AEE Low Power High Efficiency

Technical Reference Notes

48V Input, ±12V Dual Output

15W DC-DC Converter

(Rev01)

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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: 20020605

Introduction

The AEE-Dual 15W series of switching DC-DC converters is one of the most cost effective options available in component power. The AEE-Dual 15W series uses an industry standard package size and pinout configuration.

AEE-Dual 15W dual output converter comes in 48V input versions, which uses a 2:1 input range. Outputs are isolated from input and the converters are capable of providing up to 15 watts of output power.

At start up, input current passes through an input filter designed to help meet CISPR 22 level A radiated emissions, and Bellcore GR1089 conducted emissions. A fault clearing device such as a fuse should be used in line with the input to the module.

The AEE-Dual 15W converters are pulse width modulated (PWM) and operate at a nominal fixed frequency of 250kHz. Feedback to the PWM controller uses an opto-isolator, maintaining complete isolation between primary and secondary. Caution should be taken to avoid ground loops when connecting the converters to ground.

Design Features

- 2” X 1” package
- High efficiency
- High power density
- 15 watts of output power
- 2:1 wide input of 36-75V
- CNT function
- Input under-voltage lockout
- Output short circuit protection
- Output current limiting
- Output over-voltage protection
- High input-output isolation voltage
- Wide operating case temperature range: -40°C~ +100°C

Options

- Choice of CNT function
- Choice of positive logic or negative logic for CNT function
- Choice of short pins or long pins

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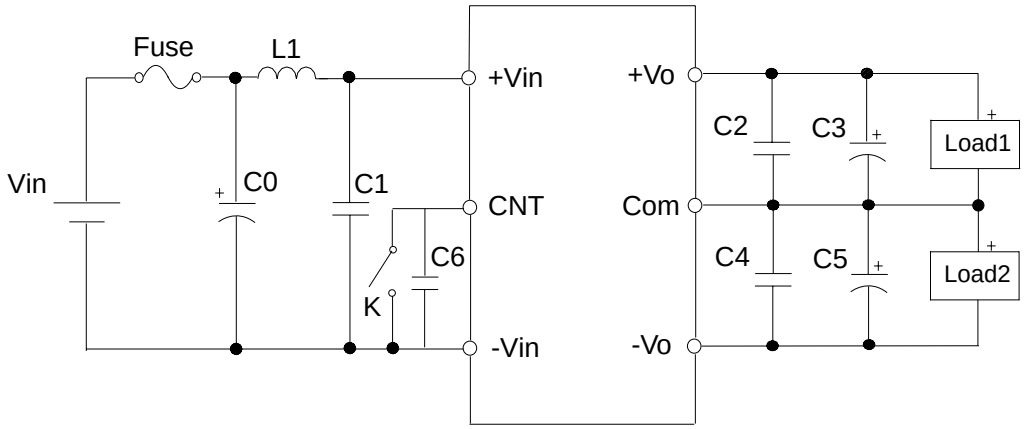
Typical Application



Fuse: 1A

C0 Recommended:

48Vin--220µF/100V electrolytic or ceramic type capacitor

C1 Recommended:

≥ 47µF/100V capacitor

C3,C5 Recommended:

100µF/25V electrolytic or ceramic type capacitor

C2,C4 Recommended:

0.1µF/50V capacitor

C6 Recommended:

1000pF capacitor

L1 Recommended:

10--12µH

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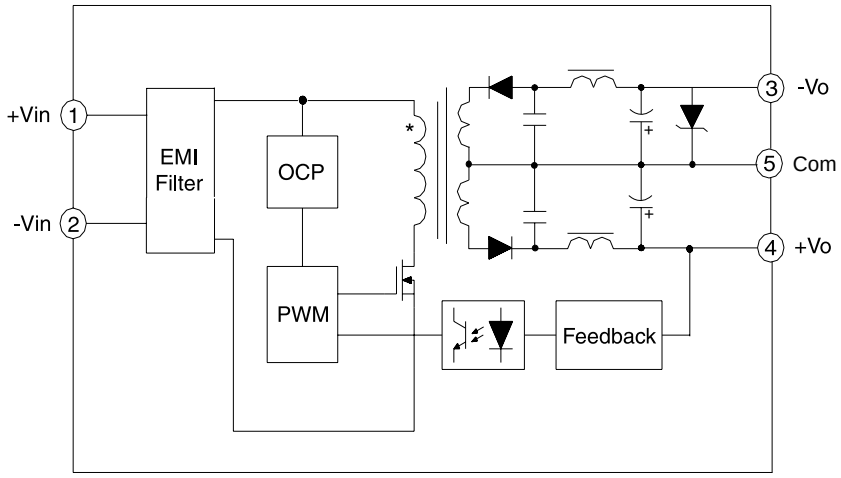
Block Diagram



Ordering Information

Model Number	Input Voltage	Output Voltage	Output Current	Ripple (mV rms) typ	Noise (mV pp) typ	Efficiency typ	Input Current (A)
AEE01BB48-7	36-75V	±12V	±0.62A	15	60	86%	0.5

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Absolute Maximum Rating

Characteristic	Min	Typ	Max	Units	Notes
Input Voltage(continuous)	-0.3		80	Vdc	
Input Voltage(peak/surge)	-0.3		100	Vdc	100ms non-repetitive
Case temperature	-40		100	°C	
storage temperature	-55		125	°C	

Input Characteristics

Characteristic	Min	Typ	Max	Units	Notes
Input Voltage Range	36	48	75	Vdc	
Input Reflected Current		5	10	mAp-p	With external input filter circuit
Turn-off Input Voltage	30	33	35	Vdc	
Turn-on Input Voltage	31	34	36	Vdc	
Turn On Time		5	20	ms	

CNT Function

Characteristic	Min	Typ	Max	Units	Notes
Logic High	3		10	Vdc	
Logic Low	0		1.2	Vdc	
Control Current	-0.8		1.5	mA	-0.8mA: -0.7V, 1.5mA: 10V

General Specifications

Characteristic	Min	Typ	Max	Units	Notes
MTBF		2,000		k Hrs	Bellcore TR332, Ta=25°C, Io=Iomax
Isolation	1500			Vdc	
Pin solder temperature			260	°C	wave solder < 10 s
Hand Soldering Time			5	s	iron temperature 425°C
Weight		30		grams	

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ASTEC

AEE01BB48-7 Output Characteristics

Characteristic	Min	Typ	Max	Units	Notes
Power		15		W	
Output Current	±0.06	±0.62		A	
Output Setpoint Voltage	+11.88	+12	+12.12	Vdc	
(rated input and output)	-11.4	-12	-12.6	Vdc	
Line Regulation +12Vo		2	24	mV	Vin=36~75V, Io=±0.62A
-12Vo		5	240	mV	Vin=36~75V, Io=±0.62A
Load Regulation +12Vo		10	60	mV	Io=±0.06~±0.62A, Vin=48V
-12Vo		500	1200	mV	Io=±0.06~±0.62A, Vin=48V
Dynamic Response*					
50-75% load		0.5	5	%Vo	Ta=25°C, di/dt=1A/50µs
		100	200	µs	Ta=25°C, di/dt=1A/50µs
50-25% load		0.5	5	%Vo	Ta=25°C, di/dt=1A/50µs
		100	200	µs	Ta=25°C, di/dt=1A/50µs
Current Limit Threshold**	0.7	0.9	1.0	A	
Short Circuit Current		1.5		A	
Efficiency	84	86		%	Vin=48V, Io=±0.62A, Ta=25°C
Over Voltage Protection Setpoint***	13.8		15	V	
Temperature Regulation			0.02	%Vo/°C	
Ripple (rms)****		15		mV	(0 to 20MHz Bandwidth)
Noise (pp)*****		60		mV	(0 to 20MHz Bandwidth)
Switching Frequency		250		kHz	

*: +12Vout connects with variable load, -12V connects with stable load, oscillograph connects between +Vo and COM.

**: Load connects between +Vo and -Vo.

***: Just for +12Vout protection.

****: The scope connects between +Vo and COM or -Vo and COM during the measurement.

*****: The scope connects between +Vo and COM or -Vo and COM during the measurement.

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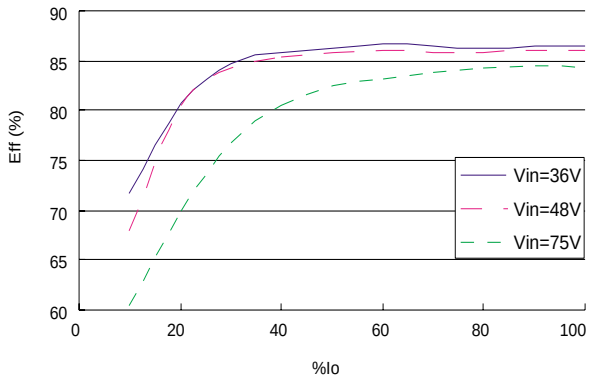
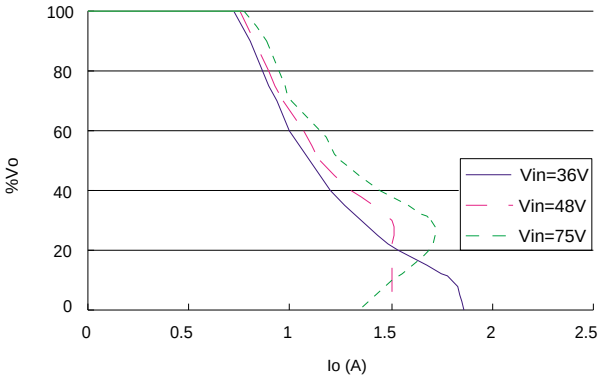
Characteristic Curves *(at 25 °C)*

Typical Efficiency AEE01BB48-7
(banlanced loads)



Typical Output Overcurrent Characteristics
AEE01BB48-7
(banlanced loads)



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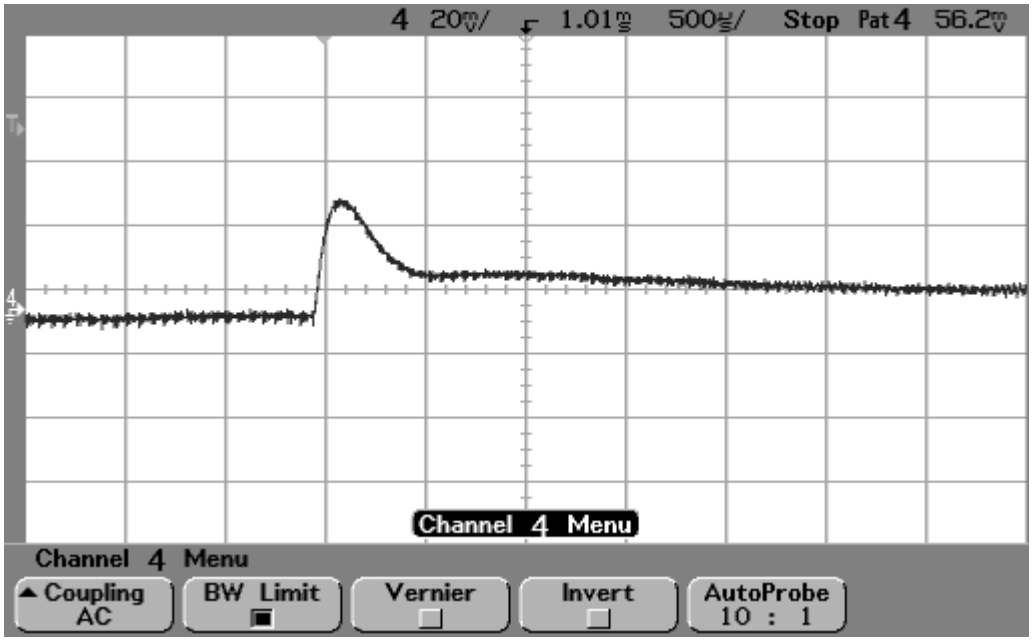
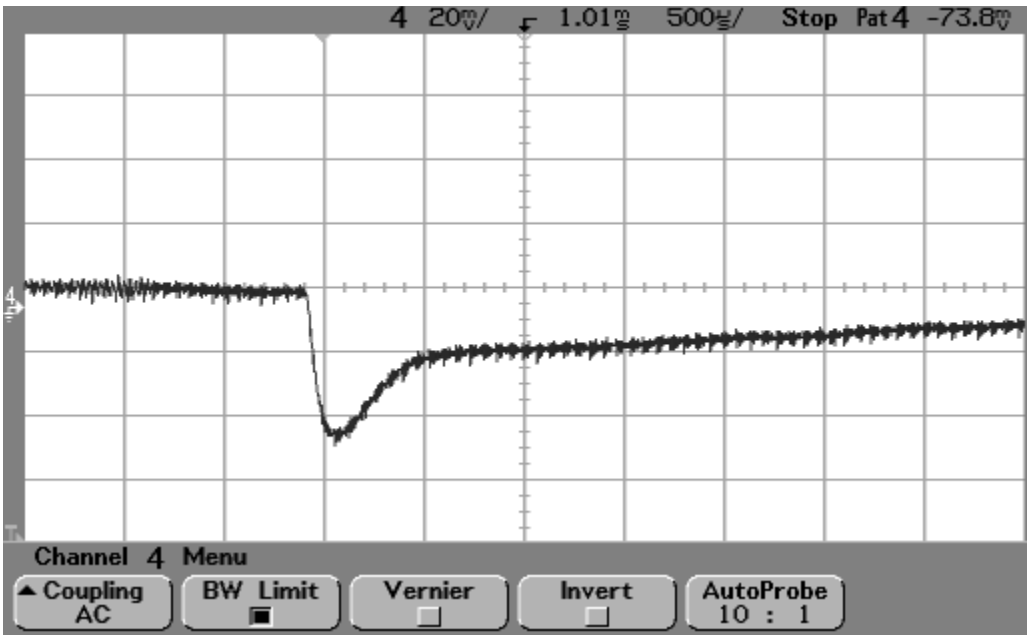
Transient response *(rated input voltage, step load, at 25 °C)*

Typical Transient Response to Step Load Change from 50%-25%Iomax
AEE01BB48-7



Typical Transient Response to Step Load Change from 50%-75%Iomax
AEE01BB48-7



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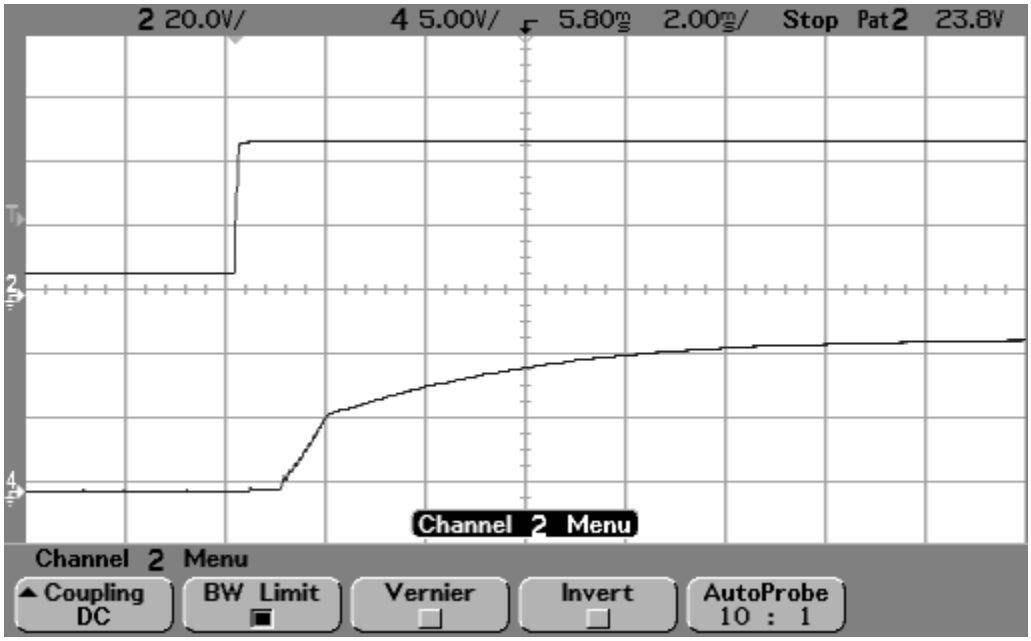
Transient response *(rated input voltage, step load, at 25 °C)*

Typical Start-Up from Power On
AEE01BB48-7

Chanel 2: Vin

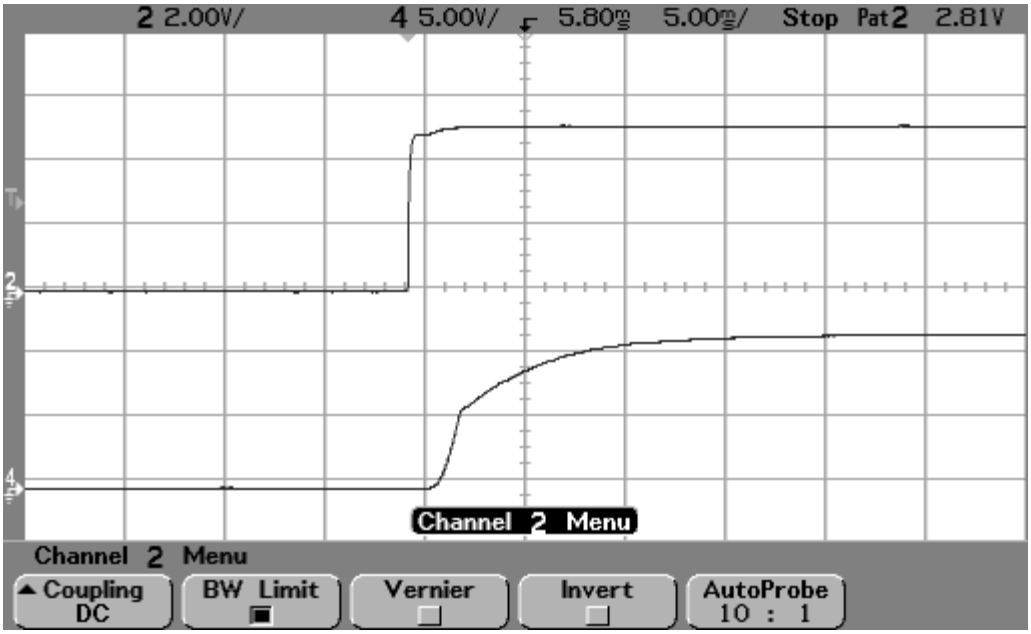
Chanel 4: Vout



Typical Start-Up from CNT Control
AEE01BB48-7

Chanel 2: Von/off

Chanel 4: Vout



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Pins

The +Vin and -Vin input connection pins are located as shown in Figure 1. AEE-Dual 15W dual output series converters have a 2:1 input voltage range of 36-75V.

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

pin side view

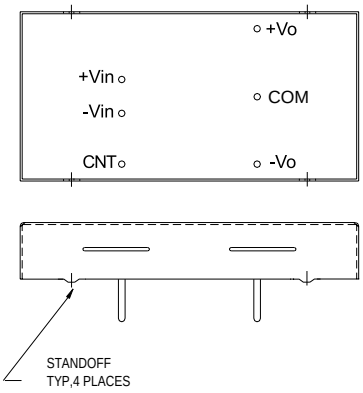

Fig.1 Pin Location

Input Characteristic

Fusing

The AEE-Dual 15W dual output 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 rating for the AEE-Dual 15W dual output series is shown in Table 1.

Table 1

Series	Fuse Rating
AEE01BB48-7	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 determined by the power of the converter. Diodes should be rated at 1A.

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.

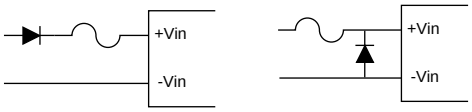

Fig.2 Reverse Polarity Protection Circuits

Input Undervoltage Protection

The AEE-Dual 15W dual output 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.

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Input Filter

Input filters are included in the converters to help achieve standard system emissions certifications. Some users may find that additional input filtering is necessary. The AEE-Dual 15W series has an internal switching frequency of 250kHz, so a high frequency capacitor mounted close to the input terminals produces the best results. To reduce reflected noise, a π filter can be added to the input as shown in Fig.3. The parameters are referred to page 3.

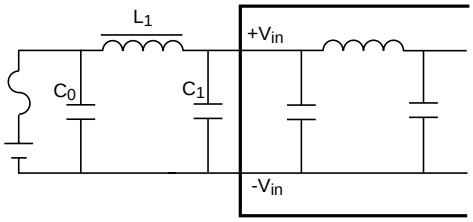

Fig.3 Ripple Rejection Input Filter

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 is a 5mH common mode choke.

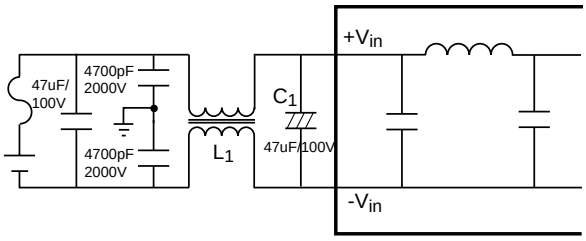

Fig.4 EMI Reduction Input Filter

When a filter inductor is connected in series with the power converter input, an input capacitor C_1 should be added. An input capacitor C_1 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 Control

Two CNT logic options are available. The CNT logic, CNT voltage and the module working state is as the following Table 2.

Table 2

	L	H	Open
N	*ON*	*OFF*	*OFF*
P	*OFF*	*ON*	*ON*

N--- means "Negative Logic"
P--- means "Positive Logic"
L--- means "Low Voltage", -0.7V ≤ L ≤ 1.2V
H--- means "High Voltage", 3V ≤ H ≤ 10V
ON--- means "module is on"
OFF--- means "module is off"
Open--- means " CNT pin is left open "
Note: The V_{CNT} ≤ 10V

The following figure 5 to 8 are a few simple CNT control circuits.

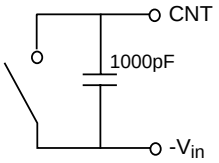

Fig.5 Simple Control

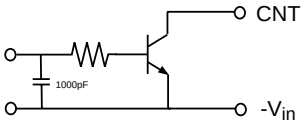

Fig.6 Transistor Control

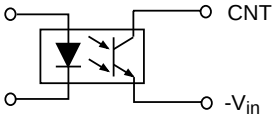

Fig.7 Isolated Control

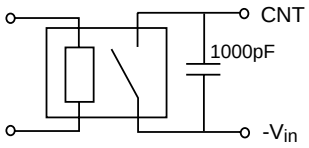

Fig.8 Relay Control

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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 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 Vinput pin and one Voutput 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 0.06A minimum load requirement for the AEE01BB48-7.

Output Over-Current Protection: (two banlanced load)

AEE-Dual 15W series DC/DC converters feature foldback current limiting as part of their Overcurrent Protection (OCP) circuits. When output current exceeds 110 to 160% of rated current, such as during a short circuit condition, the module will work on intermittent mode, also 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 C1 and C2 across the output as shown in Figure 9. The recommended value for the output capacitor C1 and C2 is 100μF/16V.

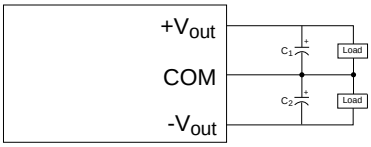

Fig.9 Output Ripple Filter

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 and C4 can be added across the load, with a 0.1μF/50V ceramic capacitor C3 and C5 in parallel generally as shown in Fig 10.

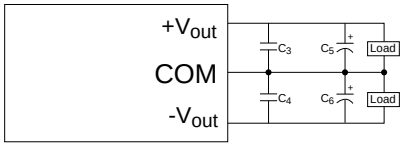

Fig.10 Output Ripple Filter For a Distant Load

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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 11. 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 12.

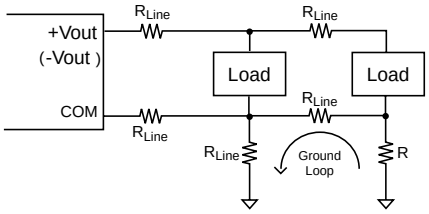

Fig.11 Ground Loops

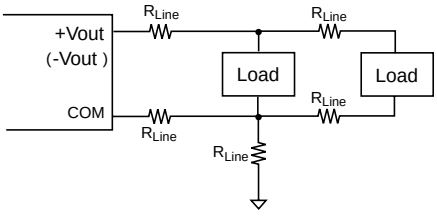

Fig.12 Single Point Ground

Output Over-voltage Protection: (just for +12Vout)

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.

Parallel Power Distribution

Figure 13 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.

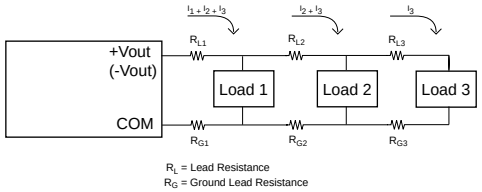

Fig.13 Parallel Power Distribution

Radial Power Distribution

Radial power distribution is the preferred method of providing power to the load. Figure 14. 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.

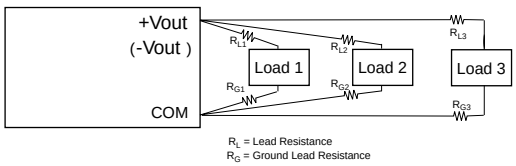

Fig.14 Radial Power Distribution

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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.

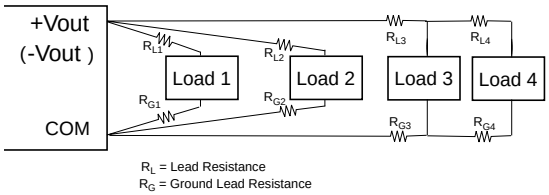

Fig.15 Mixed Power Distribution

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 16 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.

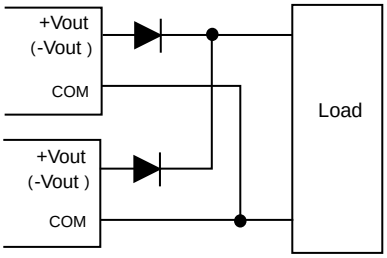

Fig.16 Redundant Operation

	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

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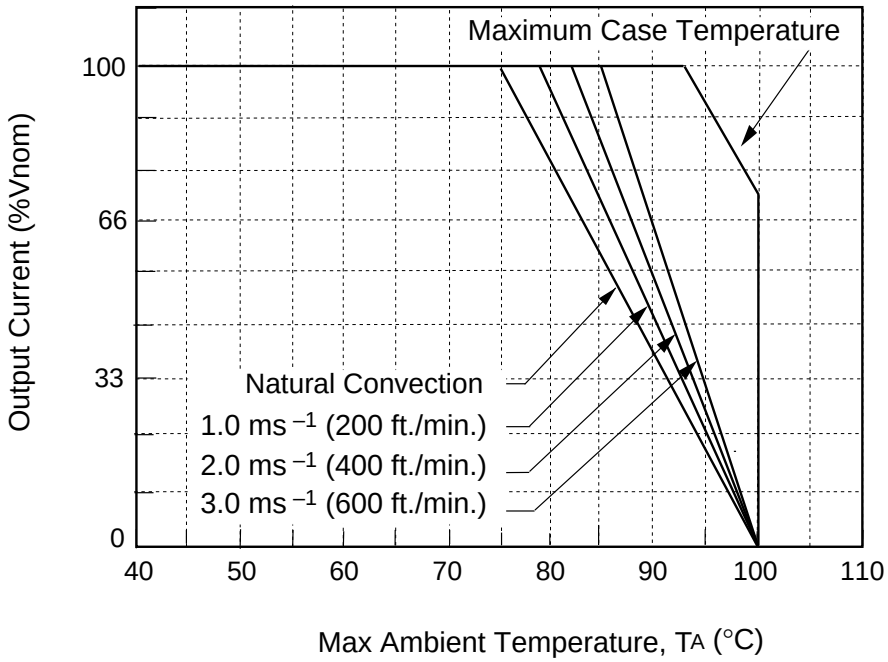
Module Derating

Typical derating curves

Forced Convection Power Derating



AEE-Dual Mechanical Considerations

Installation

Although AEE-Dual 15W 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-Dual 15W 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.

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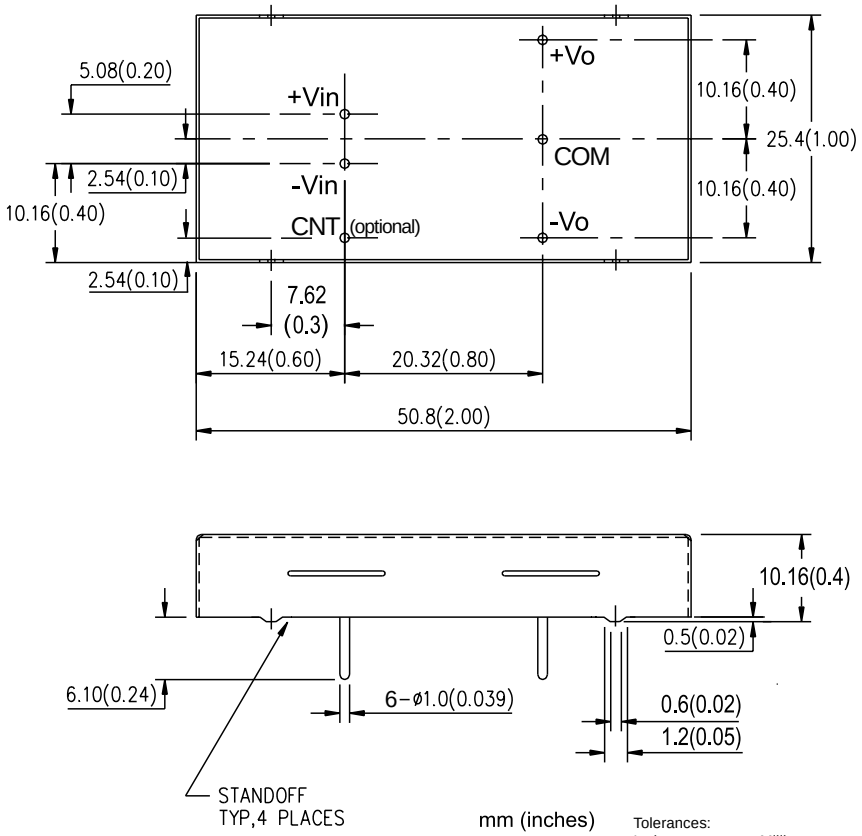
MTBF

The MTBF, calculated in accordance with Bellcore TR-NWT-000332 is 2,000,000 hours. Obtaining this MTBF in practice is entirely possible. If the ambient air temperature is expected to exceed +25°C, then we also advise an 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.

Recommended Hole Pattern *(pin side view)*



mm (inches)

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)

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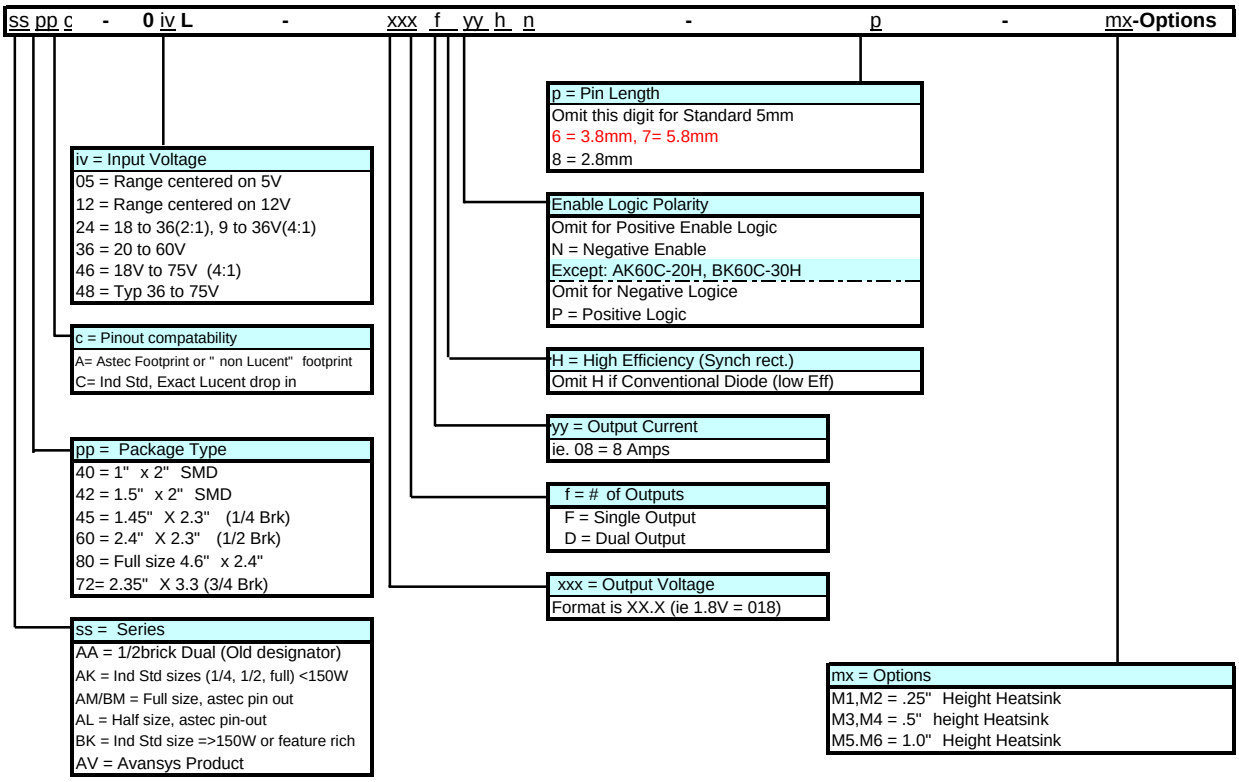
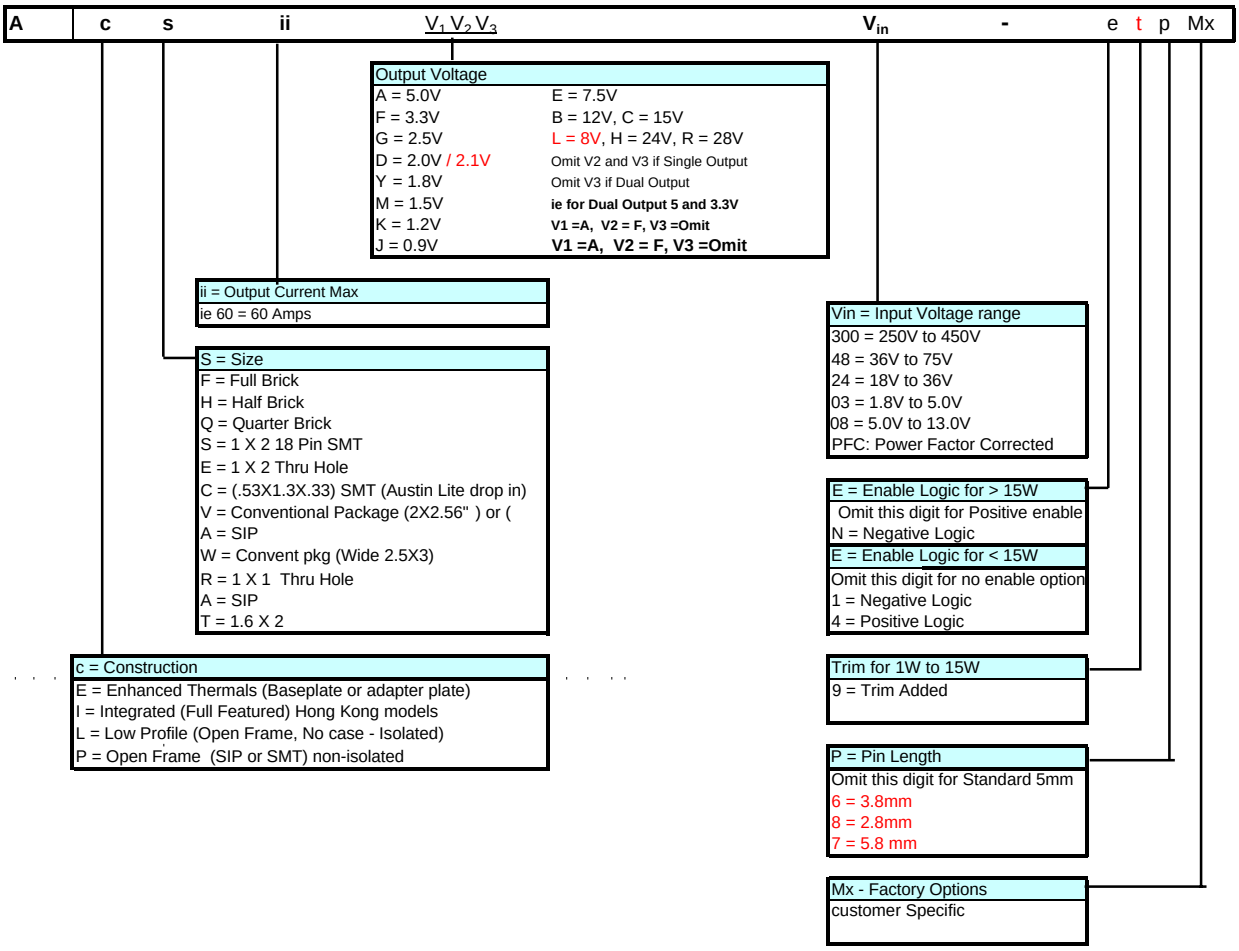
PART NUMBER DESCRIPTION



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

NEW PART NUMBER DESCRIPTION



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