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).
## Table of Contents

1. **Ag6120 Product Selector** ................................................................................. 3  
2. **Pin Description** ......................................................................................... 4  
3. **Functional Description** ............................................................................... 4  
   3.1 Power Supplies .................................................................................................. 4  
   3.2 UVLO (Under Voltage Lockout) ....................................................................... 5  
   3.3 Power and Class Options ................................................................................ 5  
   3.4 Port Output ....................................................................................................... 6  
   3.4.1 IEEE802.3af and IEEE802.3at (up to 30W) port connections ....................... 6  
   3.4.2 IEEE802.3bt or legacy high power (up to 60W) port connections ............... 7  
   3.5 Signature and Classification .......................................................................... 7  
   3.5.1 Signature Detection ....................................................................................... 7  
   3.5.2 Classification ............................................................................................... 8  
   3.6 Maintain Power Signature (MPS) .................................................................... 9  
   3.7 Output Current Limits ..................................................................................... 9  
   3.8 Output Power .................................................................................................. 10  
   3.9 STATUS Output ............................................................................................... 10  
4. **Protection** ..................................................................................................... 12  
   4.1 Input Protection ............................................................................................... 12  
   4.2 Output Protection .......................................................................................... 12  
5. **Electrical Characteristics** ............................................................................ 12  
   5.1 Absolute Maximum Ratings ........................................................................ 12  
   5.2 Recommended Operating Conditions ........................................................... 12  
   5.3 Electrical Characteristics ............................................................................. 13  
6. **Package** ....................................................................................................... 14

## Table of Figures

- Figure 1: Block Diagram .................................................................................... 3  
- Figure 2: Ag6120 Package Format ..................................................................... 3  
- Figure 3: Power Supply Connections ................................................................. 4  
- Figure 4: OPTION pin connections .................................................................... 5  
- Figure 5: Typical Connection Diagram for type1 (af) and type 2(at) .................. 6  
- Figure 6: Typical connections for high power modes ....................................... 7  
- Figure 7: Signature Cycle Time ......................................................................... 7  
- Figure 8: IEEE802.3at class timing ................................................................... 8  
- Figure 9: IEEE802.3bt class timing ................................................................... 9  
- Figure 10: STATUS Output at Port Connect and Disconnect ............................. 10  
- Figure 11: STATUS Output when an Over-Current is applied to the Output Port .... 11  
- Figure 12: STATUS Output Configuration ......................................................... 11  
- Figure 13: Package Dimensions ..................................................................... 14
1 Ag6120 Product Selector†

<table>
<thead>
<tr>
<th>Part Number†</th>
<th>Output Power (W)</th>
<th>Marking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ag6120</td>
<td>15.4 - 75W</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 1: Ordering Information


Figure 1: Block Diagram

Figure 2: Ag6120 Package Format
2 Pin Description

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

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.

---

*Fuse Value depends on max class programmed

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](image)

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

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

*1 Not recommend for new designs only for use as drop in replacement of the Ag6100
*2 See section 3.5.2 for details
*3 See section 3.7 & 3.8 for details
*4 See section 3.4 for details
*5 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”.

![Diagram showing typical connections for high power modes](image)

**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.

![Signature Cycle Time](image)

**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](image)

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.
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](image)

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:

<table>
<thead>
<tr>
<th>Fault Condition</th>
<th>Status Pulses (200ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short Circuit</td>
<td>1 x Logic 1 Pulse</td>
</tr>
<tr>
<td>Over Current</td>
<td>2 x Logic 1 Pulse</td>
</tr>
<tr>
<td>Signature/Class Error</td>
<td>3 x Logic 1 Pulse</td>
</tr>
<tr>
<td>Input Voltage &lt; UVLO limit</td>
<td>4 x Logic 1 Pulse</td>
</tr>
</tbody>
</table>

**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](image)

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](image)
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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC Supply Voltage</td>
<td>V_{DD}</td>
<td>-0.3</td>
<td>60</td>
<td>V</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>T_{S}</td>
<td>-40</td>
<td>+100</td>
<td>°C</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Supply Voltage</td>
<td>V_{DD} (Type 1 mode)</td>
<td>45</td>
<td>51</td>
<td>57</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>V_{DD} (all other modes)</td>
<td>51</td>
<td></td>
<td>57</td>
<td>V</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>T_{OP}</td>
<td>-40</td>
<td>25</td>
<td>85</td>
<td>Ta / °C</td>
</tr>
</tbody>
</table>

© Silver Telecom 2022
## 5.3 Electrical Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Sym</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 V&lt;sub&gt;DD&lt;/sub&gt; Idle Supply Current</td>
<td>I&lt;sub&gt;DD&lt;/sub&gt;</td>
<td>5.5</td>
<td></td>
<td></td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>2 Signature Detection Voltage</td>
<td>V&lt;sub&gt;SIGL&lt;/sub&gt;, V&lt;sub&gt;SIGH&lt;/sub&gt;</td>
<td>2.7</td>
<td>4.5</td>
<td>9</td>
<td>10.1</td>
<td>V</td>
</tr>
<tr>
<td>3 Minimum Valid Signature</td>
<td>R&lt;sub&gt;SIGL&lt;/sub&gt;</td>
<td>15</td>
<td></td>
<td></td>
<td>kΩ</td>
<td></td>
</tr>
<tr>
<td>4 Maximum Valid Signature</td>
<td>R&lt;sub&gt;SIGH&lt;/sub&gt;</td>
<td></td>
<td></td>
<td>32</td>
<td>kΩ</td>
<td></td>
</tr>
<tr>
<td>5 Classification Voltage</td>
<td>V&lt;sub&gt;CLASS&lt;/sub&gt;</td>
<td>14.5</td>
<td></td>
<td>20.5</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>6 Classification Mark Voltage</td>
<td>V&lt;sub&gt;MARK&lt;/sub&gt;</td>
<td>6.9</td>
<td></td>
<td>10</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>7 Classification Threshold Current</td>
<td>I&lt;sub&gt;CLASS&lt;/sub&gt;</td>
<td>5.5</td>
<td>13.5</td>
<td>21.5</td>
<td>31.5</td>
<td>45.2</td>
</tr>
<tr>
<td>8 Maintain Power Signature</td>
<td>I&lt;sub&gt;MPS&lt;/sub&gt;</td>
<td>5</td>
<td></td>
<td>10</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>9 Maximum Output Power @ 57V</td>
<td>P&lt;sub&gt;MAX&lt;/sub&gt;</td>
<td>38</td>
<td>20</td>
<td>38</td>
<td>75</td>
<td>W</td>
</tr>
<tr>
<td>10 Over load Limit</td>
<td>I&lt;sub&gt;CUT&lt;/sub&gt;</td>
<td>660</td>
<td>350</td>
<td>660</td>
<td>1320</td>
<td>mA</td>
</tr>
<tr>
<td>11 Short Circuit limit</td>
<td>I&lt;sub&gt;LIM&lt;/sub&gt;</td>
<td>1440</td>
<td></td>
<td></td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>12 Over load Limit Cut-Off Time</td>
<td>T&lt;sub&gt;CUT&lt;/sub&gt;</td>
<td>60</td>
<td></td>
<td></td>
<td>mS</td>
<td></td>
</tr>
<tr>
<td>13 STATUS Output</td>
<td>V&lt;sub&gt;OH&lt;/sub&gt;, V&lt;sub&gt;OL&lt;/sub&gt;</td>
<td>0.3</td>
<td></td>
<td>5</td>
<td>V</td>
<td>Open Circuit</td>
</tr>
</tbody>
</table>
6 Package

(Recommended PCB hole diameter = 1.1 ± 0.05)

Dimensions (in mm) are nominal unless otherwise stated

Figure 13: Package Dimensions