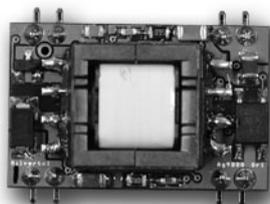




Ag9812M

Miniature PoE Module



1. Features

- Small SMT package
- IEEE802.3af compliant
- Low cost
- Input voltage range 36V to 57V
- Minimal external components required
- Short-circuit protection
- Adjustable Output
- 1500V isolation (input to output)
- Silvertel "design-in" assistance

2. Description

The Ag9812M Power-over-Ethernet (PoE) modules are designed to extract power from a conventional twisted pair Category 5 Ethernet cable, conforming to the IEEE 802.3af PoE standard.

The Ag9812M signature and control circuit provides the PoE compatibility signature required by the Power Sourcing Equipment (PSE) before applying up to 15W power to the port. The Ag9812M provides a Class 0 signature, classification programmable versions are available on request.

The DC/DC converter operates over a wide input voltage range and provides a regulated output. The DC/DC converter also has built-in short-circuit output protection.

Table of Contents

1. Features	1
2. Description.....	1
Table of Contents.....	2
Table of Figures	2
3. Ag9812M Product Selector.....	3
4. Pin Description	4
4.1 Ag9812M.....	5
5. Functional Description	6
5.1 Inputs.....	6
5.2 PD Signature	6
5.3 Isolation	6
5.4 Power Classification	7
5.5 DC/DC Converter	7
5.6 Output Adjustment.....	7
5.7 Typical Connections	8
5.8 Additional Output Filtering	10
5.9 Start-up Power.....	10
6. Typical Application.....	11
7. Operating Temperature Range.....	12
8. Protection	13
9. EMC.....	13
10. Electrical Characteristics.....	14
10.1 Absolute Maximum Ratings ¹	14
10.2 Recommended Operating Conditions.....	14
10.3 DC Electrical Characteristics	14
11. Package	15

Table of Figures

Figure 1: Block Diagram	3
Figure 2: Ag9812M SMT Package Format.....	4
Figure 3: Typical System Diagram.....	6
Figure 4: Output Adjustment	7
Figure 5: Typical Connection Diagram.....	9
Figure 6: Output Filtering	10
Figure 7: Typical Application.....	11
Figure 8: Ag9812M Operating Profile	12
Figure 9: Ag9812M Input Protection	13

3. Ag9812M Product Selector

Part Number†	Nominal Output Voltage	Maximum Output Power *	Marking
Ag9812M	12.0V	12 Watts	12

*At 25°C with $V_{IN} = 48V$

† The Ag9812M fully meets the requirements of the RoHS directive 2011/65/EC on the restriction of hazardous substances in electronic equipment.

Table 1: Ordering Information

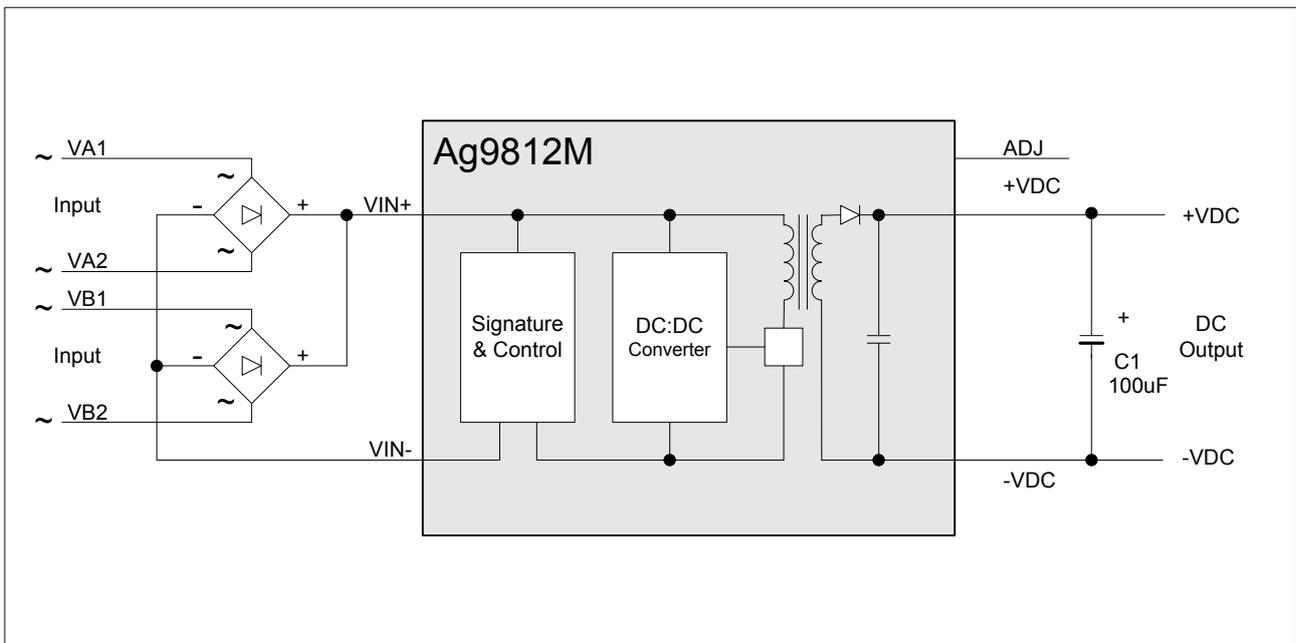


Figure 1: Block Diagram

4. Pin Description

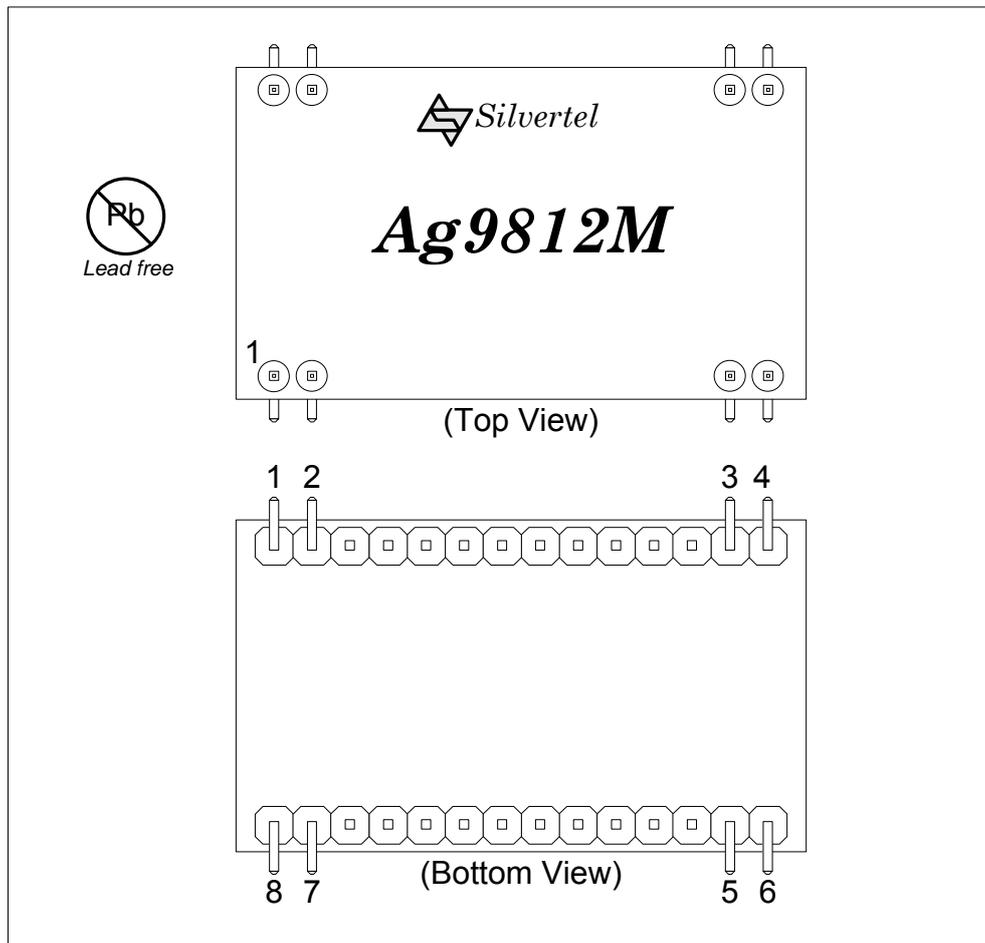


Figure 2: Ag9812M SMT Package Format

4.1 Ag9812M

Pin #	Name	Description
1	+VDC	DC Output. This pin provides the regulated output from the DC/DC converter.
2		
3	-VDC	DC Return. This pin is the return path for the +VDC output.
4	ADJ	Output Adjust. The output voltage can be adjusted from its nominal value, by connecting an external resistor from this pin to either the +VDC pin or the -VDC pin.
5	VIN+	Direct Input +. This pin connects to the positive (+) output of the input bridge rectifiers.
6		
7	VIN-	Direct Input -. This pin connects to the negative (-) output of the input bridge rectifiers.
8		

Table 2: Pin Description

5. Functional Description

5.1 Inputs

The Ag9812M is compatible with equipment that uses Alternative A (power on data pair) or Alternative B (power on spare pair) options, see Figure 3. It is specified that the PSE does not apply power to both outputs at the same time (Refer to IEEE802.3af for more information).

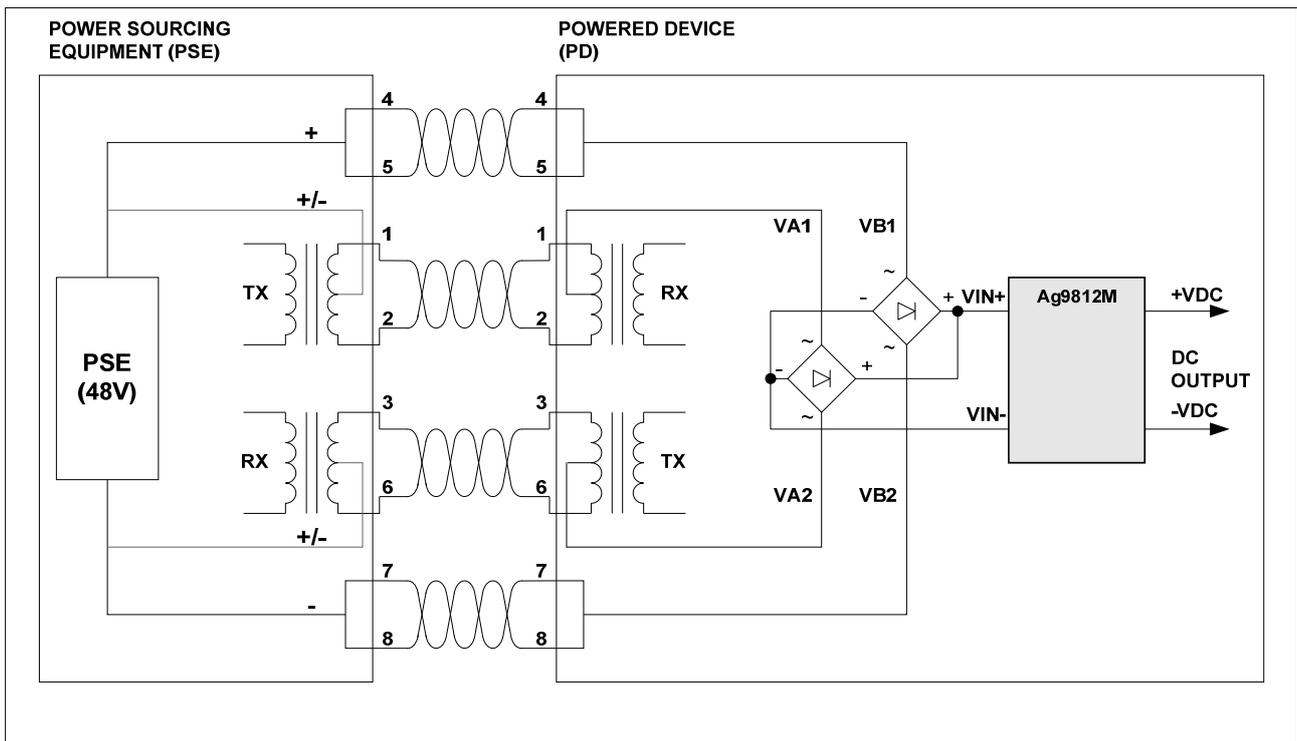


Figure 3: Typical System Diagram

5.2 PD Signature

When the Ag9812M is connected to the Cat5e cable, it will automatically present a Powered Device (PD) signature to the Power Sourcing Equipment (PSE) or Midspan Equipment, when requested. The equipment will then recognise that a powered device is connected to that line and supply power.

5.3 Isolation

To meet the safety isolation requirements of IEEE802.3af section 33.4.1 a Powered Device (PD) must pass the electrical strength test of IEC 60950 sub clause 6.2. This calls for either a) 1500Vac test or b) 1500V impulse test. The Ag9812M is specified to meet the 1500Vdc impulse test. It is also important that the tracks on either side of the isolation barrier have at least a 3mm clearance, see Figures 9 & 10 and Section 12 for more information.

5.4 Power Classification

To minimise cost, the Ag9812M is fixed for Class 0 (0.44 Watts to 12.95 Watts) operation, however class programmable versions are available on request. Please contact Silvertel, or your local agent for more information.

5.5 DC/DC Converter

The Ag9812M's DC/DC converter provides a regulated output that has built-in short-circuit output protection – refer Table 1: Ordering information for voltage and power ratings.

5.6 Output Adjustment

The Ag9812M has an ADJ pin, which allows the output voltage to be increased or decreased from its nominal value. Figure 4: Output Adjustment shows how the ADJ pin is connected.

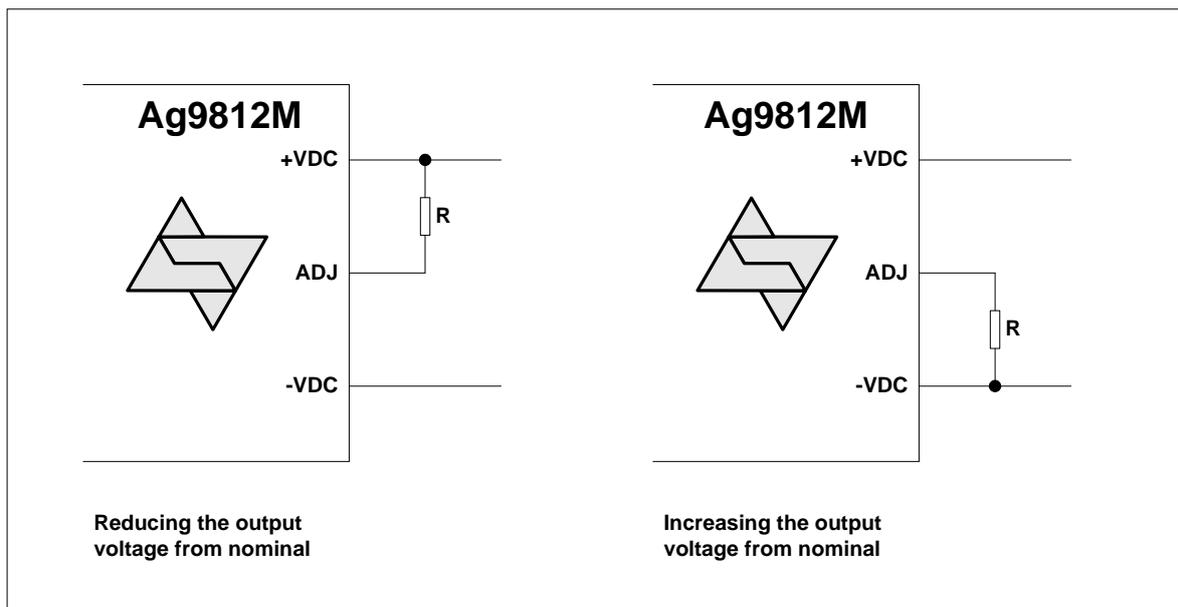


Figure 4: Output Adjustment

Reducing the output voltage, connect R between ADJ and +VDC	
Value of R	Output
Open	12.00V
0 Ohms	10V
Increasing the output voltage, connect R between ADJ and -VDC	
Value of R	Output
Open	12.00V
0 Ohms	12.62V

Table 3: Output Adjustment Resistor (R) Value

5.7 Typical Connections

The Ag9812M requires minimal external components as shown in Figure 5: Typical Connection Diagram.

C1 must be fitted for output stability and should be a minimum of 100 μ F. This capacitor should be positioned as close to the output pins as possible. C1 is also required to handle load step change and reduce the output ripple. For applications where the output needs to cope with high load step changes, or to reduce the output ripple. The value of C1 may need to be increased to a minimum of 470 μ F. This can be a standard low cost electrolytic, but by using a low ESR electrolytic this would reduce the ripple. A low ESR capacitor is recommended for operation below 0°C.

BR1 and BR2 can be inexpensive bridge rectifiers, for example MB4S or MB6S.

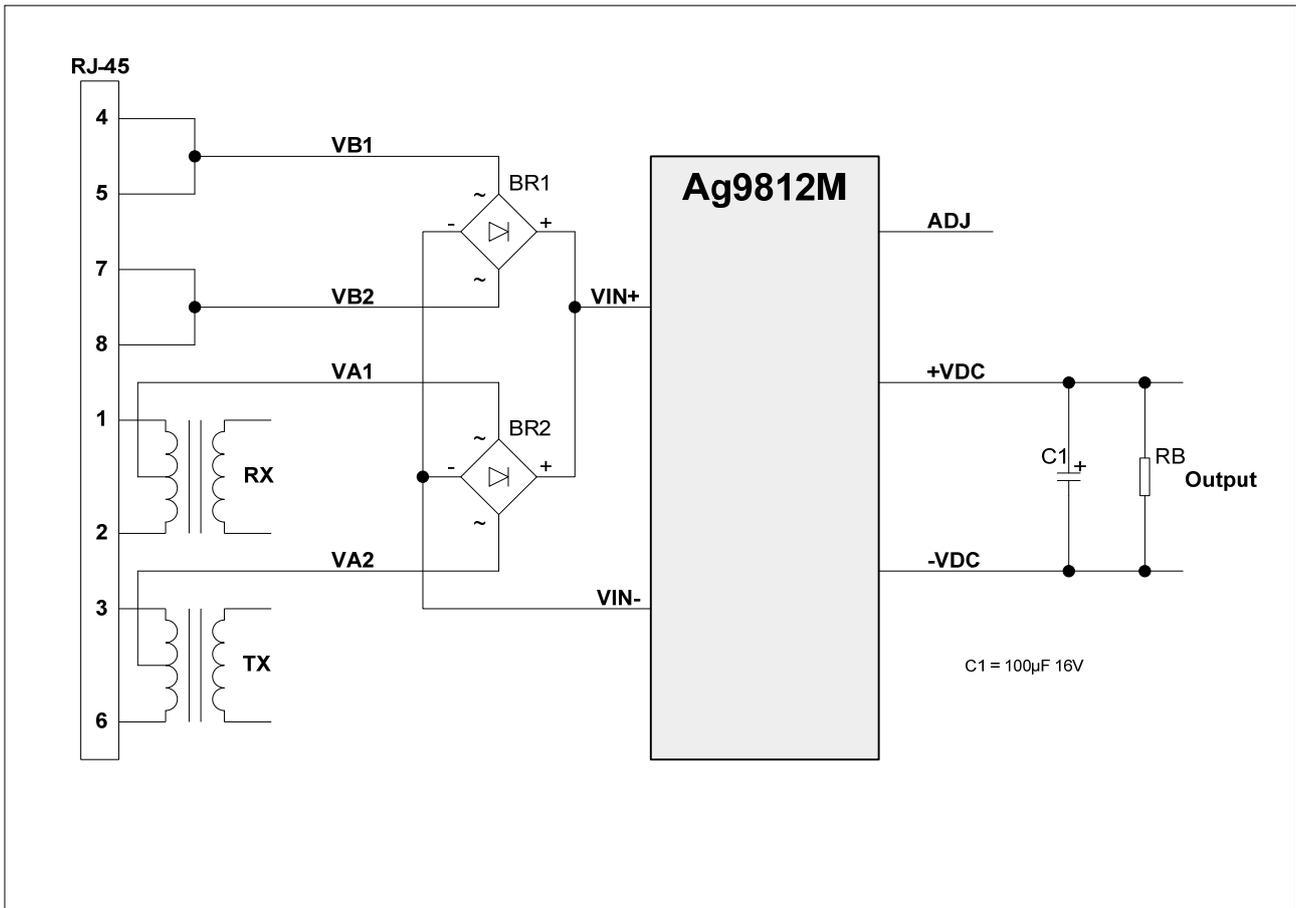


Figure 5: Typical Connection Diagram

The output adjust input (ADJ) is optional, it is provided to give greater flexibility to the Ag9812M product range. Further information on using these inputs can be found in Section 5.6.

The Ag9812M must always supply a minimum current, see Table 11.3. When operated below this level the Ag9812M will emit a low level audible noise. The reason that the module emits this noise is due to the dc/dc converter running in discontinuous mode.

If this audible noise is not an issue, then the Ag9812M can work safely with a much smaller load. But to ensure that the PSE has a sufficient load to meet its Maintain Power Signature (MPS), it would be advisable not to operate the Ag9812M below the specified minimum load.

5.8 Additional Output Filtering

The Ag9812M as shown in Figure 5, offers basic output filtering for ripple and noise; which at maximum load this is typically 160mVp-p. Figure 6 shows two cost effective methods for reducing the ripple and noise, if required.

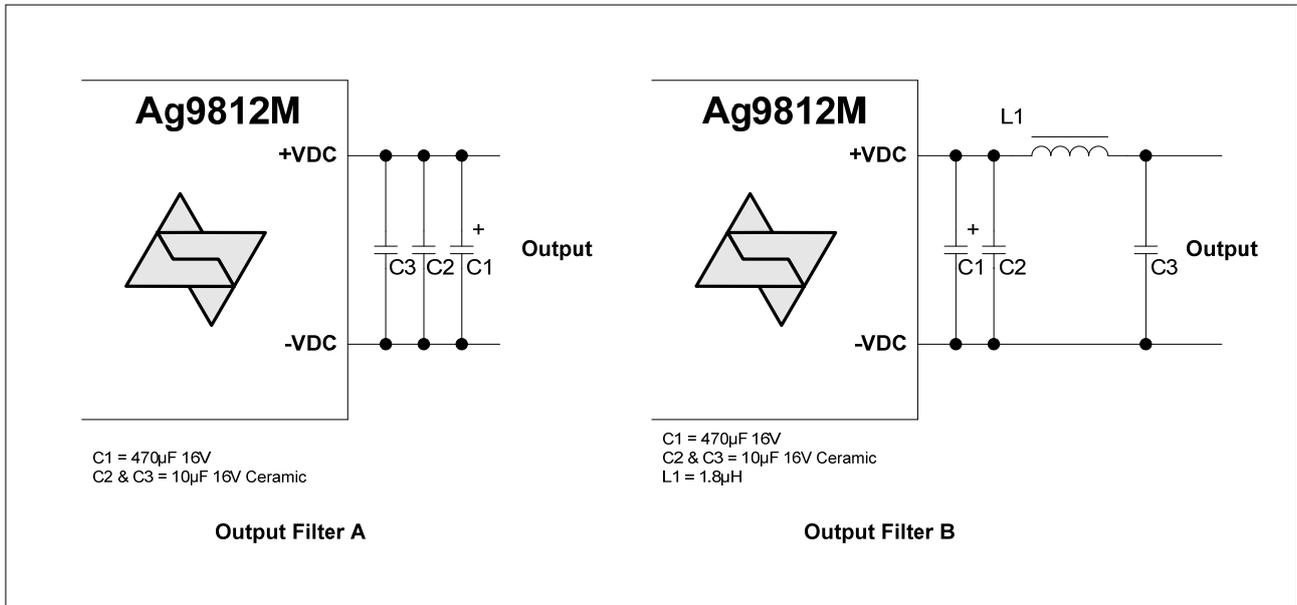


Figure 6: Output Filtering

The simplest and cheapest solution is shown in Figure 6 - Output Filter A. This will reduce the ripple and noise to typically 45mVp-p. Adding a PI filter, as shown in Figure 6 – Output Filter B, will take the ripple and noise level down to typically 16mVp-p. A low ESR electrolytic is recommended for operation below 0°C.

5.9 Start-up Power

It is important that during start-up the Ag9812M input voltage is $\geq 42V$, this will ensure that the module powers up correctly. Once the dc/dc converter is up and running the module will work normally even if the input voltage is reduced to its minimum level of 36V.

When using an IEEE802.3af compliant PSE this will not be an issue, as the minimum output voltage of the PSE must be $\geq 44V$.

6. Typical Application

The Ag9812M can be used in numerous applications. In the example shown in Figure 7, the data outputs from the switch are connected to the inputs of a midspan. The midspan will then add power (to the data) on each output that supports Power over Ethernet (PoE).

In this example port 1 is connected to an Ethernet camera and port 2 is connected to a wireless access point, both of these devices have a built-in Ag9812M. When the midspan is switched on (or when the device is connected), the midspan will check each output for a PoE signature. On ports 1 and 2 the Ag9812M will identify themselves as PoE enabled devices and the midspan will supply both data and power to these peripherals.

The other ports (shown in this example) will not have a PoE signature and the midspan will only pass the data through to these peripherals. The midspan will continuously monitor each output to see if a PoE enabled device has been added or removed.

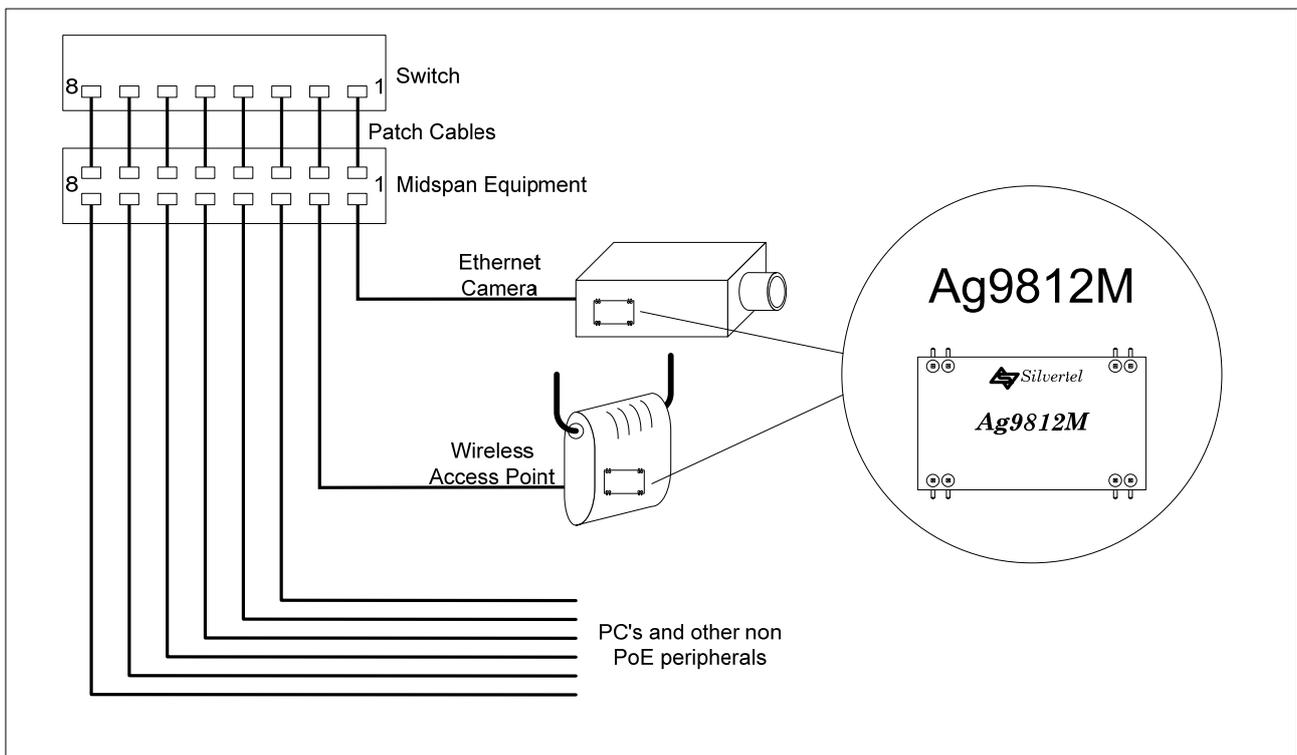


Figure 7: Typical Application

7. Operating Temperature Range

Because the Ag9812M is a power component, it will generate heat, so it is important that this be taken into consideration at the design stage.

The heart of the Ag9812M is a DC/DC converter, which like any other power supply will generate heat. The amount of heat generated by the module will depend on the load it is required to drive and the input voltage supplied by the PSE. The information shown within this section of datasheet is referenced to a nominal 48Vdc input voltage supplied by the PSE.

The Ag9812M has a maximum ambient operating temperature of 70°C see Figures 8. These results were performed in an environment chamber - Associated Environmental System SD-302, without any heat-sinking. The performance of the Ag9812M can be improved by forcing the airflow directly over the part or by using a heatsink (see application note on heat-sinking for more information).

The output stage of the Ag9812M has no built-in thermal protection. To prevent the module from being damaged it is recommended that the module be powered by an IEEE 802.3af compliant PSE or Midspan equipment. However the Ag9812M may be powered by a user designed power supply which should include thermal and over current protection and be current limited to 400mA.

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 Ag9812M and a direct airflow if possible.

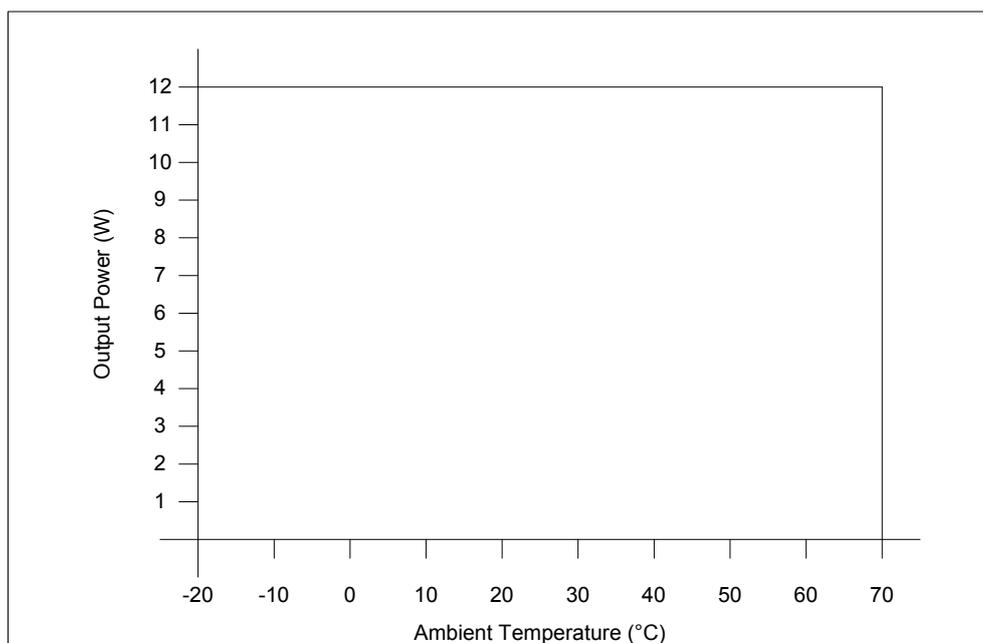


Figure 8: Ag9812M Operating Profile

It is important to remember that the ESR of the external electrolytic capacitors will increase considerably when the ambient temperature falls below 0°C. If the Ag9812M is going to be used in applications where the ambient temperature can fall below 0°C, selection of appropriate output filter components must be done at the design stage.

8. Protection

The Ag9812M must be protected from over-voltages exceeding the 80V maximum rated surge input voltage. An inexpensive but effective solution can be achieved by connecting a Tranzorb diode across the input; see Figure 9.

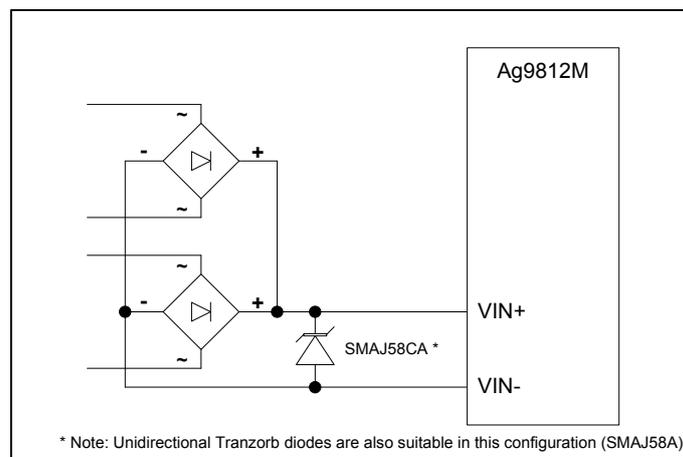


Figure 9: Ag9812M Input Protection

More information is available in App Note “ANX-POE-Protection”.

9. EMC

The Ag9812M is designed to meet EN55022 Class B (pre-compliance test results are available from Silvertel).

However, because the Ag9812M will only be one component within your system, it is impossible to say whether the final product will pass EMC testing, without the need for additional filtering. The Ag9812M uses a dc/dc converter with pulse frequency modulation, so care does need to be taken to minimise emissions.

To help with this an App Note “ANX-POE-EMI” has been written with tips and suggestions.

10. Electrical Characteristics

10.1 Absolute Maximum Ratings¹

	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	$^{\circ}C$

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.

10.2 Recommended Operating Conditions

	Parameter	Symbol	Min	Typ	Max	Units
1	Input Supply Voltage ¹	V_{IN}	36	48	57	V
2	Under Voltage Lockout	V_{LOCK}	30		36	V
3	Operating Temperature ^{2,3}	T_{OP}	-20	25	70	$T_a / ^{\circ}C$

Note 1: With minimum load

2: See Section Operating Temperature Range

3: Industrial Temperature version also available

10.3 DC Electrical Characteristics

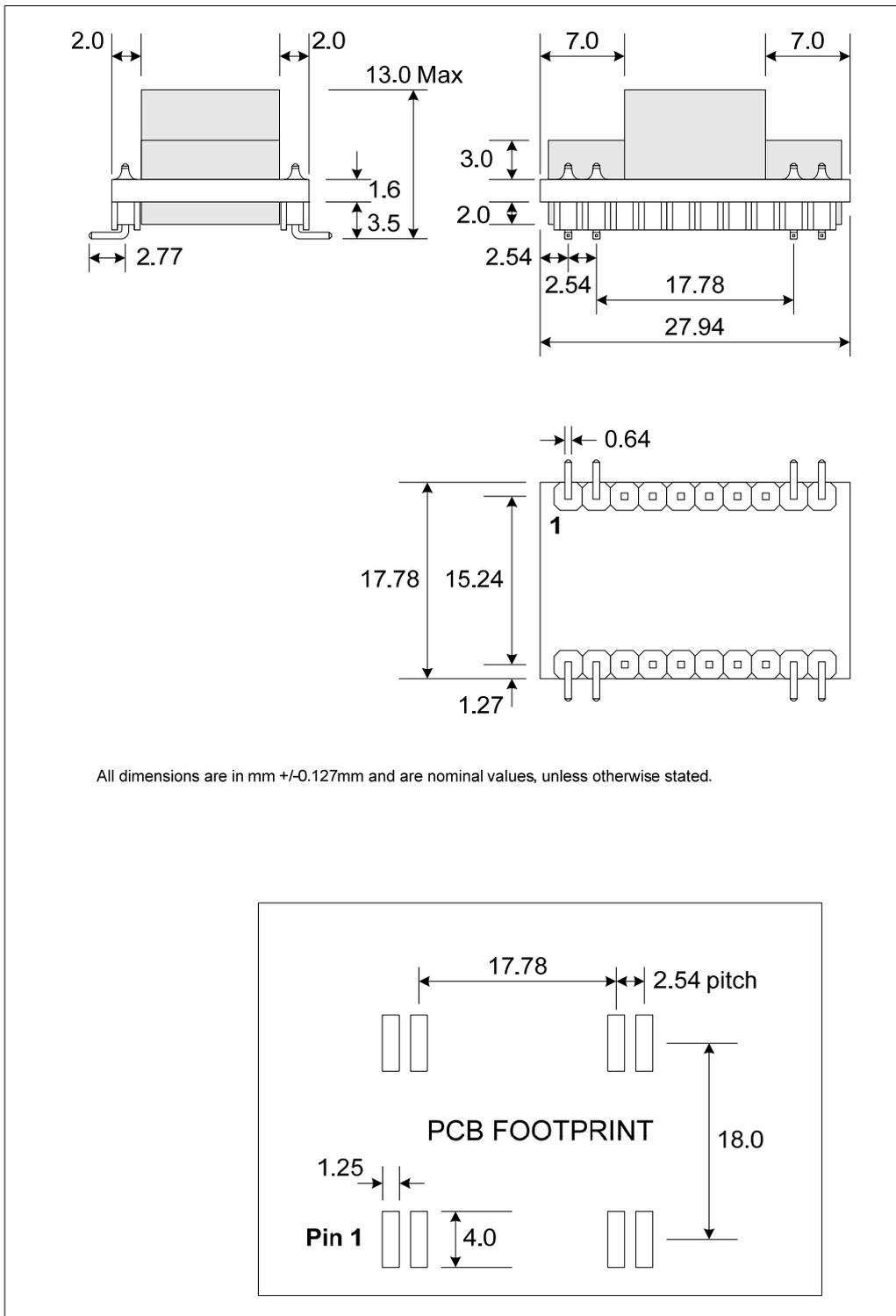
	DC Characteristic	Sym	Min	Typ ¹	Max	Units	Test Comments
1	Nominal Output Voltage	+VDC	11.5	12.0	12.5	V	
2	Output Current ($V_{IN} = 48V$)	PWR			1.0	A	
3	Line Regulation	V_{LINE}		0.02		%	
4	Load Regulation - Min to Max ($V_{IN} = 48V$)	V_{LOAD}		0.1		%	
5	Output Ripple and Noise	V_{RN}		160		mVp-p	@ Max load ²
6	Minimum Load ³	I_{LOAD}	100			mA	
7	Short-Circuit Duration	T_{SC}			∞	sec	
8	Efficiency @ 50% Load	EFF		87		%	
9	Isolation Voltage (I/O)	V_{ISO}			1500	V_{PK}	Impulse Test

Note 1: Typical figures are at 25°C with a nominal 48V supply and are for design aid only. Not Guaranteed

2: The output ripple and noise can be reduced with an external filter, see Section 5.8.

3: The module can emit an audible noise, if operated at less than the specified minimum I_{LOAD} and cause the PSE to fail its MPS.

11. Package



Information published in this datasheet is believed to be correct and accurate. Silver Telecom assumes no liability for errors which may occur or for liability otherwise arising out of use of this information or infringement of patents which may occur as a result of such use. No license is granted by this document under patents owned by Silver Telecom or licensed from third parties by Silver Telecom. The products, their specification and information appearing in this document are subject to change by Silver Telecom without notice.