

AJ80A

Economy Series



DC-DC Converter Module Technical Reference Manual

Series Highlights

- High Efficiency - up to 86%
- 85°C baseplate operating temperature
- Low output ripple and noise
- High Reliability - over 1 million hours MTBF
- Wide input voltage range

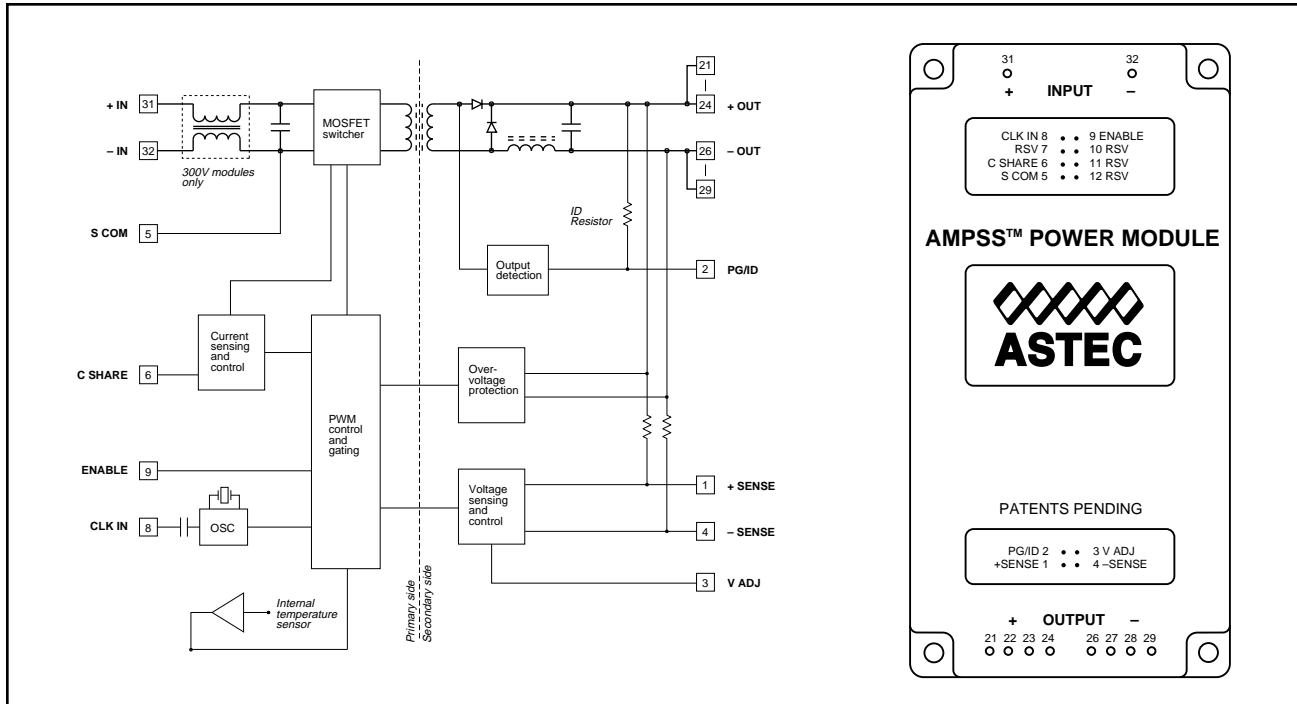
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AJ80A Economy Series DC-DC Converters



Introduction

The AJ80A is an isolated, single output DC to DC converter module, providing up to 240W output with a maximum baseplate operating temperature of 85°C with no derating. The AJ80A features adjustable output voltage and current limiting and has a baseplate operating temperature of up to 85°C. (with no derating).

Special Features

- High Efficiency - up to 86%
- 500KHz fixed switching frequency
- 85°C baseplate operating temperature - no derating
- Low output ripple and noise
- Excellent transient response
- High Reliability - over 1 million hours MTBF
- Wide input voltage range
- Paralleable
- Current and temperature monitoring outputs
- Overtemperature and short circuit protection

Ordering Information

Please contact Astec for information on other output voltages, power ranges and configurations.

Model Number	Input Voltage	Output Voltage	Output Current	Output Power
AJ80A-300L-033F50	300V	3.3V	50A	165W
AJ80A-300L-050F40	300V	5V	40A	200W
AJ80A-300L-120F18	300V	12V	18A	216W
AJ80A-300L-150F16	300V	15V	16A	240W
AJ80A-048L-033F50	48V	3.3V	50A	165W
AJ80A-048L-050F40	48V	5V	40A	200W
AJ80A-048L-120F18	48V	12V	18A	216W
AJ80A-048L-150F16	48V	15V	16A	240W

Safety

UL: UL1950
 CSA: CSA22.2-234
 CSA22.2-950
 VDE: VDE 0805
 EN60950

Please contact Astec for information on specific module approvals.

Note: Ensure all modules are used according to the Installation Instructions provided with each module.

Electrical Specifications

Absolute Maximum Ratings – all models

Exceeding the specified absolute maximum ratings may severely damage the module. These ratings are intended as guidelines for absolute worst case operating conditions and are not to be interpreted as recommended operating condition

General	300V Input	48V Input
Continuous Input Voltage	400V	72V
Input Surge Voltage (1 sec)	425V	75V
Isolation, Input to Output*	2700VDC	2100VDC
Isolation Input to Baseplate*	2121VDC	2100VDC
Isolation, Output to Baseplate*	500VDC	500VDC
Operating Temperature (Baseplate)	-20 to 85°C	
Storage Temperature	-40 to 105°C	
Operating Relative Humidity (non-condensing)	10% to 95%	
Storage Relative Humidity (non-condensing)	95% Max	
Altitude (Operating)	< 3000m	
Altitude (Storage)	< 9000m	
Lead Temperature (soldering 5 Seconds)	235°C	

Notes:

* For 300V input :

All isolation barriers on 300V input modules have been designed and tested to meet 4242VDC as required by IEC950 for reinforced insulation. The complete module should NOT be subjected to a 3000VAC input-to-output test because this can result in input-baseplate-output breakdown. AMPSS DC-DC modules are CLASS I equipment. Power supply systems using AMPSS modules MUST also be CLASS I equipment. Each AMPSS DC-DC module is fully tested in factory according to the standards. Therefore power supply systems need only be subjected to Hi-Pot test for BASIC insulation which is 1500Vac (AC) input to GROUND.

Primary Control Pins	
C SHARE	-0.5 to 7 VDC
CLK IN	-10 to 10 VDC
OVP ADJ	-0.5 to 7 VDC
ENABLE	0.5 to 20 VDC

Secondary Control Pins	
+SENSE	$V_o - 0.5$ to $V_o + 0.5$ VDC
-SENSE	-0.5 to 0.5 VDC
V ADJ	-0.5 to 7 VDC
PG/ID	0.5 to $V_o + 0.5$ VDC

Note : V_o = module output voltage

Specifications

Electrical characteristics are guaranteed over the full baseplate temperature range (-20 to 85°C) and for the full range of input voltage (V_i) and for the full load range (0 to I_o rated). Except where indicated , +SENSE and -SENSE are connected to the output terminals at the point of measurement, ENABLE is connected to -SENSE. All other pins are left floating.

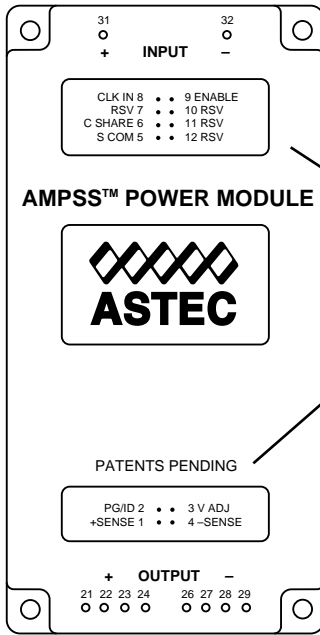
Definitions

V_i , V_o and I_o are actual operating conditions, V_{Inom} , V_{Onom} and I_{Orated} are nominal ratings.

Pin Connections - all models

INPUT PINS

Pin No	Pin Name	Type	Description	Recommended Connections
31	+INPUT	Input	Power input - positive	A 200 μ F electrolytic capacitor connected between the +INPUT and -INPUT pins is recommended
32	-INPUT	Input	Power input - negative (return)	See + INPUT for recommendations



CONTROL PINS

Pin No	Pin Name	Type	Description	Recommended Connections
1	+SENSE	Input	Used for remote sense function to compensate for load bus resistance	If remote sensing is not required connect to +OUTPUT pins 21-24 of the module
2	PG/ID	Output	High level output ($V_{PG/ID} = V_O$) indicates module converter is running. Can also be used to identify the nominal output voltage of the module by measuring resistance between PG/ID and +SENSE	Output impedance = $V_{O_{nom}} \times 1K\Omega$. Leave unconnected if not used
3	V ADJ	Input	Used to adjust module output voltage	Leave unconnected if not used
4	-SENSE	Input	Used for remote sense function to compensate for load bus resistance	If remote sensing is not required connect to -OUTPUT pins 26-29 of the module
5	S COM	-	Negative reference for all primary side signals	Connect to negative side of primary control and monitoring circuitry
6	C SHARE	Input/Output	Allows modules connected in parallel to accurately share current	Connect to C SHARE pins of other modules. Leave unconnected if not used
7	RSV	-	Reserved	Leave unconnected.
8	CLK IN	Input	Accepts a 1MHz clock input for synchronization with other modules	Capacitor coupled input. Leave unconnected if not used
9	ENABLE	Input	Enables or disables the output of the module	Must be connected to -SENSE pin or driven to $-0.8V$ to enable the output of the module
10	RSV	-	Reserved	Leave unconnected.
11	RSV	-	Reserved	Leave unconnected.
12	RSV	-	Reserved	Leave unconnected.

OUTPUT PINS

Pin No	Pin Name	Type	Description	Recommended Connections
21-24	+OUTPUT	Output	Power output - positive	Ensure good electrical connection and sufficient copper on PCB layouts
26-29	-OUTPUT	Output	Power output - negative	See +OUTPUT for recommendations

CONTROL SIGNALS

Parameter	Conditions	Min	Typ	Max	Units
PG/ID - power good/Identification function	PG/ID Low (Power Fail), $I_{SINK} \leq 10\text{mA}$			0.2	V
	Resistance, PG/ID to +OUTPUT				
	3.3 V output	3.23	3.3	4.32	K Ω
	5V output	5.00	5.1	6.12	K Ω
	12V output	11.76	12	13.02	K Ω
	15V output	14.70	15	16.02	K Ω
V ADJ - voltage adjust	$V_{Vadj} = 0\text{V}$		90		% V_{Onom}
	$V_{Vadj} = 2\text{V}$		110		% V_{Onom}
C SHARE - current share function	C SHARE pins of connected together of modules operating in parallel		$\pm 5\%$	± 15	% I_{Oave}
	Max no. of units operating in parallel			5	
CLK IN - clock input	Voltage (square wave)	4.4		5.5	Vp-p
	Frequency	0.8	1	1.2	MHz
ENABLE - module enable	Module enabled	0		0.8	V
	Module disabled	2		10	V

Insulation - all models

INSULATION

Parameter	Conditions	Min	Typ	Max	Units
Input-output insulation resistance	500VDC	10			M Ω
Input-baseplate insulation resistance	500VDC	10			M Ω
Output-baseplate insulation resistance	500VDC	10			M Ω

Electrical Specifications for 48V Input Models (AJ80A-048L-xxFyy)

INPUT CHARACTERISTICS

Parameter	Conditions	Min	Typ	Max	Units
Input voltage		36	48	72	V
Input surge voltage	(1 second)			75	V
Input low line power on voltage	Module power on	27		35	V
Input low line power off voltage	Module shutdown	50		80	%V _{Ion}
No load input power	V _I = V _{Inom}			10	W
Input capacitance				2.5	μF

TRANSIENT CHARACTERISTICS

Parameter	Conditions	Min	Typ	Max	Units
Turn-on time			100	1000	msec
Transient response	(25% to 75% load change @ 0.1A/μS, recovery to 1% V _o)				
	Step-load excursion			10	%V _O
	Step-load response			100	μS

OUTPUT CHARACTERISTICS

Parameter	Conditions	Min	Typ	Max	Units
Nominal (factory set) output voltage	AJ80A-048L-033F50		3.3		V
	AJ80A-048L-050F40		5.0		V
	AJ80A-048L-120F18		12.0		V
	AJ80A-048L-150F16		15.0		V
Output voltage set point accuracy	T _C = +25°C, V _I = V _{Inom} , I _O = I _{Orated}	-1		1	%V _{Onom}
Remote sense compensation ¹	V _I = V _{Imin}			0.5	V
Output voltage adjust		30		110	%V _{Onom}
Nominal (factory set) output overvoltage protection trip point		120	130	140	%V _{Onom}
Line regulation	V _{Imin} to V _{Imax}			0.2	%V _{Onom}
Load regulation	I _{Omin} to I _{Omax}			0.5	%V _{Onom}
Noise and ripple	20Mhz bandwidth			3	%V _{Onom}
Output current	AJ80A-048L-033F50	0		50	A
	AJ80A-048L-050F40	0		40	A
	AJ80A-048L-120F18	0		18	A
	AJ80A-048L-150F16	0		16	A
Output current limit	V _O dropped to 90% of V _{Onom}	105	115	125	%I _{Orated}
Short circuit current		105		125	%I _{Orated}
Temperature coefficient	Per °C Baseplate temperature			0.02	%V _O /°C
Overtemperature shutdown	Baseplate temperature	87		110	°C
Efficiency	V _O = V _{Onom} , I _O = I _{Onom} , I _O = I _{Orated}				
	AJ80A-048L-033F50	72	74		%
	AJ80A-048L-050F40	78	80		%
	AJ80A-048L-120F18	83	84		%
	AJ80A-048L-150F16	84	85		%

Electrical Specifications for 300V Input Models (AJ80A-300L-xxFyy)

INPUT CHARACTERISTICS

Parameter	Conditions	Min	Typ	Max	Units
Input voltage		180	300	400	V
Input surge voltage	(1 second)			425	V
Input low line power on voltage	Module power on	140		175	V
Input low line power off voltage	Module shutdown	50		80	%V _{Ion}
No load input power	V _I = V _{Inom}			10	W
Input capacitance				0.5	μF

TRANSIENT CHARACTERISTICS

Parameter	Conditions	Min	Typ	Max	Units
Turn-on time			100	1000	msec
Transient response	(25% to 75% load change @ 0.1A/μS, recovery to 1% V _o)				
	Step-load excursion			10	%V _O
	Step-load response			300	μS

OUTPUT CHARACTERISTICS

Parameter	Conditions	Min	Typ	Max	Units
Nominal (factory set) output voltage	AJ80A-300L-033F50		3.3		V
	AJ80A-300L-050F40		5.0		V
	AJ80A-300L-120F18		12.0		V
	AJ80A-300L-150F16		15.0		V
Output voltage set point accuracy	T _c = +25°C, V _I = V _{Inom} , I _O = I _{Orated}	-1		1	%V _{Onom}
Remote sense compensation ¹	V _I = V _{Imin}			0.5	V
Output voltage adjust		90		110	%V _{Onom}
Nominal (factory set) output overvoltage protection trip point		120	130	140	%V _{Onom}
Line regulation	V _{Imin} to V _{Imax}			0.2	%V _{Onom}
Load regulation	I _{Omin} to I _{Omax}			0.5	%V _{Onom}
Noise and ripple	20Mhz bandwidth			3	%V _{Onom}
Output current	AJ80A-300L-033F50	0		50	A
	AJ80A-300L-050F40	0		40	A
	AJ80A-300L-120F18	0		18	A
	AJ80A-300L-150F16	0		16	A
Output current limit	V _O dropped to 90% of V _{Onom}	105	115	125	%I _{Orated}
Short circuit current		105		125	%I _{Orated}
Temperature coefficient	Per °C Baseplate temperature			0.02	%V _O /°C
Overtemperature shutdown	Baseplate temperature	87		110	°C
Efficiency	V _O = V _{Onom} , I _O = I _{Onom} , I _O = I _{Orated}				
	AJ80A-300L-033F50	76	78		%
	AJ80A-300L-050F40	79	81		%
	AJ80A-300L-120F18	84	86		%
	AJ80A-300L-150F16	85	87		%

Notes :

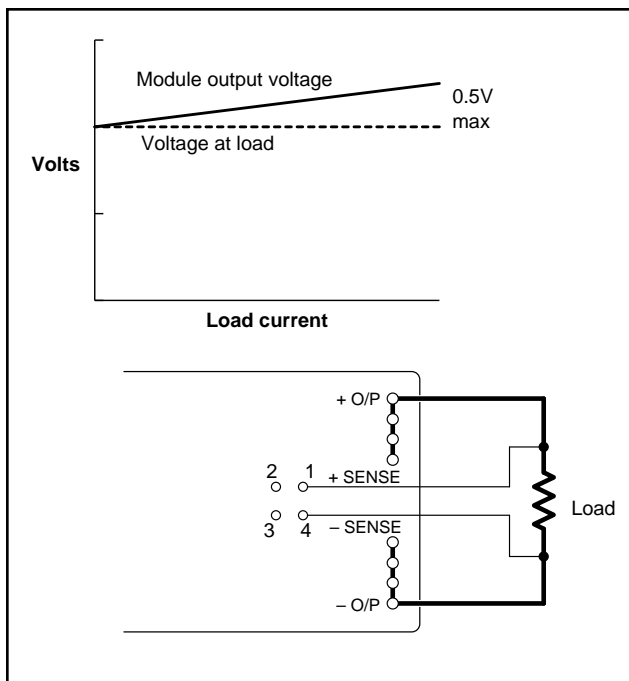
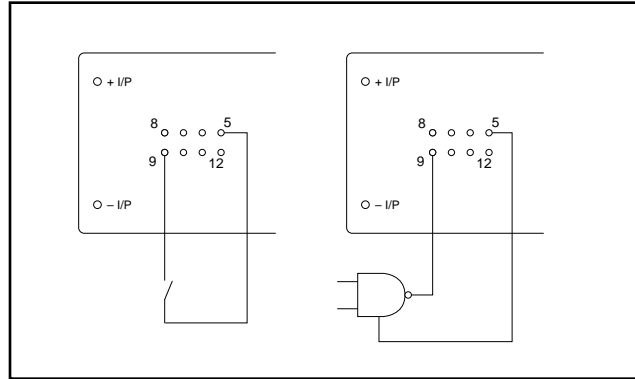
1. The de-rating of output current is -0.123A/°C for baseplate temperatures higher than 55°C. Maximum output current at 85°C baseplate is 6.3A

Functional Description

This section explains the how to implement the functions found on the AJ80A Economy series.

Remote Sense (+SENSE, -SENSE)

Connect the +SENSE and -SENSE pins directly to the load to allow the module to compensate for the voltage drop across the conductors carrying the load current. If remote sensing is not required (for example if the load is close to the module) the sense pins should be connected directly to the module's output pins to ensure accurate regulation.



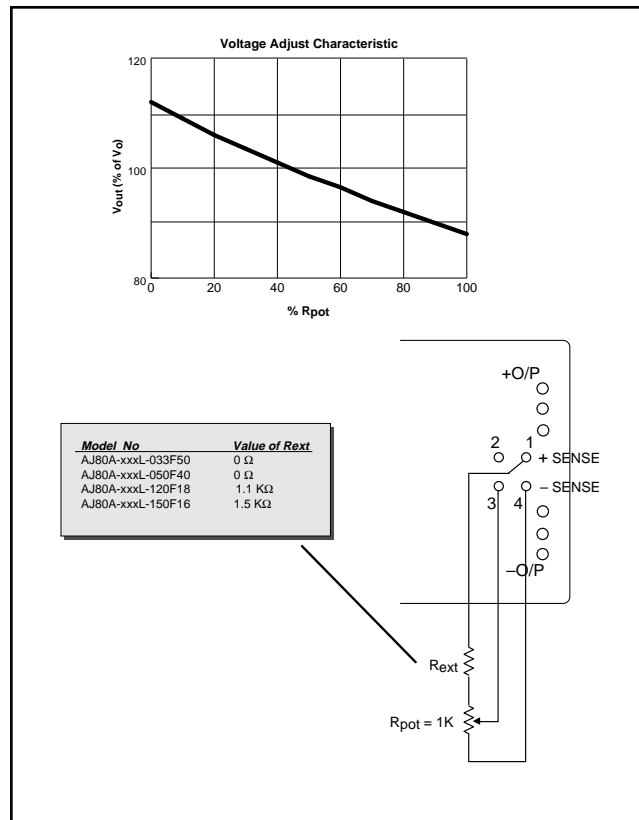
Note: If the sense leads fail open circuit, the module will revert to local sense at the output pins. If the sense leads are reversed, the module will latch off via the OVP.

Enable Control (ENABLE)

The enable pin is a TTL compatible input used to turn the output of the module on or off. The module output is enabled when the ENABLE pin is connected to S COM or driven to a logic low of <math><0.8V</math> (but not negative) with respect to S COM. The output is disabled when the enable pin is open or driven to a logic high >2V with respect to S COM. If the AJ80A is operated in parallel, all ENABLE pins must be connected in parallel to ensure all modules are enabled simultaneously.

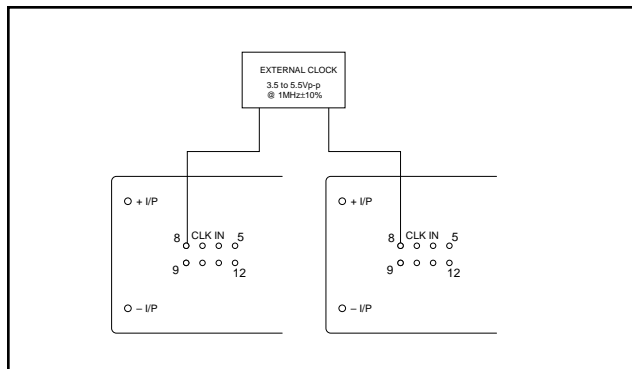
Output Voltage Adjustment (V ADJ)

The output voltage of the module may be accurately adjusted by up to $\pm 10\%$ of the nominal factory set output. Adjustment is carried out using a 1K Ω trimming potentiometer connected as indicated.



Clock Signals (CLK IN)

The module's internal clock is accurate and stable over its full operating range and synchronization is not normally required, but it can reduce noise in paralleled systems.



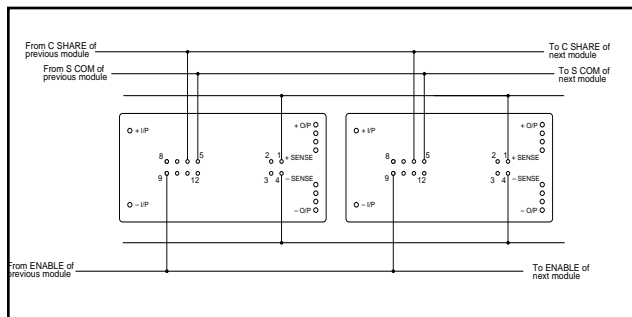
An external clock signal of 3.5 to 5Vpk-pk at 1MHz±10% can be connected to the CLK IN pins of all the modules.

If the clock input to any module fails, the module will automatically switch back to its internal clock and will continue to operate at full power even in current sharing systems. The CLK IN signal is AC coupled.

Current Sharing (C SHARE)

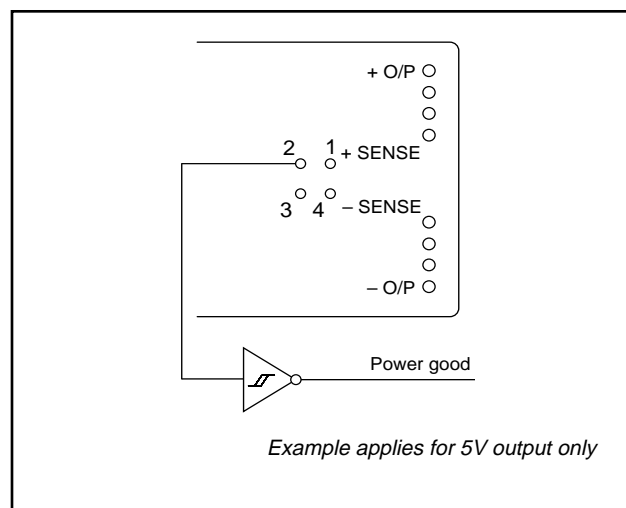
To ensure that all modules in a parallel system accurately share current, the C SHARE and S COM pins on each module should be connected together as shown.

The ENABLE pins of each of the modules should be connected either directly to S COM or to a common enable control to ensure that all modules are enabled simultaneously. After the module is enabled, the C SHARE for the module becomes active. Only when all C SHARE signals are active will power be delivered to the load.



Power Good/Identification (PG/ID)

This pin provides an indication that the module's converter is working, and can also be used to identify the factory set output voltage of the module. The PG/ID pin goes high to the level of the output voltage (V_o) to indicate that the module is operating and delivering power. The output goes low if the converter stops operating due to a fault such as an overtemperature or overvoltage condition. The PG/ID pin will also go low if the module is disabled via the ENABLE pin.



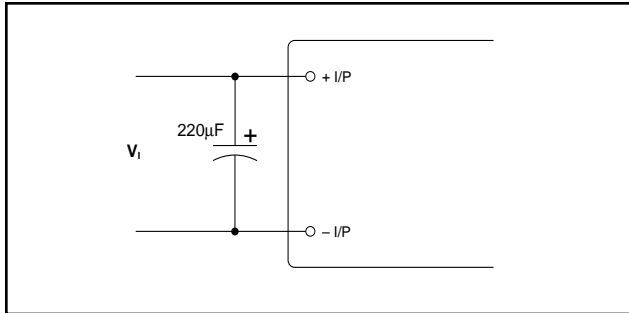
The resistance between the PG/ID pin and the +ve output of the module can be used to determine the output voltage of the module with no power applied according to the table shown:

Output Voltage (V)	Resistance (K Ω)
3.3	3.3
5	5.1
12	12
15	15

Design Considerations

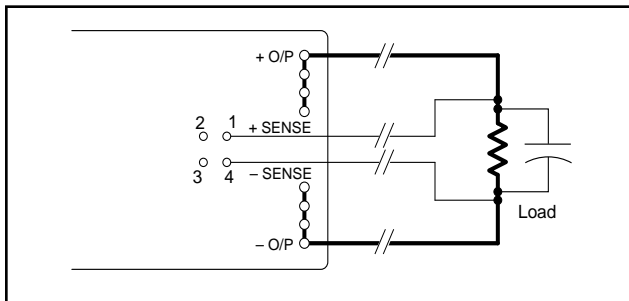
Input Bulk Capacitors

Electrolytic bulk reservoir capacitors placed close to the module input pins are recommended to ensure the module is fed with a low source impedance. For the AJ80A Economy Series module typical values are 220 μ F/100V for 48V modules and 220 μ F/450V for 300V modules.



Remote Loads

If the sensed load is some distance from the module, the module's output voltage may rise sufficiently to trigger the OVP protection circuit during a step load change due to bus inductance. Fitting a decoupling capacitor at the load can reduce this effect. It should be noted that a distributed power solution, using AMPSS™ modules placed close to their loads, will optimize transient response.



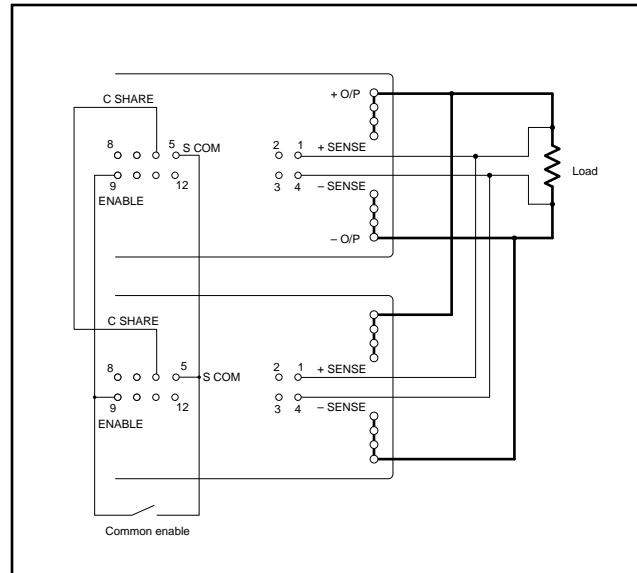
Input Fusing

AMPSS modules do not have an in-line fuse fitted internally. In order to comply with CSA, VDE and UL safety regulations it is recommended that a fuse of the following rating be fitted at the module's input.

Input	Fuse Rating
300V	5A / 250V
48V	10A / 250V

Parallel Connection Considerations

A master-slave configuration is not required for AMPSS™ modules. AJ80A modules may be connected in parallel using a simple wiring scheme.



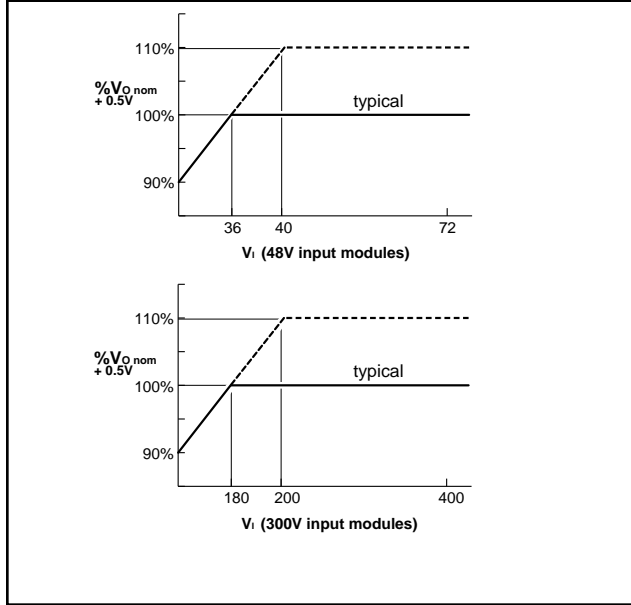
Current Sharing

In multi-module paralleled systems, all modules will share current to within $\pm 5\%$ (typical) of the average load current per module when the C SHARE pins of each module are connected together. The +SENSE and -SENSE pins of each module should be connected to common points as close as possible to the load.

NOTE: After a module is enabled the C SHARE becomes active. Only when all C SHARE signals are active will power be delivered to the load. For this reason the AJ80A Series is unsuitable for hot pluggable or redundancy systems.

Break Regulation

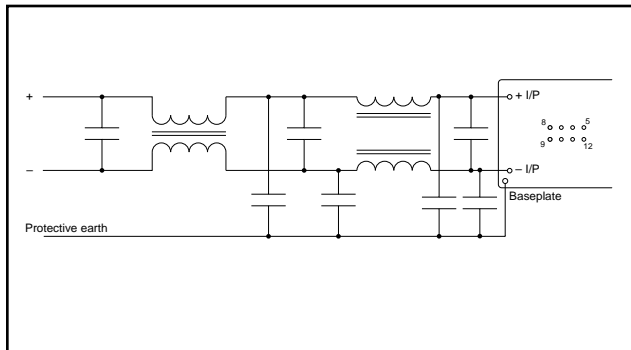
AJ80A Economy Series modules are designed to deliver full rated output current at up to 0.5V above $V_{O\text{nom}}$ at the minimum specified input voltage.



Conducted EMI

Although AMPSS™ modules contain both common mode and differential mode input EMI filtering, power supply systems using these modules will require additional EMI filtering to enable the system to meet relevant EMI standards.

AJ80A modules have an effective input to ground (baseplate) capacitance of 440pF for the 300V input models and 520pF for the 48V input models. This should be accounted for when calculating the maximum EMI 'Y' capacitance to meet ground leakage current specifications.



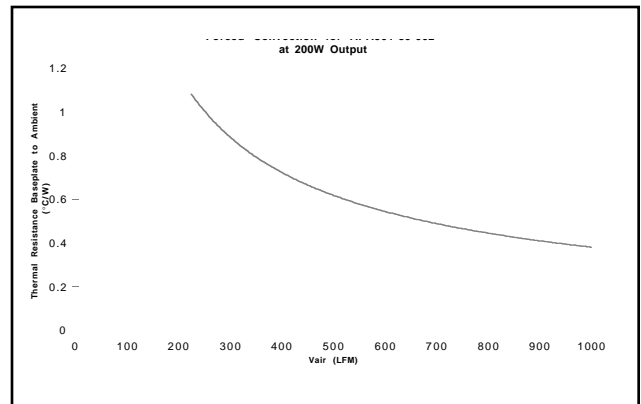
Overtemperature Protection

If the module's internal temperature exceeds 95°C, the module will latch OFF. To reset the module the input supply must be cycled off and then on again, allowing a period of time for the module to cool down.

Overtemperature shutdown can also be programmed to occur at lower temperatures by using the TEMP MON output to control the ENABLE pin.

Thermal Data

Natural convection thermal impedance of the AJ80A package without a heatsink is approximately 4°C/W. A standard horizontal fin heatsink available from Astec (part number APA501-80-002) with 11mm fins and 8mm pitch, will reduce module thermal impedance to 1°C/W with a forced air flow of 250 LFM when mounted with a thermal pad (ASTEC P/N APA502-80-001) between heatsink and module.



MTBF

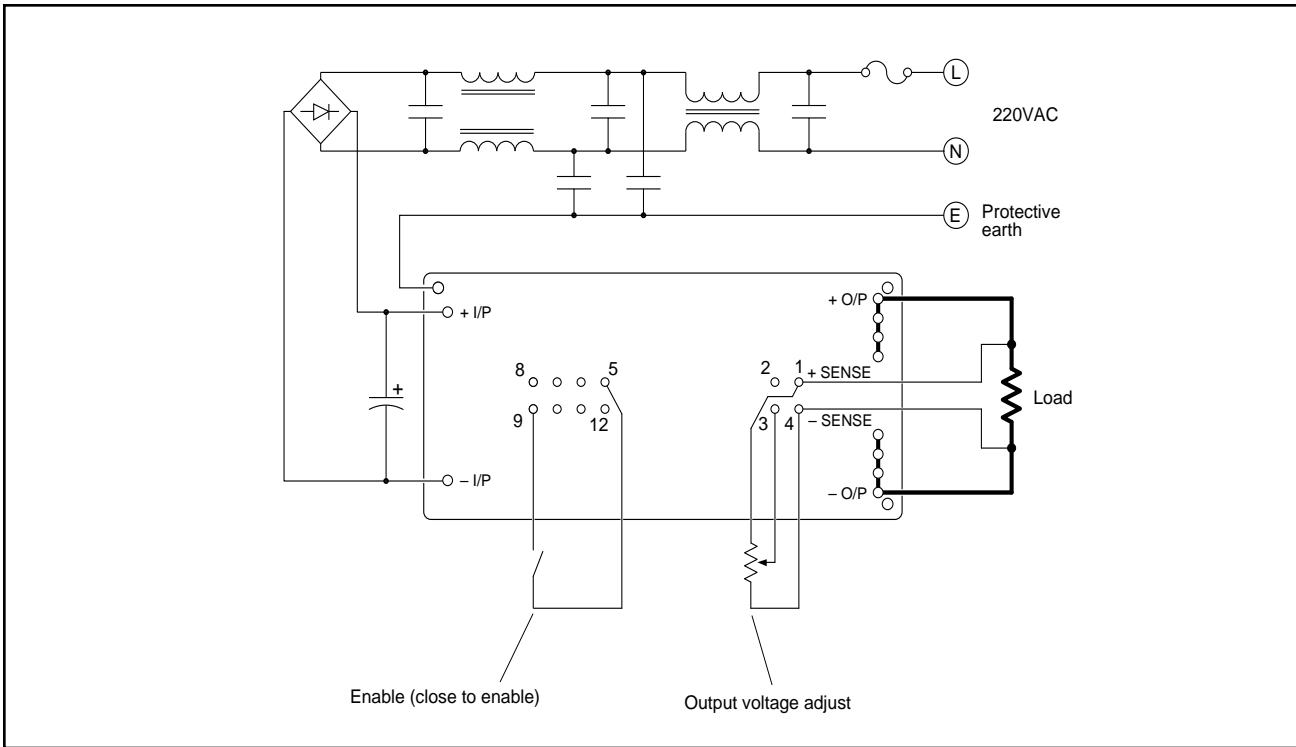
Predicted MTBF for the AJ80A Economy Series is greater than 1,000,000 hours at maximum rated output and 50°C baseplate temperature.

Output Ripple and Noise

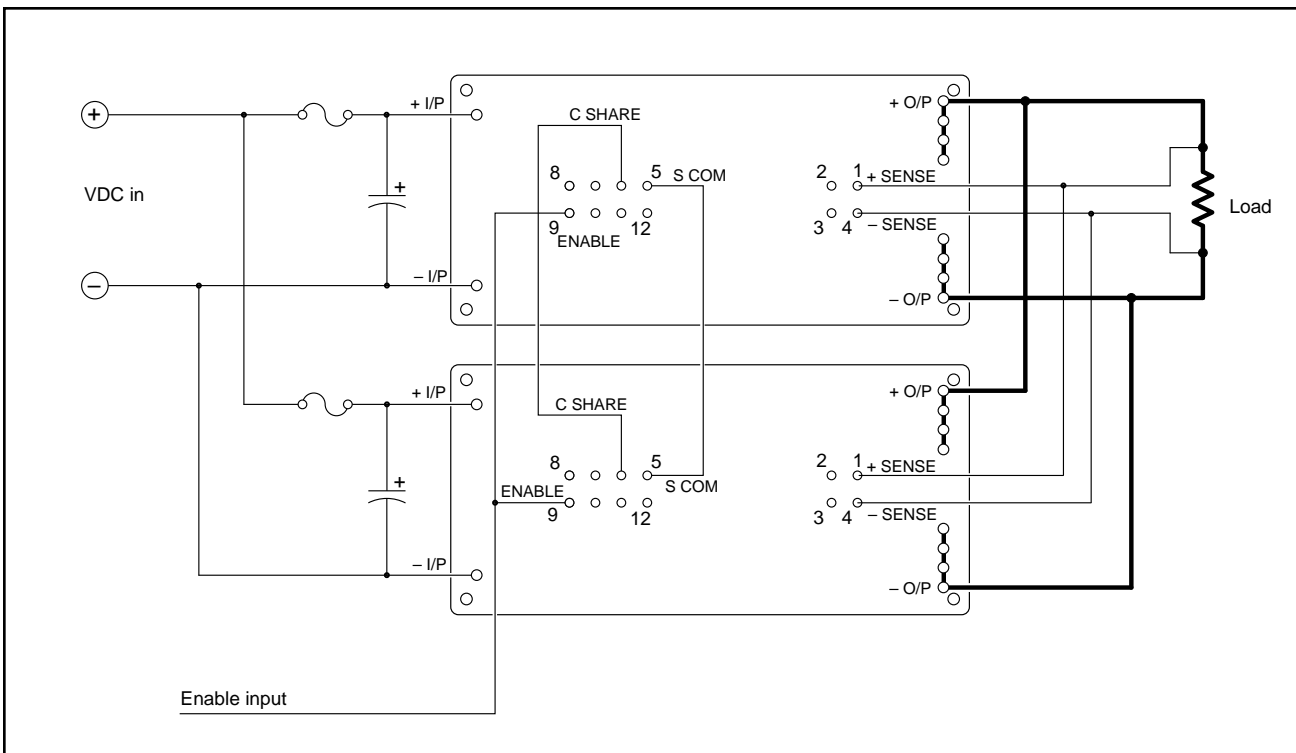
AJ80A Economy Series modules are designed to generate very low ripple and noise. When mounted on logic boards, for example, sufficient decoupling is normally provided by the components used to decouple the logic ICs, and no additional decoupling is required.

Application Examples

AC Input Design



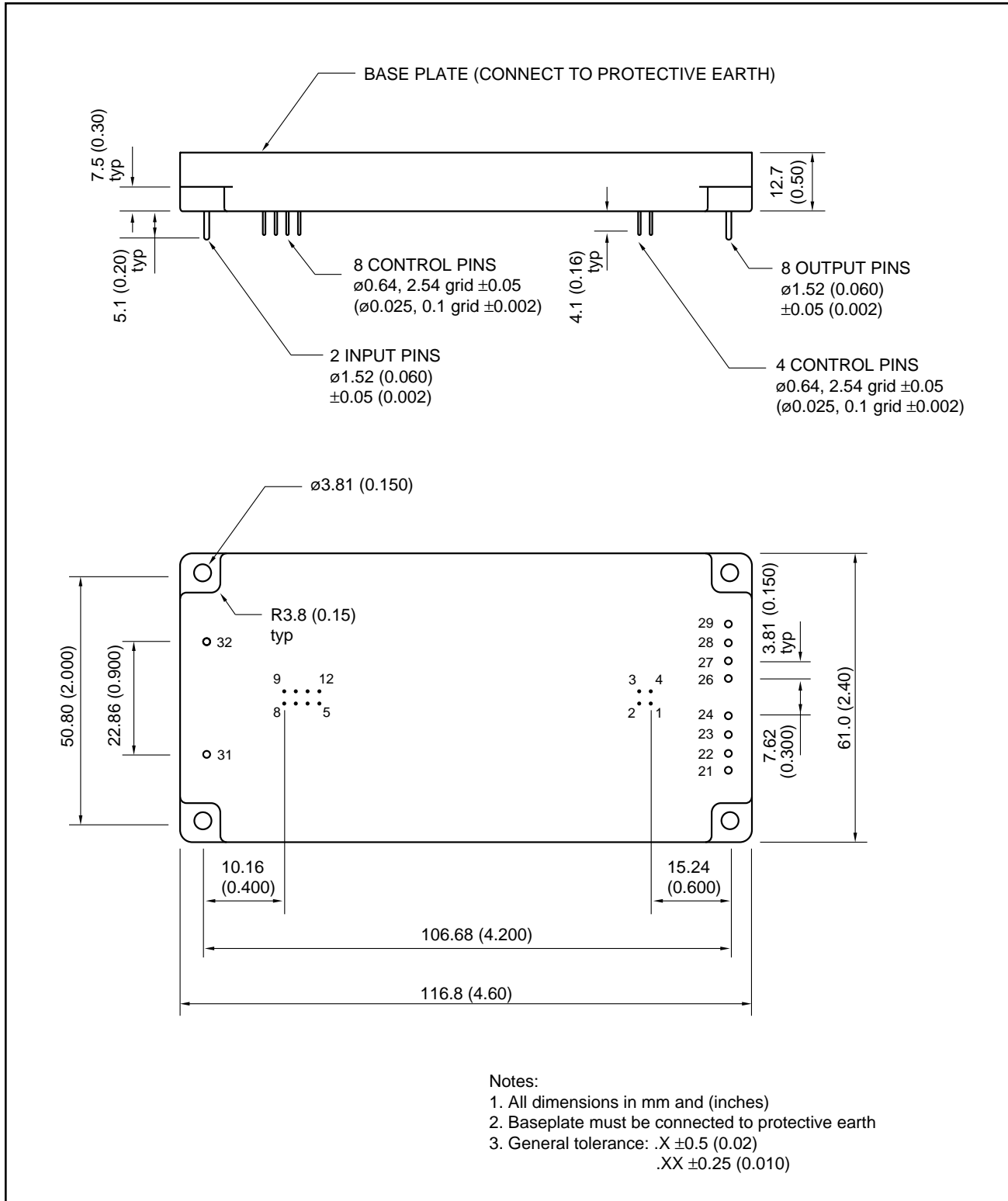
Parallel Connection Design



Mechanical Information

Dimensions

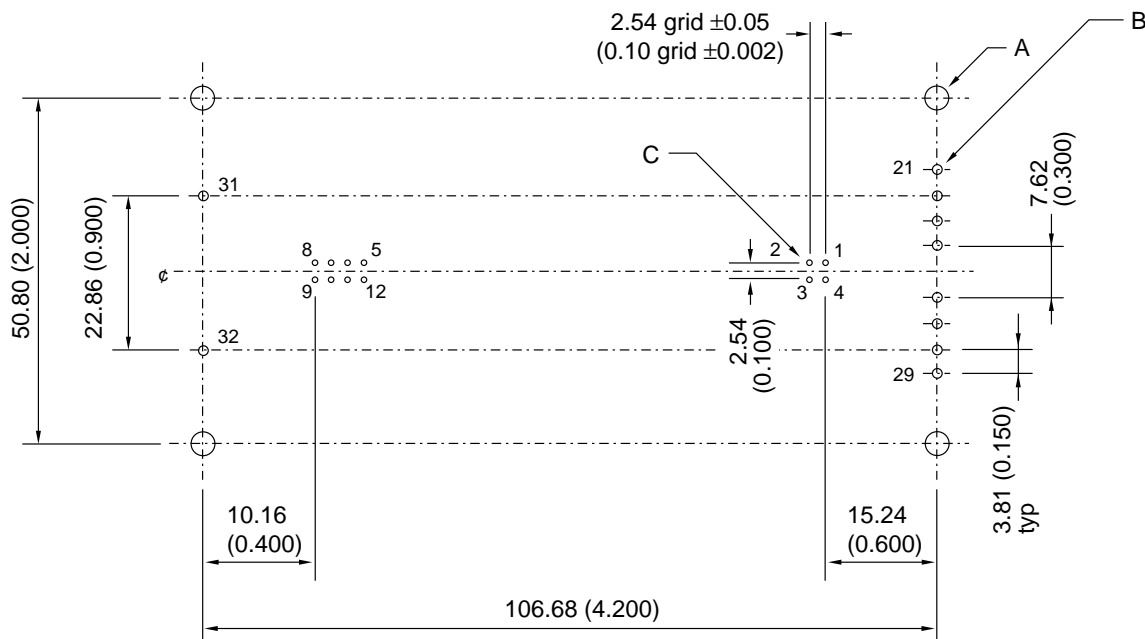
The dimensions are given in mm (inches). Note that the baseplate must be connected to protective earth before power is supplied to the module.



Recommended PCB Layout

The AJ80A Economy Series module may be mounted to a board either by soldering or by using spring sockets.

Materials :
Control pins are gold plated phospher-bronze.
Input and output pins are tin plated copper.



VIEW FROM PCB COMPONENT SIDE

- NOTES:
1. PCB COMPONENT SIDE VIEW IS SHOWN.
 2. ALL DIMENSIONS IN mm AND (INCHES).
 3. GENERAL TOLERANCE : .XX ± 0.1 (0.006).

RECOMMENDED HOLE SIZE TABLE :-

	A	B	C
HOLE SIZE FOR PCB DIRECT SOLDERING		$\varnothing 2.00 + 0.15 / - 0$ ($\varnothing 0.079 + 0.006 / - 0$)	$\varnothing 1.00 + 0.15 / - 0$ ($\varnothing 0.039 + 0.006 / - 0$)
HOLE SIZE FOR SPRING SOCKET MOUNTING*		$\varnothing 2.67 \pm 0.05$ ($\varnothing 0.105 \pm 0.002$)	$\varnothing 1.37 \pm 0.05$ ($\varnothing 0.054 \pm 0.002$)
HOLE SIZE FOR M3.5 MACHINE SCREW	$\varnothing 4.5 + 0.08 / - 0$ ($\varnothing 0.177 + 0.0031 / - 0$) FOR M3.5		

*Spring sockets are available from Astec in packs of 20 control pin sockets and 15 power pin sockets, part no. APA504-00-001. Sockets are not suitable for output current greater than 10A per pin.

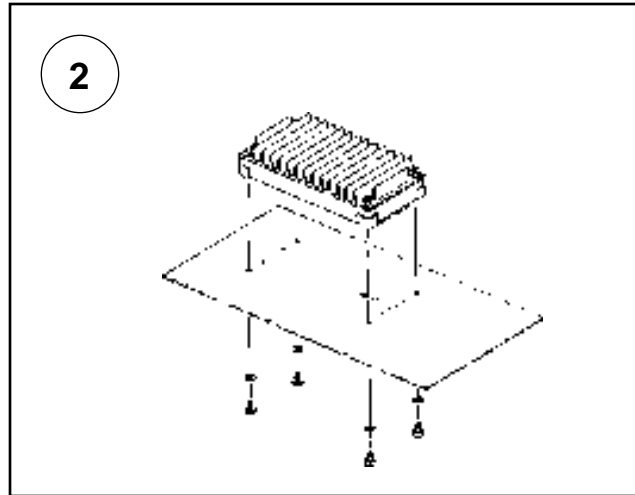
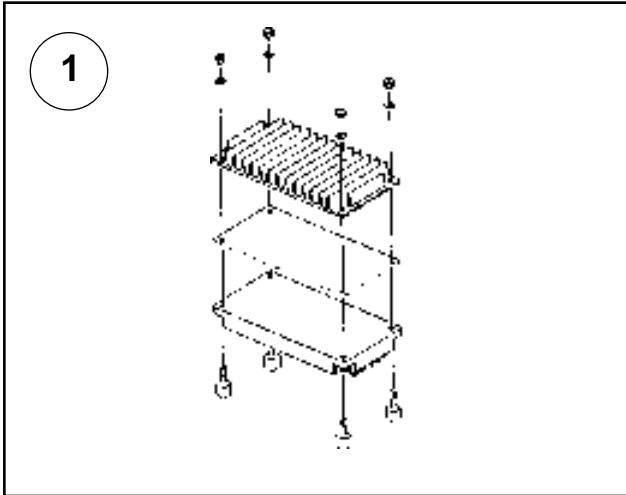
Heatsink Mounting Information

Heatsinks for AMPSS™ modules are available in a variety of sizes and fin orientation. Mounting kits and thermal pads are also available. The table below shows the options available for AJ80A Economy Series.

A heatsink mounting kit provides the most convenient way to mount the heatsink to the module and then mount the assembly onto a circuit board

AMPSS™ modules may be retained by their input and output pins only, or may be fixed to the board using bolts screwed into the tapped studs which are provided as part of the mounting kit. In both cases the studs provide clearance between the module and the circuit board to facilitate PCB cleaning operations.

Note: baseplate and heatsink must be connected to protective earth



Description	Model Number	Dimensions		Free air thermal resistance
		inches	mm	
Heatsink, "80" size, vertical fin.	APA501-80-001	4.5x2.3x0.6	115x59x15	2.7°C/W
Heatsink, "80" size, horizontal fin	APA501-80-002	4.5x2.3x0.6	115x59x15	2.4°C/W
Heatsink, "80" size, vertical fin.	APA501-80-003	4.5x2.3x0.9	115x59x24	2.2°C/W
Heatsink, "80" size, horizontal fin	APA501-80-004	4.5x2.3x0.9	115x59x24	2.0°C/W
Heatsink, "80" size, vertical fin.	APA501-80-005	4.5x2.3x1.5	115x59x37	2.0°C/W
Heatsink, "80" size, horizontal fin	APA501-80-006	4.5x2.3x1.5	115x59x37	1.7°C/W
Heatsink, "80" size, low profile	APA501-80-007	4.6x3.5x0.5	115.6x89x12	2.0°C/W
Thermal Pad, "80" size	APA502-80-001			
Mounting Kit, Tapped Studs	APA503-00-001			
Mounting Kit, Solder Studs	APA503-00-002			
Mounting Kit, Tapped Studs for low profile heatsink	APA503-00-007			
Mounting Kit, Solder Studs for low profile heatsink	APA503-00-008			
Spring Sockets (20 cont. 15pwr)	APA504-00-001			

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