AEE-10W 24V&48V Input Series

Technical Reference Notes

±5V, ±12V, ±15V Dual Output

10W DC-DC Converter

(Rev01)

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Publishing Date: 20020628

Introduction

The AEE-10W dual output series of switching DC-DC converters is one of the most cost effective options available in component power. The series uses an industry standard package size and pinout configuration, but has a lower profile than most competitive products. This allows users the additional headroom often needed in card cage configurations, or can be used to improve airflow and cooling efficiency.

AEE-10W dual output converters come in 24V or 48V input versions, each of which uses a 2:1 input range. Outputs are isolated from the input and single or dual output versions are available. Dual output AEE-10W converters are capable of providing up to 10 watts of output power. In the case of dual output converters, power can be divided equally or unequally between the two outputs. This allows much greater flexibility and is an advantage for independently varying loads.

At startup, input current passes through an input filter designed to help meet CISPR 22 level A radiated emissions, and Bellcore GR1089 conducted emissions. A fuse should be used in line with the input to the module.

The AEE-10W converters are pulse width modulated (PWM) and operate at a nominal fixed frequency of 330 kHz. Feedback to the PWM controller uses an opto-isolator, maintaining complete isolation between primary and secondary. Dual outputs are tied together with a central common. Caution should be taken to avoid ground loops when connecting the converter to ground.

Design Features

- 2” X 1” package
- High efficiency
- High power density
- 10 watts of output power
- 2:1 wide input of 18-36V and 36-72V
- Output short circuit protection
- Output current limiting
- Wide operating case temperature range:
  -25°C~ +95°C

Application

- DATACOM equipment
- Computer equipment
- Distributed power architecture
- Communications equipment

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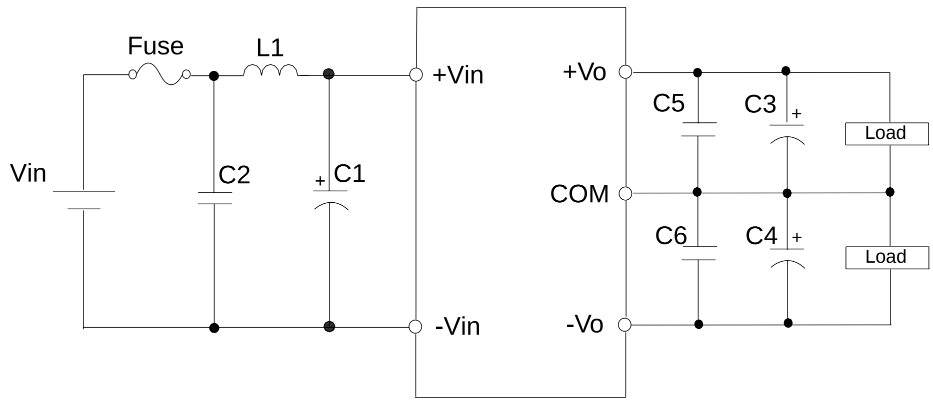
Typical Application



Note: There is 3% minimum load requirement for AEE-10W dual outputs series.

Recommended Fuse: 2A for 24Vin, 1A for 48Vin

L1: 10-12µH

C1: ≥ 47µF/100V electrolytic capacitor

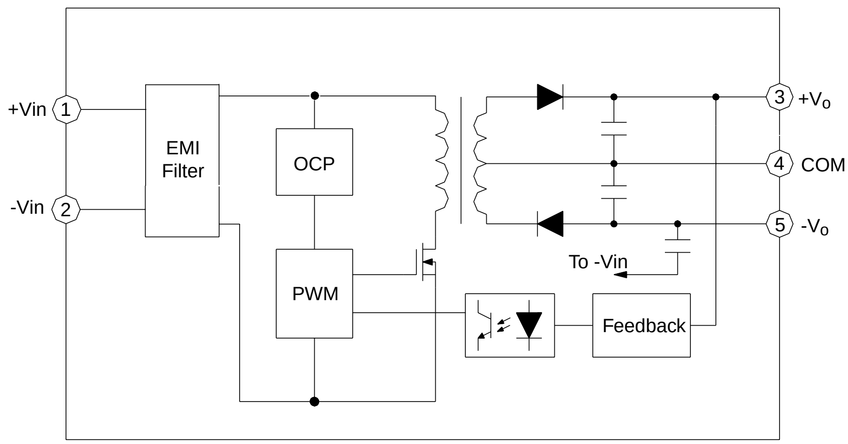
C2: 1µF/100V metal film or ceramic high frequency capacitor

(The detailed information about C1 and C2 can refer to the paragraph " Input Filter " on page 14.)

C3 and C4 can refer to the specification list on page 4.

C5 and C6 : 1µF ceramic capacitor

Block Diagram



Ordering Information

Model Number	Input Voltage (V)	Output Voltage (V)	Output Current(A) Min	Output Current(A) Max	Ripple (mV rms) Typ	Noise (mV pp) Typ	Efficiency typ (%)	Output Capacitor (µF)
AEE01AA24	24	±5	0.1	1.0	10	60	79	100
AEE00BB24	24	±12	0.04	0.42	10	90	83	100
AEE00CC24	24	±15	0.03	0.33	10	90	83	47
AEE01AA48	48	±5	0.1	1.0	10	60	79	100
AEE00BB48	48	±12	0.02	0.25	5	20	85	150
AEE00CC48	48	±15	0.03	0.33	10	90	83	47

Absolute Maximum Rating

Characteristic	Min	Typ	Max	Units	Notes
Input Voltage(continuous)			40	Vdc	For 24Vin
			80	Vdc	For 48Vin
Input Voltage(peak/surge)			50	Vdc	For 24Vin, 100ms non-repetitive
			100	Vdc	For 48Vin, 100ms non-repetitive
Case temperature	-25		95	°C	
storage temperature	-40		105	°C	

Input Characteristics

Characteristic	Min	Typ	Max	Units	Notes
Input Voltage Range	18	24	36	Vdc	For 24Vin
	36	48	72	Vdc	For 48Vin
Input Reflected Current			10	%Iin	
Turn-off Input Voltage		——		Vdc	
Turn-on Input Voltage		——		Vdc	
Turn On Time		250		ms	

General Specifications

Characteristic	Min	Typ	Max	Units	Notes
MTBF		2700		k Hrs	Bellcore TR332, Tcase=30°C
Isolation	500			Vdc	
Pin solder temperature			260	°C	wave solder < 10 s
Hand Soldering Time			5	s	iron temperature 425°C
Weight		24		grams	

AEE-01AA24/AEE01AA48 Output Characteristics

Characteristic	Min	Typ	Max	Units	Notes
Power		10		W	
Output Current		±1		A	
Output Setpoint Voltage	±4.95	±5	±5.05	Vdc	Vin=24/48V, Io=±1A
Line Regulation			0.2	%Vo	Vin=18~36V/36~72V, Io=±1A
Load Regulation			0.5	%Vo	Io=0~±1A, Vin=24/48V
Dynamic Response					
50-75% load			100	mV	Ta=25°C, DI/Dt=1A/10µs
			200	µs	Ta=25°C, DI/Dt=1A/10µs
50-25% load			100	mV	Ta=25°C, DI/Dt=1A/10µs
			200	µs	Ta=25°C, DI/Dt=1A/10µs
Current Limit Threshold	±1.1		±1.5	A	
Short Circuit Current	——		——	A	
Efficiency	77	79		%	Vin=24/48V, Io=±1A, Ta=25°C
Trim Range	——		——	%Vo	
Over Voltage Protection Setpoint	——		——	V	
Temperature Regulation			0.02	%Vo/°C	
Ripple (rms)		10		mV	(0 to 20MHz Bandwidth)
Noise (p-p)		30		mV	(0 to 20MHz Bandwidth)
Switching Frequency		330		kHz	

AEE-00BB24/AEE00BB48 Output Characteristics

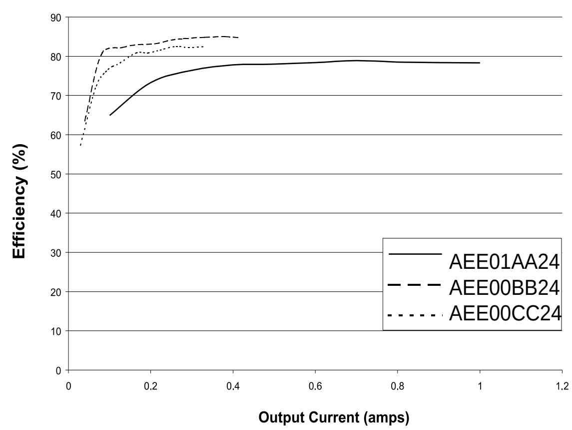
Characteristic	Min	Typ	Max	Units	Notes
Power		10		W	
Output Current		±0.42		A	
Output Setpoint Voltage	±11.88	±12	±12.12	Vdc	Vin=24/48V, Io=±0.42A
Line Regulation			0.2	%Vo	Vin=18~36/36~48V, Io=±0.42A
Load Regulation			0.5	%Vo	Io=0~±0.42A, Vin=24/48V
Dynamic Response					
50-75% load			100	mV	Ta=25°C, DI/Dt=1A/10µs
			200	µs	Ta=25°C, DI/Dt=1A/10µs
50-25% load			100	mV	Ta=25°C, DI/Dt=1A/10µs
			200	µs	Ta=25°C, DI/Dt=1A/10µs
Current Limit Threshold	±0.46		±0.63	A	
Short Circuit Current	—		—	A	
Efficiency	81/81	83/85		%	Vin=24/48V,Io=±0.42A,Ta=25°C
Trim Range	—		—	%Vo	
Over Voltage Protection Setpoint	—		—	V	
Temperature Regulation			0.02	%Vo/°C	
Ripple (rms)		5		mV	(0 to 20MHz Bandwidth)
Noise (pp)		30		mV	(0 to 20MHz Bandwidth)
Switching Frequency		330		kHz	

AEE-00CC24/AEE-00CC48 Output Characteristics

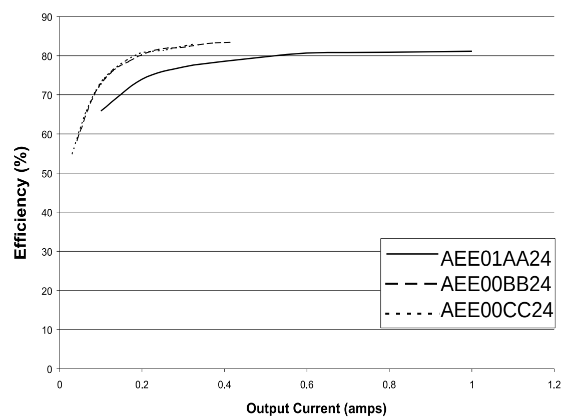
Characteristic	Min	Typ	Max	Units	Notes
Power		10		W	
Output Current		±0.33		A	
Output Setpoint Voltage	±14.85	±15	±15.15	Vdc	Vin=24/48V, Io=±0.33A
Line Regulation			0.2	%Vo	Vin=18~36/36~72V, Io=±0.33A
Load Regulation			0.5	%Vo	Io=0~±0.33A, Vin=24/48V
Dynamic Response					
50-75% load			100	mV	Ta=25°C, DI/Dt=1A/10µs
			200	µs	Ta=25°C, DI/Dt=1A/10µs
50-25% load			100	mV	Ta=25°C, DI/Dt=1A/10µs
			200	µs	Ta=25°C, DI/Dt=1A/10µs
Current Limit Threshold				A	
Short Circuit Current	———		———	A	
Efficiency	81	83		%	Vin=24/48V, Io=±0.33A,Ta=25°C
Trim Range	———		———	%Vo	
Over Voltage Protection Setpoint	———		———	V	
Temperature Regulation			0.02	%Vo/°C	
Ripple (rms)		10		mV	(0 to 20MHz Bandwidth)
Noise (pp)		30		mV	(0 to 20MHz Bandwidth)
Switching Frequency		330		kHz	

Characteristic Curves

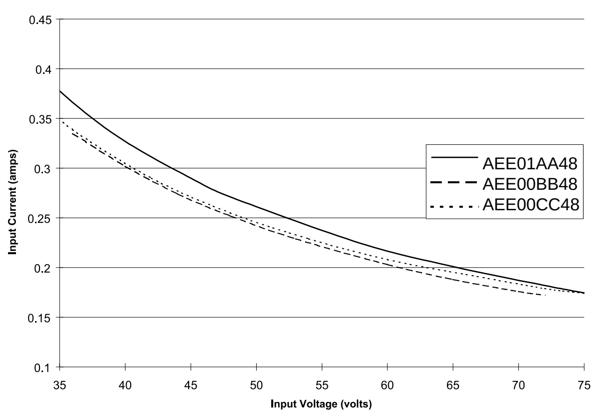
Typical Efficiency Curves
AEE-10W 24Vin, Dual Outputs series



Typical Efficiency Curves
AEE-10W 48Vin, Dual Outputs series



Typical Input Current
AEE-10W 48Vin, Dual Outputs series



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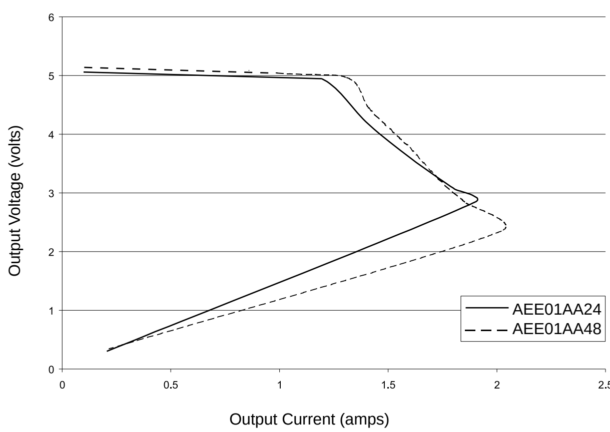
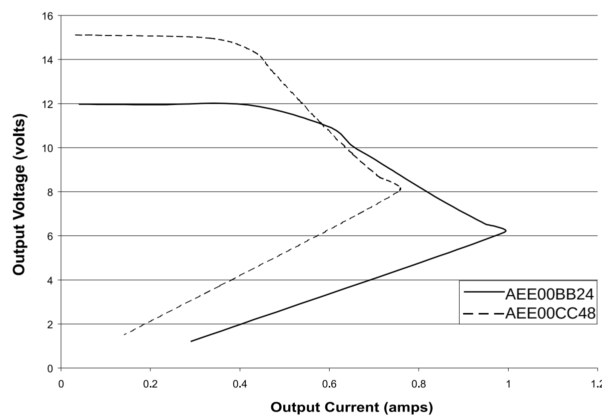
Characteristic Curves

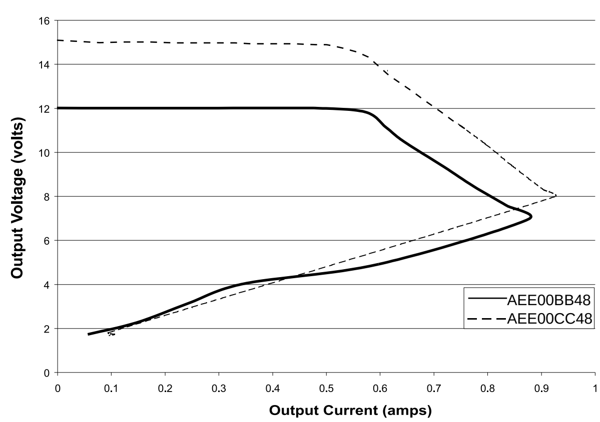
Typical Overcurrent Curves
AEE-10W ±5Vout Series



Typical Overcurrent Curves
AEE-10W ±12&±15Vout Series, 24Vin



Typical Overcurrent Curves
AEE-10W ±12&±15Vout Series, 48Vin



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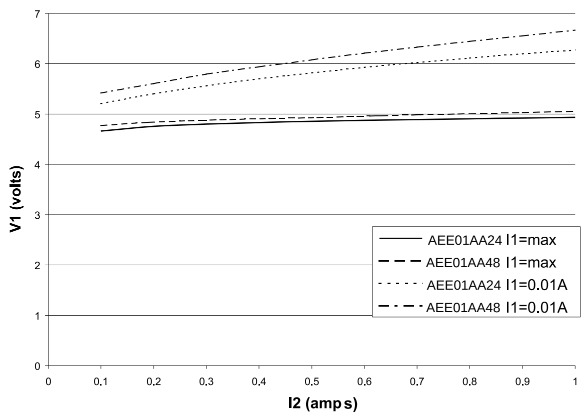
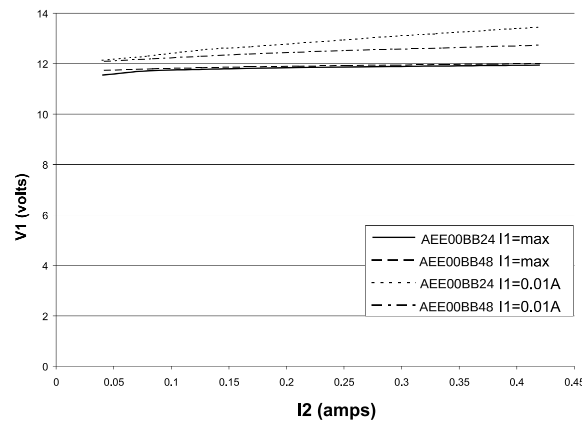
Transient response *(rated input voltage, step load, at 25 °C)*

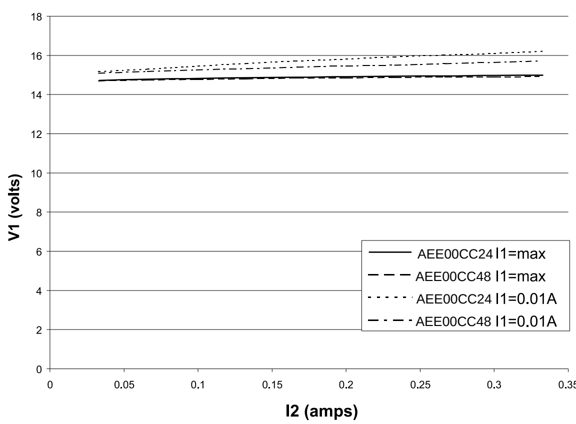
Typical Cross Regulation
AEE-10W Series ±5V Outputs



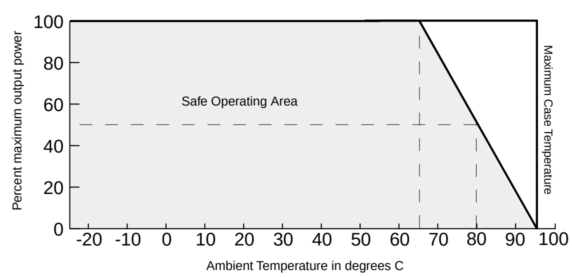
Typical Cross Regulation
AEE-10W Series ±12V Outputs



Typical Cross Regulation
AEE-10W Series ±15V Outputs

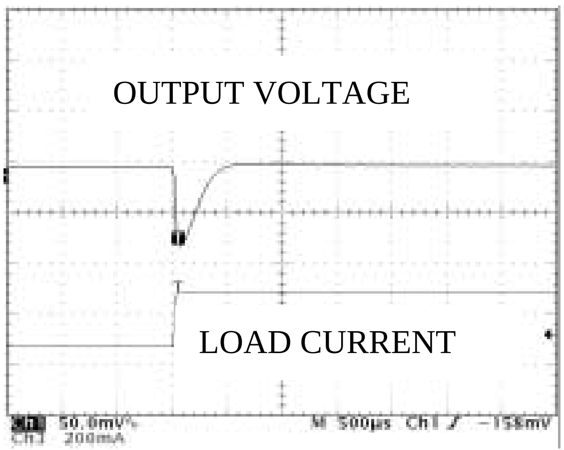


Derating Curves
AEE-10W Dual Outputs
24Vin & 48Vin series

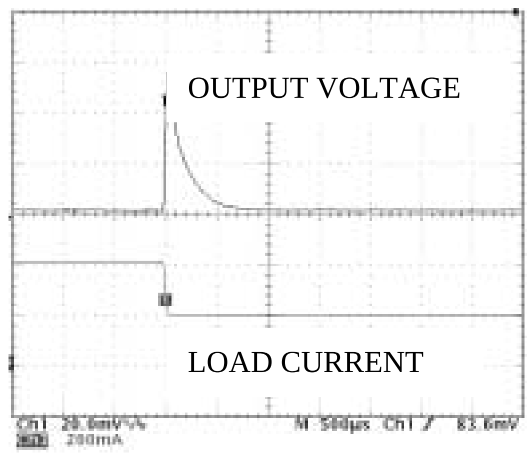


Transient response *(rated input voltage, step load, at 25 °C)*

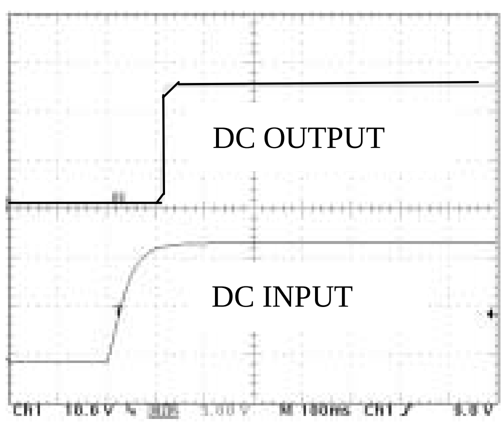
Typical Transient Response to Step Load Change from 50%-75%Iomax



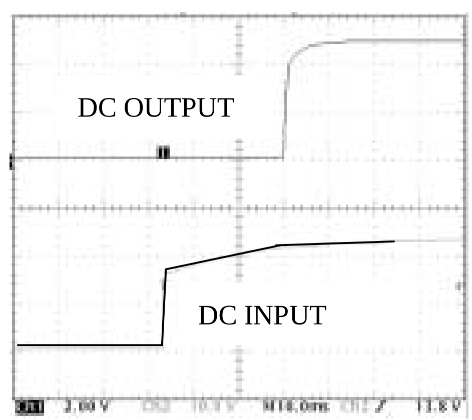
Typical Transient Response to Step Load Change from 50%-25%Iomax



Typical Output Startup From Power On AEE00BB24



Typical Output Startup From Power On AEE01AA24



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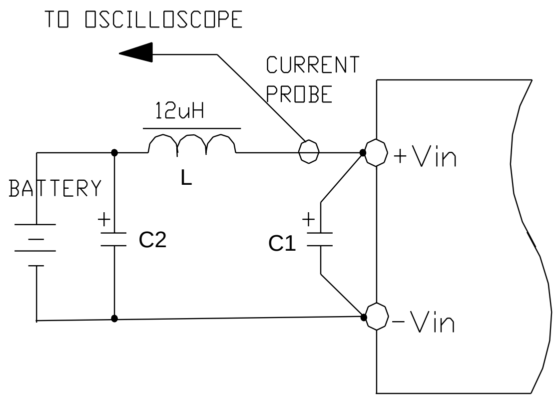
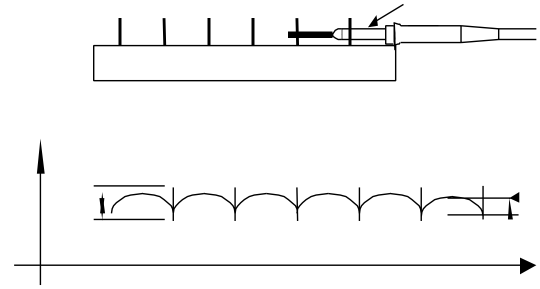
Characteristics

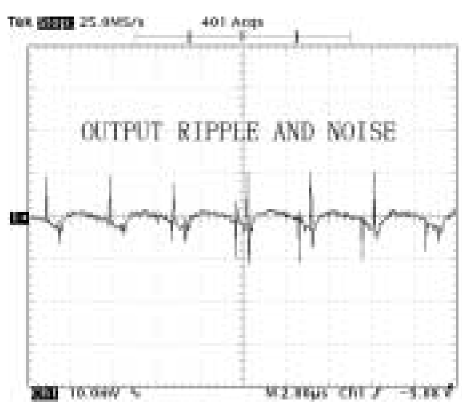
Measurement of reflected noise current (with an simulated source impedance of 12 µH, and current is detected at the input of the module)



Measurement of Output Ripple (p-p)



Typical Output Ripple and Noise
AEE-10W Dual Outputs
24Vin & 48Vin series



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Pin Location

The +Vin and -Vin input connection pins are located as shown in Figure 1. AEE-10W dual output converters have a 2:1 input voltage range of 18-36V or 36-72V.

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

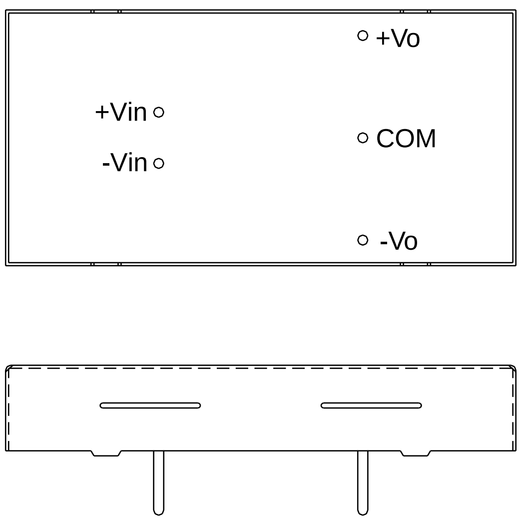

Fig.1 Pin Location (Bottom View)

Input Characteristic

Fusing

The AEE-10W dual output series power module has 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 AEE-10W dual output series are shown in Table1.

Table 1

Series	Fuse Rating
24Vin	2A
48Vin	1A

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 rated for 2A/100V.

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.

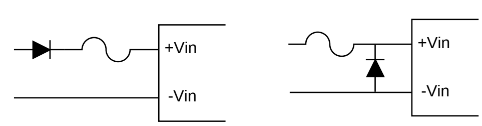

Fig.2 Reverse Polarity Protection Circuits

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 AEE-10W series has an internal switching frequency of 330 kHz 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

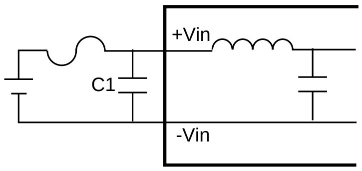

Fig.3 Ripple Rejection Input Filter

shown in Figure 3, forming a π filter. A 47µF/100V electrolytic capacitor is recommended for C1.

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 is a 12 µH differential inductor, C1 is a 47µF/100V electrolytic capacitor, and C2 is a 1µF/100V metal film or ceramic high frequency capacitor. When a filter inductor L1 is connected in series with the power converter input, an input capacitor C2 should be added. An input capacitor C2 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.

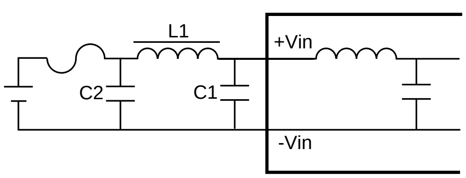

Fig.4 EMI Reduction Input Filter

Input-Output Characteristic

Isolation

The isolation voltage between input to output, input to case and case to output are all greater than 500 Volt DC. If the system using the power module needs to meet safety agency approval, certain rules must be followed in the design of the system using the module. In particular, all of the creepage and clearance requirements of the end-use safety requirement must be observed. These documents include EN60950, UL-1950, and CSA 22.2-960. Also specific applications need to receive other or additional requirements.

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 500VDC 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 60Vdc 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.

Output Characteristics

Minimum Load Requirements

There is **3%** minimum load required for the AEE-10W dual outputs series modules.

Output Connections (+Vout, -Vout, COM)

Outputs on the AEE-10W series are isolated from the input and can therefore be left to float or can be grounded. Both outputs of dual outputs versions are tied to the common pin. Pin connections for +Vout, -Vout, and COM are shown in the mechanical chart at the end of this manual.

Sharing Power Between Dual Outputs

Each output of a dual outputs AEE-10W series is limited to one half of the total power capacity of the converter. For example, if the positive output of an AEE01AA48 only draws 0.5A (2.5W), the negative output will still be limited to 1A (5W). Voltage regulation performance is best when the outputs are balanced. Figure 5 shows typical cross regulation for a 15 volt output.

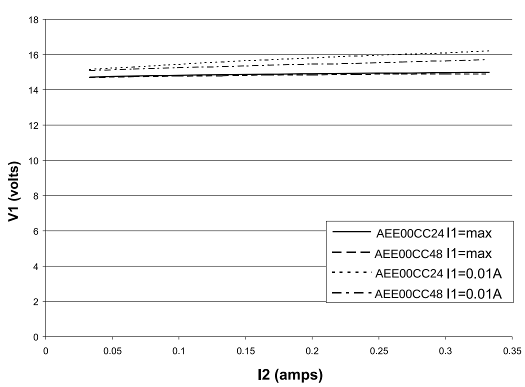

Fig.5 Dual Outputs Cross Regulation

Overcurrent Protection (OCP)

AEE-10W series dual outputs DC/DC converters feature foldback current limiting as part of their Overcurrent Protection (OCP) circuits. When output current exceeds 110 to 150% of rated current, such as during a short circuit condition, the output will shutdown. When the overcurrent condition is removed, the converter will automatically restart.

Note: If input voltage exceeds 60V, the continuous shortcircuit may damage the module or decrease Its life.

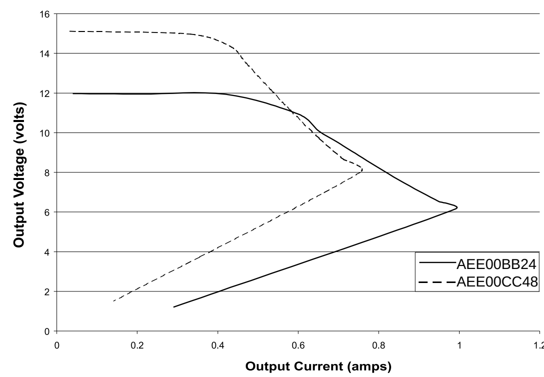

Fig.6 Overcurrent Foldback

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 7. The recommended value for the output capacitor C3 and C4 can refer to the specialization list on the page 20.

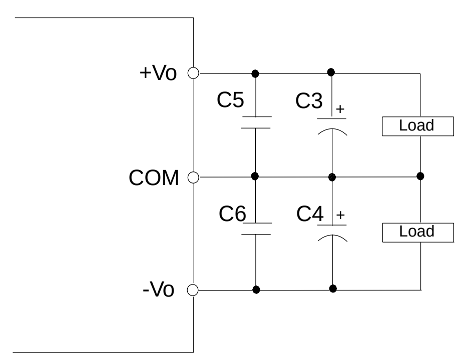

Fig.7 Output Ripple Filter

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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 the capacitor C5 and C6 can be added across the load as shown in Figure 7. The recommended component for C5 and C6 is 1µF ceramic capacitor.

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.

Design Considerations

Ground Loops

Ground loops occur when different circuits are given multiple paths to common or earth ground, as shown in Figure 8. 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 9.

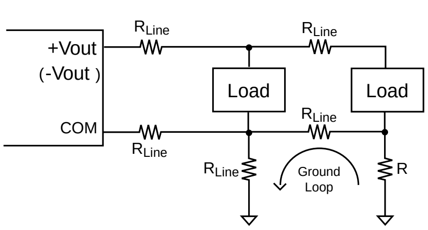

Fig.8 Ground Loops

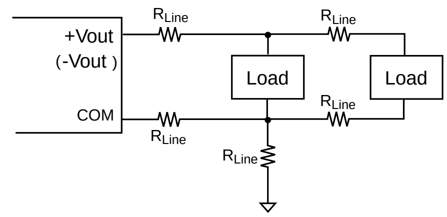

Fig.9 Single Point Ground

Parallel Power Distribution

Figure 10 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.

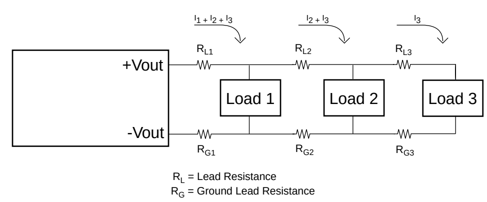

Fig.10 Parallel Power Distribution

Radial Power Distribution

Radial power distribution is the preferred method of providing power to the load. Figure 11 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.

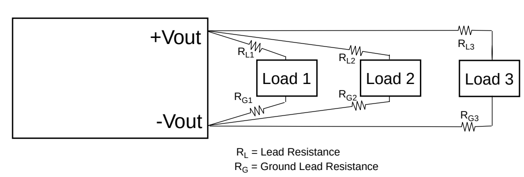

Fig.11 Radial Power Distribution

	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

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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.

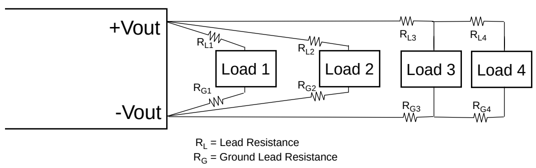


Fig.12 Mixed Power Distribution

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 13 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.

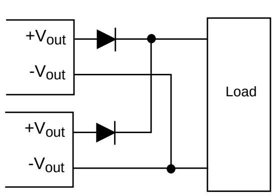


Fig.13 Redundant Operation

Module Derating

Thermal Derating

AEE-10W single and dual outputs converters are rated for full power up to a case temperature of 95°C. Under typical conditions this equates to an ambient temperature of 65°C. For operation above ambient air temperatures of 65°C, output power must be derated as shown in Figure 14, or airflow over the converter must be provided. When airflow is provided, the case temperature of the converter should be used to determine maximum temperature limits. The minimum operating temperature for the AEE-10W series is -25°C. Operation at temperatures as low as -40°C is possible, but output performance below -25°C is not specified.

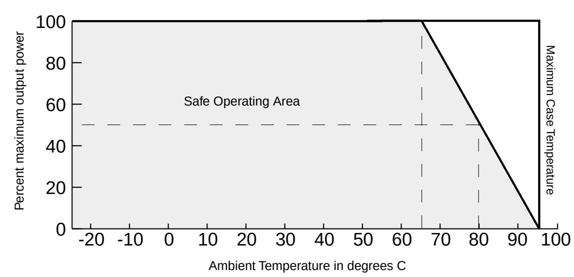


Fig.14 Derating Curves

Mechanical Considerations

Installation

Although AEE-10W dual outputs 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

AEE-10W dual outputs 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.

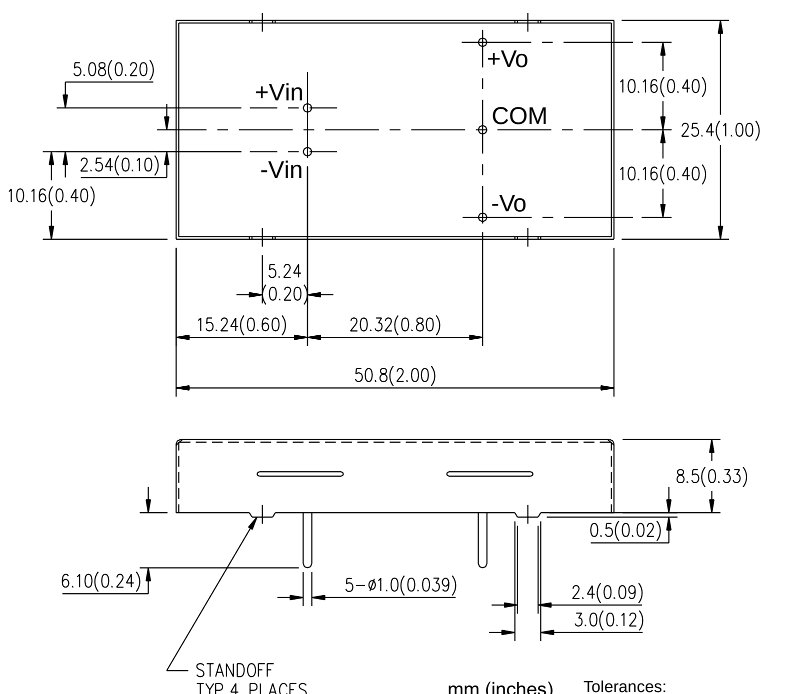
When hand soldering, the iron temperature should be maintained at 425°C and applied to the converter pins for less than 5 seconds. Longer exposure can cause internal damage to the converter. Cleaning can be performed with cleaning solvent IPA or with water.

MTBF

The MTBF, calculated in accordance with Bellcore TR-NWT-000332 is 2,700,000 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 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.

Mechanical Chart *(Pin side view)*



mm (inches)

Tolerances:

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

	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

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PART NUMBER DESCRIPTION

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

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

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

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

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

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

yy = Output Current
ie. 08 = 8 Amps

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)

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

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

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

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.