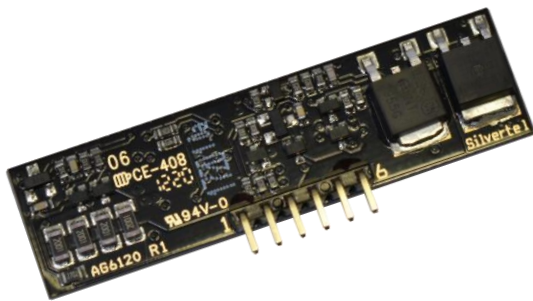




# Ag6120

Single Channel Power Sourcing Equipment Module



## Features

- Programmable Output power limit up to 75W
- Compliant with IEEE802.3bt\*, IEEE802.3af and IEEE802.3at specifications.
- Small SIL package size - 53mm (L) x 14mm (H)
- Low cost
- Minimal (low cost) external components required
- Over-current and short circuit protection
- Industrial Temperature Range
- Silvertel “design-in” assistance

\*fully compliant up to 30W output

## Description

The Ag6120 is a single channel Power Sourcing Equipment (PSE) module designed for use in Power over Ethernet (PoE) applications for a wide range of power levels from 15.4W (IEEE802.3af) up to 75W proprietary power levels.

The Ag6120 is aimed at a wide range of applications requiring PSE functionality such as CCTV DVR, home networking and industrial Ethernet.

Ag6120 is a self-contained module, requiring just a few external components to provide simple and cost effective power source for a wide range of Powered Devices (PD).

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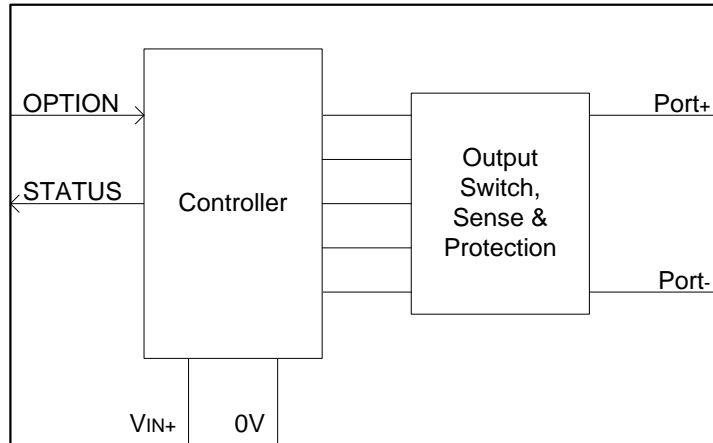
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## 1 Ag6120 Product Selector†

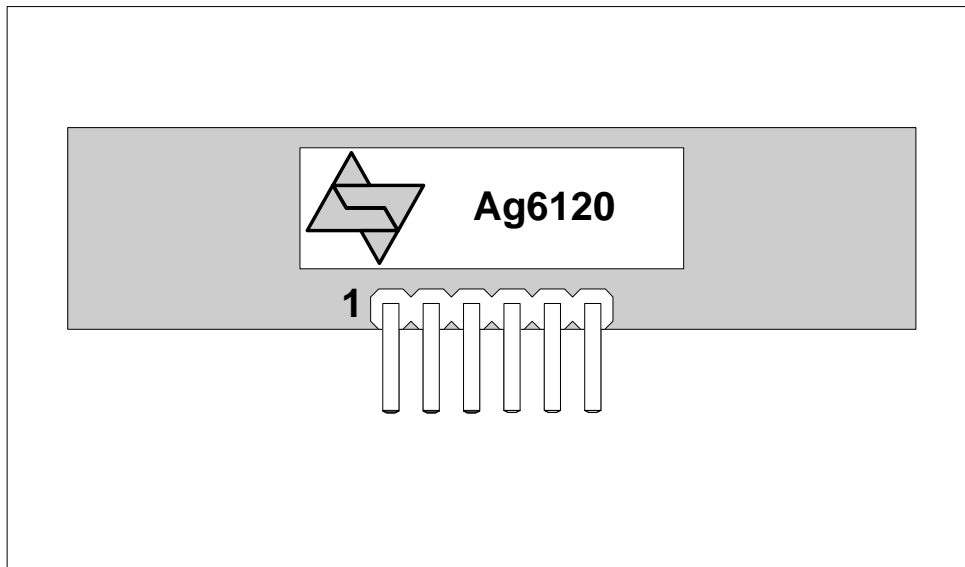
Part Number†	Output Power (W)	Marking
Ag6120	15.4 - 75W	-

**Table 1: Ordering Information**

† The Ag6120 complies with the European Directive 2011/65/EU for the Restriction of use of certain Hazardous Substances (RoHS) including Directive 2015/863 published in 2015, amending Annex II of Directive 2011/65/EU. Moisture Sensitive Level 1 and HBM 1.



**Figure 1: Block Diagram**



**Figure 2: Ag6120 Package Format**

## 2 Pin Description

Pin #	Name	Description
1	V <sub>IN+</sub>	<b>Main Power Supply.</b> This pin connects to an isolated 45V to 57V supply; relative to the 0V.
2	0V	<b>0V.</b> This pin is the return path for the isolated V <sub>IN+</sub> power supply.
3	STATUS	<b>Status Output.</b> This output shows the status of the Ag6120.
4	Port+	<b>Port Output.</b> This output pin monitors the line and supplies power to valid powered device.
5	Port-	<b>Port Output Return.</b> This pin is the return path for Port+.
6	OPTION	<b>Option select pin.</b> A resistor should be fitted to select the power and class profile required. (see 3.3)

Table 2 - Pin Descriptions

## 3 Functional Description

### 3.1 Power Supplies

The Ag6120 requires only one power supply. To conform to the IEEE802.3af, IEEE802.3at and IEEE802.3bt specifications; this supply must be isolated from mains ground, as shown in Figure 3.

In case the power supply is capable of supplying >100W of power we would highly recommend protection in the form of a fuse to be fitted to the positive input rail of the Ag6120. This will help prevent damage to the Ag6120 during an over voltage or over current event.

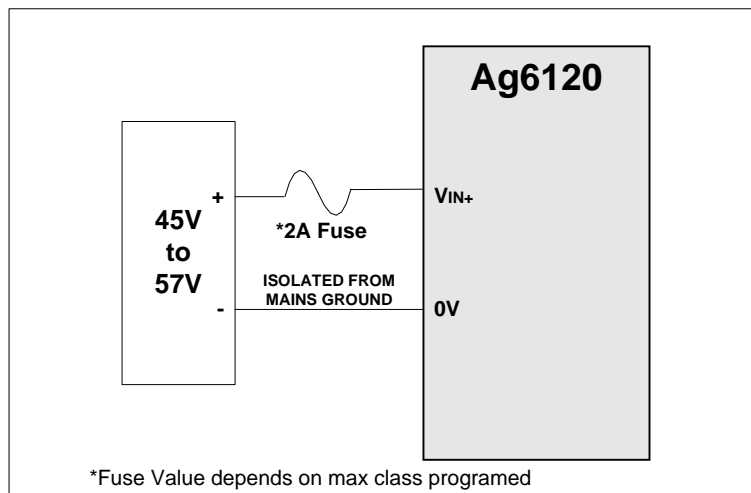


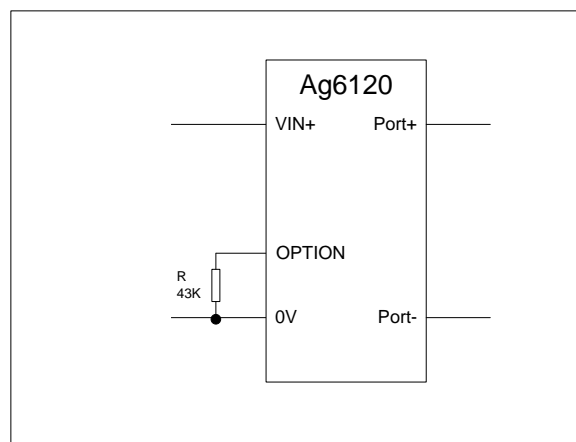
Figure 3: Power Supply Connections

### 3.2 UVLO (Under Voltage Lockout)

The Ag6120 requires a minimum input voltage of 45V in 'Type 1' mode or 51V in all other modes to provide enough power to the connected PD. However if the input voltage during operation falls below ~40.5V in 'Type 1' mode or ~46.5V in all other modes the Ag6120 will turn off its output ports and remain in the idle state whilst monitoring the input voltage. Once the input voltage rises above ~41.5V in IEEE802.3af mode or ~47.5V in all other modes the Ag6120 will then begin its start-up sequence and resume normal operation.

### 3.3 Power and Class Options

The 'OPTION' pin (pin 6) on the Ag6120 can be used to select the max output power and classification type used by the module. This is achieved by fitting a resistor between the 'OPTION' pin (pin 6) and '0V' pin (pin 2). As shown in Figure 4



**Figure 4: OPTION pin connections**

The Ag6120 has a number of modes to allow for various power limits and different types of PD. These are detailed in Table 3

Mode	Option resistor	Classification type* <sup>2</sup>	Max output power* <sup>3</sup>	Connected pair sets* <sup>4</sup>
Legacy Type 2 (at)* <sup>1</sup>	Open circuit	IEEE802.3at	38W	Either 2
Type 1 (af)	16K	IEEE802.3bt	20W	Either 2
Type 2 (at)	43K	IEEE802.3bt	38W	Either 2
Legacy high power	91K	at + legacy class 5	75W	All 4
BT 1 pair (bt class 5)* <sup>5</sup>	180K	IEEE802.3bt	46W	Either 2/all 4
BT Type 3 (bt class 6)* <sup>5</sup>	470K	IEEE802.3bt	75W	All 4

**Table 3: option selections and limits**

\*<sup>1</sup> Not recommend for new designs only for use as drop in replacement of the Ag6100

\*<sup>2</sup> See section 3.5.2 for details

\*<sup>3</sup> See section 3.7 & 3.8 for details

\*<sup>4</sup> See section 3.4 for details

\*<sup>5</sup> Compatible with IEEE802.3bt single signature PDs

## 3.4 Port Output

The Ag6120 has been design for its output to be connected to 2 pairs of an Ethernet link to support IEEE802.3af and IEEE802.3at powered devices, or connected to all 4 pairs to support up to 60W powered devices (IEEE802.3bt or legacy high power modes).

### 3.4.1 IEEE802.3af and IEEE802.3at (up to 30W) port connections

The output port can be connected directly to the centre-tap of an IEEE802.3at compliant data transformer or to the spare pair connection for 10/100BASE-T applications, as shown in Figure 5. For 1000BASE-T (Gigabit) Ethernet applications all four cable pairs require magnetics, this is explained in more detail in application note “ANX-1000BASE-T-CONNECTIONS”.

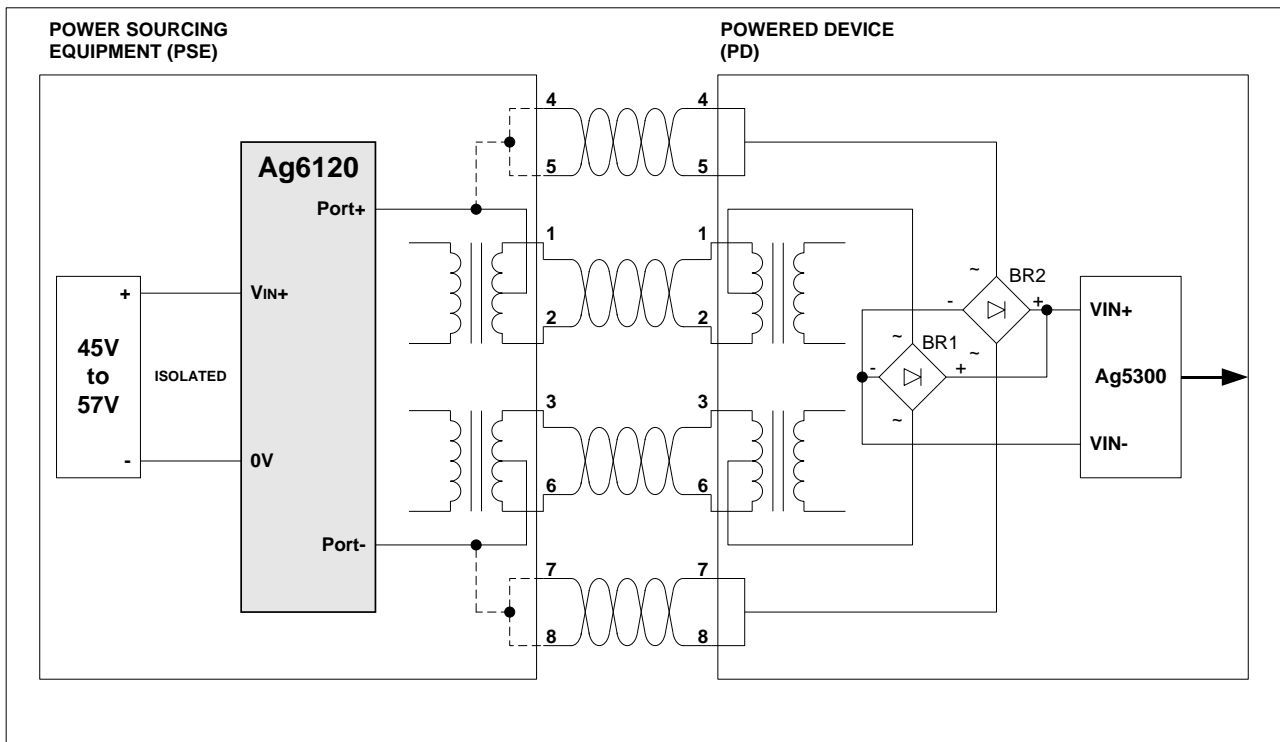
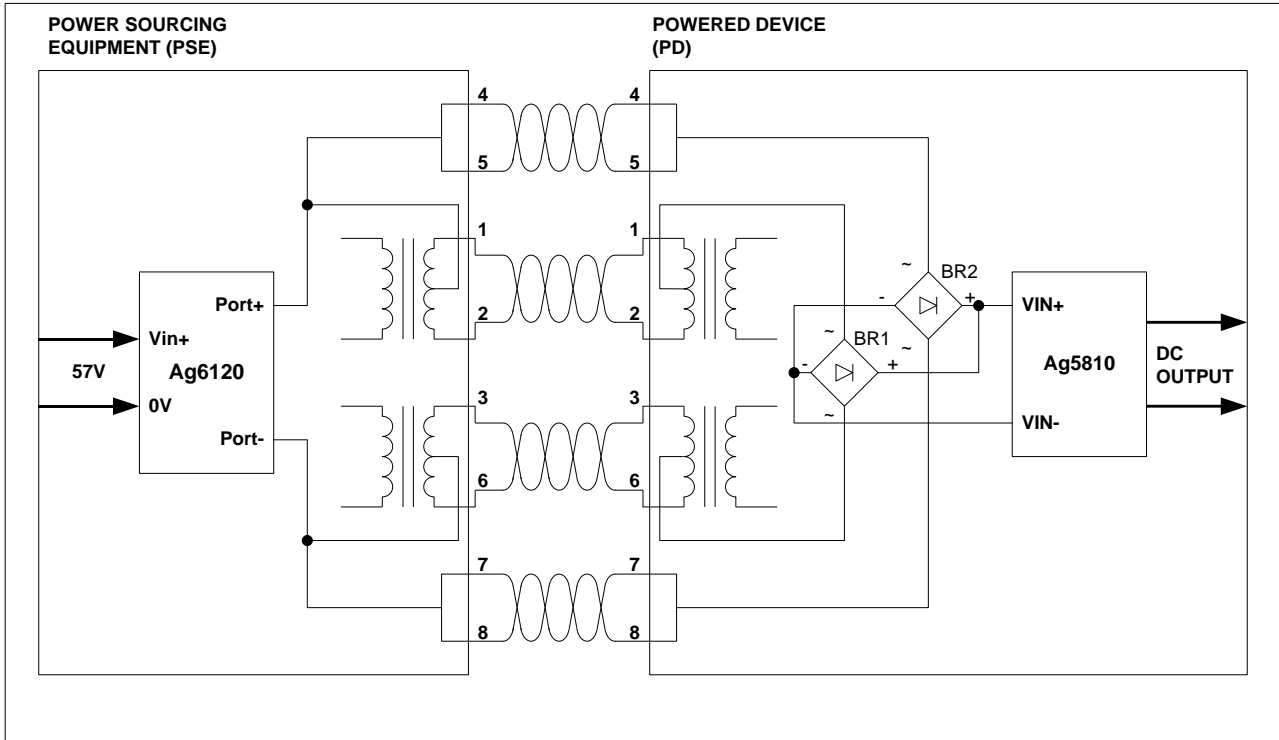


Figure 5: Typical Connection Diagram for type1 (af) and type 2(at)

**3.4.2 IEEE802.3bt or legacy high power (up to 60W) port connections**

The output port can be connected directly to the centre-tap of an IEEE802.3at compliant data transformer and to the spare pair connection for 10/100BASE-T applications, as shown in Figure 6. For 1000BASE-T (Gigabit) Ethernet applications all four cable pairs require magnetics, this is explained in more detail in application note “ANX-1000BASE-T-CONNECTIONS”.

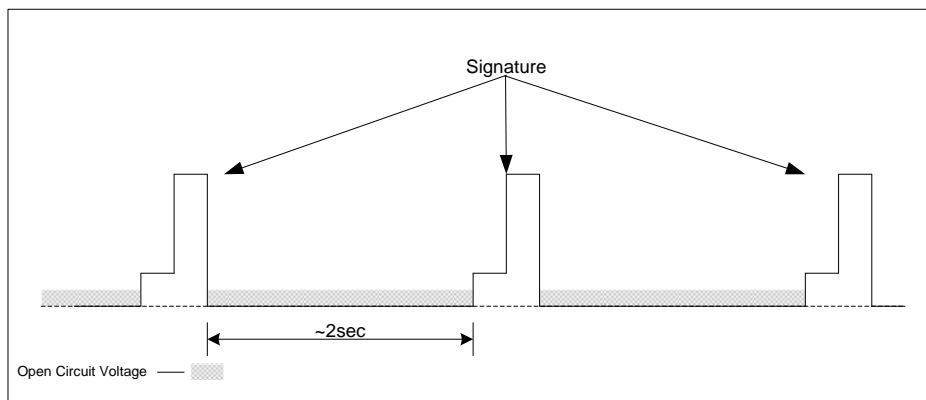


**Figure 6: Typical connections for high power modes**

**3.5 Signature and Classification**

**3.5.1 Signature Detection**

To ensure that the Ag6120 does not apply power to a non-PoE enabled device the output port first checks for a valid PoE signature. The PD should present a nominal 25kΩ (23.75kΩ to 26.25kΩ) signature resistance. If the Ag6120 does not see a valid signature then it will disconnect, wait approximately 2 seconds then try again, see Figure 7 below.



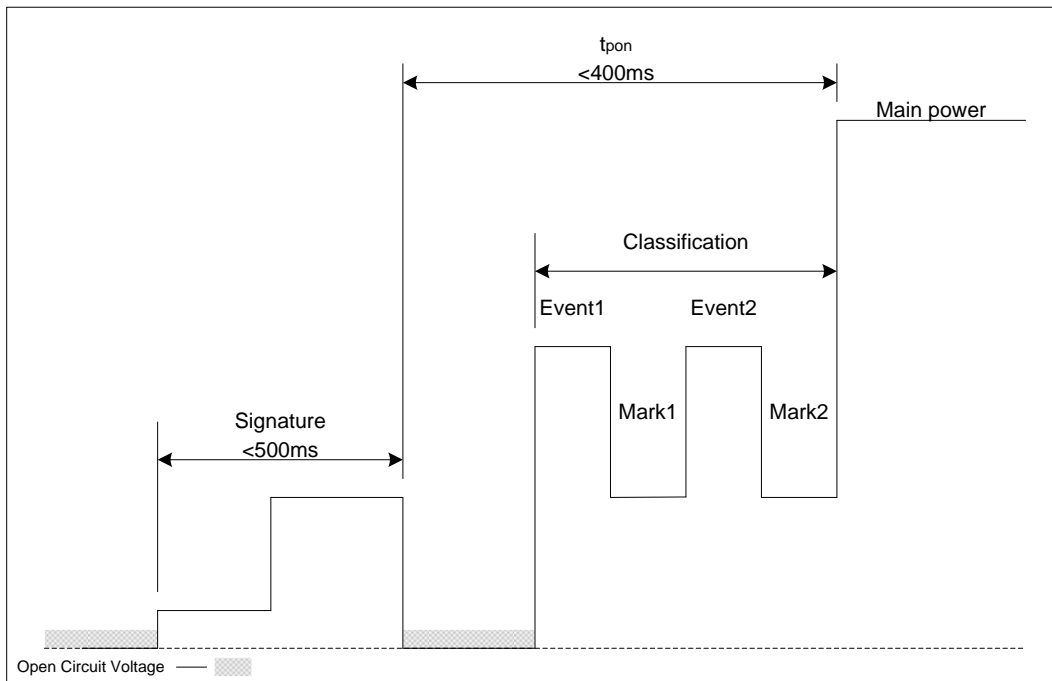
**Figure 7: Signature Cycle Time**

### 3.5.2 Classification

On completion of a valid signature, the Ag6120 will then interrogate the PD to see what classification signature is present. The classification signature is used to determine the amount of power the PD will draw and limits the output power accordingly.

The Ag6120 has 2 primary class timing sequences dependent on the mode selected 'IEEE802.3at' or 'IEEE802.3bt' as shown in Figure 8 and Figure 9. The differences between the two are as followed:

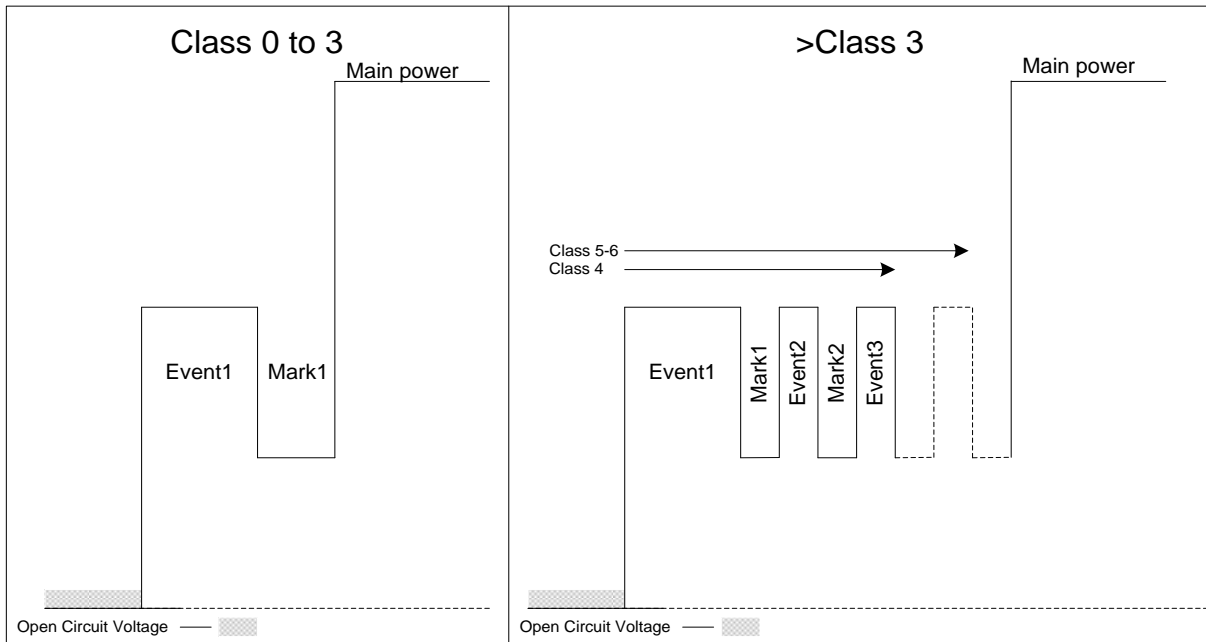
'IEEE802.3at' produces 1 or 2 short class pulses (dependant on the current class detected) where the PD expects to see the same current.



**Figure 8: IEEE802.3at class timing**

In the 'IEEE802.3bt' classification the first pulse is much longer. This is to indicate to the PD that the Ag6120 implements the bt specification's lower Maintain Power Signature (MPS) requirements (see section 3.6 below for details of MPS). Additionally if the Ag6120 is set in 'BT 1 pair' or 'BT Type 3' modes the ag6120 will produce a third class pulse looking for a change in class current presented. If the current changes correctly the Ag6120 will produce 1 further pulse which indicates to the PD the requested power (>30W) has been granted. After classification is complete the Ag6120 will begin to power up its output with the current limit selected based on the detected class and mode of the module.





**Figure 9: IEEE802.3bt class timing**

If the Ag6120S fails to detect a valid classification signature for the selected mode it will detect this as 'Class Error' (indicated as described in section 3.9) and will retry the signature after a 2 second delay.

### 3.6 Maintain Power Signature (MPS)

On successful completion of a valid signature (and classification) the Ag6120 will apply main power to the Port output and the STATUS output will go to Logic 1.

Once main power has been applied, the Ag6120 will constantly monitor the PD to ensure that it is still connected; this is referred to as the Maintain Power Signature (MPS).

The Ag6120 will remove power and return to the signature cycle (looking for a valid signature) if the MPS requirements are no longer meet. The Ag6120 defines the MPS as being present if the current draw  $> I_{HOLD}$  (~between 5 and 10mA) for at least  $T_{MPS}$  (6ms) in every  $T_{MPDO}$  325ms.

### 3.7 Output Current Limits

The Ag6120 has two over current limits – 'Overload Limit' and 'Short circuit limit'. These are dependent on the mode selected and PD class detected during classification (see section 3.3 and 0).

The Ag6120 will allow the output port to exceed 'Overload Limit' for a short duration –  $T_{cut}^*$ . If the output port continues to exceed the 'Overload Limit'; the output power will be removed and the STATUS output will indicate an over-current fault (See section 3.9).

If the output exceeds 'Short circuit limit', the Ag6120 will remove power (without waiting for  $T_{cut}$ ) and the STATUS output will indicate a short circuit fault.

\*Note: See Section 9.3 Electrical Characteristics

### 3.8 Output Power

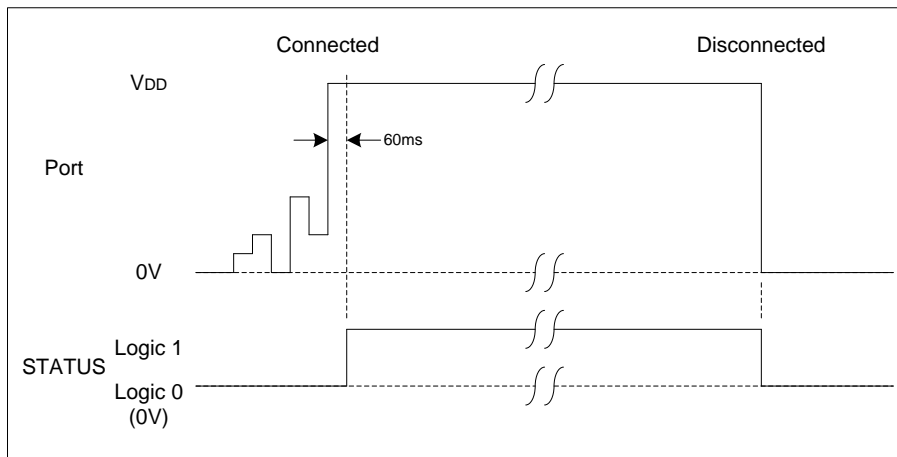
The Ag6120 output power is limited by fixed current limits. To maximise the output power available we would recommend that the supply voltage is set close to the maximum whenever possible.

Please note that the power available at the input of the Powered Device (PD) will be less than the power at the output of the Ag6120. There are cable, connector and polarity protection losses to be taken into account; this is explained in more detail in application note “ANX-POE-Power”.

### 3.9 STATUS Output

The STATUS output pin of the Ag6120 is sourced through the 47kΩ current limiting resistor. This output is at Logic 0 when the output ports are disconnected. After completion of a valid signature, classification and inrush (~60ms) the STATUS output will go to Logic 1.

When the output port is disconnected the STATUS output will go to Logic 0, see Figure 10.



**Figure 10: STATUS Output at Port Connect and Disconnect**

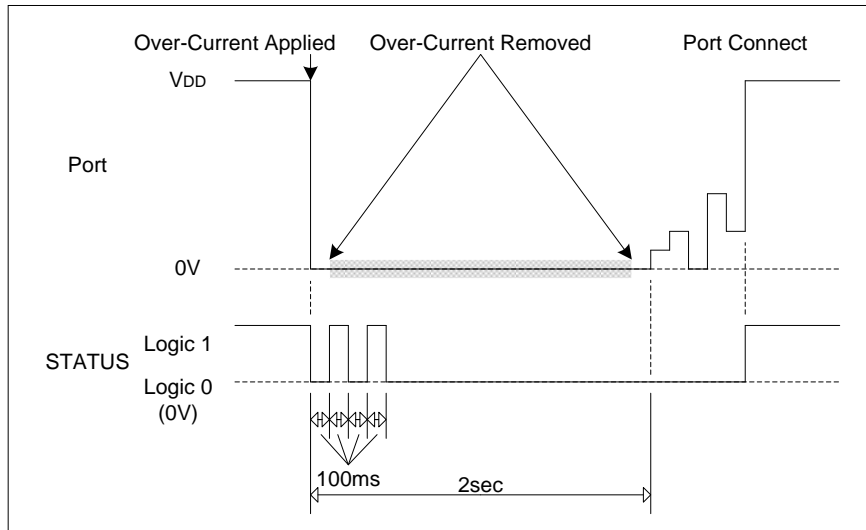
In addition to the STATUS output reporting when the output ports are connected or disconnected, the STATUS output also reports when a fault has been detected.

If a fault condition occurs to one or both output ports the STATUS output goes to Logic 0 for 200ms followed by a number of pulses as shown in Table 4:

Fault Condition	Status Pulses (200ms)
Short Circuit	1 x Logic 1 Pulse
Over Current	2 x Logic 1 Pulse
Signature/Class Error	3 x Logic 1 Pulse
Input Voltage < UVLO limit	4 x Logic 1 Pulse

**Table 4: Status Output**

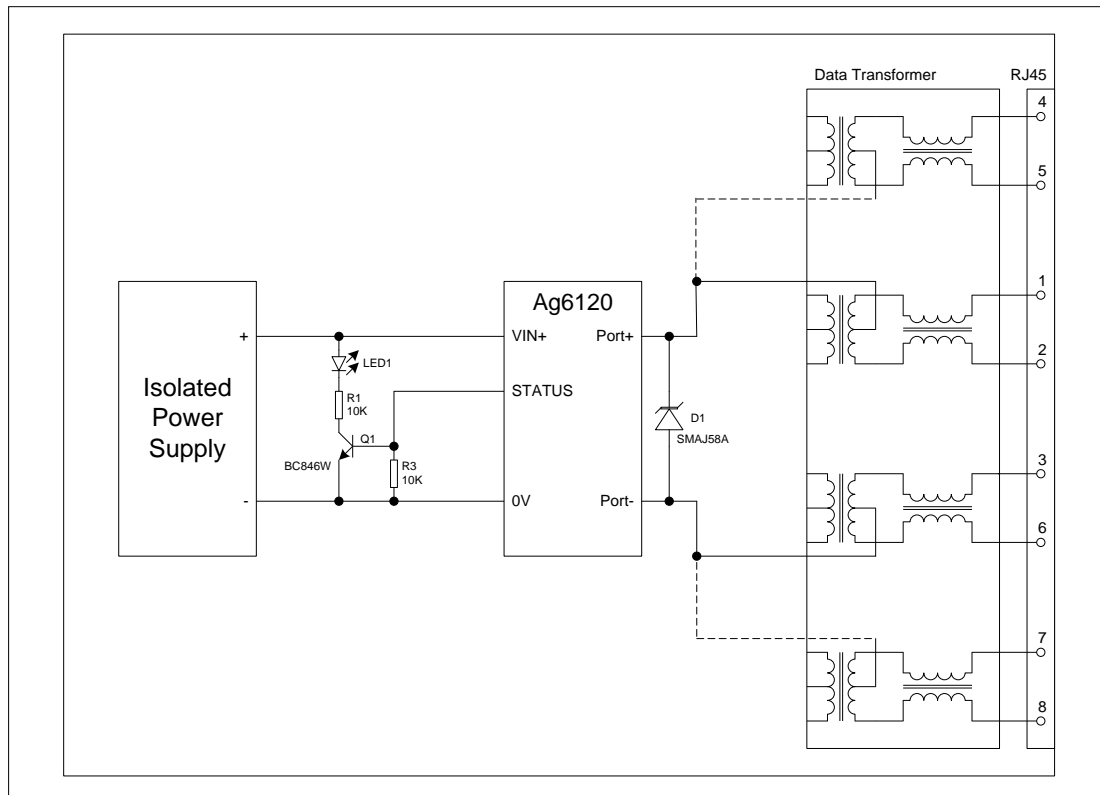
An example of the STATUS output during an over current condition can be seen below in Figure 11:



**Figure 11: STATUS Output when an Over-Current is applied to the Output Port**

If the over current is not removed the Ag6120 will start up again and repeat the fault shutdown cycle until the over-current fault is removed.

The slow duration of the pulses is to allow for an LED to be connected for visual indication of the output status. As the Ag6120 has a limited internal source a transistor is needed to drive the LED as shown in Figure 12:



**Figure 12: STATUS Output Configuration**

## 4 Protection

### 4.1 Input Protection

The Ag6120 has built-in tranzorb diode across its input, to protect the module from transients from the power supply. For further protection we would recommend a 2A slow blow fuse to be fitted in line with the positive input rail due to the high power capability of the power supply as described in section 5.1 and shown in Figure 3.

### 4.2 Output Protection

To protect the module from voltage transients coming from the RJ45 cable we would recommend fitting a SMAJ58 or higher on the Ag6120 output as shown in Figure 12.

## 5 Electrical Characteristics

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

	Parameter	Symbol	Min	Max	Units
1	DC Supply Voltage	$V_{DD}$	-0.3	60	V
2	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.

### 5.2 Recommended Operating Conditions

	Parameter	Symbol	Min	Typ	Max	Units
1	Input Supply Voltage	$V_{DD}$ (Type 1 mode)	45		57	V
		$V_{DD}$ (all other modes)	51		57	V
2	Operating Temperature	$T_{OP}$	-40	25	85	$T_a$ / °C

## 5.3 Electrical Characteristics

	Parameter	Sym	Min	Typ	Max	Units	Condition
1	V <sub>DD</sub> Idle Supply Current	I <sub>DD</sub>		5.5		mA	
2	Signature Detection Voltage	V <sub>SIGL</sub> V <sub>SIGH</sub>	2.7	4.5 9	10.1	V	
3	Minimum Valid Signature	R <sub>SIGL</sub>	15			kΩ	
4	Maximum Valid Signature	R <sub>SIGH</sub>			32	kΩ	
5	Classification Voltage	V <sub>CLASS</sub>	14.5		20.5	V	
6	Classification Mark Voltage	V <sub>MARK</sub>	6.9		10	V	
7	Classification Threshold Current	I <sub>CLASS</sub>	5.5 13.5 21.5 31.5 45.2	6.5 14.5 23 33 48 60	7.5 15.5 24.5 34.9 50.8	mA	Class 0 - 1 Class 1 - 2 Class 2 - 3 Class 3 - 4 Class 4 - 5 Class 5 - Over-current
8	Maintain Power Signature	I <sub>MPS</sub>	5		10	mA	
9	Maximum Output Power @ 57V	P <sub>MAX</sub>		38 20 38 75 46 75		W	legacy Type 2 Type 1 Type 2 Legacy HP 802.3bt 1 pair Type 3
10	Over load Limit	I <sub>CUT</sub>		660 350 660 1320 815 1320		mA	legacy Type 2 Type 1 Type 2 Legacy HP 802.3bt 1 pair Type 3
11	Short Circuit limit	I <sub>LIM</sub>		1440		mA	
12	Over load Limit Cut-Off Time	T <sub>CUT</sub>		60		mS	
13	STATUS Output	V <sub>OH</sub> V <sub>OL</sub>		0.3	5	V	Open Circuit

### 6 Package

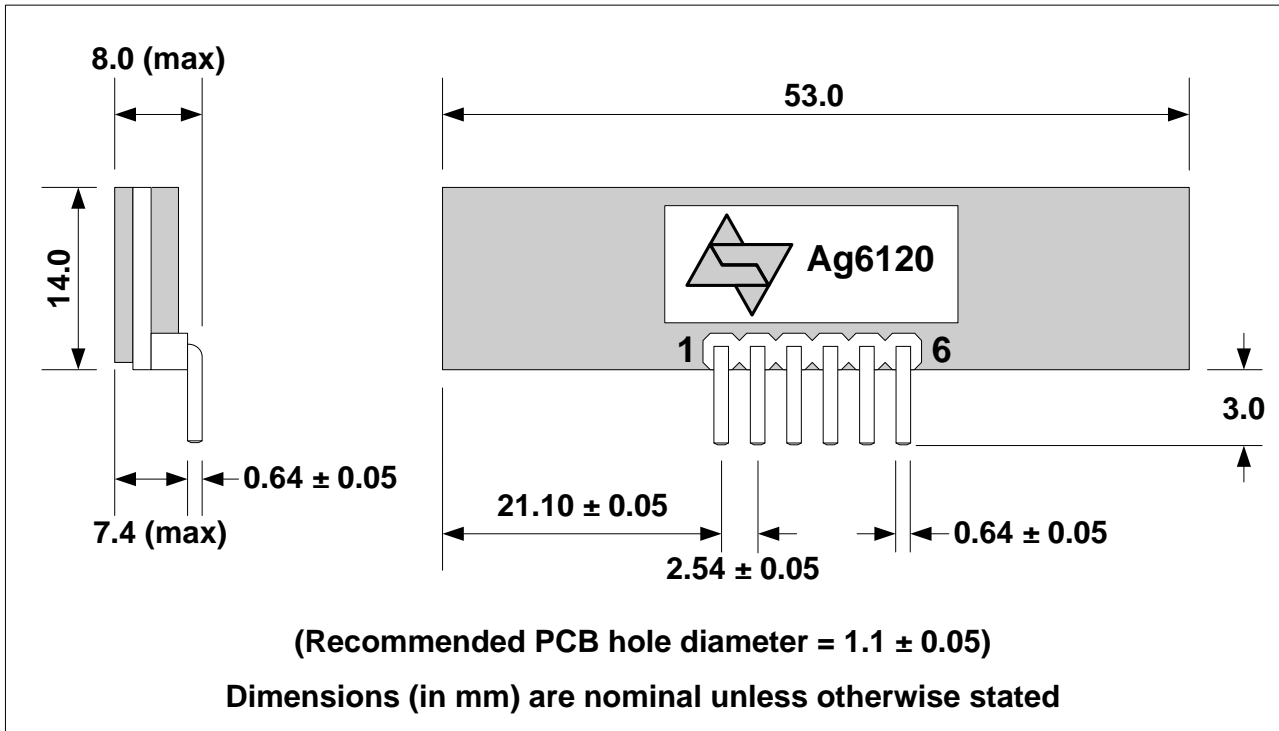


Figure 13: Package Dimensions

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