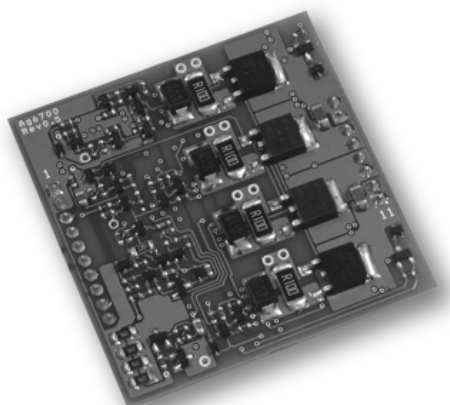




# Ag6700

## 230W Power Sourcing Module



### 1. Features

- Maximum 230 Watt output power
- Unbalance output protection
- Input and output over-voltage protection
- Output short-circuit protection
- Low power protection mode
- Smart signature detection
- Minimal external components required
- Silvertel “design-in” assistance

### 2. Description

The Ag6700 is a high Power Sourcing Module (PSM) that can deliver up to 230 Watts of output power, over a standard Cat 5e / 6 Ethernet cable.

It is designed to work with the Ag5700 Powered Device (PD) module to provide a complete Power over Ethernet (PoE) solution for very high power applications such as TV's, Displays, computer monitors and laptops.

The Ag6700 incorporates a wide range of protection features to ensure the safe operation of very high power PoE.

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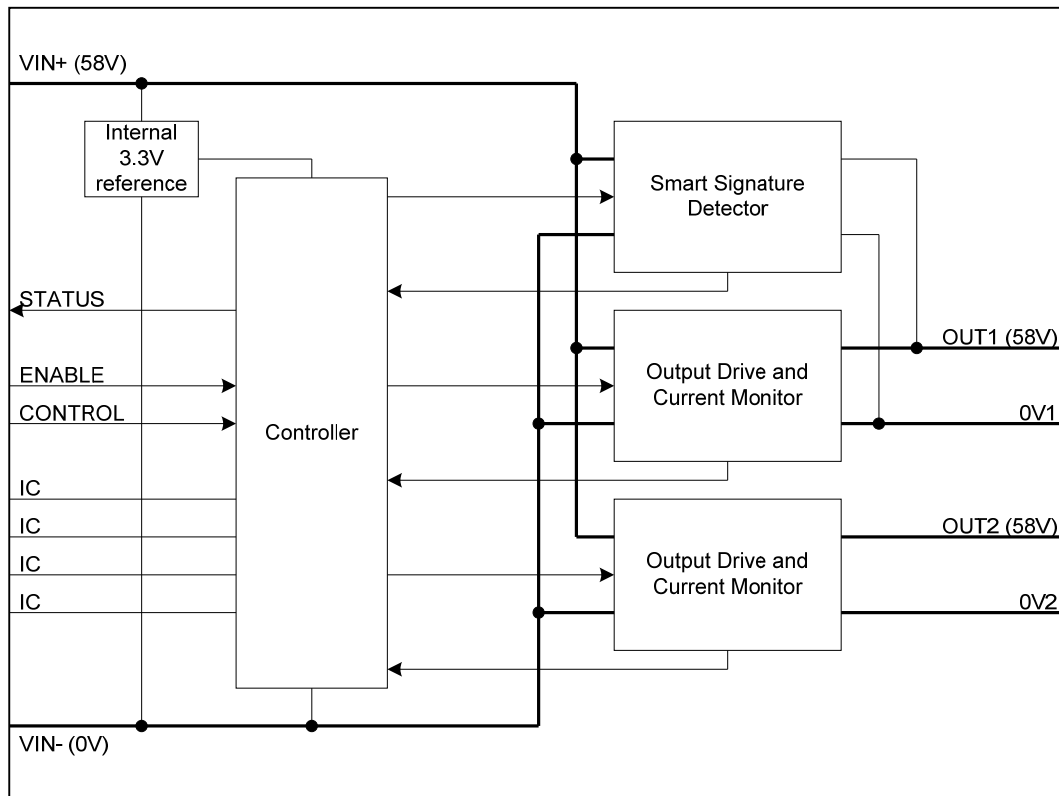
### 3. Ag6700 Product Selector

Part Number†	Input / Output Voltage	Maximum Output Power *
Ag6700	58V / 58V	230W

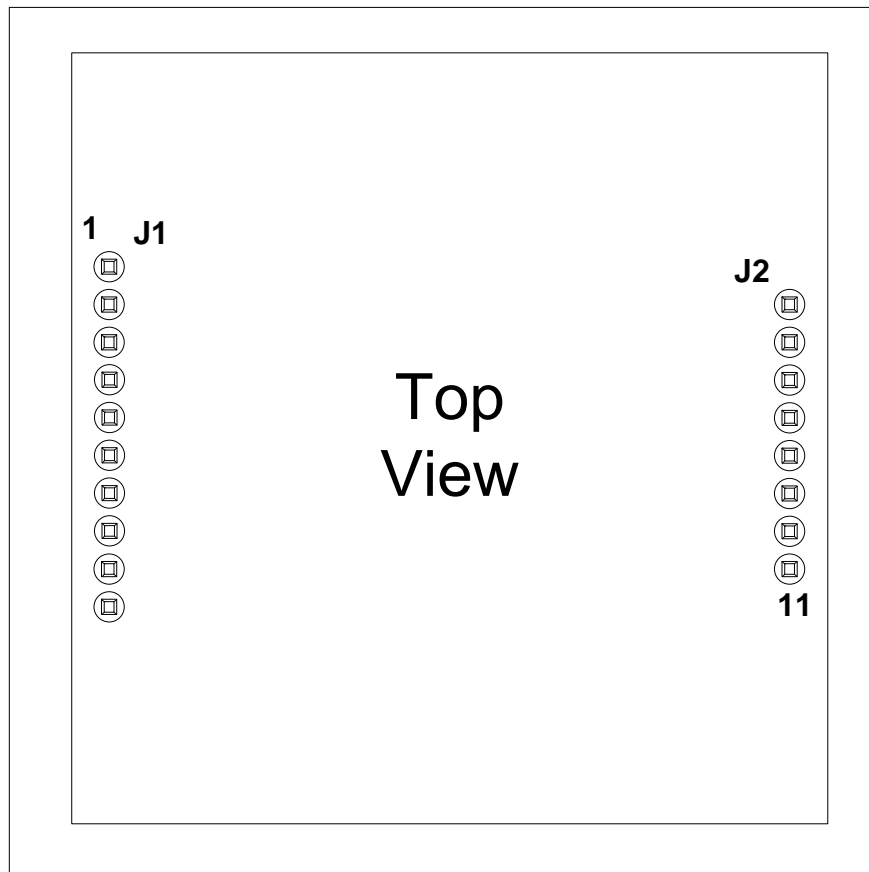
\*At 25°C must include adequate thermal management

† The Ag6700 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: Ag6700 Package Format*

## 4. Pin Description

### Input Connector pins J1

Pin #	Name	Description
1	VIN+	<b>Direct Input +.</b> These pins connect to the external 58V supply, positive terminal.
2		
3	ENABLE	<b>Input.</b> This pin is used to enable the Ag6700. Logic '0' will disable the outputs, logic '1' will enable the outputs.
4	CONTROL	<b>Input.</b> This pin is used to control the output power cut off threshold. Logic '0' limits the output power to ~20W, logic '1' enables the full 230W output power.
5	STATUS	<b>Output.</b> This output pin is used to indicate the Ag6700 status.
6	IC	<b>Internal Connection.</b> Do not connect to this pin
7	IC	<b>Internal Connection.</b> Do not connect to this pin
8	IC	<b>Internal Connection.</b> Do not connect to this pin
9	VIN-	<b>Direct Input -.</b> These pins connect to the external 58V supply, negative terminal.
10		

### Output Connector pins J2

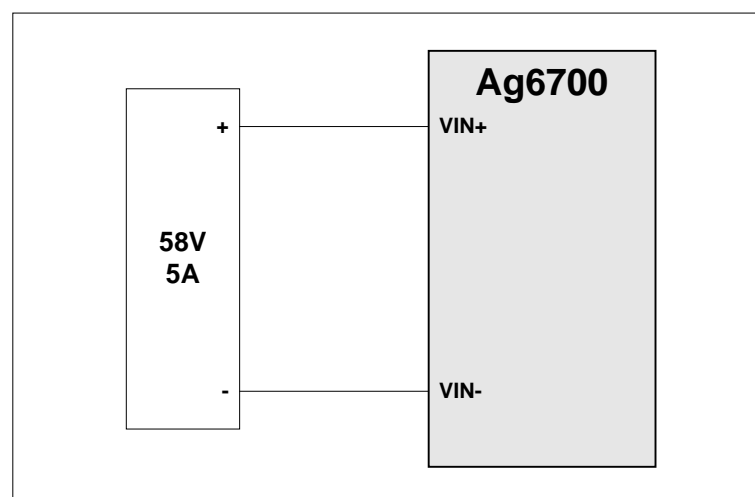
Pin #	Name	Description
11	OUT1	<b>Output.</b> This output detects the smart signature, then monitors the line and supplies power to valid device.
12		
13	0V1	<b>Ground.</b> The ground return for the OUT1 output.
14		
15	0V2	<b>Ground.</b> The ground return for the OUT2 output.
16		
17	OUT2	<b>Output.</b> This output monitors the line and supplies power after a valid smart signature has been detected on OUT1.
18		

## 5. Functional Description

### 5.1 Power Supplies

The Ag6700 only requires a single input voltage of typically 58V. If the voltage <48V the Under Voltage Lockout Circuit (UVLO) will prevent operation of the device and the Status output will report an error code (when the enable input is set to logic 1). The Ag6700 supplies power to the Ag5700 PD which is designed to provide output power up to 200W. The Ag5700 is 90% efficient therefore it needs an input up to ~220W. It is important that the power supply to the input of the Ag6700 has the capability of supplying enough power for the load at the far end taking into account the efficiency of the PD and the voltage drop in the cables, connectors and diode bridges between the PSE and the PD. Please see applications note ANX-POE-POWER for more details.

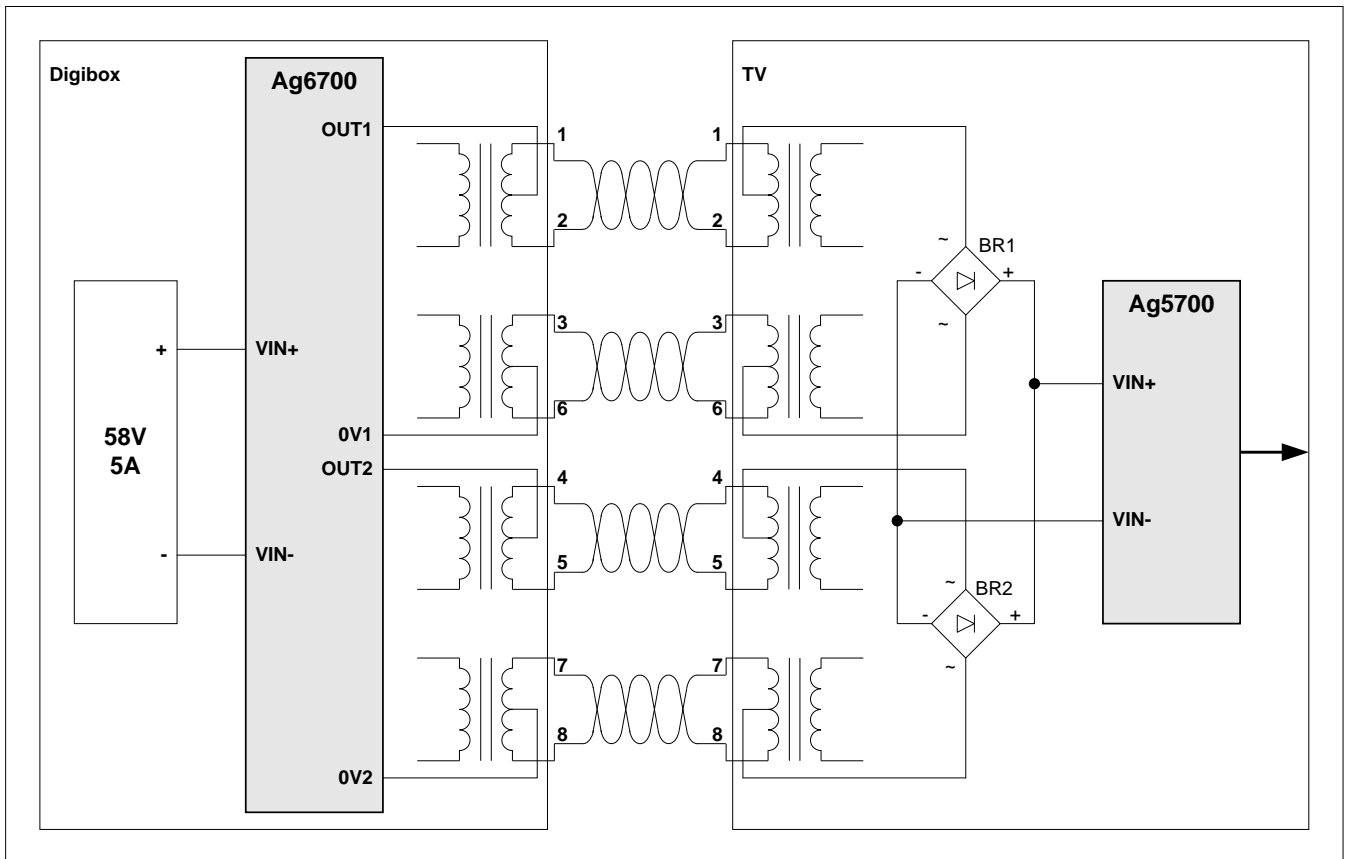
It is important that the input power supply to the Ag6700 is isolated from ground (see Section 7).



*Figure 3: Power Supply Connections*

## 5.2 Output Ports

Both outputs must be connected directly to the centre-tap of the data transformer, as shown in Figure 4. The Ag6700 will look for a valid smart signature on both outputs before the main power is applied to the outputs.



*Figure 4: Typical System Connection Diagram*

The Ag6700 is designed for high data rate connections with transformers connected on all pairs. This is important for current balance.

### 5.3 Control Inputs

The Ag6700 has two control pins “Enable” & “Control” and a status output pin “Status”. By default both inputs are pulled low via internal 10K resistors, as shown in Figure 5.

When the “Enable” input is set to logic ‘0’ the Ag6700 outputs are disabled and the module is set in standby mode. In standby mode the “Status” output is reset to logic “0” and the “Control” input is disabled.

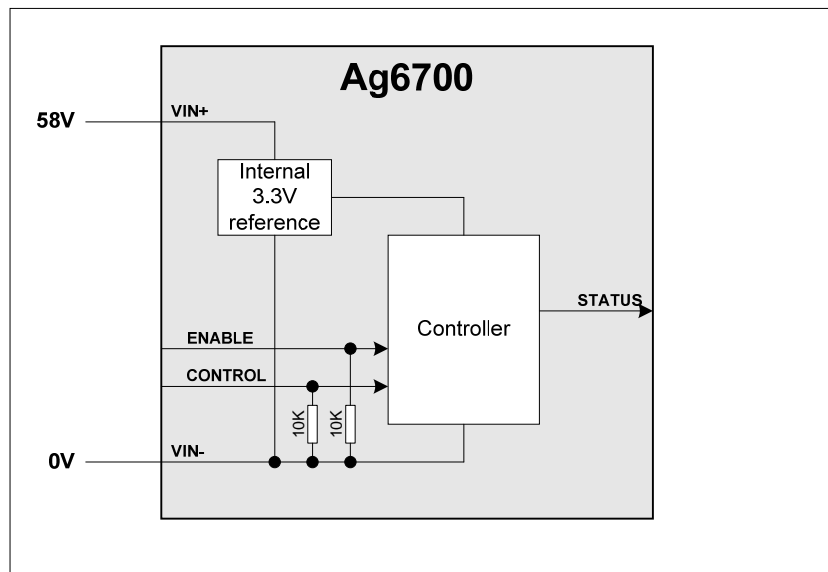


Figure 5: Control Inputs

When the “Enable” input is set to logic “1”, the Ag6700 looks for a Smart Signature on both outputs. If a valid Smart Signature is not detected the Ag6700 will repeat the test approximately once a second. When a valid Smart Signature is detected the Ag6700 will apply the full voltage to both outputs and check the input stage of the Ag5700 whilst it is in idle mode. The current drawn from the Ag6700 during this test should be less than 50mA (25mA per channel).

During the Smart Signature and idle test cycle the “Status” output is held at logic “0”. Upon successfully completing the above, the Ag6700 will go into normal mode and the “Status” output will be set to logic “1”.

If the idle test fails, the Ag6700 will switch the outputs off and the Status will output an error code, see Section 5.5.

The control pin must initially be set to logic “0”, this limits the current trip threshold to ~20W (10W per channel). This mode is used during the start-up diagnostic cycle to limit the output power in case there is a fault.

When the control pin is set to logic “1”, the Ag6700 will be enabled to deliver up to 230W.

## 5.4 Smart Signature

The Ag6700 uses a custom Smart Signature which has been designed specifically to work with the Ag5700. The Ag6700's maximum output power of 230W far exceeds the IEEE802.3af or IEEE802.3at standard, so for safety reasons the detection signature is designed to prevent anyone from using the Ag6700 to power a conventional PoE Powered Device (PD). The smart signature is performed on both the spare pair and data pair to prevent power-up if the Ethernet cable is not correctly connected on all wires.

## 5.5 Status Output

The Status output pin is used to determine the condition of the Ag6700. If the Ag6700 is off this output pin will be a steady state Logic '0', if the output is on and working normally the Status output pin will be steady state Logic '1'.

In the event of an error condition occurring, the outputs will be turned off and the Status output pin will pulse, reporting the error mode detected. Table 2 shows a list of the modes and the condition of the Status output pin.

An error condition can only be cleared by resetting the Enable input. Taking this input to Logic '0', allowing the Status pin to return to a steady Logic '0' (> 1 second) and then setting it back to Logic '1'.

Mode	Status Mode	Status Output
0	Off	Steady State 'Logic 0'
1	On (Normal)	Steady State 'Logic 1'
2	Failed Idle Current Test	1 Pulse
3	Failed 20W Power Limit	2 Pulses
4	Failed 230W Power Limit	3 Pulses
5	Outputs Current Imbalance	4 Pulses
6	Over Temperature	5 Pulses
7	UVLO Tripped	6 Pulses

**Table 2: Status Output Conditions**

The error pulse timing is shown in Figure 6; the slow duration of the pulses is to allow for an LED to be connected for visual indication of the output status, shown in Figure 7.

It is important to remember that the Ag6700 supply should be isolated from mains ground. If the controller's supply is connected to mains ground then the input and output pins should be isolated with opto-isolators.

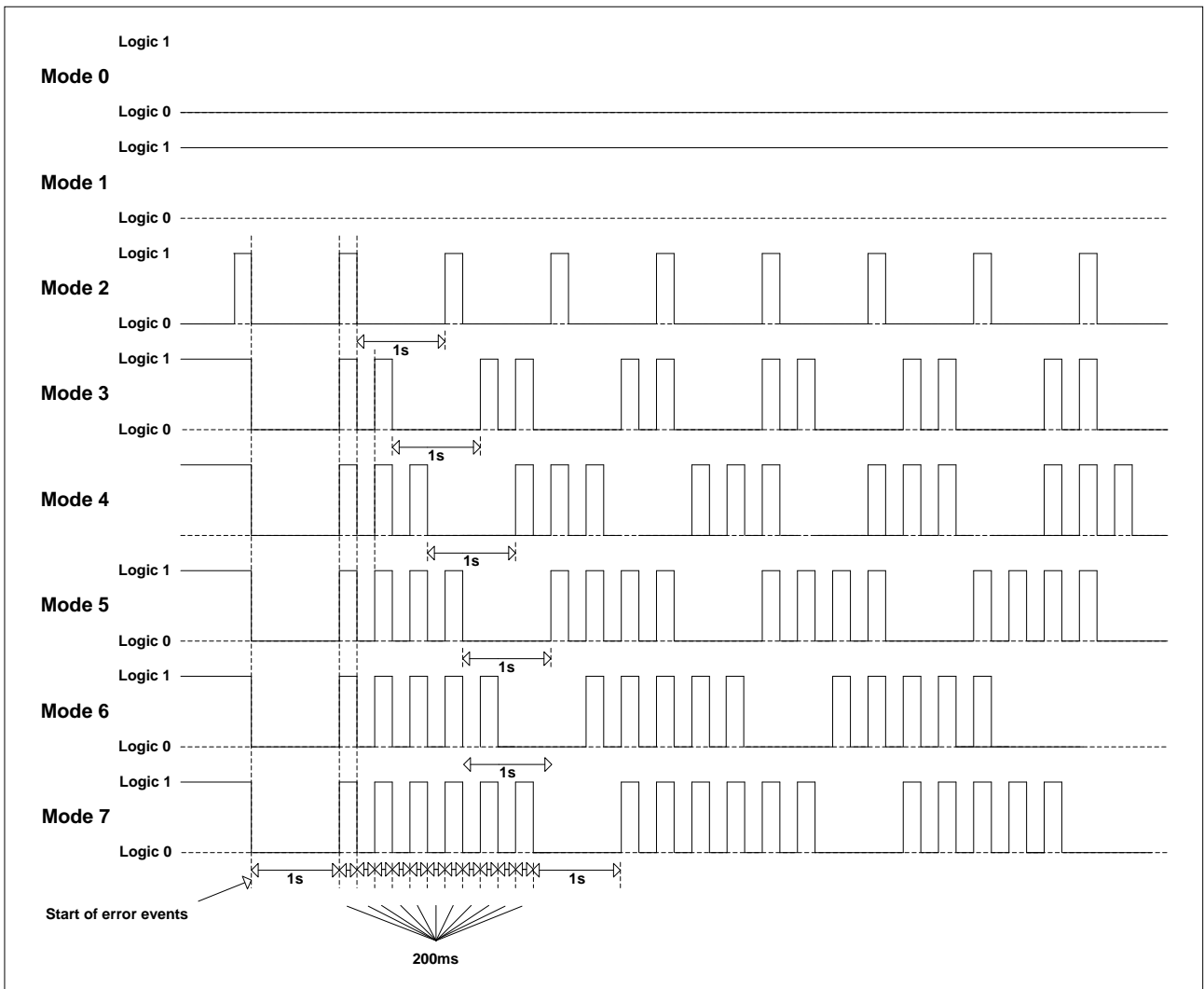


Figure 6: Status Output Timing

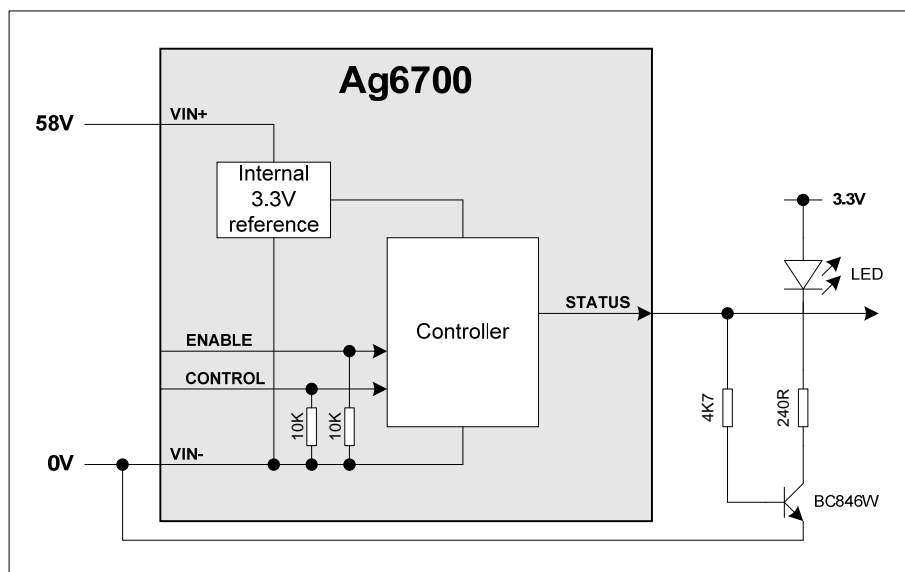


Figure 7: Status Output Connection

## Mode 0 –Disconnected

If the Enable input is Logic '0' the Ag6700 output is off then the module will be set in Mode 0. If the Enable pin is Logic '1' module will remain in Mode 0 until a smart signature is detected. The Ag6700 automatically tests for a smart signature with a one second interval between tests.

## Mode 1 – Normal

This indicates that the Ag6700 output is on and everything is operating normally.

## Mode 2 – Failed Idle Current

This test is performed immediately after the completion of a successful smart signature test. The Ag5700 holds its output off so that the Ag6700 can test the idle current to ensure that there are no damaged components in the Ag5700 front end circuit.

## Mode 3 – Failed Low Power Test (20W)

When the Control pin is set to Logic '0' the Ag6700 will report a fault if the total power exceeds ~20W ( $V_{IN} = 58V$ ).

## Mode 4 – Failed High Power Test (230W)

When the Control pin is set to Logic '1' the Ag6700 will report a fault if the total power exceeds ~230W ( $V_{IN} = 58V$ ).

## Mode 5 – Failed Output Current Imbalance Test

The Ag6700 monitors the current on both outputs. This is done to ensure the integrity of the Cat 5e / 6 cable. When the Ag6700 detects a current imbalanced it will report an imbalance fault.

## Mode 6 – Over Temperature Error

The Ag6700 monitors the module temperature. If the temperature exceeds 115°C, the outputs will be removed and an error reported.

## Mode 7 – Under Voltage Lockout (UVLO) Tripped

The Ag6700 monitors the UVLO detection circuit to ensure that the supply rail is >48V. The detection circuit can be tripped by one of two conditions.

1. The input power supply used is <48V
2. The input supply dips <48V during an output short circuit\*

\*Note: If a short circuit is applied to the Ag6700 after the output has been applied, the module will protect itself as quickly as possible. The UVLO detection circuit and the  $\mu$ -controller over-current detection are independent of each other to offer maximum protection. However the  $\mu$ -controller will report the first fault condition it detects first, this could be Mode 6 or Modes 3 or 4 (depending on the status of the Control input).

## 5.6 Typical Connections

Figure 8 shows a typical connection setup for the Ag6700.

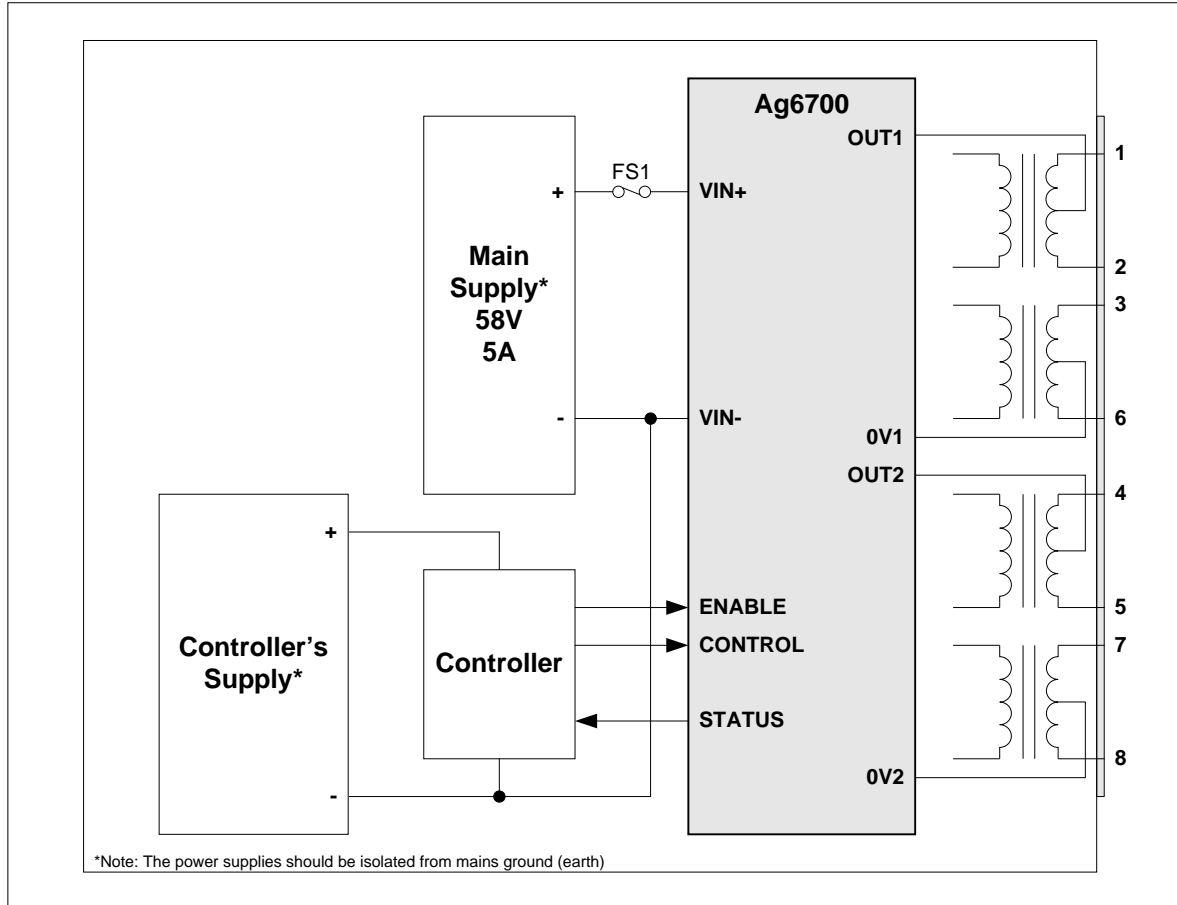


Figure 8: Typical Connection Diagram

## 5.7 EMC Performance

The Ag6700 is designed to meet EN55022 Class B. Test results are available by contacting Silvertel.

## **6. Protection**

### **6.1 Hardware Protection**

The Ag6700 has built-in protection Transorb diodes across the input pins (VIN+ / VIN-) and across both outputs. It also has thermal protection, to prevent the module from being damaged by over-temperature conditions.

Because the Ag6700 is a power supply, for single fault protection an in-line fuse should be put in the input line, see Figure 8.

### **6.2 Software Protection**

The Ag6700 continually monitors the UVLO detection circuit and the outputs for an over-current condition. If either condition is detected the outputs will be switched off and an error reported on the Status output.

In addition to the above the Ag6700 also monitors the feed and return current in both outputs. If one of the feed or return pairs goes open circuit, then the other (feed or return) pair takes the additional current. From a power capability stand point, at loads < 100W the working pair can handle the extra current without any problem. But this would be a major problem at higher power > 100W, where the wires in the unbroken (feed or return) pair would exceed 1A each.

To prevent damage, the Ag6700 will switch the outputs off and report an error on the Status output when an unbalance condition is detected.

## **7. Important Safety Considerations**

### **7.1 Regulatory Safety Approval to IEC60950-1**

The Ag6700 output of 230W exceeds the 100W limit for “Inherently limited power sources” as defined in IEC60950 Section 2.5. To meet the requirements of IEC60950 Section 3.5.4 “Data ports for additional equipment”, systems using the Ag6700 must be fitted with a “Fire Enclosure” meeting the requirements of IEC60950 Section 4.7. Enclosures are a normal part of products for both consumer and professional use. Meeting the requirements of Section 4.7 involves the use of materials with the correct flammability class and wall thickness in the design of these enclosures. The design must also use the correct spacing between components on the Ag6700 and the walls of the enclosure.

### **7.2 Normal Operating Power**

Even though the Ag6700 has many built in protection and safety features it should be remembered that the module can still deliver 230W to the PD under normal operating conditions. If the powered device goes faulty whilst the Ag6700 is applying high power and the power does not exceed 230W then it will continue to operate normally.

### **7.3 Cable and Connector Requirements**

It is the user’s responsibility to ensure the cables, connectors and components connected to the Ag6700 are capable of handling the rated current.

For example if the Ag6700 is supplying output power of 232W at 58V this gives a total current of 4A. This means each conductor in the Ethernet cable and each contact in the RJ45 connector is carrying  $4A / 4 = 1A$ . Therefore the cables and connectors used must be able to handle this current safely. Standard RJ45 connectors are rated to carry 1A per pin. When using Cat 5e / 6 cables at 1A per wire to meet UL temperature rise limit of 10°C it may be necessary to limit the number of cables in a bundle to <3 or 4.

### **7.4 Isolated Power Supply**

The Ag6700 module is non-isolated, therefore it is very important that the input power supply is isolated from mains ground. Creating a barrier will make the Ethernet cable less susceptible to being a conductive path for lightning or even static electricity to ground. It is also important to create a barrier between the Ethernet cable and the chassis if it is made from a conductive material. This is to protect the end user from high voltage transients that may be picked up on the Ethernet cable.

## 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	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	$V_{IN}$	54	58	60	V
2	Input Supply Current at 230W ( $V_{IN} = 58V$ )	$I_{IN}$		4		A
3	Operating Temperature	$T_{OP}$	-20	25	70	$T_a / ^\circ C$

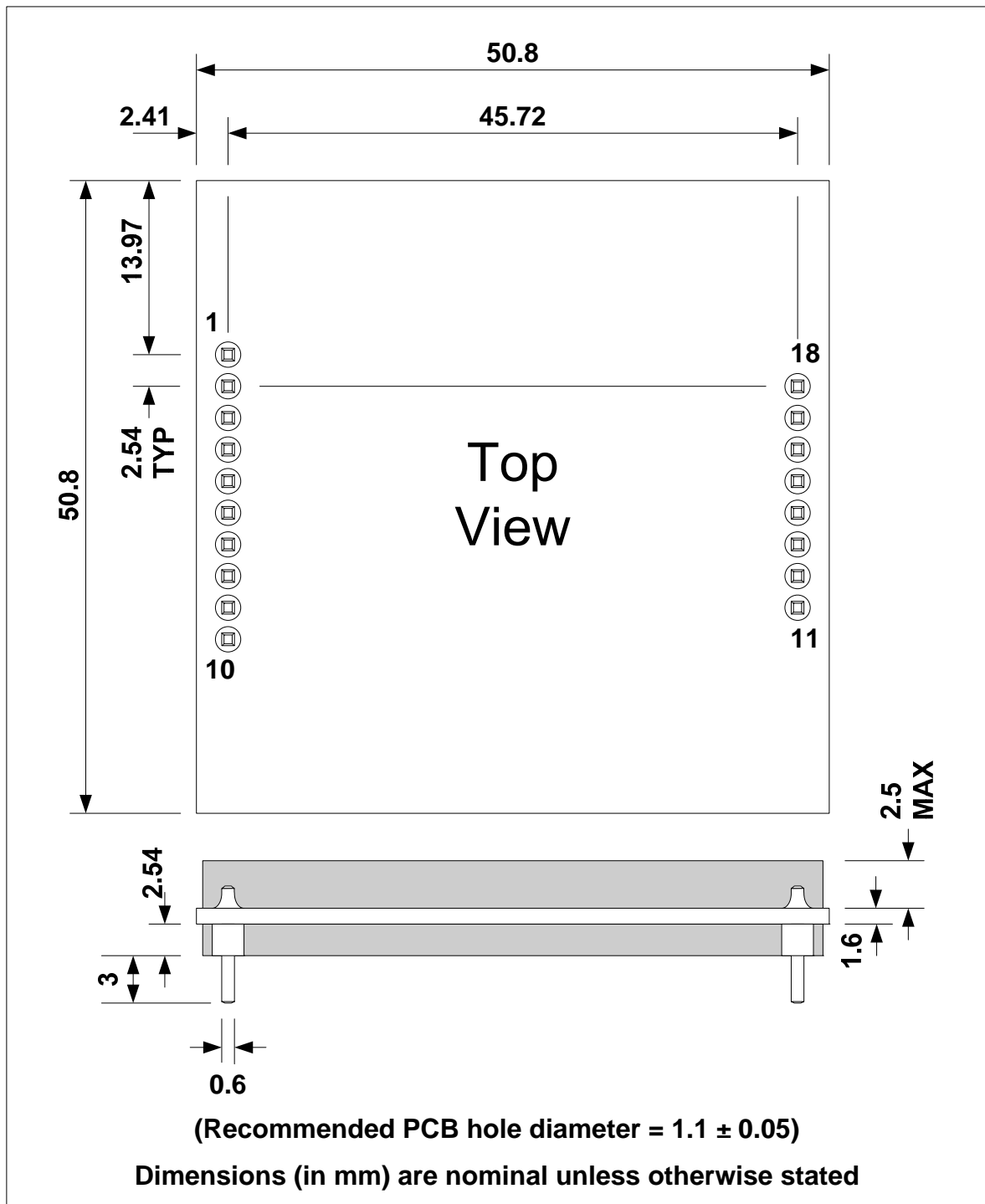
### 8.3 DC Electrical Characteristics

	DC Characteristic	Sym	Min	Typ <sup>1</sup>	Max	Units	Test Comments
1	Input Supply Voltage at Maximum Load	$V_{IN}$	56	58	59	V	
2	Input Idle Current	$I_{IN}$			15	mA	$V_{IN} @ 58V$
3	Under Voltage Lockout	$V_{UVLO}$		48		V	
3	Inputs – Enable & Control Input Low Voltage Input High Voltage	$V_{IL}$			0.7	V	
		$V_{IH}$	2.4			V	
4	Output – Status Output Low Voltage	$V_{OL}$			0.3	V	@ 1mA
					0.6	V	@ 5mA
5	Output – Status Output High Voltage	$V_{OH}$	3.0 2.7			V	@ -1mA
						V	@ -5mA
6	Output Status Timing – Mark Space Delay <sup>2</sup>	$S_{MK}$		200		ms	
		$S_{MS}$		200		ms	
		$S_{DLY}$		1000		ms	
7	Unbalance Detect Threshold	$V_{UD}$	300			mA	

Note 1: Typical figures are at 25°C with a nominal 58V supply.

2: Delay between error mode pulses.

## 9. Package



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