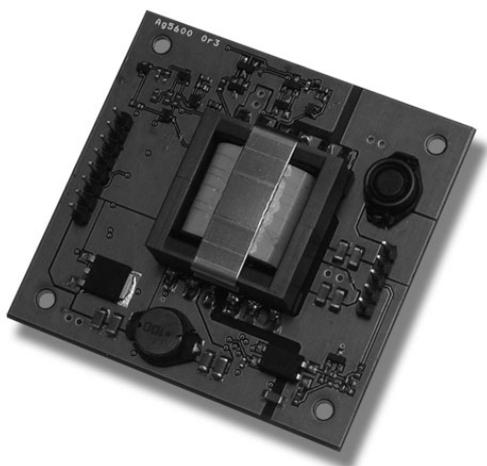




# Ag5600

## Power-Over-HDBaseT (PoH) Module



### 1 Features

- PoH, Cisco ® UPOE, IEEE802.3at and IEEE802.3af compliant
- Maximum 100 Watt output power
- High efficiency DC/DC converter
- Wide adjustable output voltage range
- 1500Vdc isolation (input to output)
- Input voltage range 52V to 57V
- Low output ripple and noise
- Minimal (low cost) external components required
- Overload, thermal and short-circuit protection
- Can be used with Silvertel Ag6600 100W PSE
- No minimum load required
- Silvertel “design-in” assistance

### 2 Description

The Ag5600 is a Twin High Power over HDBaseT (PoH) module that can deliver up to 100 Watts of output power. Suitable for applications such Monitors, TV's and LED Displays.

The Ag5600 has been designed to extract power from Power Sourcing Equipment (PSE) over a conventional twisted pair Category 5 or 6 Ethernet cable. The module's input conforms to the PoH, IEEE802.3af and IEEE803.2at standards for signature recognition.

The high efficiency DC/DC converter operates over a wide input voltage range and provides a regulated low ripple and low noise output. The DC/DC converter also has built-in overload, thermal and short-circuit output protection.

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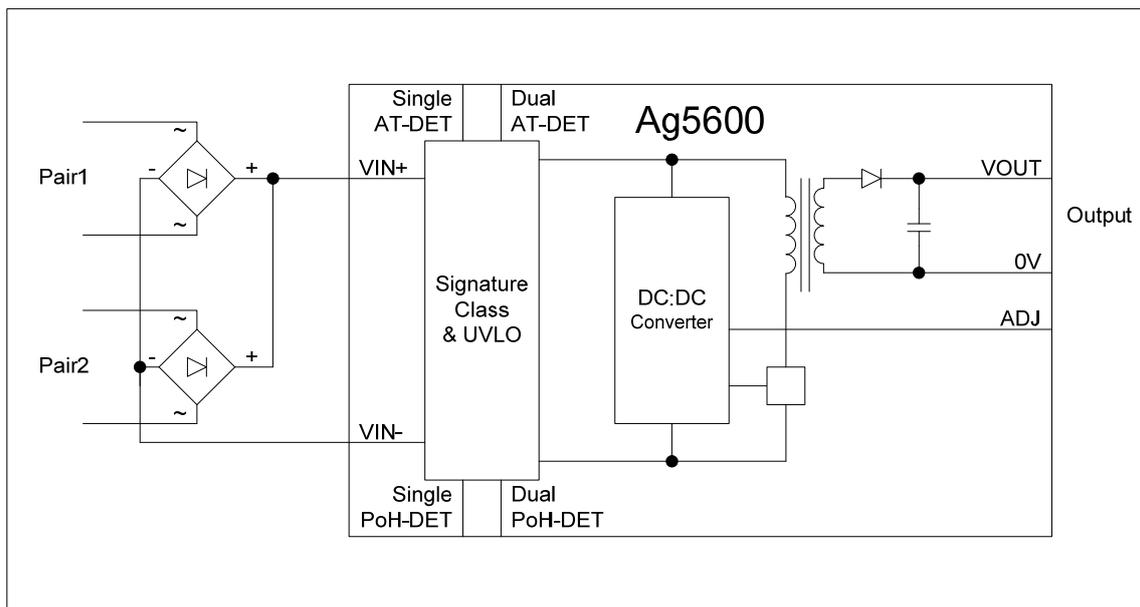
### 3 Ag5600 Product Selector

Part Number†	Nominal Output Voltage	Maximum Output Power *
Ag5600	24V	100

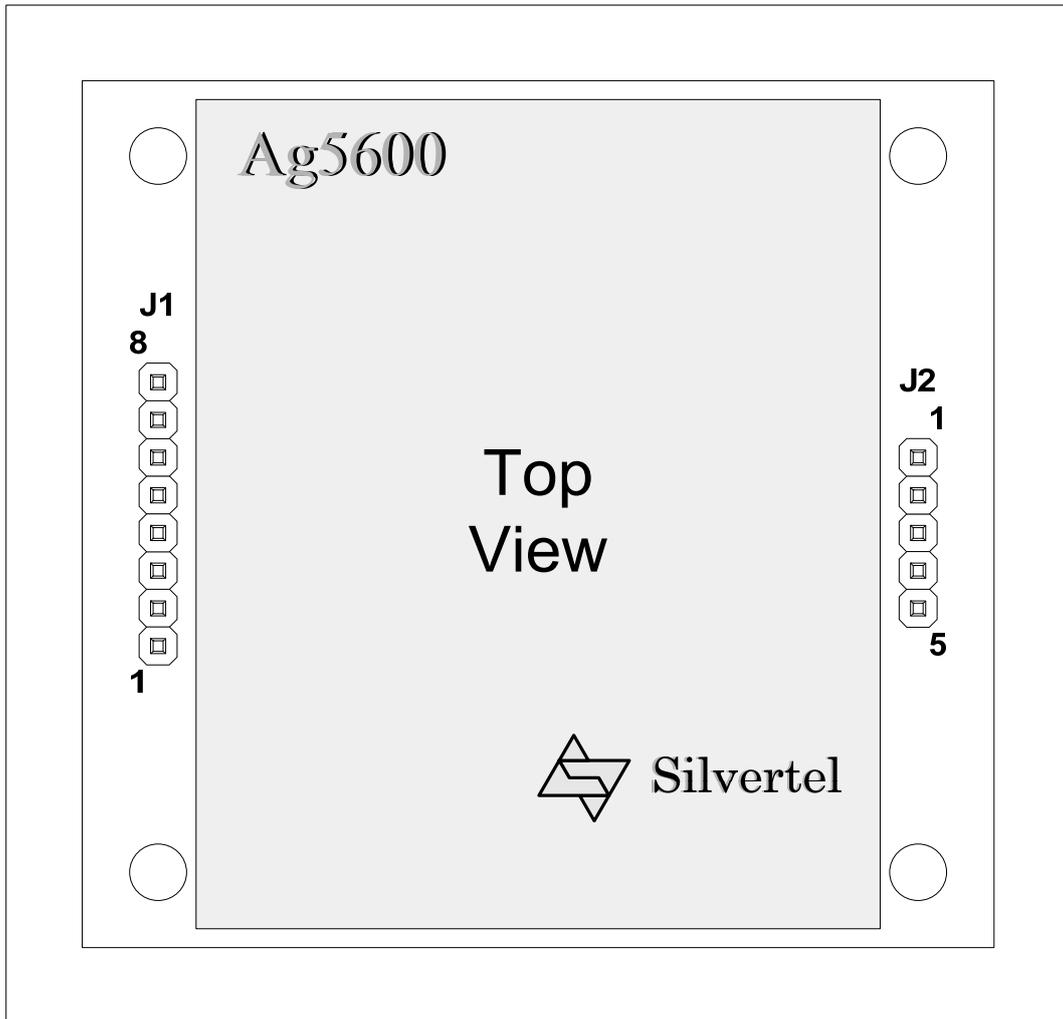
\*At 25°C with heatsink

† The Ag5600 fully meets the requirements of the RoHS directive 2002/95/EC on the restriction of hazardous substances in electronic equipment.

**Table 1: Ordering Information**



**Figure 1: Block Diagram**



**Figure 2: Ag5600 DIL Package Format (Top View)**

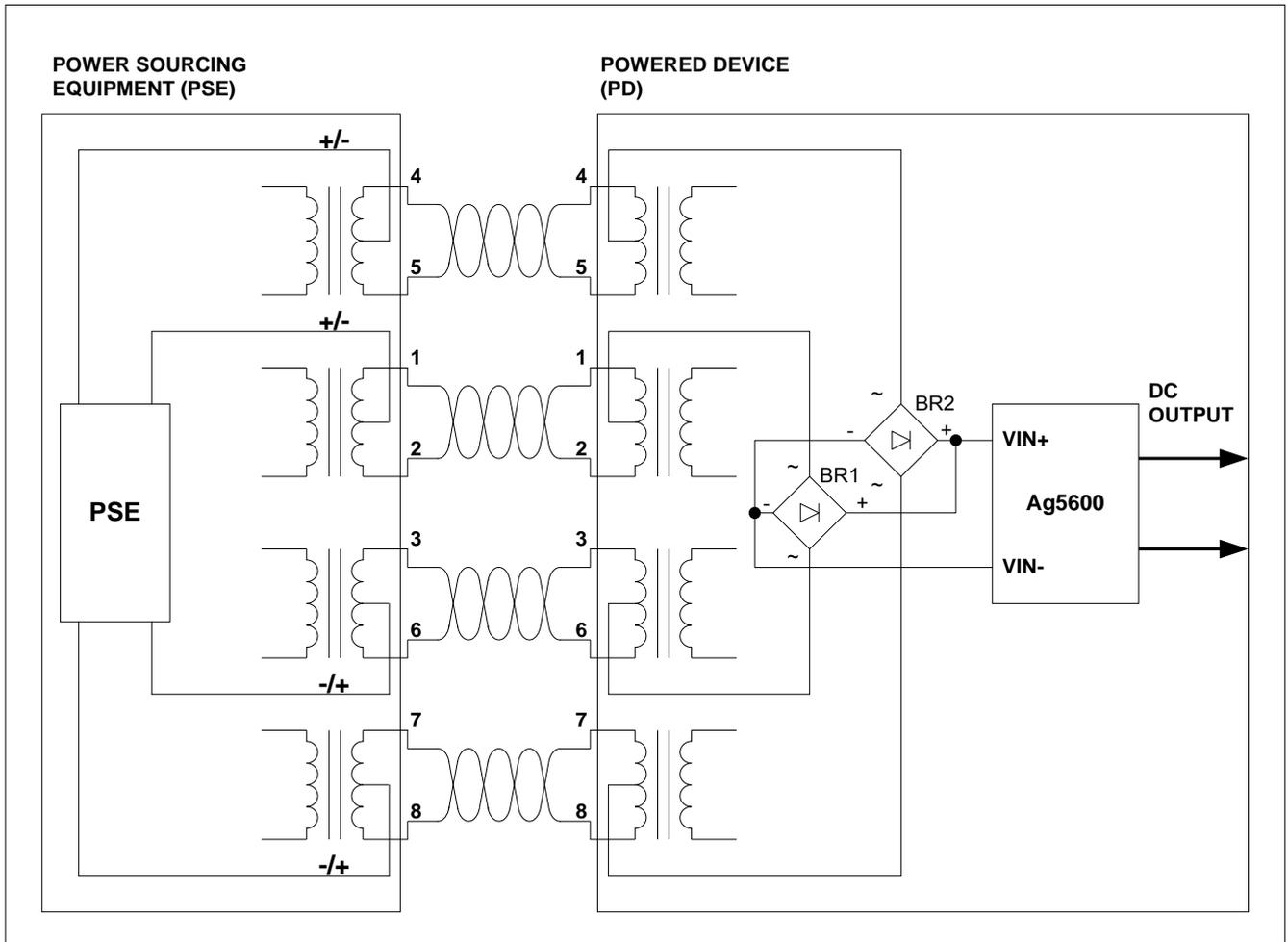
## 4 Pin Description

Pin #	Name	Description
J1		
1	VIN+	<b>Direct Input +.</b> This pin connects to the positive (+) output of the input bridge rectifiers.
2		
3	AT-DET1	<b>Single AT Detect Output.</b> This pin indicates if an IEEE802.3at PSE is supplying power to one input, see Section 5.4 for more details.
4	AT-DET2	<b>Dual AT Detect Output.</b> This pin indicates if an IEEE802.3at PSE is supplying power to both inputs, see Section 5.4 for more details.
5	PoH-DET1	<b>Single PoH Detect Output.</b> This pin indicates if a PoH PSE is supplying power to one input, see Section 5.4 for more details.
6	PoH-DET2	<b>Dual PoH Detect Output.</b> This pin indicates if an PoH PSE is supplying power to both input, see Section 5.4 for more details.
7	VIN-	<b>Direct Input -.</b> This pin connects to the negative (-) output of the input bridge rectifiers.
8		
J2		
1	VOUT	<b>DC Output.</b> This pin provides the main regulated output from the DC/DC converter.
2		
3	ADJ	<b>Output Adjust.</b> The output voltage can be adjusted from its nominal value, by connecting an external resistor from this pin to either the VOUT pin or the 0V pin.
4	0V	<b>Ground.</b> The ground return for the VOUT output.
5		

## 5 Functional Description

### 5.1 Inputs

The Ag5600 has input pins VIN+ and VIN-, these must be connected to external bridge rectifiers to ensure the input is polarity protected, see Figure 3: Typical System Diagram.



**Figure 3: Typical System Diagram**

### 5.2 PD Signature

The input Signature complies with IEEE802.3af, IEEE802.3at and HDBaseT (draft) specifications. When the input is connected to a Power Sourcing Equipment (PSE) via a Cat 5e or Cat 6 cable, it will automatically present a Powered Device (PD) signature to the PSE (when requested). The equipment will then recognise that a PD is connected to that line and supply power.

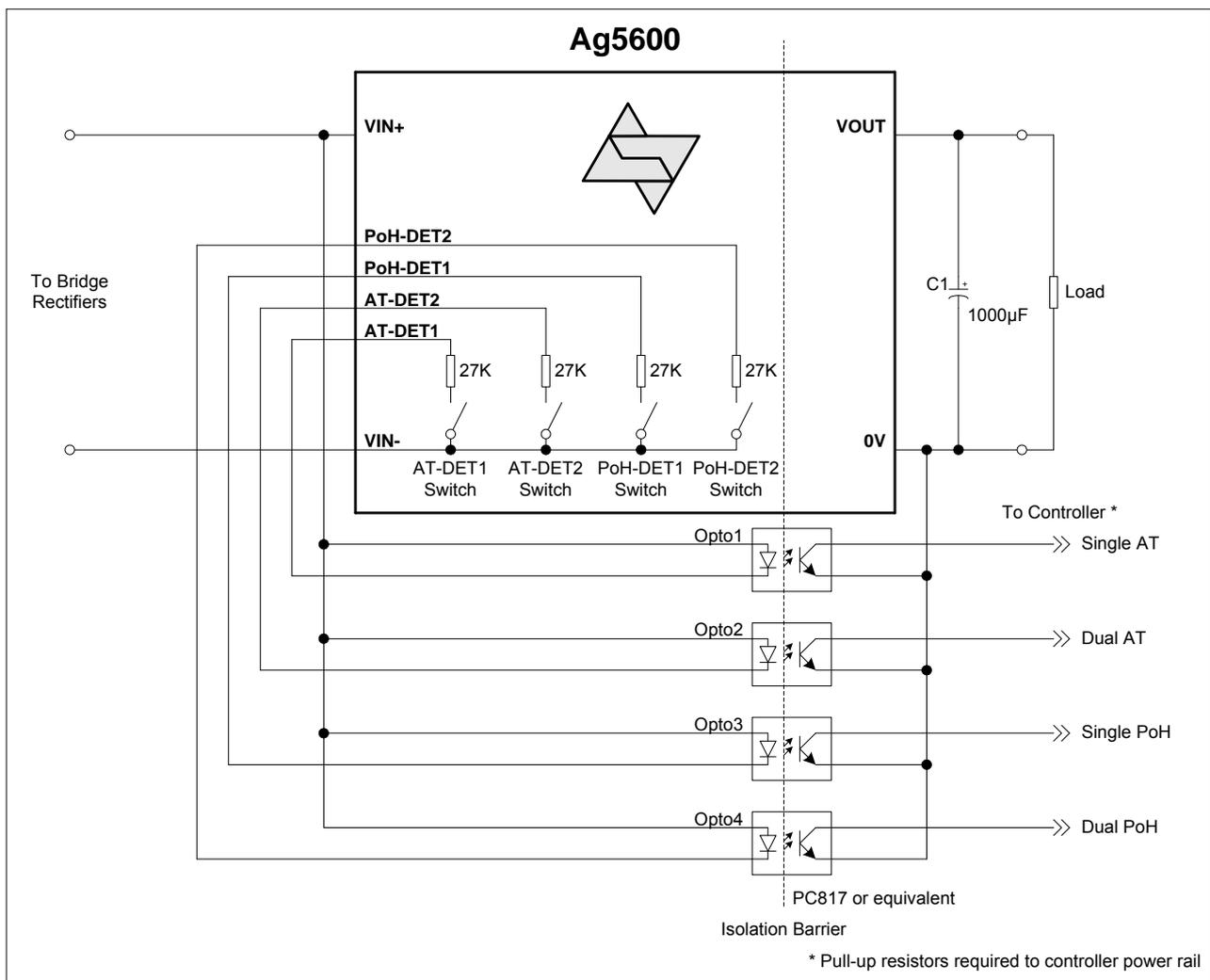
### 5.3 Power Classification

The Ag5600 classification is fixed at Class 4, this means that an IEEE802.3at Type 1 or an IEEE802.3af PSE will default to Class 0. For HDBaseT PSE and IEEE802.3at Type 2 PSE the Ag5600 will be recognised as Class 4.

### 5.4 PSE Type Detection

The Ag5600 has four output pins which are used to identify the Type of PSE connected to its input.

Each output pin can be connected directly to an opto-coupler, so that the output can cross the isolation barrier, as shown in Figure 4.



**Figure 4: 2 - Event Physical Layer Detect Configuration**

If an IEEE802.3af PSE is connected, the Ag5600 will power up but none of the detect outputs will be active.

If a standard IEEE802.3at PSE is connected, the AT-DET1 pin will be active and Opto1 will turn ON.

If a dual IEEE802.3at PSE is connected, the AT-DET2 pin will be active and Opto2 will turn ON.

If a standard PoH PSE is connected, the PoH-DET2 pin will be active and Opto4 will turn ON.

If one of the PoH inputs is not connected (or a proprietary single output PoH PSE is connected), the PoH-DET1 pin will be active and Opto3 will turn ON.

It is important to remember that Ag5600's output is limited to the capability of the PSE.

## **5.5 Isolation**

To meet the safety isolation requirements of IEEE802.3at section 33.4.1 a PD must pass the electrical strength test of IEC 60950-1:2001 sub clause 6.2.1. This calls for either a) 1500Vac test or b) 2250Vdc test or c) 1500Vdc impulse test. The Ag5600 has been designed to meet c) 1500Vdc impulse test.

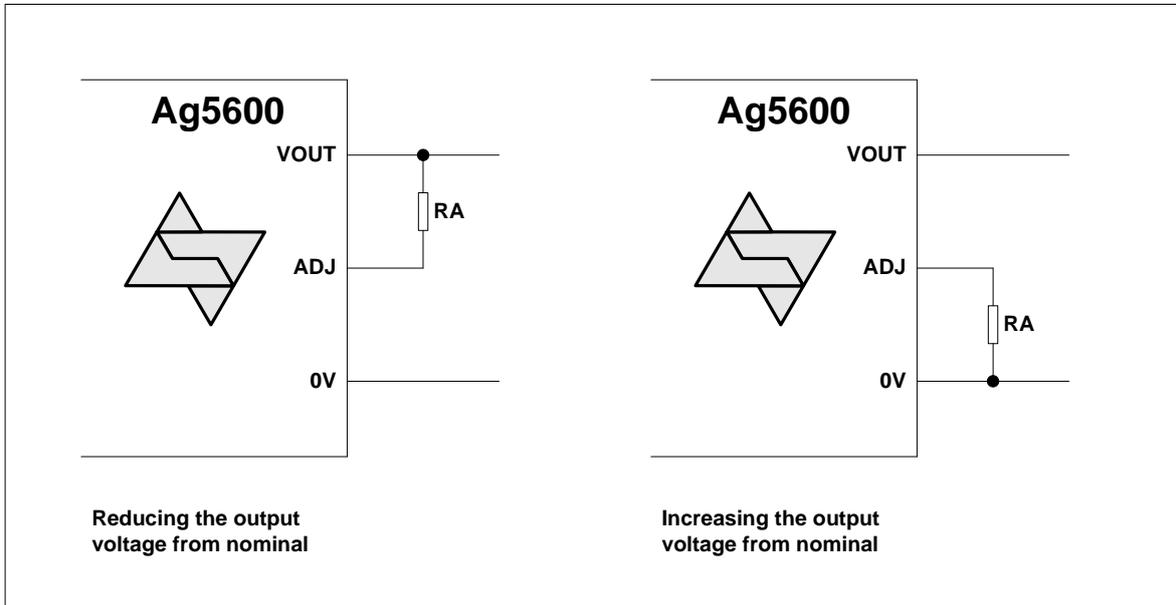
## **5.6 DC/DC Converter**

The Ag5600's DC/DC converter provides a regulated low ripple and low noise output that has built-in over-load and short-circuit output protection.

## 5.7 Output Adjustment

The Ag5600 has an ADJ pin, which allows the output voltage to be increased or decreased from its nominal value.

Figure 5: Output Adjustment Figure 5 shows how the ADJ pin is connected: -



**Figure 5: Output Adjustment**

<b>Reducing the output voltage, connect RA between ADJ and VOUT</b>	
Value of RA	VOUT
Open Circuit	24V
36K	17.5V
<b>Increasing the output voltage, connect RA between ADJ and 0V</b>	
Value of RA	VOUT
Open Circuit	24V
0R	30.8V

**Table 2: Output Adjustment Resistor (R) Value**

## 5.8 Output Power

The Ag5600 is capable of delivering a maximum output power of 85W continuous / 100W peak; however this is limited by the available input power to the module.

When calculating the output power, the following factors must be taken into account: -

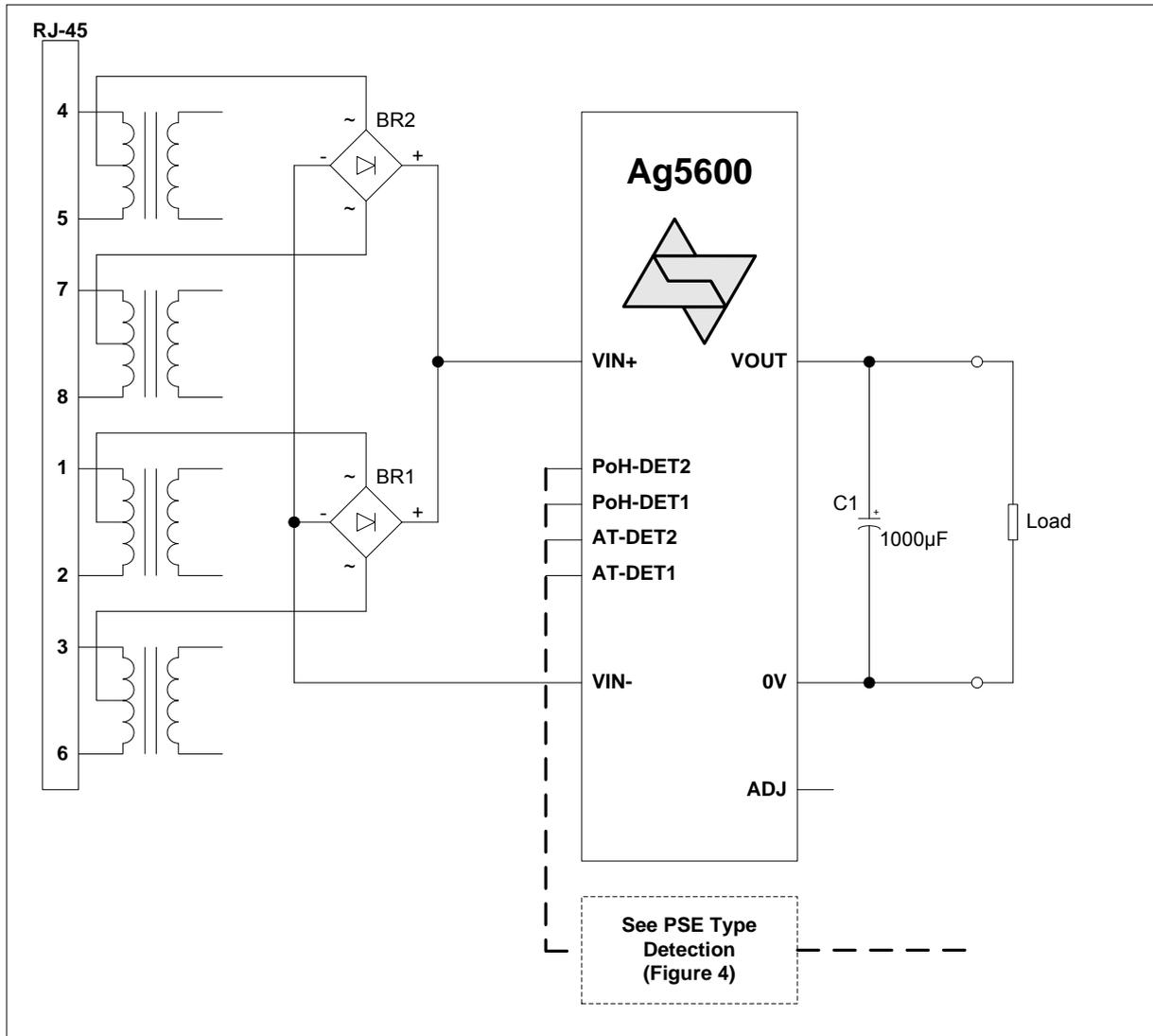
1. Ag5600 efficiency
2. PSE output power
3. Cable and connector losses
4. Input bridge rectifier losses

## 5.9 Typical Connections

Figure 6 shows the typical configuration of the Ag5600. A minimum of 1000 $\mu$ F must be connected across the output for output stability and positioned as close to the pins as possible. This capacitor is also needed for step load change performance and can be a standard low cost electrolytic. It does not need to be a low ESR type, unless the ambient temperature is  $\leq 0^{\circ}\text{C}$ .

**Note:** When connecting to an IEEE802.3af PSE, too much capacitance can cause the PSE to shut-down as it may not be able to handle the in-rush current.

The Output Adjust input is optional and is provided to give great flexibility to the Ag5600. Further information on using this input can be found in section Output Adjustment.



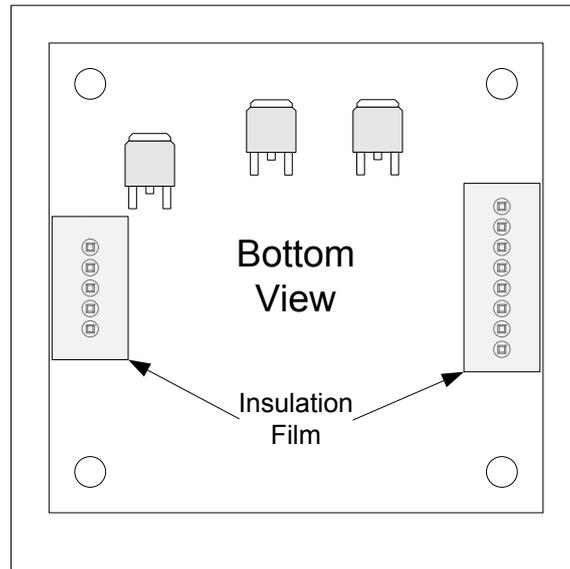
**Figure 6: Typical Connection Diagram**

## 6 Operating Temperature Range

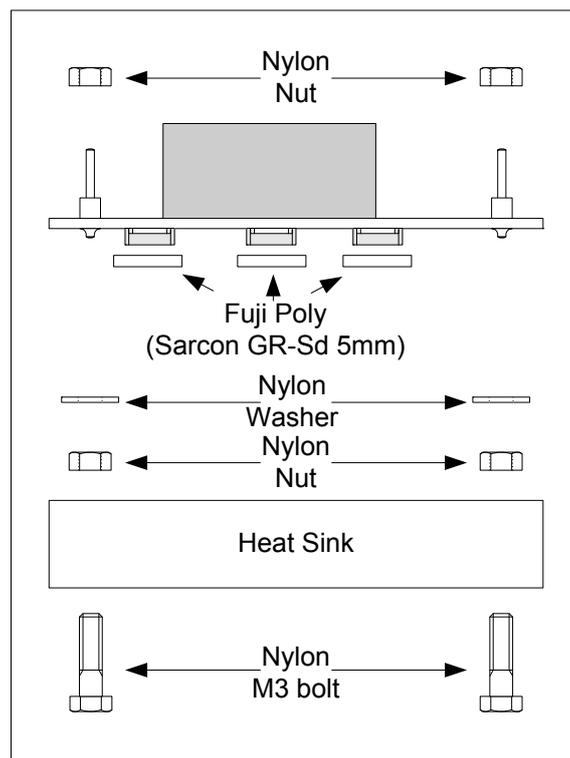
It is important to remember that Ag5600 is a power supply, and as such careful consideration should be taken over the mechanical design of the host product, with provision for heat sinking and/or forced air cooling.

At full power the Ag5600 will generate approximately 11W of heat. The device has been designed to be used with heat-sink plate such as Aavid Thermalloy heat sink 241204B91200G, or thermally connected to the chassis of the host equipment, or cooled with forced air.

Below is a suggested mounting method for this type of heat sink.



**Figure 7: Module Pin Isolation (bottom view)**

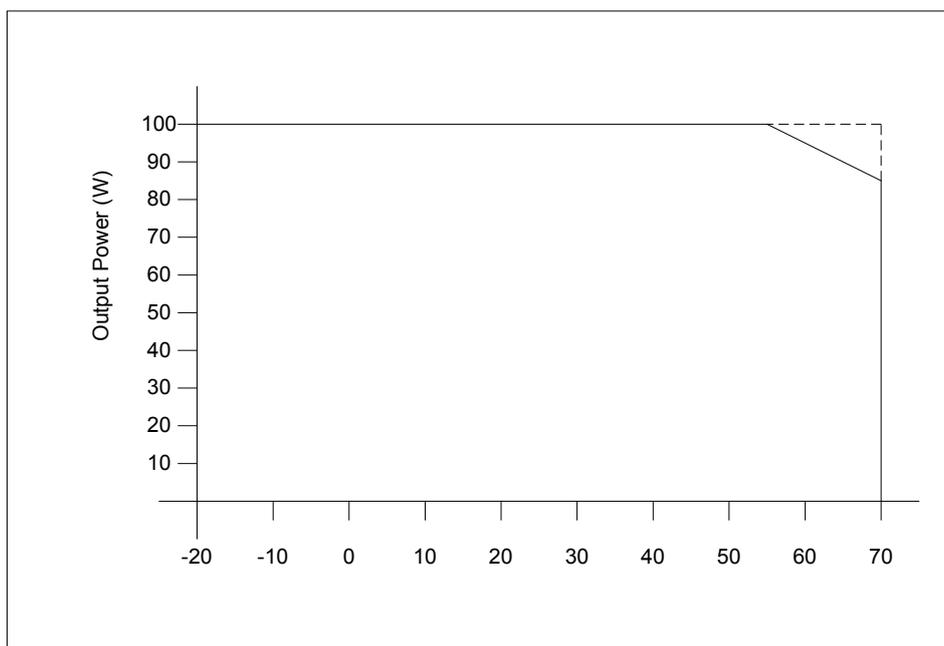


**Figure 8: Suggested Heat Sink Assembly**

The output stage of the Ag5600 has a built-in thermal protection circuit, to prevent the module from being damaged if operated beyond its power / temperature specification.

Because each application is different it is impossible to give fixed and absolute thermal recommendations. However it is important that any enclosure used has sufficient ventilation for the Ag5600 and a direct airflow if possible.

The results shown in Figure 9 were measured inside an Associated Environmental System SD-302 chamber. The solid line shows the performance with an Aavid Thermalloy heat sink (241204B91200G) fitted. The dotted line shows how the thermal performance can be extended by directly blowing air over the module with a fan. In this example an EMBPAPST – RLF35-8/14N was used.



**Figure 9: Ag5600 Operating Profile with Heatsink**

## 7 Protection

The Ag5600 must be protected from over-voltages exceeding the 80V maximum rated surge input voltage. An inexpensive but effective solution can be achieved by connecting Tranzorb diodes across each of the inputs; see Apps Note “ANX-POE-Protection”.

## 8 Electrical Characteristics

### 8.1 Absolute Maximum Ratings<sup>1</sup>

	Parameter	Symbol	Min	Max	Units
1	DC Supply Voltage	$V_{CC}$	-0.3	60	V
2	DC Supply Voltage Surge for 1ms	$V_{SURGE}$	-0.6	80	V
3	Storage Temperature	$T_S$	-40	+100	°C

Note 1: Exceeding the above ratings may cause permanent damage to the product. Functional operation under these conditions is not implied. Maximum ratings assume free airflow.

### 8.2 Recommended Operating Conditions

	Parameter	Symbol	Min	Typ	Max	Units
1	Input Supply Voltage <sup>1</sup>	$V_{IN}$	36		57	V
2	Under Voltage Lockout	$V_{LOCK}$	30		36	V
3	Operating Temperature <sup>2</sup>	$T_{OP}$	-20	25	70	Ta / °C

Note 1: With minimum load

2: See Section Operating Temperature Range

### 8.3 DC Electrical Characteristics

	DC Characteristic	Sym	Min	Typ <sup>1</sup>	Max	Units	Test Comments
1	Input Voltage Range at Full Load	$V_{INFL}$	52	56	57	V	
2	Nominal Output Voltage	+VDC	22.8	24	25.2	V	
3	Voltage Adjust Range	$V_{ADJMIN}$		17.5		V	See Output Adjustment
		$V_{ADJMAX}$		30.8		V	See Output Adjustment
4	Output Current <sup>2</sup> ( $V_{IN} = 56V$ )	$I_{OUT}$			4.17	A	
5	Line Regulation	$V_{LINE}$		0.038		%	@ 50% Load
6	Load Regulation	$V_{LOAD}$		0.177		%	
7	Output Ripple and Noise	$V_{RN}$		260		mVp-p	@ Max load <sup>3</sup>
8	Minimum Load <sup>4</sup>	$R_{LOAD}$	0			mA	
9	Short-Circuit Duration	$T_{SC}$			∞	sec	
10	Efficiency	EFF		90		%	50% Load
11	Isolation Voltage (I/O)	$V_{ISO}$			1500	$V_{PK}$	Impulse Test

Note 1: Typical figures are at 25°C with a nominal 56V supply, parallel output configuration (unless otherwise stated) and are for design aid only. Not Guaranteed

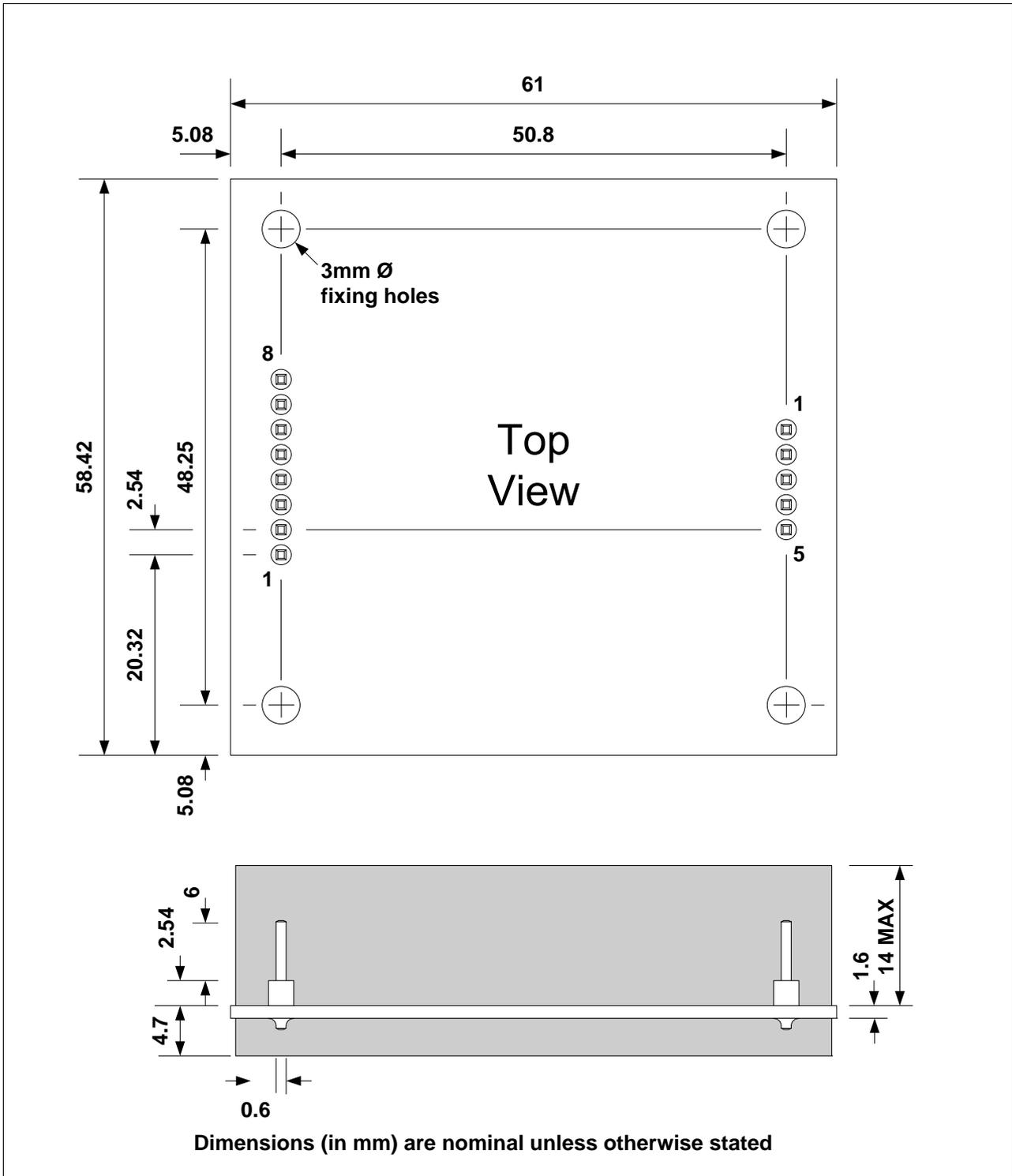
2: The output will be limited by the available power from the PSE.

3: The output ripple and noise can be reduced with an external filter, see application note.

4: The Ag5600 has been designed to work normally when no load is connected.

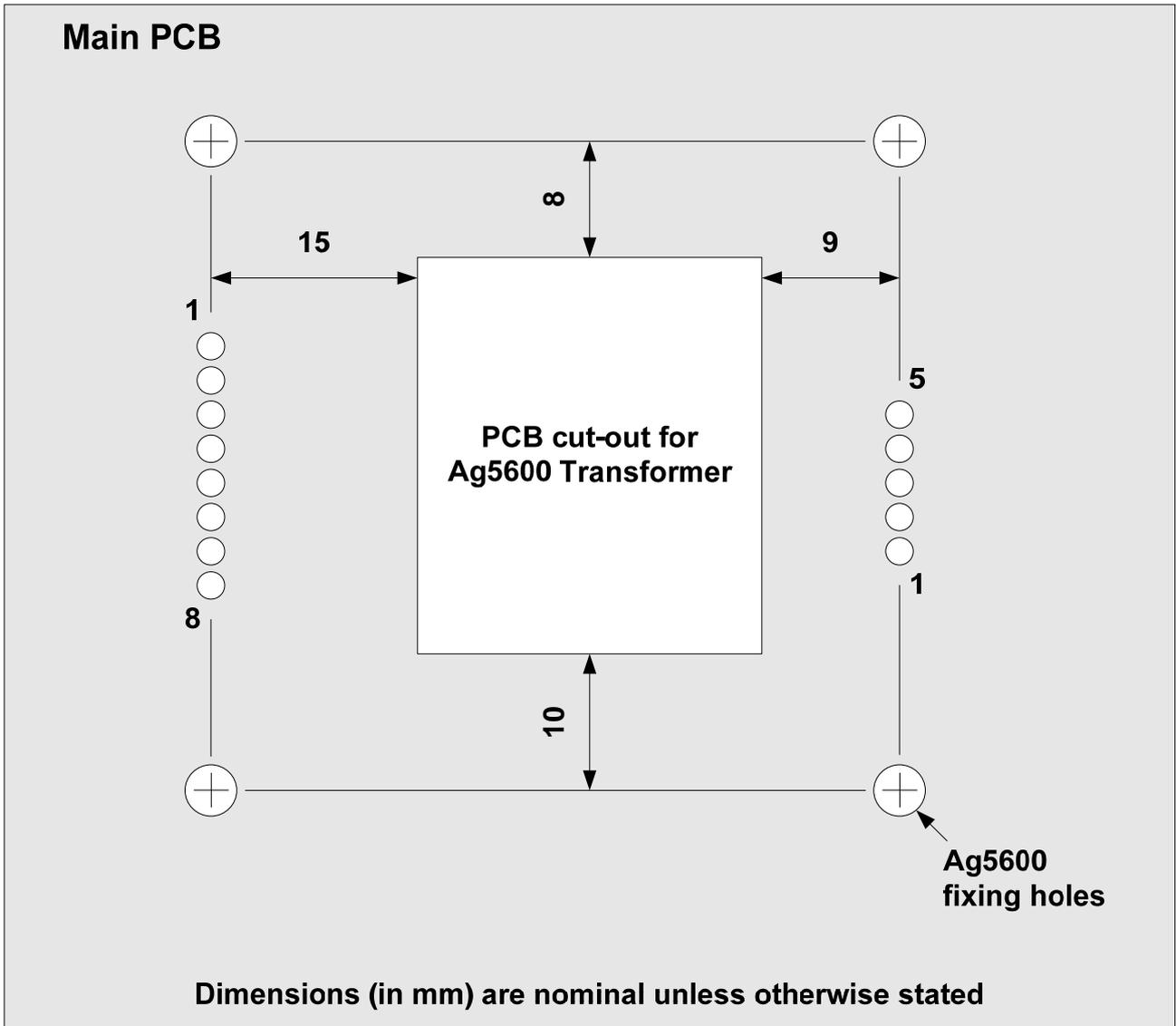
## 9 Package

### 9.1 Ag5600



## 9.2 PCB Cut-out for Ag5600 Transformer

The drawing shown below details the cut-out dimension of the host PCB for the Ag5600 transformer.



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