) |
| Over Temperature Protection | | 105 | | °C | |
| Switching Frequency | | 330 | | kHz | |

**AEH20A24(N) Output Characteristics**

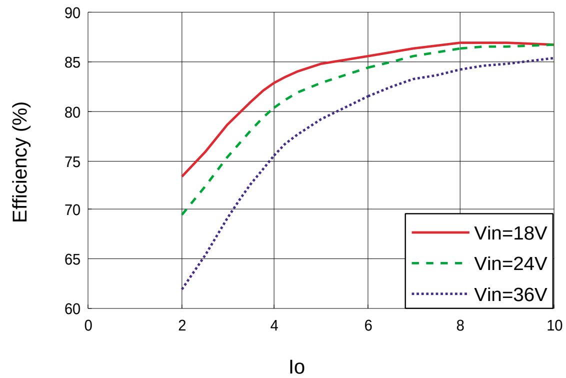
| Characteristic | Min | Typ | Max | Units | Notes |
|---|---|---|---|---|---|
| Power | | 100 | | W | |
| Output Current | | 20 | | A | |
| Output Setpoint Voltage | 4.92 | 5.0 | 5.08 | Vdc | Vin=24V, Io=20A |
| Line Regulation | | 0.02 | 0.2 | %Vo | Vin=18~36V, Io=20A |
| Load Regulation | | 0.1 | 0.5 | %Vo | Io=0~20A, Vin=24V |
| Dynamic Response | | | | | |
| 50-75% load | | 1.5 | | %Vo | Ta=25°C, di/dt =1A/10µs |
| | | 100 | | µs | Ta=25°C, di/dt =1A/10µs |
| 50-25% load | | 1.5 | | %Vo | Ta=25°C, di/dt =1A/10µs |
| | | 100 | | µs | Ta=25°C, di/dt =1A/10µs |
| Current Limit Threshold | 22 | 24.5 | 28 | A | |
| Short Circuit Current | | 30 | | A | |
| Efficiency | 86 | 88 | | % | Vin=24V, Io=20A |
| Trim Range | 90 | | 110 | %Vo | |
| Over Voltage Protection Setpoint | 5.75 | | 7.0 | V | |
| Sense Compensation | | | 0.5 | V | 0.25V each leg |
| Temperature Regulation | | | 0.02 | %Vo/°C | |
| Ripple (rms) | | 20 | 40 | mV | ( 0 to 20MHz Bandwidth ) |
| Noise (pp) | | 100 | 150 | mV | ( 0 to 20MHz Bandwidth ) |
| Over Temperature Protection | | 105 | | °C | |
| Switching Frequency | | 280 | | kHz | |

# Characteristic Curves (at 25 °C)

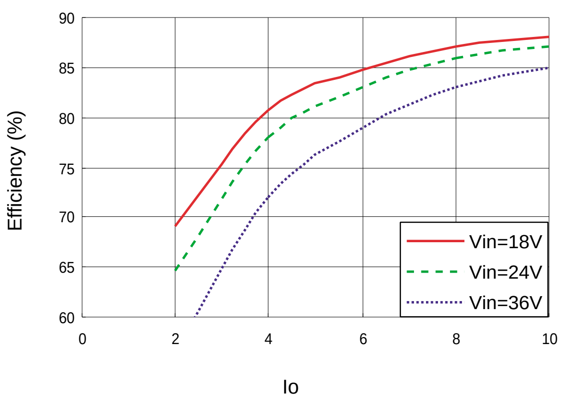
### Typical Efficiency AEH10G24N



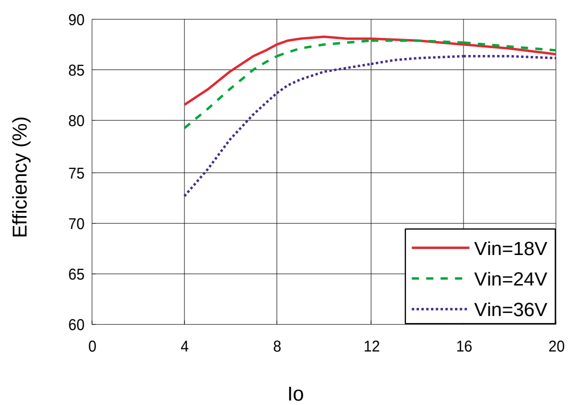

### Typical Efficiency AEH10F24N



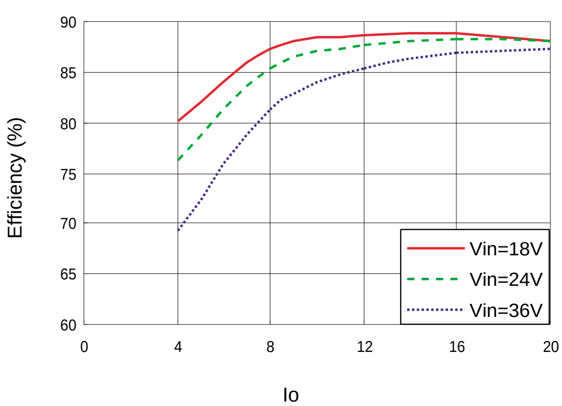

### Typical Efficiency AEH10A24N



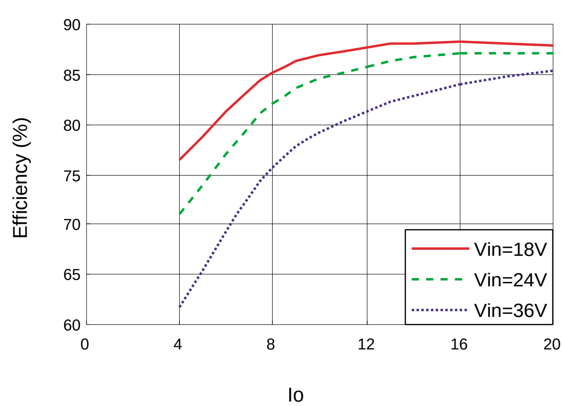

### Typical Efficiency AEH20G24N




### Typical Efficiency AEH20F24N

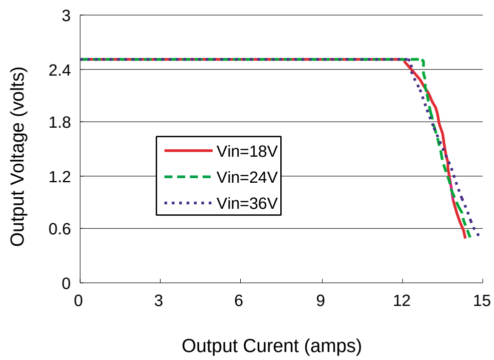



### Typical Efficiency AEH20A24N

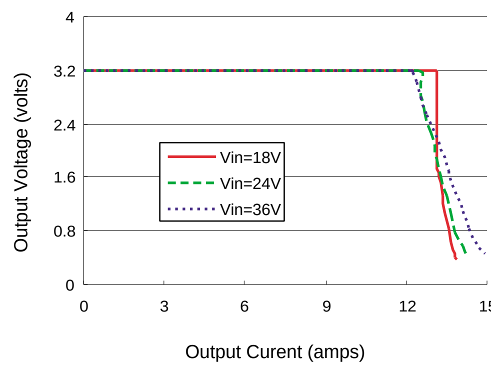


# Characteristic Curves *(at 25 °C)*

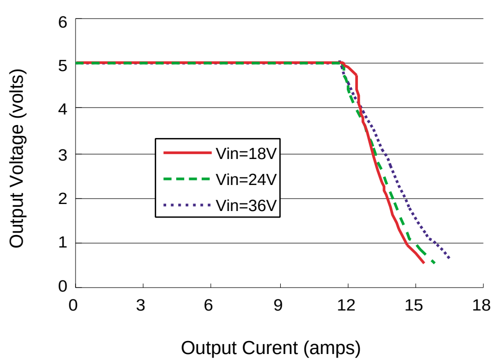
**Typical Output Overcurrent Characteristics AEH10G24N**



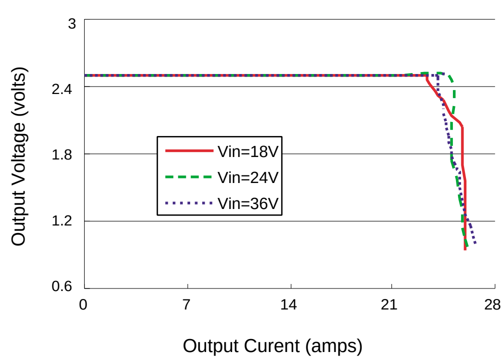

**Typical Output Overcurrent Characteristics AEH10F24N**



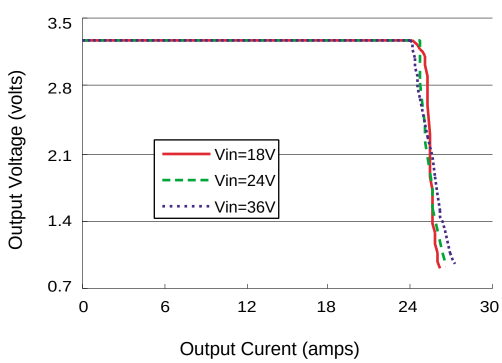

**Typical Output Overcurrent Characteristics AEH10A24N**



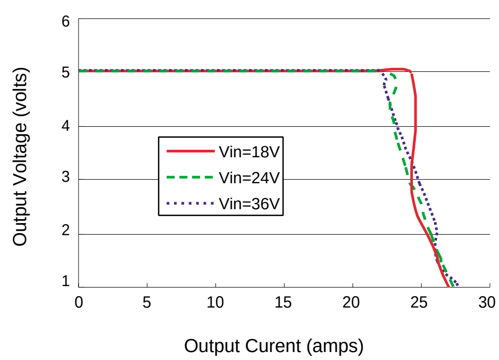

**Typical Output Overcurrent Characteristics AEH20G24N**




**Typical Output Overcurrent Characteristics AEH20F24N**

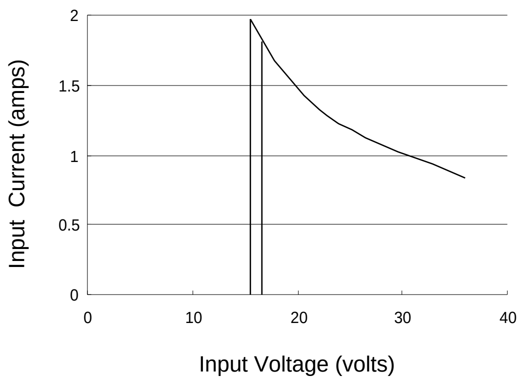



**Typical Output Overcurrent Characteristics AEH10A24N**

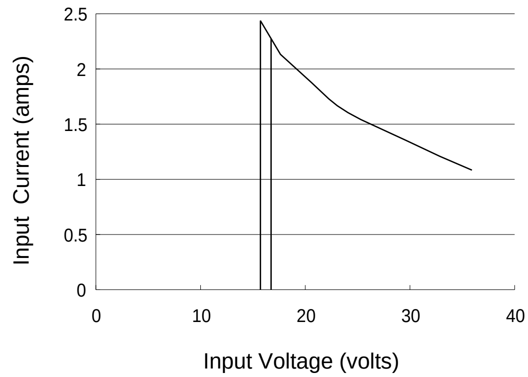


# ***Characteristic Curves*** *(at 25 °C)*

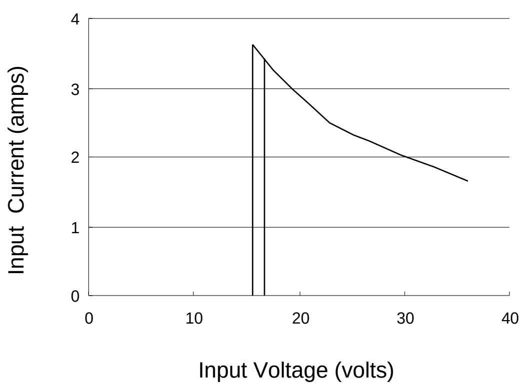
**Typical Input-Output Characteristics**
**AEH10G24N**



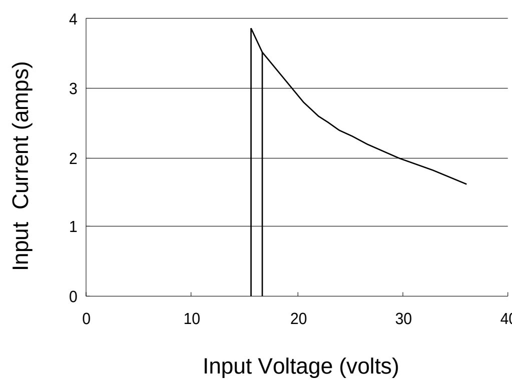

**Typical Input-Output Characteristics**
**AEH10F24N**



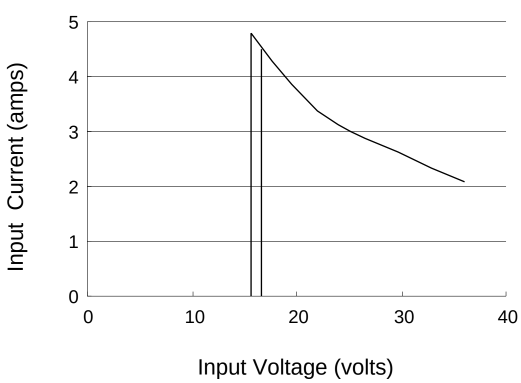

**Typical Input-Output Characteristics**
**AEH10A24N**



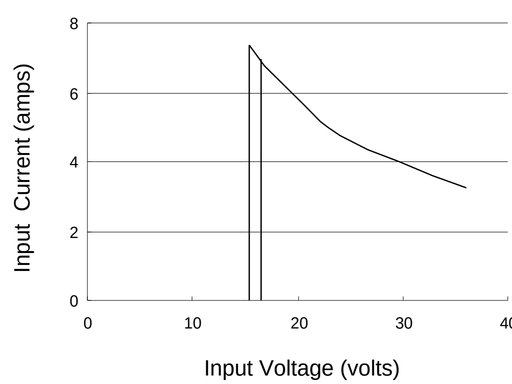

**Typical Input-Output Characteristics**
**AEH20G24N**




**Typical Input-Output Characteristics**
**AEH20F24N**

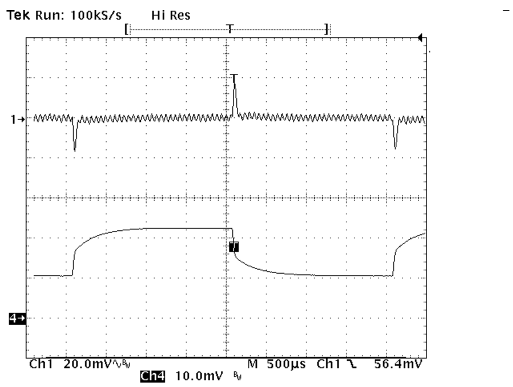



**Typical Input-Output Characteristics**
**AEH20A24N**

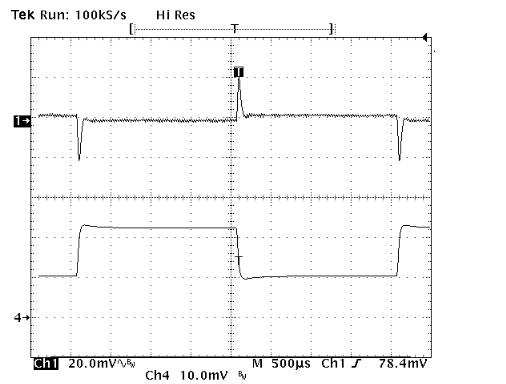


# Transient response *(24V rated input, variable load, at 25 °C)*

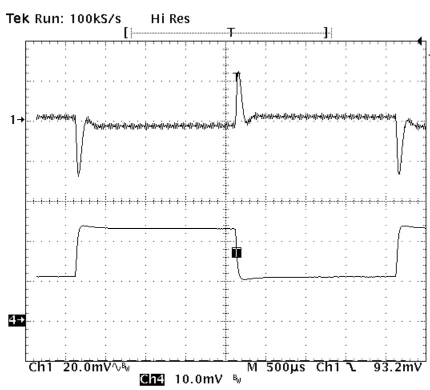
**Typical Transient Response to Step Load Change from 25%-50%-25%Iomax AEH10G24N**



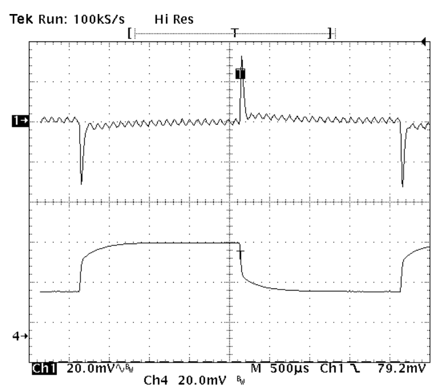

**Typical Transient Response to Step Load Change from 25%-50%-25%Iomax AEH10F24N**



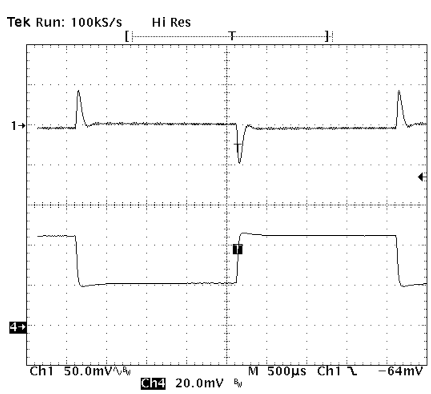

**Typical Transient Response to Step Load Change from 25%-50%-25%Iomax AEH10A24N**



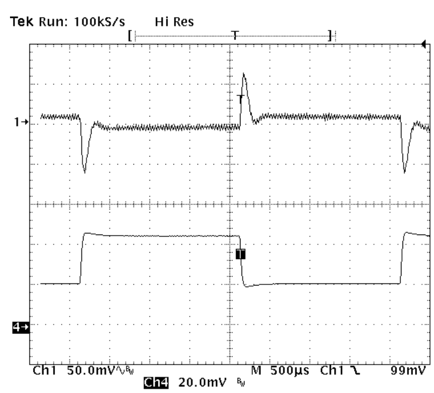

**Typical Transient Response to Step Load Change from 25%-50%-25%Iomax AEH20G24N**




**Typical Transient Response to Step Load Change from 25%-50%-25%Iomax AEH20F24N**

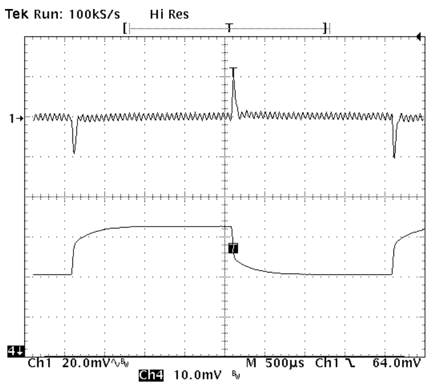



**Typical Transient Response to Step Load Change from 25%-50%-25%Iomax AEH20A24N**

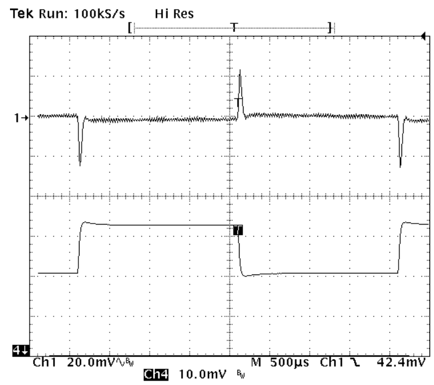


# Transient response *(24V rated input, variable load, at 25 °C)*

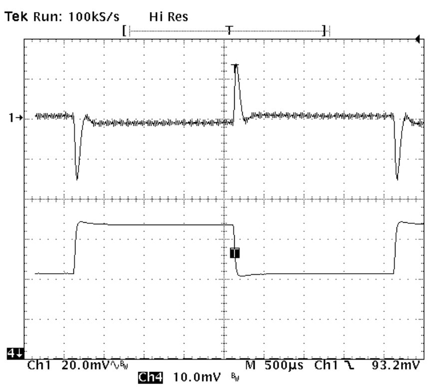
**Typical Transient Response to Step Load Change from 75%-50%-75%Iomax AEH10G24N**



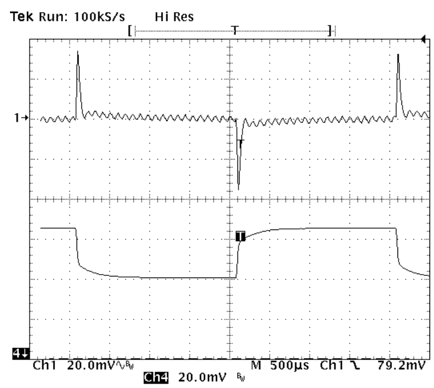

**Typical Transient Response to Step Load Change from 75%-50%-75%Iomax AEH10F24N**



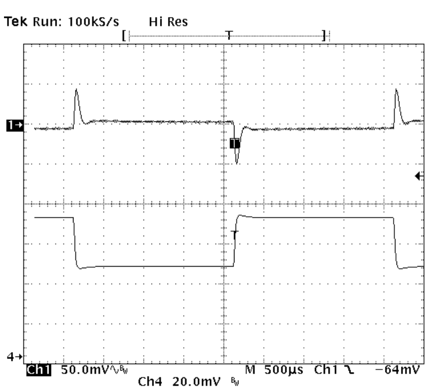

**Typical Transient Response to Step Load Change from 75%-50%-75%Iomax AEH10A24N**



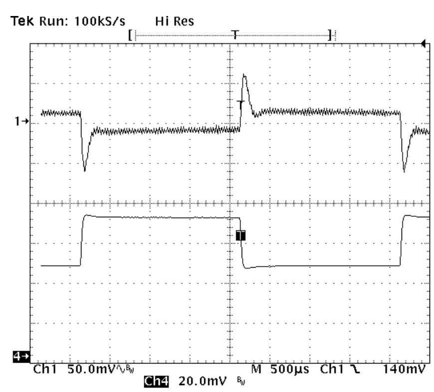

**Typical Transient Response to Step Load Change from 50%-75%-50%Iomax AEH20G24N**




**Typical Transient Response to Step Load Change from 50%-75%-50%Iomax AEH20F24N**

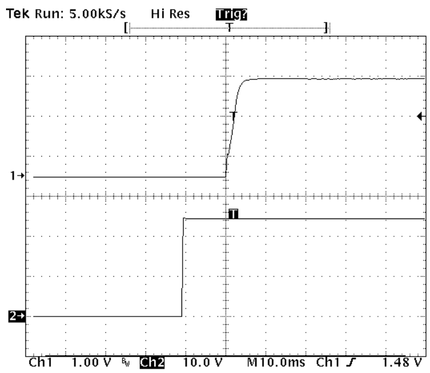



**Typical Transient Response to Step Load Change from 75%-50%-75%Iomax AEH20A24N**

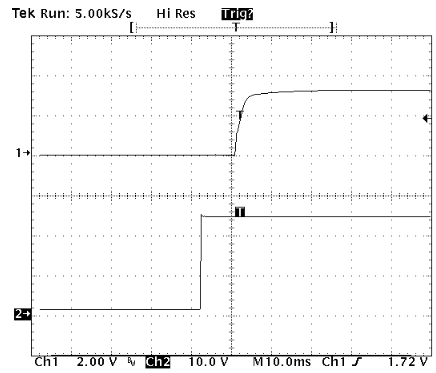


# Characteristic Curves *(24V rated input voltage, full load, at 25 °C)*

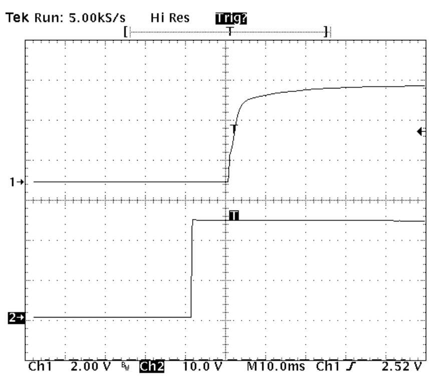
**Typical Start-Up from Power On**
**AEH10G24N**



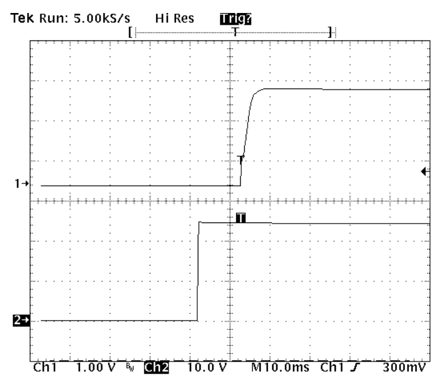

**Typical Start-Up from Power On**
**AEH10F24N**



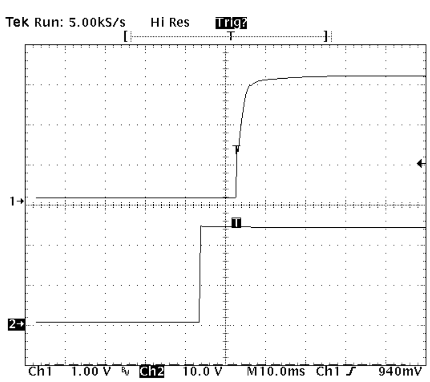

**Typical Start-Up from Power On**
**AEH10A24N**



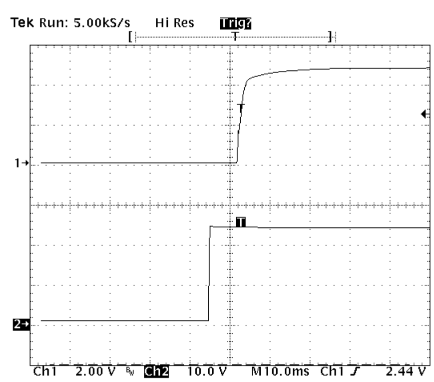

**Typical Start-Up from Power On**
**AEH20G24N**




**Typical Start-Up from Power On**
**AEH20F24N**

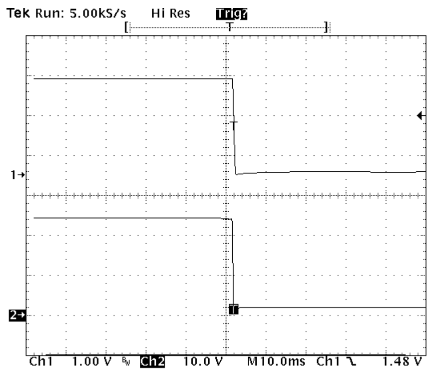



**Typical Start-Up from Power On**
**AEH20A24N**

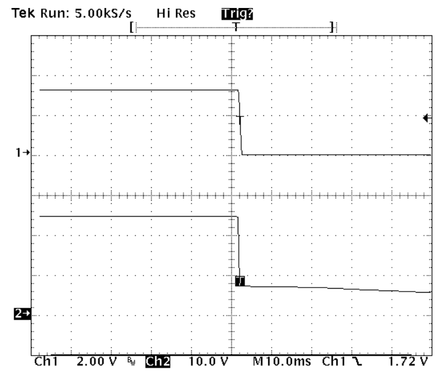


# Characteristic Curves *(24V rated input voltage, full load, at 25 °C)*

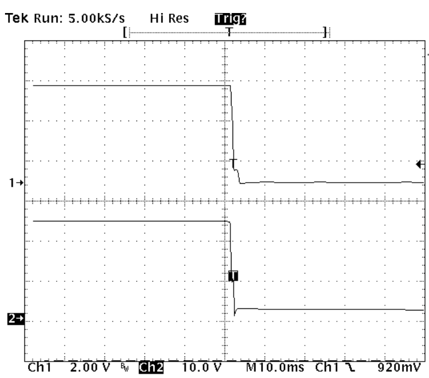
**Typical Shut-down from Power Off**
**AEH10G24N**



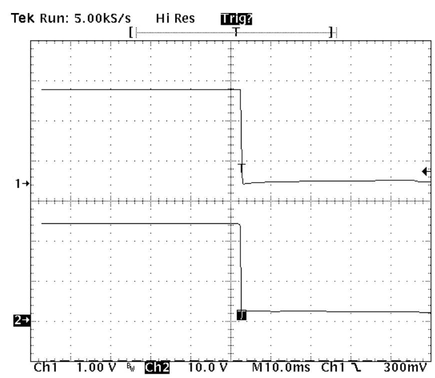

**Typical Shut-down from Power Off**
**AEH10F24N**



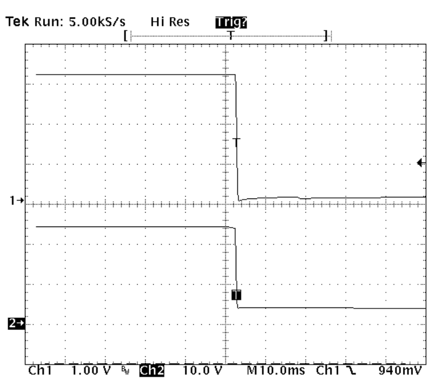

**Typical Shut-down from Power Off**
**AEH10A24N**



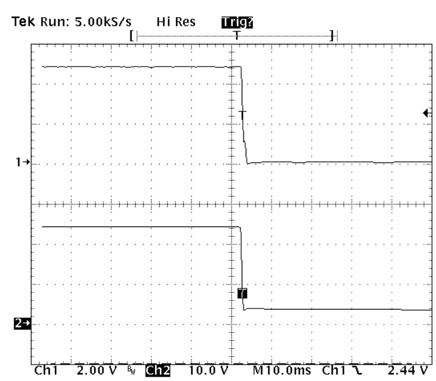

**Typical Shut-down from Power Off**
**AEH20G24N**




**Typical Shut-down from Power Off**
**AEH20F24N**

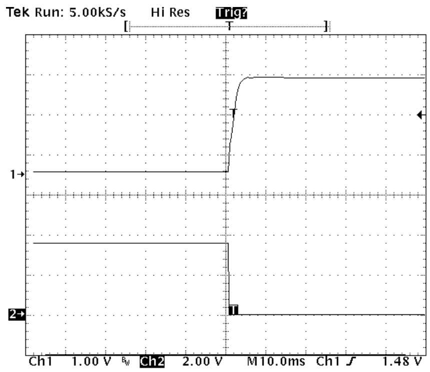



**Typical Shut-down from Power Off**
**AEH20A24N**

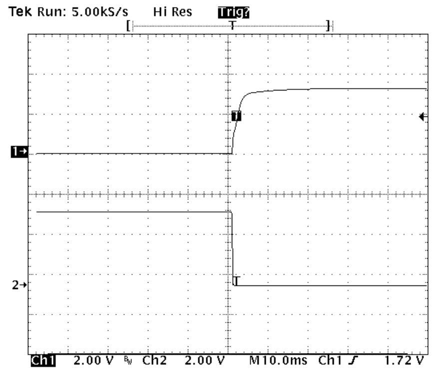


# Characteristic Curves *(24V rated input voltage, full load, at 25 °C)*

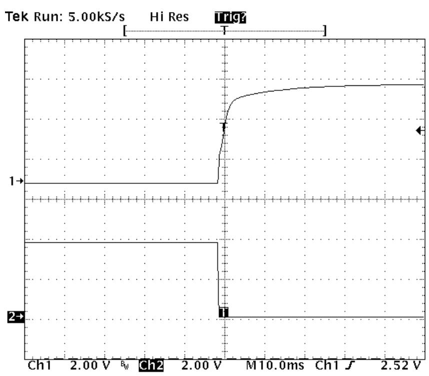
**Typical Start-Up Transient with CNT Control
AEH10G24N**



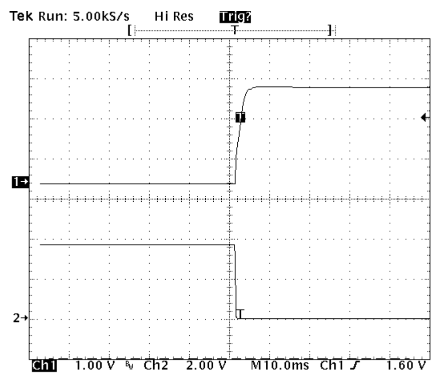

**Typical Start-Up Transient with CNT Control
AEH10F24N**



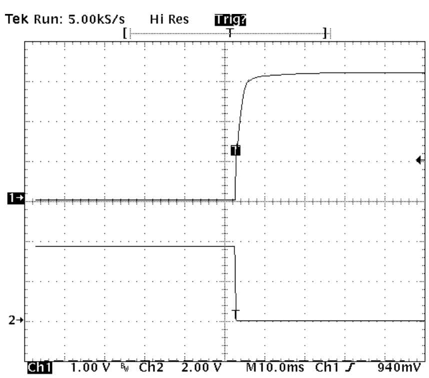

**Typical Start-UpTransient with CNT Control
AEH10A24N**



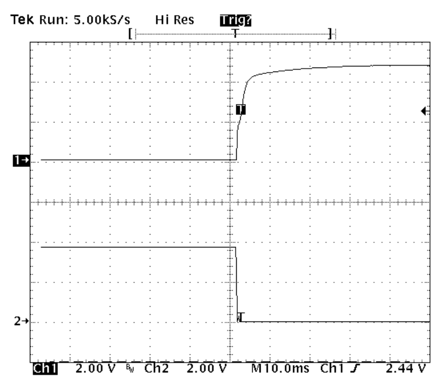

**Typical Start-UpTransient with CNT Control
AEH20G24N**




**Typical Start-UpTransient withCNT Control
AEH20F24N**

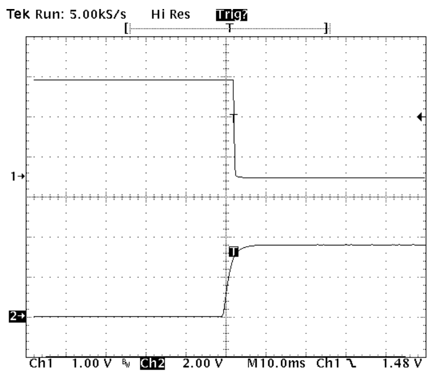



**Typical Start-UpTransient withCNT Control
AEH20A24N**

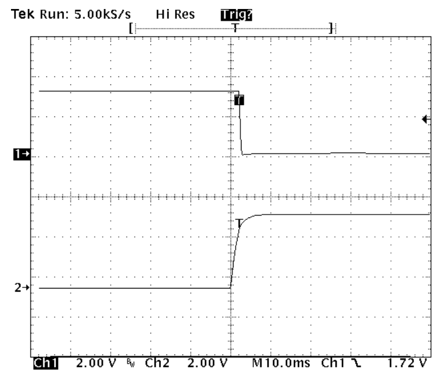


# Characteristic Curves *(24V rated input voltage, full load, at 25 °C)*

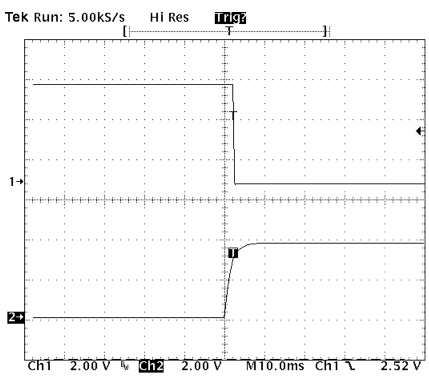
**Typical Shut-down Transient with CNT Control**
**AEH10G24N**



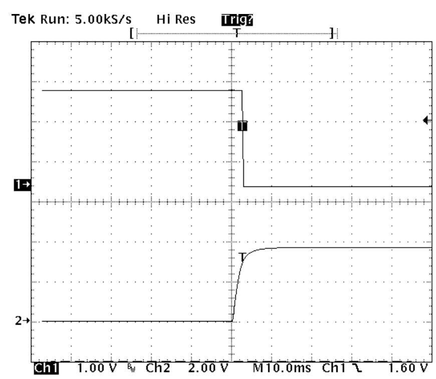

**Typical Shut-downTransient with CNT Control**
**AEH10F24N**



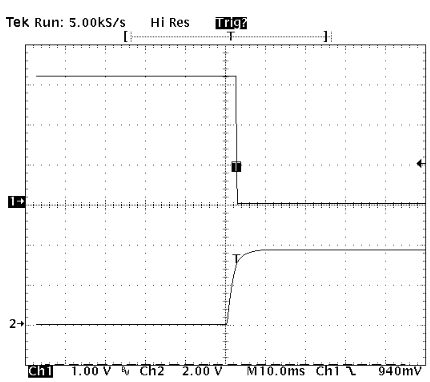

**Typical Shut-downTransient with CNT Control**
**AEH10A24N**



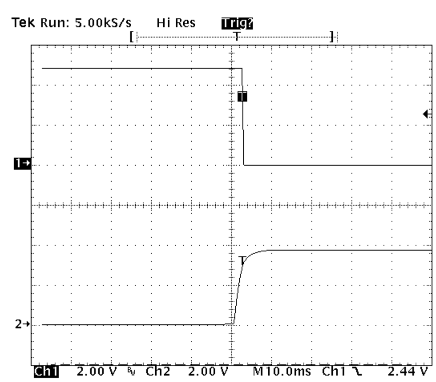

**Typical Shut-downTransient with CNT Control**
**AEH20G24N**




**Typical Shut-downTransient withCNT Control**
**AEH20F24N**




**Typical Shut-downTransient withCNT Control**
**AEH20A24N**





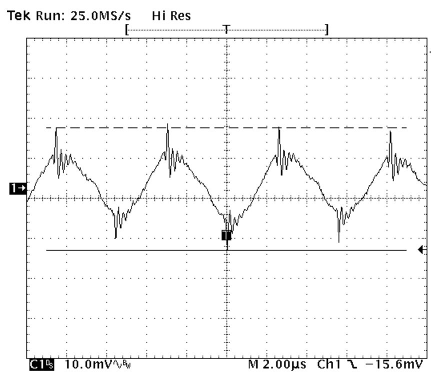

| | USA | Europe | Asia |
|---|---|---|---|
| TEL: | 1-760-930-4600 | 44-(0)1384-842-211 | 852-2437-9662 |
| FAX: | 1-760-930-0698 | 44-(0)1384-843-355 | 852-2402-4426 |

www.astec.com

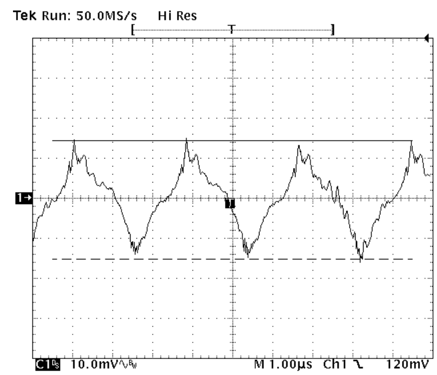
ASTEC

# Characteristic Curves *(24V rated input voltage, full load, at 25 °C)*

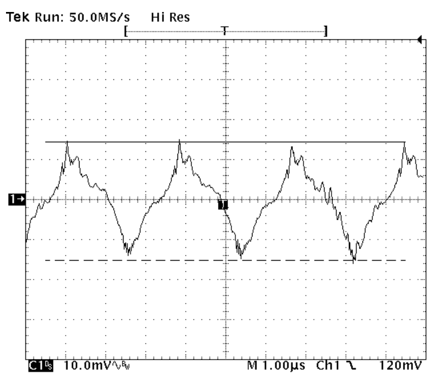
**Typical Output Ripple Voltage
AEH10G24N**



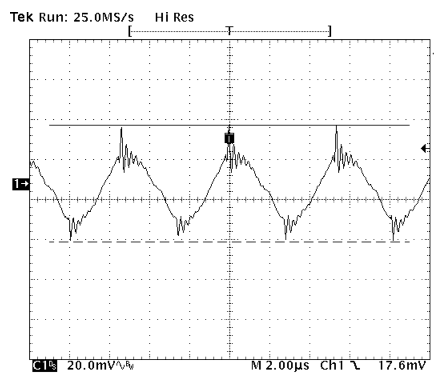

**Typical Output Ripple Voltage
AEH10F24N**



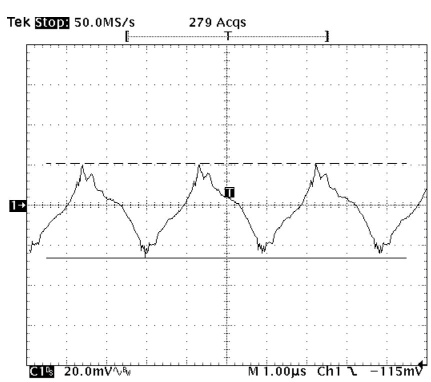

**Typical Output Ripple Voltage
AEH10A24N**



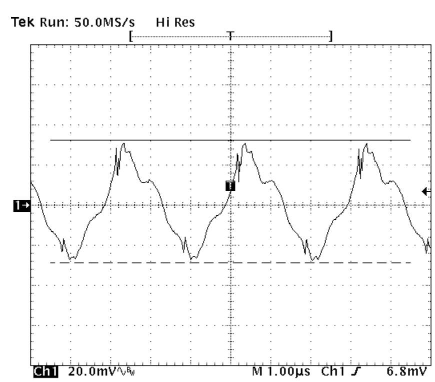

**Typical Output Ripple Voltage
AEH20G24N**




**Typical Output Ripple Voltage
AEH20F24N**

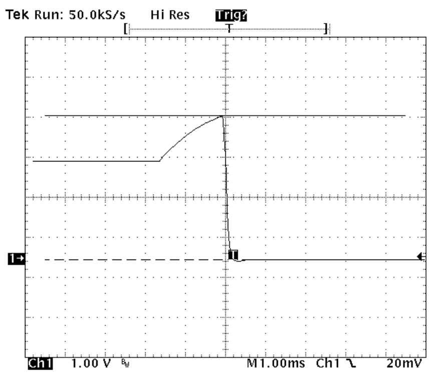



**Typical Output Ripple Voltage
AEH20A24N**

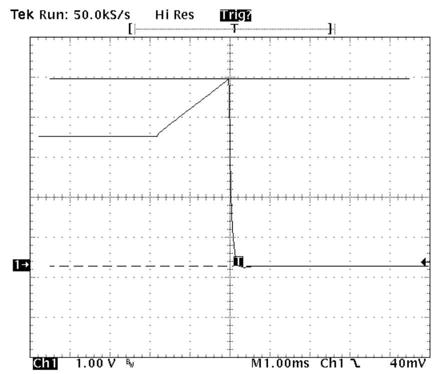


# Characteristic Curves *(24V rated input voltage, full load, at 25 °C)*

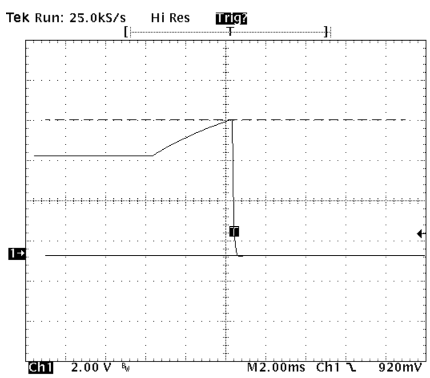
**Overvoltage Protection**
**AEH10G24N**



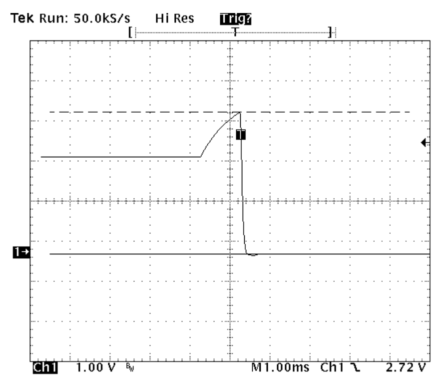

**Overvoltage Protection**
**AEH10F24N**



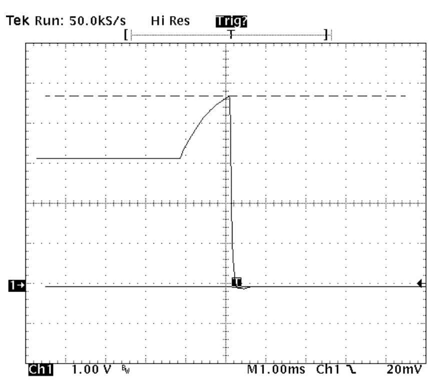

**Overvoltage Protection**
**AEH10A24N**



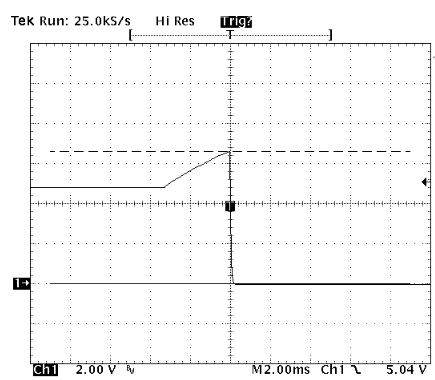

**Overvoltage Protection**
**AEH20G24N**




**Overvoltage Protection**
**AEH20F24N**




**Overvoltage Protection**
**AEH20A24N**



# Pins

The +Vin and -Vin input connection pins are located as shown in Figure 1. AEH 24Vin converters have a 2:1 input voltage range and can accept 18-36 Vdc.

**Care should be taken to avoid applying reverse polarity to the input which can damage the converter.**

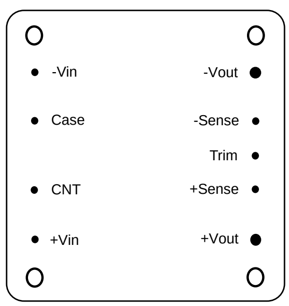



**Fig.1 Pin Location**

# Input Characteristic

### *Fusing*

**The AEH 24Vin power modules have no internal fuse. An external fuse must always be employed!** To meet international safety requirements, a 250 Volt rated fuse should be used. If one of the input lines is connected to chassis ground, then the fuse must be placed in the other input line.

Standard safety agency regulations require input fusing. Recommended fuse ratings for the AEH 24Vin Series are shown in Table 1.

***Table 1***

| Series | Fuse Rating(24Vin) |
|---|---|
| 50W | 10A |
| 75W | 15A |
| 100W | 20A |
| 150W | 30A |

### *Input Reverse Voltage Protection*

Under installation and cabling conditions where reverse polarity across the input may occur, reverse polarity protection is recommended. Protection can easily be provided as shown in Figure 2. In both cases the diode rating is determined by the power of the converter. Diodes should be rated as shown in Table1.

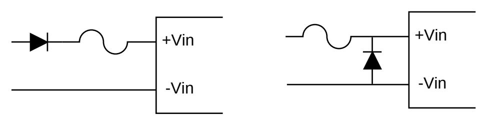



**Fig.2 Reverse Polarity Protection Circuits**

**Placing the diode across the inputs rather than in-line with the input offers an advantage in that the diode only conducts in a reverse polarity condition, which increases circuit efficiency and thermal performance.**

### *Input Undervoltage Protection*

The AEH 24Vin series is protected against undervoltage on the input. If the input voltage drops below the acceptable range, the converter will shut down. It will automatically restart when the undervoltage condition is removed.

### *Input Filter*

Input filters are included in the converters to help achieve standard system emissions certifications. Some users however, may find that additional input filtering is necessary. The AEH 24Vin 2.5Vout series has an internal switching frequency of 180kHz so a high frequency capacitor mounted close to the input terminals produces the best results. To reduce reflected noise, a capacitor can be added across the input as shown in Figure 3, forming a $\pi$ filter. A 100$\mu$F/63V electrolytic capacitor is recommended for C1.

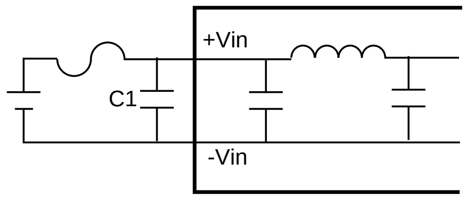



**Fig.3 Ripple Rejection Input Filter**

For conditions where EMI is a concern, a different input filter can be used. Figure 4 shows an input filter designed to reduce EMI effects. L1, L2 is a 2mH common mode choke.

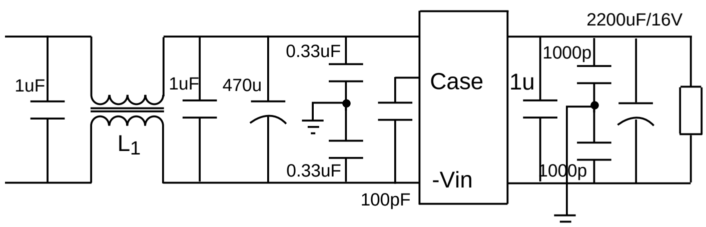



**Fig.4 EMI Reduction Input Filter**

When a filter inductor is connected in series with the power converter input, an input capacitor C1 should be added. An input capacitor C1 should also be used when the input wiring is long, since the wiring can act as an inductor. Failure to use an input capacitor under these conditions can produce large input voltage spikes and an unstable output.

### *CNT Function*

Two remote on/off options are available.

**Negative logic** applying a voltage less than 1.2V to the CNT pin will enable the output, and applying a voltage greater than 3V will disable it.

**Positive logic** applying a voltage larger than 3V to the CNT pin will enable the output, and applying a voltage less than 1.2V will disable it.
Negative logic, device code suffix “ N “ .
Positive logic, device code suffix nothing is the factory-preferred.

**If the CNT pin is left open, the converter will default to “ control off ” operation in negative logic, but default to “ control on ” in positive logic.**

The maximum voltage that can be applied to the CNT pin is 15V.

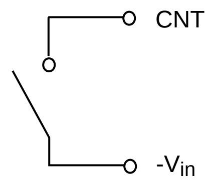



**Fig.5 Simple Control**

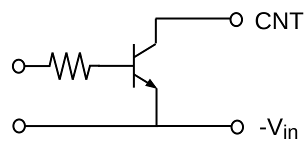



**Fig.6 Transistor Control**

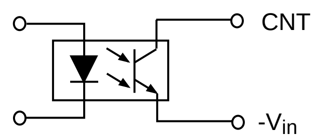



**Fig.7 Isolated Control**

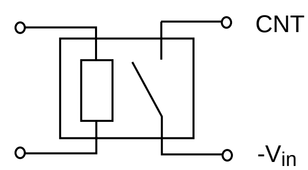



**Fig.8 Relay Control**

## *Input-Output Characteristic*

### *Safety Consideration*

For safety-agency approval of the system in which the power module is used, the power module must be installed in compliance with the spacing and separation requirements of the end-use safety agency standard, i.e., UL1950, CSA C22.2 No. 950-95, and EN60950.

The input-to-output 1500VDC isolation is an operational insulation. The DC/DC power module should be installed in end-use equipment, in compliance with the requirements of the ultimate application, and is intended to be supplied by an isolated secondary circuit. When the supply to the DC/DC power module meets all the requirements for SELV(<60Vdc), the output is considered to remain within SELV limits (level 3). If connected to a non-SELV power system, double or reinforced insulation must be provided in the power supply that isolates the input from any hazardous voltages, including the ac mains. One Vi pin and one Vo pin are to be grounded or both the input and output pins are to be kept floating. Single fault testing in the power supply must be performed in combination with the DC/DC power module to demonstrate that the output meets the requirement for SELV. The input pins of the module are not operator accessible.

**Note**: Do not ground either of the input pins of the module, without grounding one of the output pins. This may allow a non-SELV voltage to appear between the output pin and ground.

### *Case Grounding*

For proper operation of the module, the case or baseplate of the AEH 24Vin module does not require a connection to a chassis ground. If the AEH module is not in a metallic enclosure in a system, it may be advisable to directly ground the case to reduce electric field emissions. Leaving the case floating can help to reduce magnetic field radiation from common mode noise currents. If the case has to be grounded for safety or other reasons, an inductor can be connected to chassis at DC and AC line frequencies, but be left floating at switching frequencies. Under this condition, the safety requirements are met and the emissions are minimized.

## *Output Characteristic*

### *Minimum Load Requirement*

There no minimum load requirement for the AEH 24Vin series modules.

### *Remote Sensing*

The AEH 24Vin converter can remotely sense both lines of its output which moves the effective output voltage regulation point from the output of the unit to the point of connection of the remote sense pins. This feature automatically adjusts the real output voltage of the AEH 24Vin in order to compensate for voltage drops in distribution and maintain a regulated voltage at the point of load.

When the converter is supporting loads far away, or is used with undersized cabling, significant voltage drop can occur at the load. The best defense against such drops is to locate the load close to the converter and to ensure adequately sized cabling is used. When this is not possible, the converter can compensate for a drop of up to 0.5V, through use of the sense leads.

When used, the + and - sense leads should be connected from the converter to the point of load as shown in Figure 9 using twisted pair wire. The converter will then regulate its output voltage at the point where the leads are connected. Care should be taken not to reverse the sense leads. If reversed, the converter will trigger the OVP protection and turn off. **When not used, the +Sense lead must be connected with +Vo directly, and -Sense with -Vo.** Also note that the output voltage and the remote sense voltage offset must be less than the min-

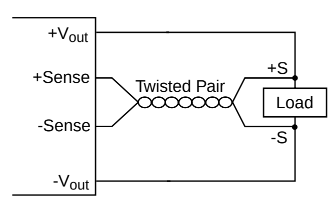



**Fig.9 Sense Connections**

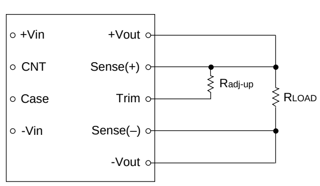
imum overvoltage trip point. **Note that at elevated output voltages the maximum power rating of the module remains the same, and the output current capability will decrease correspondingly.**

### *Output Trimming*

Users can increase or decrease the output voltage set point of a module by connecting an external resistor between the TRIM pin and either the SENSE (+ ) or SENSE ( - ) pins. The trim resistor should be positioned close to the module. **If not using the trim feature, leave the TRIM pin open.**

Trimming up by more than 10% of the nominal output may damage the converter or trig the OVP protection. Trimming down more than 10% can cause the converter to regulate improperly. Trim down and trim up circuits and the corresponding configuration are shown in Figure 10 to Figure 15 next page.

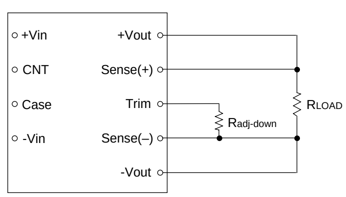
**Note that at elevated output voltages the maximum power rating of the module remains the same, and the output current capability will decrease correspondingly.**




$$R_{adj\text{-}up} = \frac{Vo(100+y)}{1.26y} - \frac{(100+2y)}{y}$$

Where y is the adjusting percentage of the voltage.
$0 < y < 10$
Radj-up is in kΩ.

**Fig.10 Circuit and Equation to Trim Up**




$$R_{adj\text{-}down} = \frac{100}{y} - 2$$

where y is the adjusting percentage of the voltage.
$0 < y < 10$
Radj-down is in kΩ.

**Fig.11 Circuit and Equation to Trim Down**

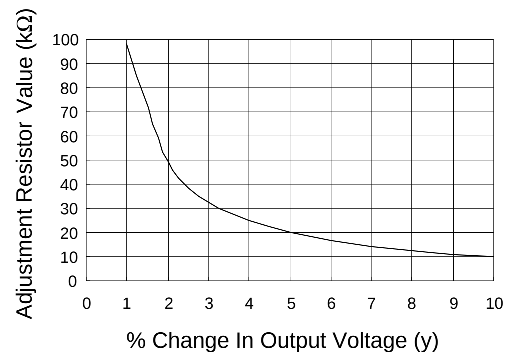



**Fig.12 Resistor Selection for 2.5Vout Trim Up**

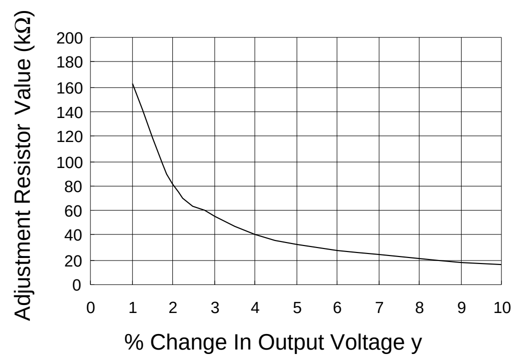



**Fig.13 Resistor Selection for 3.3Vout Trim Up**

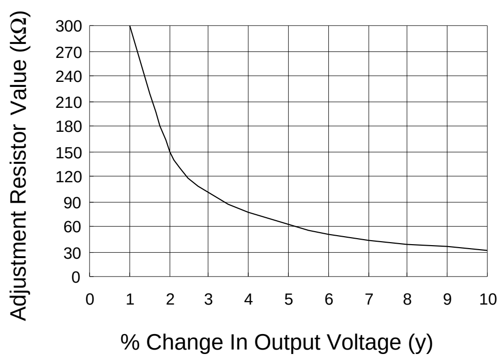



**Fig.14 Resistor Selection for 5Vout Trim Up**

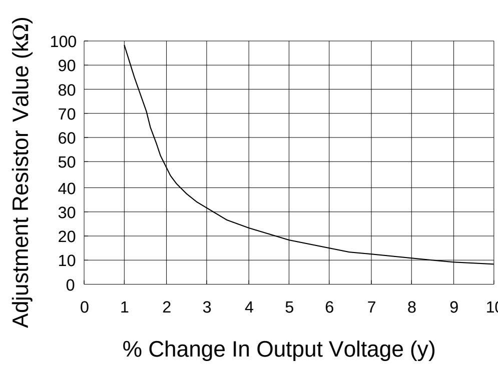



**Fig.15 Resistor Selection for Trim Down**



| | USA | Europe | Asia |
|---|---|---|---|
| TEL: | 1-760-930-4600 | 44-(0)1384-842-211 | 852-2437-9662 |
| FAX: | 1-760-930-0698 | 44-(0)1384-843-355 | 852-2402-4426 |

www.astec.com
ASTEC

### *Output Over-Current Protection*

AEH 24Vin series DC/DC converters feature foldback current limiting as part of their Overcurrent Protection (OCP) circuits. When output current exceeds 110 to 140% of rated current, such as during a short circuit condition, the output will shutdown immediately, and can tolerate short circuit conditions indefinitely. When the overcurrent condition is removed, the converter will automatically restart.

### *Output Filters*

When the load is sensitive to ripple and noise, an output filter can be added to minimize the effects. A simple output filter to reduce output ripple and noise can be made by connecting a capacitor across the output as shown in Figure 16. The recommended value for the output capacitor C1 is 2200µF/10V.

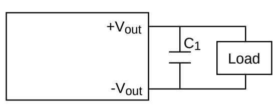



**Fig.16 Output Ripple Filter**

Extra care should be taken when long leads or traces are used to provide power to the load. Long lead lengths increase the chance for noise to appear on the lines. Under these conditions C2 can be added across the load as shown in Figure 17. The recommended component for C2 is 2200µF/10V capacitor and connecting a 0.1µF ceramic capacitor C1 in parallel generally.

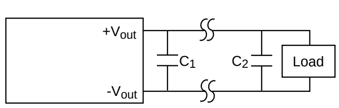



**Fig.17 Output Ripple Filter For a Distant Load**

### *Decoupling*

Noise on the power distribution system is not always created by the converter. High speed analog or digital loads with dynamic power demands can cause noise to cross the power inductor back onto the input lines. Noise can be reduced by decoupling the load. In most cases, connecting a 10 µF tantalum capacitor in parallel with a 0.1µF ceramic capacitor across the load will decouple it. The capacitors should be connected as close to the load as possible.

### *Ground Loops*

Ground loops occur when different circuits are given multiple paths to common or earth ground, as shown in Figure 18. Multiple ground points can  slightly different potential and cause current flow through the circuit from one point to another. This can result in additional noise in all the circuits. To eliminate the problem, circuits should be designed with a single ground connection as shown in Figure 19.

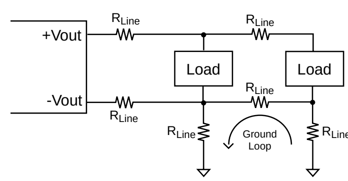



**Fig.18 Ground Loops**

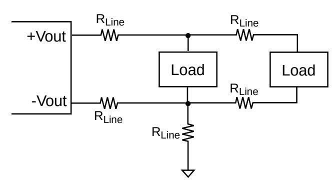



**Fig.19 Single Point Ground**

### *Output Over-Voltage Protection*

The over-voltage protection has a separate feedback loop which activates when the output voltage is between 120% and 140% of the nominal output voltage. When an over-voltage condition occurs, a “ turn off “ signal was sent to the input of the module, and shut off the output. The module will restart after power on again.



| | USA | Europe | Asia | |
|---|---|---|---|---|
| TEL: | 1-760-930-4600 | 44-(0)1384-842-211 | 852-2437-9662 | |
| FAX: | 1-760-930-0698 | 44-(0)1384-843-355 | 852-2402-4426 | www.astec.com |
ASTEC

### *Parallel Power Distribution*

Figure 20 shows a typical parallel power distribution design. Such designs, sometimes called daisy chains, can be used for very low output currents, but are not normally recommended. The voltage across loads far from the source can vary greatly depending on the IR drops along the leads and changes in the loads closer to the source. Dynamic load conditions increase the potential problems.

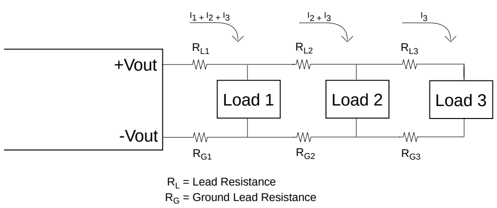



**Fig.20 Parallel Power Distribution**

### *Radial Power Distribution*

Radial power distribution is the preferred method of providing power to the load. Figure 21 shows how individual loads are connected directly to the power source. This arrangement requires additional power leads, but it avoids the voltage variation problems associated with the parallel power distribution technique.

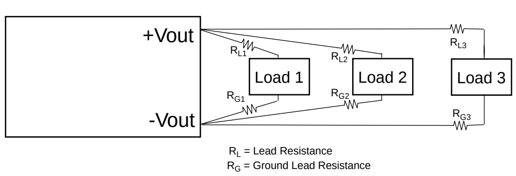



**Fig.21  Radial Power Distribution**

### *Mixed Distribution*

In the real world a combination of parallel and radial power distribution is often used. Dynamic and high current loads are connected using a radial design, while static and low current loads can be connected in parallel. This combined approach minimizes the drawbacks of a parallel design when a purely radial design is not feasible.

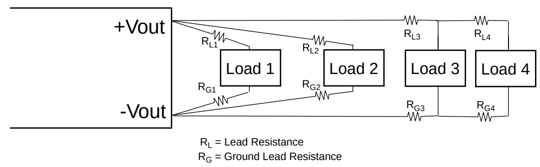



**Fig.22 Mixed Power Distribution**

### *Redundant Operation*

A common requirement in high reliability systems is to provide redundant power supplies. The easiest way to do this is to place two converters in parallel, providing fault tolerance but not load sharing. Oring diodes should be used to ensure that failure of one converter will not cause failure of the second. Figure 23  shows such an arrangement. Upon application of power, one of the converters will provide a slightly higher output voltage and will support the full load demand. The second converter will see a zero load condition and will "idle". If the first converter should fail, the second converter will support the full load. When designing redundant converter circuits, Shottky diodes should be used to minimize the forward voltage drop. The voltage drop across the Shottky diodes must also be considered when determining load voltage requirements.

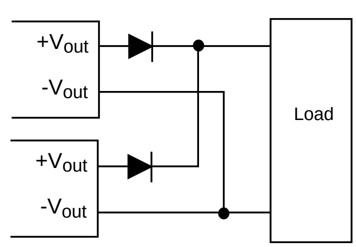



**Fig.23 Redundant Operation**



| | USA | Europe | Asia | |
|---|---|---|---|---|
| TEL: | 1-760-930-4600 | 44-(0)1384-842-211 | 852-2437-9662 | |
| FAX: | 1-760-930-0698 | 44-(0)1384-843-355 | 852-2402-4426 | www.astec.com |

ASTEC

# Thermal Management

### *Technologies*

AEH 24V input series features high efficiency and the module have typical efficiency high up to 88% at full load. With less heat dissipation and temperature-resistant components such as ceramic capacitors, these modules exhibit good behavior during prolonged exposure to high temperatures. Maintaining the operating case temperature (Tc) within the specified range help keep internal-component temperatures within their specifications which in turn help keep MTBF from falling below the specified rating. Proper cooling of the power modules is also necessary for reliable and consistent operation.

### *Basic Thermal Management*

Measuring the case temperature of the module (Tc) as the method shown in Figure 24 can verify the proper cooling. Figure 24 shows the metal surface of the module and the pin locations. The module should work under 90°C for the reliability of operation and $T_C$ must not exceed 100 °C while operating in the final system configuration. The measurement can be made with a surface probe after the module has reached thermal equilibrium. If a heat sink is mounted to the case, make the measurement as close as possible to the indicated position. It makes the assumption that the final system configuration exists and can be used for a test environment.

The following text and graphs show guidelines to predict the thermal performance of the module for typical configurations that include heat sinks in natural or forced airflow environments. Note that Tc of module must always be checked in the final system configuration to verify proper operational due to the variation in test conditions.

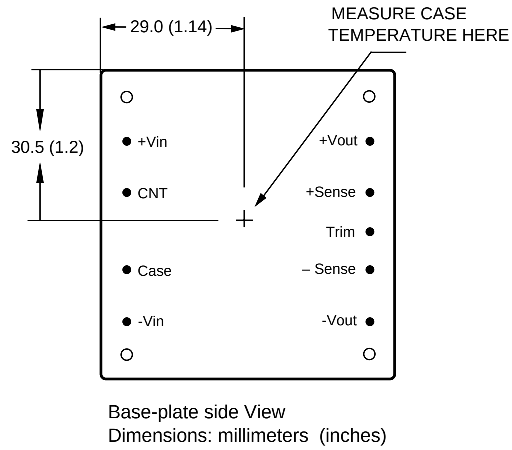



**Fig.24. Case Temperature Measurement**

Thermal management acts to transfer the heat dissipated by the module to the surrounding environment. The amount of power dissipated by the module as heat ($P_D$) is got by the equation below:

$$P_D = P_I - P_O$$

where : $P_I$ is input power;
$P_O$ is output power;
$P_D$ is dissipated power.

Also, module efficiency ($\eta$) is defined as the following equation:

$$\eta = P_O / P_I$$

If eliminating the input power term, from two above equations can yield the equation below:

$$P_D = P_O (1-\eta) / \eta$$

The module power dissipation then can be calculated through the equation.

Because each power module output voltage has a different power dissipation curve, a plot of power dissipation versus output current over three different line voltages is given in each module-specific data sheet. The typical power dissipation curve of AEH series are shown as figure 25 to figure 30.



| | USA | Europe | Asia |
|---|---|---|---|
| TEL: | 1-760-930-4600 | 44-(0)1384-842-211 | 852-2437-9662 |
| FAX: | 1-760-930-0698 | 44-(0)1384-843-355 | 852-2402-4426 |

www.astec.com

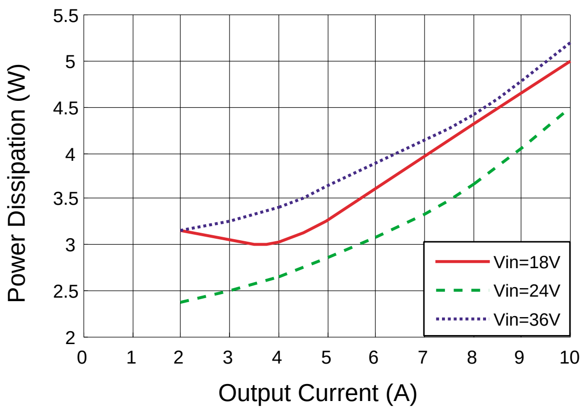



**Fig.25 AEH10G24N Power Dissipation Curves**

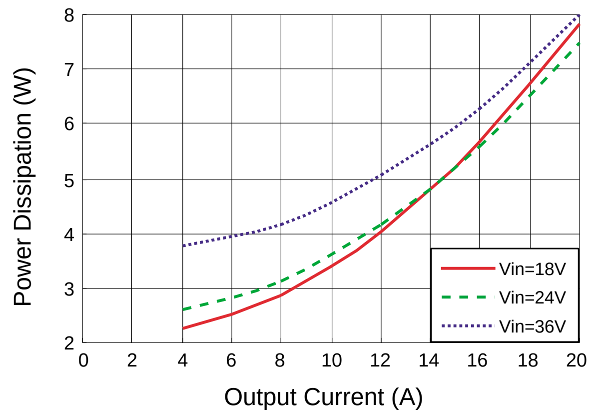



**Fig.28 AEH10F24N Power Dissipation Curves**

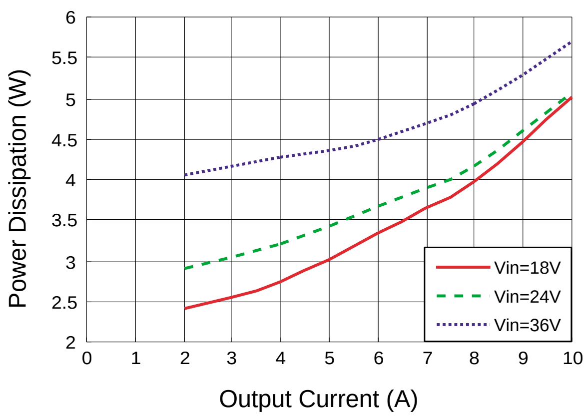



**Fig.26 AEH10A24N Power Dissipation Curves**

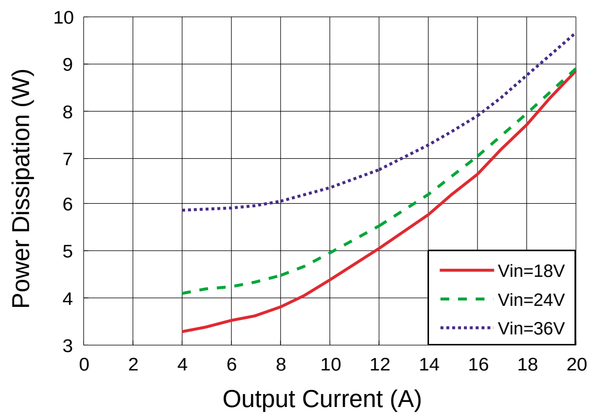



**Fig.29 AEH20G24N Power Dissipation Curves**

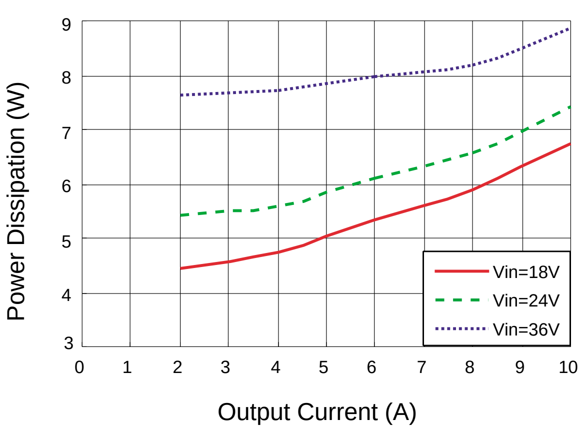



**Fig.27 AEH20F24N Power Dissipation Curves**

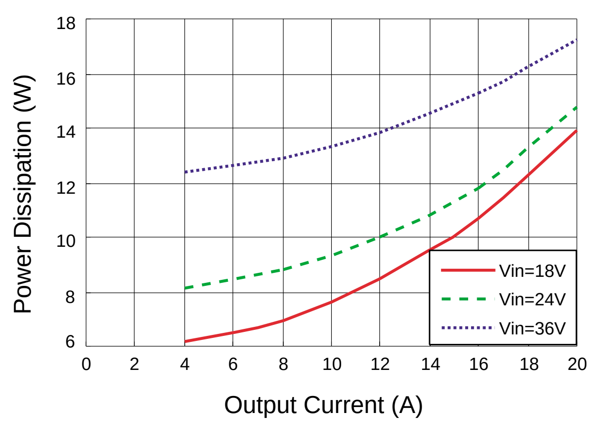



**Fig.30 AEH20A24N Power Dissipation Curves**

# Module Derating

### Experiment Setup

From the experimental set up shown in figure 31, the derating curves as figure 32 can be drawn. Note that the PWB ( printed-wiring board ) and the module must be mounted vertically. The passage has a rectangular cross-section. The clearance between the facing PWB and the top of the module is kept 13 mm (0.5 in.) constantly.

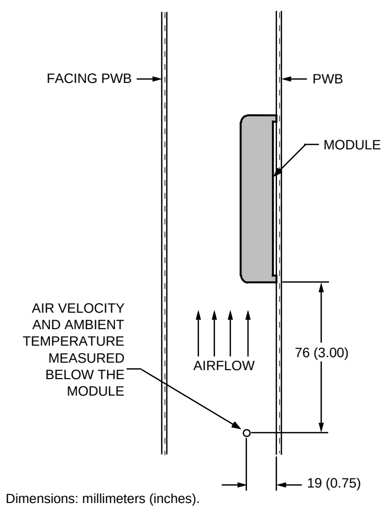



**Fig.31 Experiment Set Up**

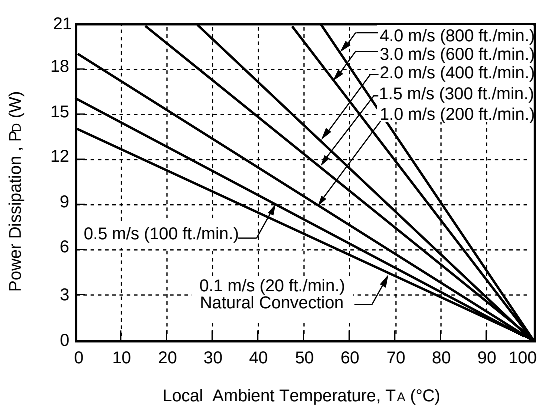



**Fig.32 Forced Convection Power Derating without Heat Sink**

### Convection Without Heat Sinks

Heat transfer can be enhanced by increasing the airflow over the module. Figure 32 shows the maximum power that can be dissipated by the module.

In the test, natural convection airflow was measured at 0.05 m/s to 0.1 m/s (10 ft./min. to 20 ft./min.). The 0.5 m/s to 4.0 m/s (100 ft./min. to 800 ft./min.) curves are tested with externally adjustable fans. The appropriate airflow for a given operating condition can be determined through figure 32.

**Example 1. How to calculate the minimum airflow required to maintain a desired Tc?**

If a AEH20A24N module operates with a 24V line voltage, a 20 A output current, and a 40 °C maximum ambient temperature, What is the minimum airflow necessary for the operating?

**Determine $P_D$ (** referenced **Fig.30 )** with condition:

$V_{in} = 24$ V

$I_O = 20$ A

**Get:** $P_D = 15$ W

**And** with $T_A = 40$ °C

**Determine airflow ( Fig.32 ):**

v = 1.5 m/s (300 ft./min.)

**Example 2. How to calculate the maximum output power of a module in a certain convection and a max. $T_A$?**

What is the maximum power output for a AEH20A24N operating at following conditions:

$V_{in} = 24$ V

v = 1.5 m/s (300 ft./min.)

$T_A = 40$ °C

**Determine $P_D$ ( Fig.32 )**

$P_D = 15$W

**Determine $I_O$ ( Fig.30 ):**

$I_O = 20$ A

**Calculate $P_O$:**



| | USA | Europe | Asia |
|---|---|---|---|
| TEL: | 1-760-930-4600 | 44-(0)1384-842-211 | 852-2437-9662 |
| FAX: | 1-760-930-0698 | 44-(0)1384-843-355 | 852-2402-4426 |

www.astec.com

$P_O = (V_O) \times (I_O) = 5 \times 20 = 100$ W

Although the two examples above use 100 °C as the maximum case temperature, for extremely high reliability applications, one may design to a lower case temperature as shown in Example 4 on page 35.

### *Heat Sink Configuration*

Several standard heat sinks are available for the AEH 24Vin 50 W to 150 W modules as shown in Figure 33 to Figure 35.

The heat sinks mount to the top surface of the module with screws torqued to 0.56 N-m (5 in.-lb). A thermally conductive dry pad or thermal grease is placed between the case and the heat sink to minimize contact resistance (typically 0.1°C/W to 0.3°C/W) and temperature differential.

Nomenclature for heat sink configurations is as follows:

WDxyyy40

where:

x = fin orientation: longitudinal (L) or transverse (T)

yyy = heat sink height (in 100ths of inch)

For example, WDT5040 is a heat sink that is transverse mounted (see Figure 35) for a 61 mm x 57.9 mm (2.4 in.x 2.28 in.) module with a heat sink height of 0.5 in.

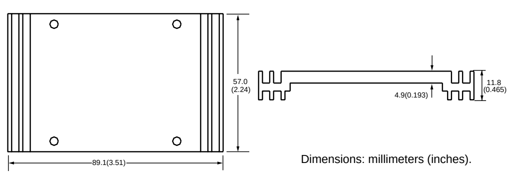



**Fig.33 Non Standard Heatsink**

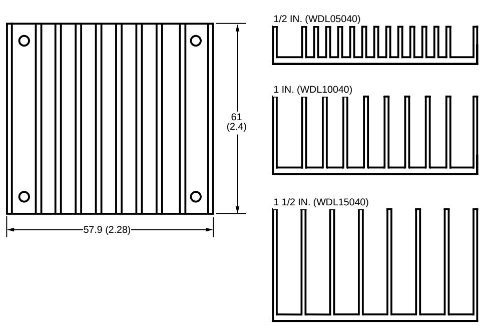



**Fig.34 Longitudinal Fins Heat Sink**

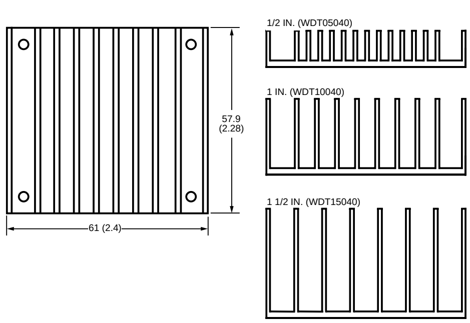



**Fig.35 Transverse Fins Heat Sink**

### *Heatsink Mounting Advice*

A crucial part of the thermal design strategy is the thermal interface between the baseplate of the module and the heatsink. Inadequate measures taken here will quickly negate any other attempts to control the baseplate temperature. For example, using a conventional dry insulator can result in a case-heatsink thermal impedance of >0.5°C/W, while use one of the recommended interface methods (silicon grease

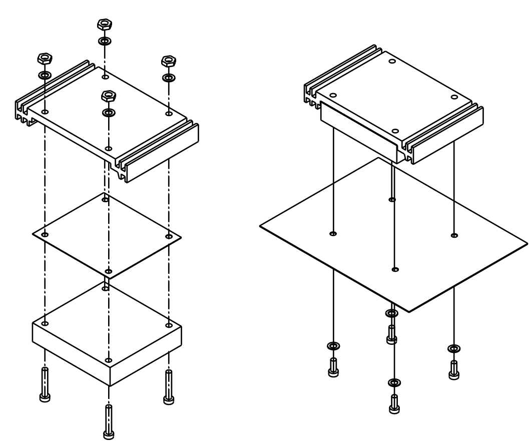


**Fig.36 Heat Sink Mounting**

or thermal pads available from Astec) can result in a case-heatsink thermal impedance around 0.1°C/W.

### *Natural Convection with Heat Sink*

The power derating for a module with the heat sinks ( shown as figure 25 to figure 30) in natural convection is shown in figure 35. In this test, natural convection generates airflow about 0.05 m/s to 0.1 m/s ( 10ft./min to 20ft./min ).
Figure 37 can be used for heat-sink selection in natural convection environment.

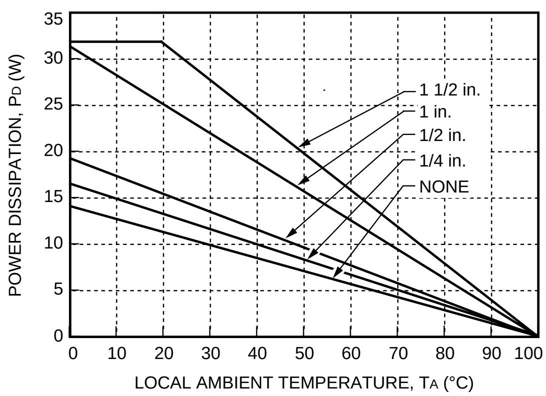



**Fig.37 Heat Sink Power Derating Curves, Natural Convection**

**Example 3. How to select a heat sink**?
What heat sink would be appropriate for a AEH20A24N in a natural convection environment at nominal line, 2/3 load, and maximum ambient temperature of 40°C?
**Determine $P_D$ (** referenced **Fig.30 )** with condition:

$V_{in}$ = 24 V
$I_O$ = 2/3 (20) = 13 A
$T_A$ = 40 °C

**Get:** $P_D$ = 10.5 W
**Determine Heat Sink ( Fig.37 ):**
no heat sink allows up to $T_A$ = 30 °C
1/4 in. allows up to $T_A$ = 40 °C

### *Basic Thermal Model*

There is another approach to analyze module thermal performance, to model the overall thermal resistance of the module. This presentation method is especially useful when considering heat sinks. The following equation can be used to calculate the total thermal resistance .

$R_{CA} = \Delta T_{C,\ max} \ / \ P_D$

**Where** $R_{CA}$ is the module thermal resistance;
$\Delta T_{C,\ max}$ is the maximum case temperature rise;
$P_D$ is the module power dissipation.

In this model, $P_D$, $\Delta T_{C,\ max}$, and $R_{CA}$ are equals to current flow, voltage drop, and electrical resistance, respectively, in Ohm's law, as shown in Figure 38. Also, $\Delta T_{C,\ max}$ is defined as the difference between the module case temperature ($T_C$) and the inlet ambient temperature ($T_A$).

$\Delta T_{C,\ max} = T_C - T_A$

**Where** $T_C$ is the module case temperature,
$T_A$ is the inlet ambient temperature.

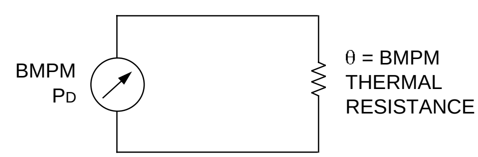



**Fig.38 Basic Thermal Resistance Model**

For AEH 24Vin Series 50W to 150W converters, the module's thermal resistance values versus air velocity have been determined experimentally and shown in figure 39. The highest values on each curve represents the point of natural convection.

Figure 39 is used for determining thermal performance under various conditions of airflow and heat sink configurations.

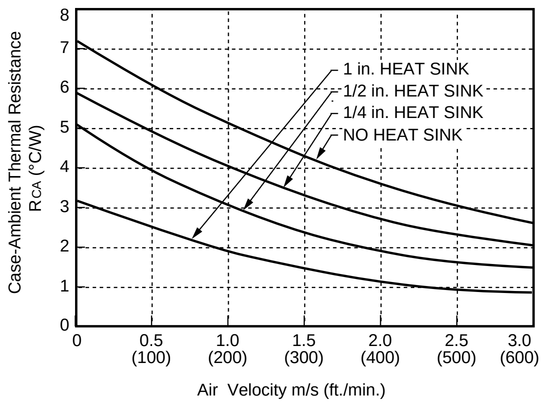



**Fig.39 Case-to-Ambient Thermal Resistance Curves; Either Orientation**

**Example 4. How to determine the allowable minimum airflow to heat sink combinations necessary for a module under a desired Tc and a certain condition?**

Although the maximum case temperature for the AEH Series converters is 100°C, you can improve module reliability by limiting Tc,max to a lower value. How to decide? For example, what is the allowable minimum airflow for AEH 100W heat sink combinations at desired Tc of 80 °C?

The working condition is as following:

$V_{in}$ = 24 V, $I_O$ = 20 A, $T_A$ = 40 °C

**Determine $P_D$ ( Fig.30. )**

$P_D$ = 15 W

**Then solve $R_{CA}$:**

$R_{CA} = \Delta T_{C,\ max} / P_D$

$R_{CA} = (T_C - T_A) / P_D$

$R_{CA} = (80 - 40) / 15 = 2.7°C/W$

**determine air velocity from figure 39:**

If no heat sink:

v = 3 m/s (600 ft./min.)

If 1/4 in. heat sink:

v = 2 m/s (400 ft./min.)

If 1/2 in. heat sink:

v = 1.4 m/s (280 ft./min.)

If 1 in. heat sink:

v = 0.5 m/s (100 ft./min.)

**Example 5. How to determine case temperature ( Tc ) for the various heat sink configurations at certain air velocity?**

What is the allowable Tc for AEH 24Vin 100W heat sink configurations at desired air velocity of 2.0 m/s, and it is operating at a 24 V line voltage, a 20 A output current, a 40 °C maximum ambient temperature?

**Determine $P_D$ ( Fig.30 )** with condition:

$V_{in}$ = 24 V

$I_O$ = 20 A

$T_A$ = 40 °C

v = 2.0 m/s (400 ft./min.)

**Get: $P_D$** = 15 W

**Determine $T_C$:** $T_C = (R_{CA} \times P_D) + T_A$

**Determine the corresponding thermal resistances ( $R_{CA}$ ) from Figure 39 :**

No heat sink: $R_{CA}$ = 3.8 °C/W

$T_C$ = (3.8 x 15) + 40 = 97 °C

1/4 in. heat sink: $R_{CA}$ = 2.8 °C/W

$T_C$ = (2.8 x 15) + 40 = 82 °C

1/2 in. heat sink: $R_{CA}$ = 2.0 °C/W

$T_C$ = (2.0 x 15) + 40 = 70 °C

1 in. heat sink: $R_{CA}$ = 1.2 °C/W

$T_C$ = (1.2 x 15) + 40 = 58 °C

In this configuration, the heat sink would not need and the power module does not exceed the maximum case temperature of 100°C.

# Mechanical Considerations

### *Installation*

Although AEH 24Vin series converters can be mounted in any orientation, free air-flowing must be taken. Normally power components are always put at the end of the airflow path or have the separate airflow paths. This can keep other system equipment cooler and increase component life spans.

***Soldering***

AEH 24Vin series converters are compatible with standard wave soldering techniques. When wave soldering, the converter pins should be preheated for 20-30 seconds at 110° C, and wave soldered at 260°C for less than 10 seconds.

When hand soldering, the iron temperature should be maintained at 425°C and applied to the converter pins for less than 5 seconds. Longer exposure can cause internal damage to the converter. Cleaning can be performed with cleaning solvent IPA or with water.

# MTBF

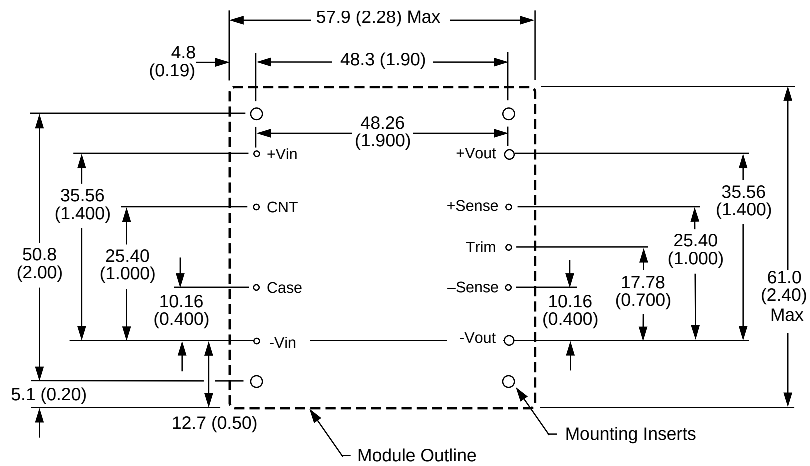
The MTBF, calculated in accordance with Bellcore TR-NWT-000332 is 1,880,000 hours. Obtaining this MTBF in practice is entirely possible. If the ambient air temperature is expected to exceed +25°C, then we also advise a heatsink on the AEH, oriented for the best possible cooling in the air stream.

ASTEC can supply replacements for converters from other manufacturers, or offer custom solutions. Please contact the factory for details.

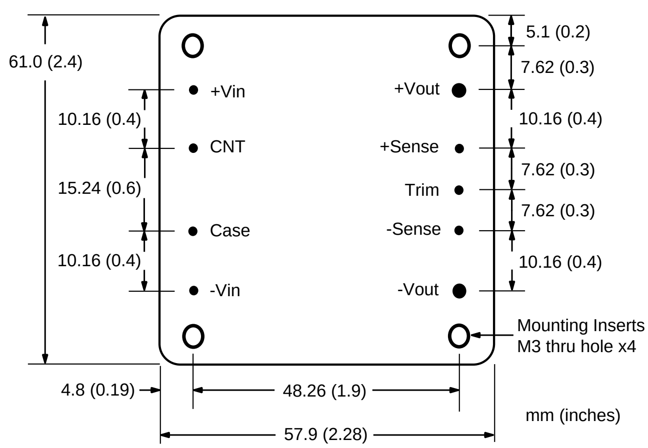
# Recommend Hole Pattern

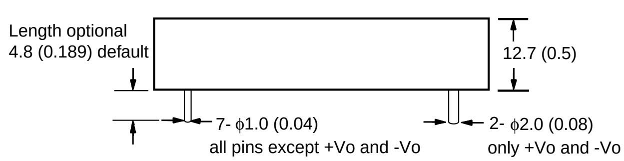
Base-plate side view

Dimensions are in millimeters and (inches).




# Mechanical chart




| Pin Length Option | Device Code Suffix |
|---|---|
| 4.80mm ± 0.5mm<br>0.189in. ± 0.020in. | none (default) |
| 3.80mm ± 0.25mm<br>0.150in. ± 0.010in. | -6 |
| 5.80mm ± 0.5mm<br>0.228in. ± 0.02in. | -7 |
| 2.80mm ± 0.25mm<br>0.110in. ± 0.010in. | -8 |

Tolerances:

| Inches | Millimeters |
|---|---|
| .xx ±0.020 | .x ±0.5 |
| .xxx ±0.010 | .xx ±0.25 |

Pins

| | |
|---|---|
| >4mm | ±0.02inch ( ±0.5mm) |
| <4mm | ±0.01inch ( ±0.25mm) |

Base-plate side view

# PART NUMBER DESCRIPTION

**ss pp c - 0 iv L - xxx f yy h n - p - mx-Options**

**iv = Input Voltage**
- 05 = Range centered on 5V
- 12 = Range centered on 12V
- 24 = 18 to 36(2:1), 9 to 36V(4:1)
- 36 = 20 to 60V
- 46 = 18V to 75V (4:1)
- 48 = Typ 36 to 75V

**c = Pinout compatability**
- A= Astec Footprint or " non Lucent" footprint
- C= Ind Std, Exact Lucent drop in

**pp = Package Type**
- 40 = 1" x 2" SMD
- 42 = 1.5" x 2" SMD
- 45 = 1.45" X 2.3" (1/4 Brk)
- 60 = 2.4" X 2.3" (1/2 Brk)
- 80 = Full size 4.6" x 2.4"
- 72= 2.35" X 3.3 (3/4 Brk)

**ss = Series**
- AA = 1/2brick Dual (Old designator)
- AK = Ind Std sizes (1/4, 1/2, full) <150W
- AM/BM = Full size, astec pin out
- AL = Half size, astec pin-out
- BK = Ind Std size =>150W or feature rich
- AV = Avansys Product

**p = Pin Length**
- Omit this digit for Standard 5mm
- 6 = 3.8mm, 7= 5.8mm
- 8 = 2.8mm

**Enable Logic Polarity**
- Omit for Positive Enable Logic
- N = Negative Enable
- Except: AK60C-20H, BK60C-30H
- Omit for Negative Logice
- P = Positive Logic

**H = High Efficiency (Synch rect.)**
- Omit H if Conventional Diode (low Eff)

**yy = Output Current**
- ie. 08 = 8 Amps

**f = # of Outputs**
- F = Single Output
- D = Dual Output

**xxx = Output Voltage**
- Format is XX.X (ie 1.8V = 018)

**mx = Options**
- M1,M2 = .25" Height Heatsink
- M3,M4 = .5" height Heatsink
- M5.M6 = 1.0" Height Heatsink

Note: For some products, they may not conform with the PART NUMBER DESCRIPTION above absolutely.

# NEW PART NUMBER DESCRIPTION

| A | c | s | ii | $V_1 V_2 V_3$ | $V_{in}$ | - | e | t | p | Mx |
|---|---|---|---|---|---|---|---|---|---|---|

**Output Voltage**

| | |
|---|---|
| A = 5.0V | E = 7.5V |
| F = 3.3V | B = 12V, C = 15V |
| G = 2.5V | L = 8V, H = 24V, R = 28V |
| D = 2.0V / 2.1V | Omit V2 and V3 if Single Output |
| Y = 1.8V | Omit V3 if Dual Output |
| M = 1.5V | **ie for Dual Output 5 and 3.3V** |
| K = 1.2V | **V1 =A, V2 = F, V3 =Omit** |
| J = 0.9V | **V1 =A, V2 = F, V3 =Omit** |

**ii = Output Current Max**
ie 60 = 60 Amps

**S = Size**
F = Full Brick
H = Half Brick
Q = Quarter Brick
S = 1 X 2 18 Pin SMT
E = 1 X 2 Thru Hole
C = (.53X1.3X.33) SMT (Austin Lite drop in)
V = Conventional Package (2X2.56" ) or (
A = SIP
W = Convent pkg (Wide 2.5X3)
R = 1 X 1 Thru Hole
A = SIP
T = 1.6 X 2

**c = Construction**
E = Enhanced Thermals (Baseplate or adapter plate)
I = Integrated (Full Featured) Hong Kong models
L = Low Profile (Open Frame, No case - Isolated)
P = Open Frame (SIP or SMT) non-isolated

**Vin = Input Voltage range**
300 = 250V to 450V
48 = 36V to 75V
24 = 18V to 36V
03 = 1.8V to 5.0V
08 = 5.0V to 13.0V
PFC: Power Factor Corrected

**E = Enable Logic for > 15W**
Omit this digit for Positive enable
N = Negative Logic

**E = Enable Logic for < 15W**
Omit this digit for no enable option
1 = Negative Logic
4 = Positive Logic

**Trim for 1W to 15W**
9 = Trim Added

**P = Pin Length**
Omit this digit for Standard 5mm
6 = 3.8mm
8 = 2.8mm
7 = 5.8 mm

**Mx - Factory Options**
customer Specific

Note: For some products, they may not conform with the NEW PART NUMBER DESCRIPTION above absolutely.