

1. Features

- Small SIL package
- Selectable LED Current, 350mA, 500mA, 700mA & 1000mA
- Wide Input range 12V to 57V, SEPIC – Buck/Boost Technology
- Very Long Life - No external electrolytic capacitors required
- Output Short-circuit and Over-Voltage protection
- Input Over-voltage and Under-voltage protection
- Wide LED String Voltage (2V-34V)
- 0.5V-10V Dimmable capability
- Fully isolated (3.75KV) DALI Input
- Low cost
- High efficiency (>89%)
- Silvertel “design-in” assistance

2. Description

The Ag201 module from Silvertel is an extremely versatile, low voltage DC input, constant-current LED driver module. Its' wealth of features are all delivered in a tiny package, with a maximum of flexibility. Selectable constant current output drive allows connection to a huge variety of market leading LEDs. In addition, the module's SEPIC, Buck-Boost DC-DC converter topology means the input voltage can be either higher or lower than the string (output) voltage, allowing for ease of design with a wide range of DC input voltages and LEDs. Flexible and powerful dimming control is built in with both fully isolated DALI and analogue (0.5V-10V) dimming inputs available.

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3. Ag201 Product Selector

Part Number†	Output Voltage	Output Current	Maximum Output Power *	Date code‡ Marking
Ag201	2V to 34V	350-1000mA	24 Watts	WWYY

*At 25°C with $V_{IN} = 57V$

† The Ag201 fully meets the requirements of the RoHS directive 2011/65/EC on the restriction of hazardous substances in electronic equipment.

‡ Date code format: "WW" = Week Number, "YY" = Year.

Table 1: Ordering Information

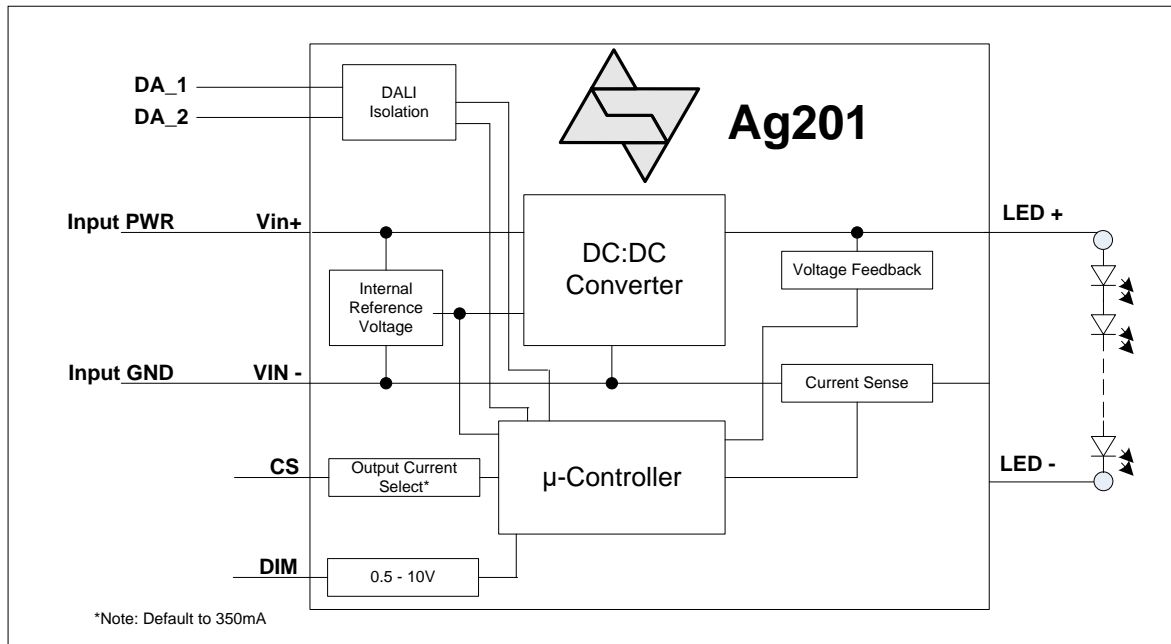


Figure 1: Block Diagram

4. Pin Description

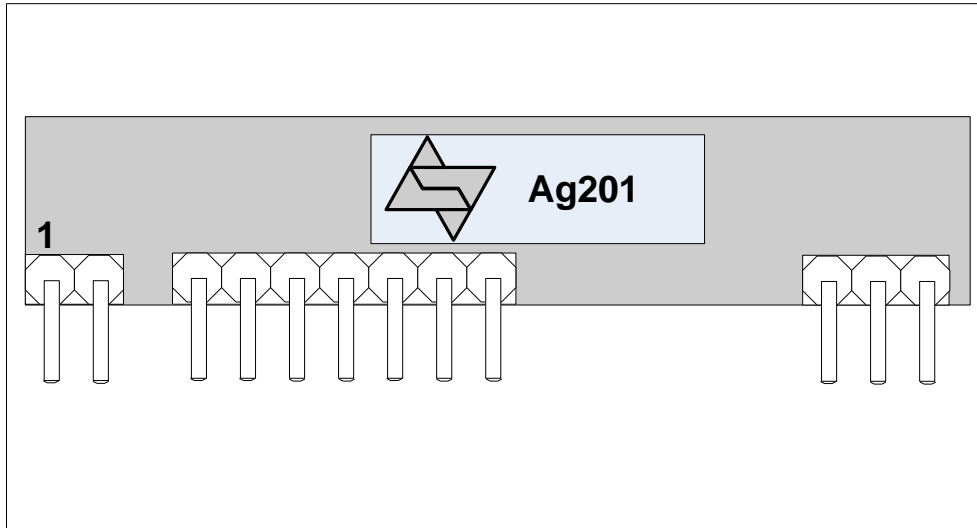


Figure 2: Ag201 Package Format

4.1 Ag201 Pin Description

Pin #	Name	Description
1	DA_1	DALI Connection. These pins connect to the DALI controller and are not polarity sensitive.
2	DA_2	
3	VIN+	Direct Input +. This pin connects to the positive (+) output of the power supply.
4	DIM	0.5-10V Dimming control. This pin can be connected directly to a positive power supply (0-10V), connected to a Potentiometer (25K) or a standard shunt dimmer to set the required brightness.
5	CS	Current Select. This pin selects the constant current output of the Ag201. This can be done by connecting an external resistor from this pin to the VIN- pin. (Will default to 350mA if left unconnected)
6	IC	Internal Connection. Do not connect to this pin.
7	IC	Internal Connection. Do not connect to this pin.
8	IC	Internal Connection. Do not connect to this pin.
9	VIN -	Direct Input -. This pin connects to the negative (-) output of the power supply.
10	LED +	DC Output. This pin provides the regulated output from the DC/DC converter to the customers LED.
11	LED -	DC Return. These pins are the return path for the LED + output.
12	LED -	

Table 2: Pin Description

5. Functional Description

5.1 Input

The Ag201 has a wide input voltage range of 12Vdc to 57Vdc which can be either higher or lower than the string (output) voltage. However, if operating the Ag201 between 12-20V the output power is reduced as shown in Figure 10.

Although not required by the Ag201, if a noisy power supply is connected then fitting a 100 μ F electrolytic capacitor across the Ag201 input will reduce the ripple from the supply. This value can be adjusted, depending on the quality of the power supply being used.

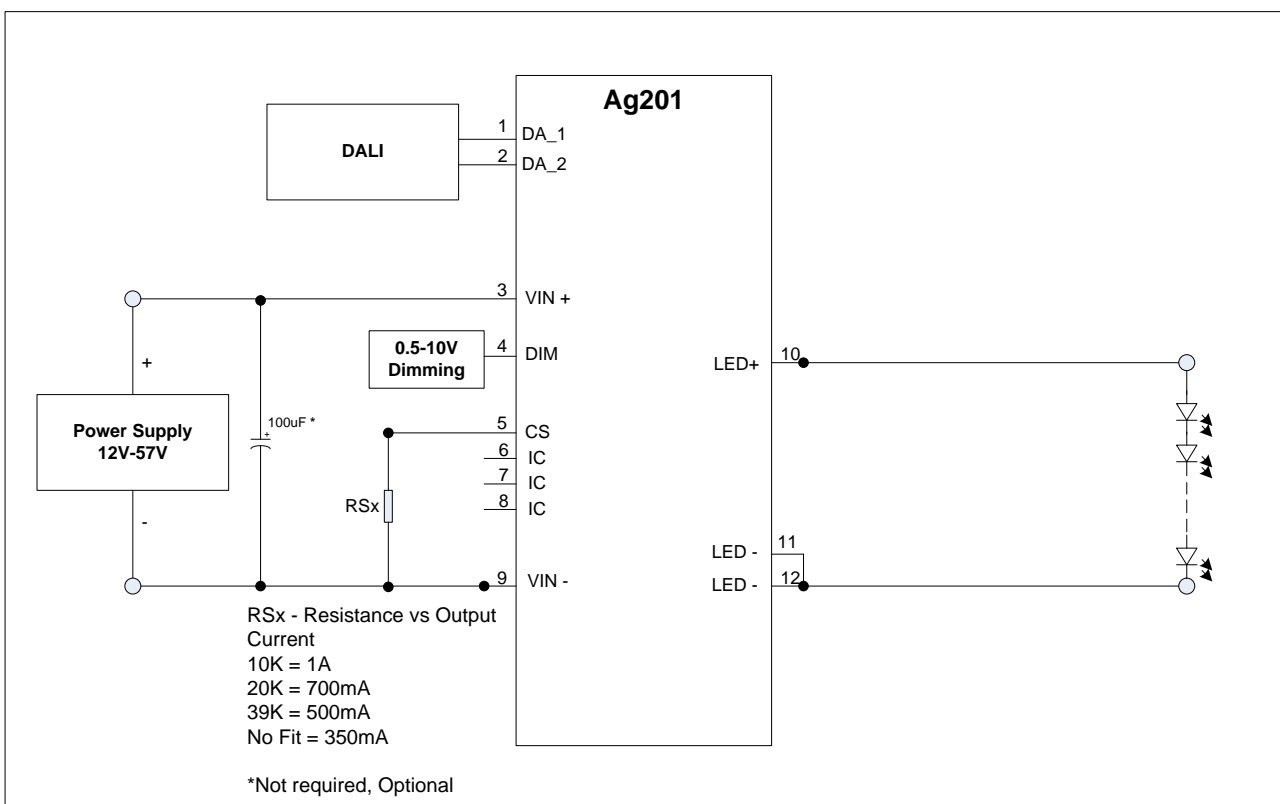


Figure 3: Typical System Diagram

5.2 Output

The Ag201 has been designed to operate with no electrolytic capacitor connected to its output. In order to avoid undesirable operation no capacitor should be fitted across the LED+ and LED- pins.

The Ag201 can power an LED string voltage from 2V up to 34V providing a maximum power output of 24W to the LED as shown in Table 3.

Output Current VS Output Voltage (>20Vin)		
I_{out}	V_{out}	LED Power
350mA	34V	11.9W
500mA	34V	17W
700mA	34V	23.8W
1000mA	24V	24W
Output Current VS Output Voltage (<20Vin)		
350mA	22V	7.7W
500mA	22V	11W
700mA	22V	15.4W

Table 3: Maximum LED Power

5.3 Output Current Setting

The Ag201 has 4 selectable constant current output values 350mA, 500mA, 700mA and 1000mA with its default, no resistor connected to CS pin, set to 350mA. Fitting a resistor between the CS and VIN- pin, as shown in Figure 4, will increase the constant current output to the required values shown in Table 4.

The multiple current setting available from the Ag201 provides the advantage of only having one product to cover a range of LEDs'. Selected LED current is detected and set during power on, in order to change the required LED current the module must be power cycled.

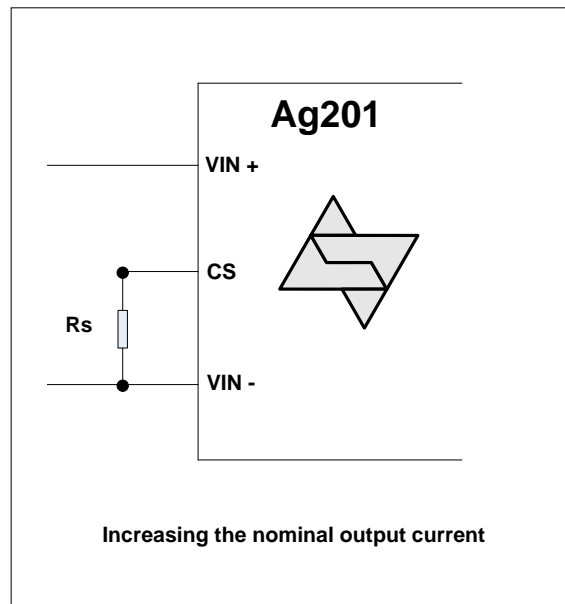


Figure 4: Constant Output Current Adjustment

Increase the constant output current, connect Rs between CS and VIN-	
Rs	Iout
Not Fitted	350mA
39K	500mA
20K	700mA
10K	1000mA

Table 4: Output Current Adjustment Resistor Value

5.4 Efficiency

The Ag201 achieves a maximum efficiency of greater than 89% as shown in Figure 5.

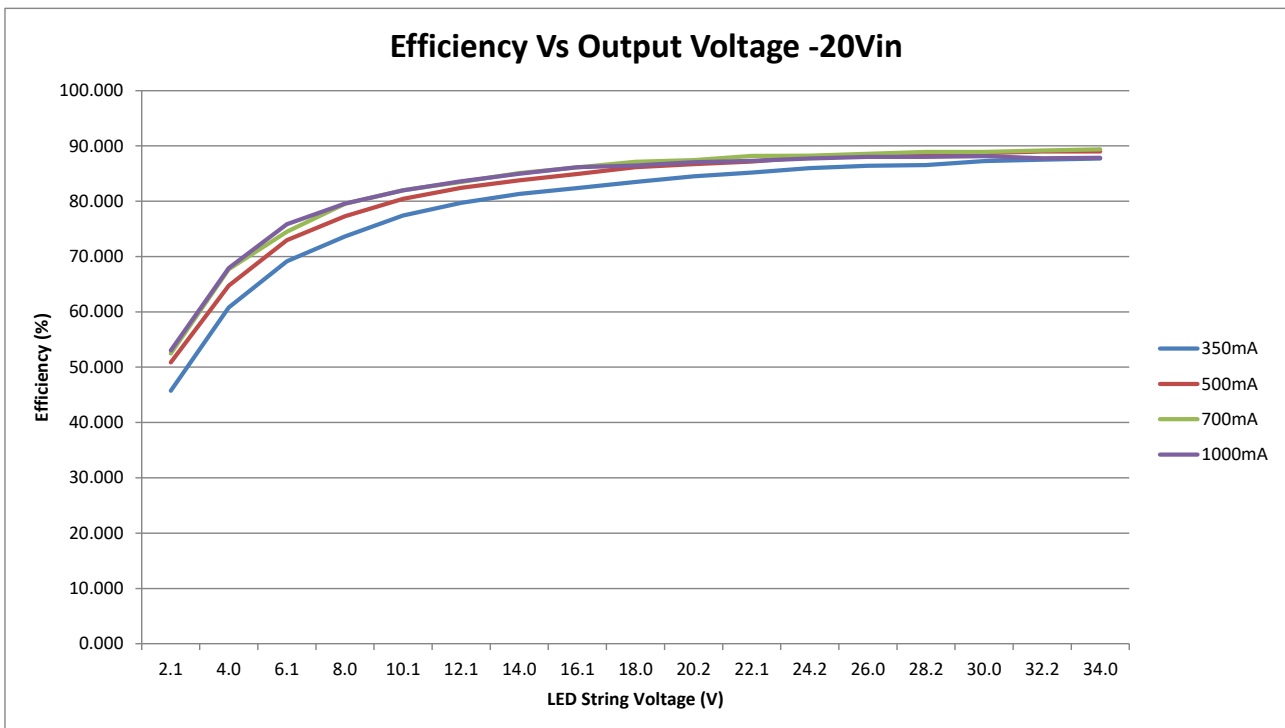


Figure 5: Efficiency at 20Vin

5.5 Isolation

As per DALI specification the Ag201 provides the required 3.75KV (AC rms) isolation, protecting the module from damage if the mains voltage was to appear onto the DALI wires. It is also important that the tracks on the customers' PCB between the DALI pins and VIN+ keep the isolation barrier by having at least a 3.75mm clearance. See Figure 8 for layout consideration.

6. Dimming Control

The Ag201 can control the brightness of an LED from 100% down to 5% via its internal digital PWM controller which runs at ~1.25KHz. LED brightness can be set in two ways, DALI or the analogue 0.5-10V DIM pin, however if DALI is connected it will take priority over the DIM input.

6.1 DALI

The Ag201 has a built in DALI controller which provides a bidirectional interface enabling control and monitoring of the LED fixture optimising various lighting areas such as wall and ceiling luminaries to floor lighting, emergency lighting and LED displays. DALI has the ability to control up to 64 single elements, up to 16 groups and creating a total of 16 scenes.

6.2 0.5-10V Dimming Control

The Ag201 DIM pin has an open circuit voltage of 11V providing a 0.7mA maximum current source enabling the customer to use a conventional dimmer or a 25K potentiometer to shunt the current, allowing the LED brightness to be dimmed from 100% - 5% using its internal digital PWM controller, as shown in Figure 7.

The DIM pin may also be over-riden by using an external voltage source. Please note: Care must be taken to ensure no more than 10.5V is fed into the DIM pin as this can cause damage to the Ag201.

When the voltage on the DIM pin drops below 0.5V the LED will be turned off, as shown in Figure 7.

If the 0.5-10V is initially used and DALI is then connected, the 0.5-10V dimming will be disabled until the DALI connection is removed and the Ag201 is power cycled.

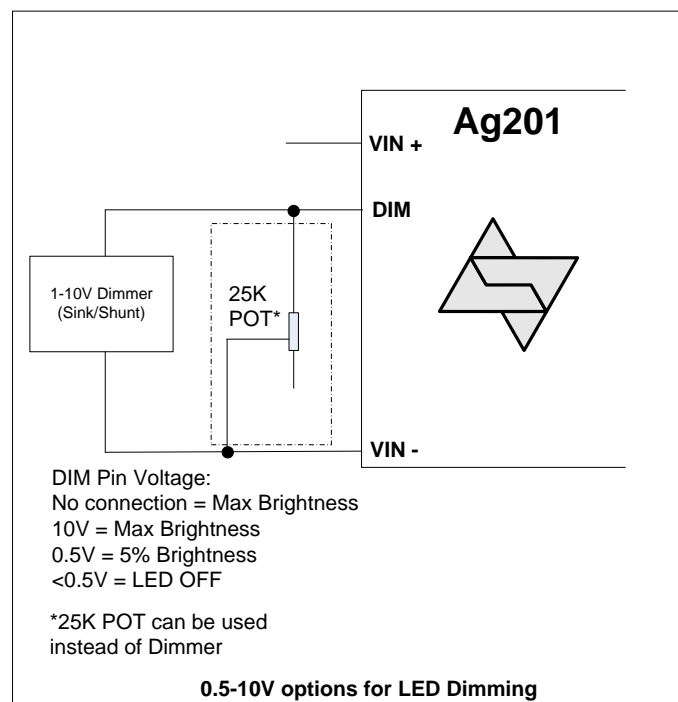


Figure 6: 0.5-10V Dimming

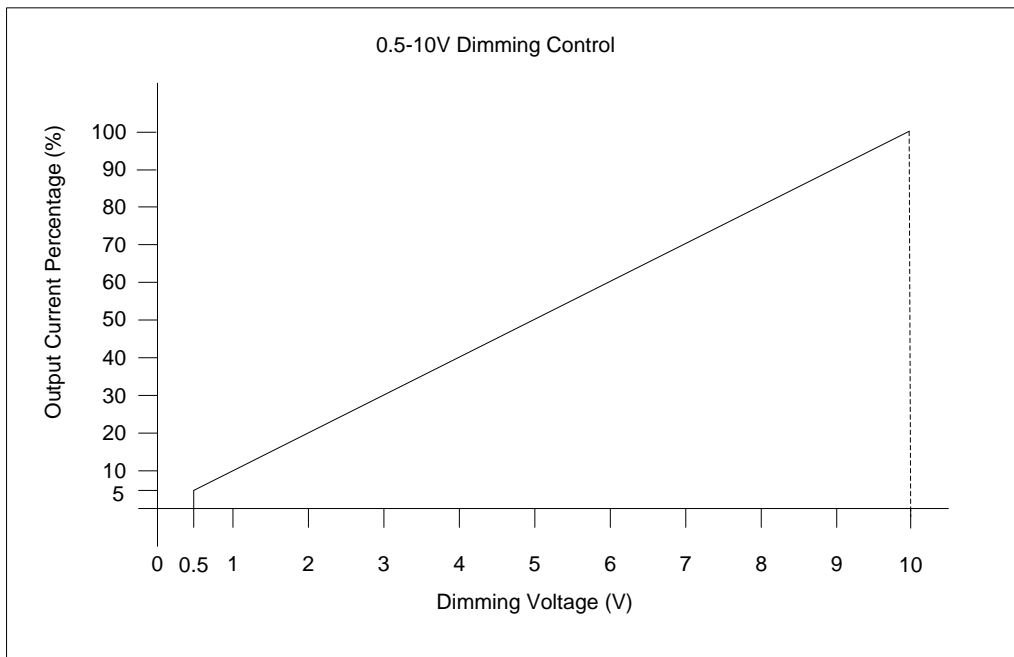


Figure 7: 0.5-10V Dimming

7. Layout Consideration

One simple technique that can be used to draw heat away from the module is to add power planes to the input and output pins.

Figure 8 shows our suggested board layout for the Ag201, with reference to the typical connection diagram shown in Figure 3.

It is important that tracks (on the top layer) and through hole vias are not placed in the “Keep Out Area” shown in Figure 8. This area is required to maintain the integrity of the isolation barrier, described in Section 5.4.

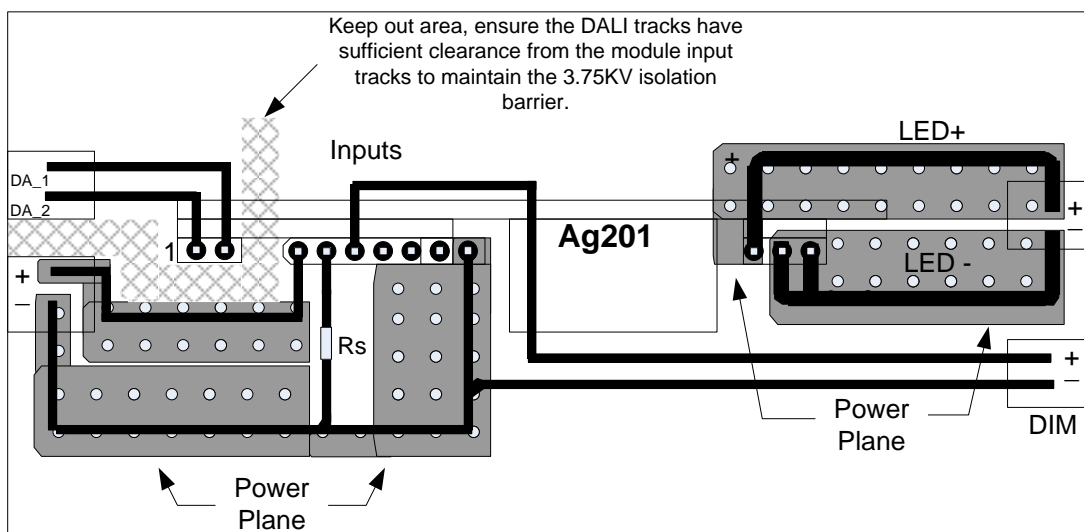


Figure 8: Layout Consideration- Thermal Relief Power Planes

8. Operating Temperature Range

The Ag201 is a power component and will generate heat so it is important that this is taken into consideration at the design stage.

The heart of the Ag201 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 forward voltage drop of the LED, the output current chosen and the input voltage supplied.

The Ag201 can operate up to a maximum of 85°C ambient (measured within a few cm's of the module) but the maximum output power is limited by the input voltage and power output, see Figures 9 & 10. These results were performed in an environment chamber - Associated Environmental System SD-302, without any heat-sinking. The performance of the Ag201 can be improved by forcing the airflow directly over the part or by using thermal relief pads to draw heat away from the module.

The Ag201 does not have thermal protection so it is important that the maximum operating temperature is never exceeded.

If operating the Ag201 between the core voltages of 20V – 57V then the following ambient temperature vs Output current must not be exceeded.

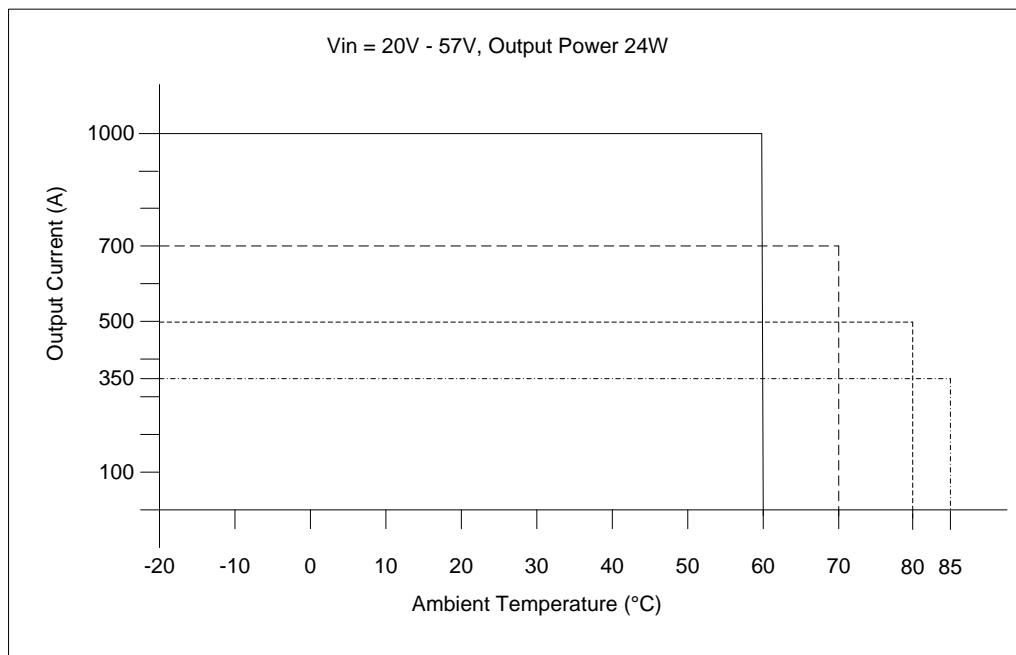


Figure 9: Ag201 Operating Profile 20-57V Input, Pout = 24W

If the customer uses a power supply between 12-20V, the Ag201 is only able to supply an output current up to 700mA with a 22V maximum LED string voltage as shown in Figure 10.

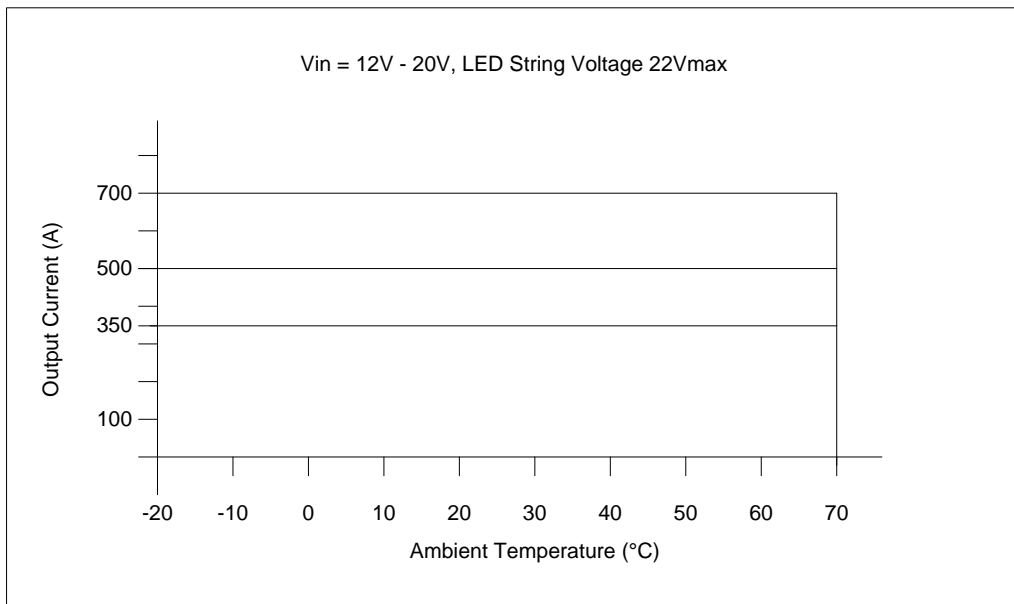


Figure 10: Ag201 Operating Profile 12-20V Input, VLED= 2-22V

Due to its small size, it is important that as much heat is drawn away from the module as possible. It is also important that any enclosure used has sufficient ventilation for the Ag201 and a direct airflow if possible. But because each application is different, it is impossible to give fixed and absolute thermal recommendations. One simple technique that can be used to draw heat away from the module is to add power planes to the input and output pins as shown in Figure 8.

9. Protection

9.1 Input Protection

The Ag201 has input voltage protection which monitors the input voltage and shuts down its output if the input voltage either drops below 12V or goes above 57V. The Ag201 will continue to monitor its input and if the voltage returns to its operating voltage (12-57V) then the Ag201 will re-apply power to its output.

9.2 Output Current Protection

The Ag201 is a constant current power device and thus when a short is applied to the output the Ag201 limits the current into the short to the output current which has been set via the CS resistor.

9.3 Output Voltage Protection

The Ag201 has open circuit proof protection clamping the output voltage to 36V if the output is left unconnected.

10. EMC

The Ag201 is designed to meet EN55032 Class B (pre-compliance test results are available from Silvertel).

However, because the Ag201 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.

11. Electrical Characteristics

11.1 Absolute Maximum Ratings¹

	Parameter	Symbol	Min	Max	Units
1	DC Supply Voltage	V_{CC}	12	57	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.

11.2 Recommended Operating Conditions

	Parameter	Symbol	Min	Typ	Max	Units
1	Input Supply Voltage ¹	V_{IN}	12	24	57	V
2	Input Under Voltage Lockout	V_{LOCK}	10.4		11.5	V
3	Operating Temperature ¹	T_{OP}	-20	25	85	T_a / °C

Note 1: See Section 8.

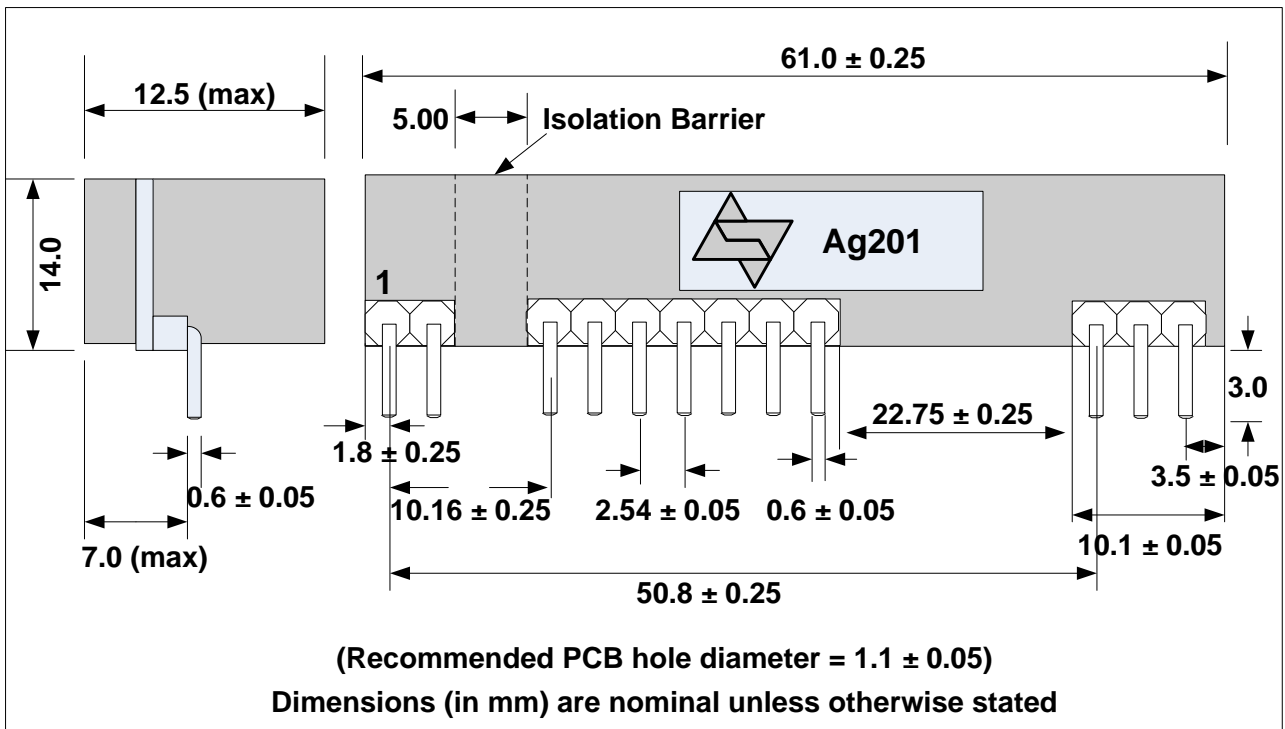
11.3 DC Electrical Characteristics

	DC Characteristic	Sym	Min	Typ ¹	Max	Units	Test Comments
1	Nominal Output Voltage ² (20V-57V Input)	+VDC	2		34	V	
2	Nominal Output Voltage ² (<20V Input)	+VDC	2		22	V	
3	Output Clamp Voltage	V_{CLAMP}			36	V	
4	Idle Current	I_{idle}	19		26	mA	
5	Output Current ³	I_{LOAD}		350 500 700 1000		mA mA mA mA	12V-57V 12V-57V 12V-57V 20V-57V
6	Line Regulation (20V-57V)	V_{LINE}		0.2	0.6	%	
7	Load Regulation - Min to Max (2V – 34V)	V_{LOAD}		1.2	1.7	%	
8	Output Current Drift	I_{Reg}	0	0.5	1	%	
9	Max Output Current Deviation (combined)	I_{Dev}	0		3.3	%	
10	Dimming Range	V_{DIM}	5		100	%	
11	DIM Voltage (Inserted)	V_{DMax}			10.5	V	Maximum inserted voltage

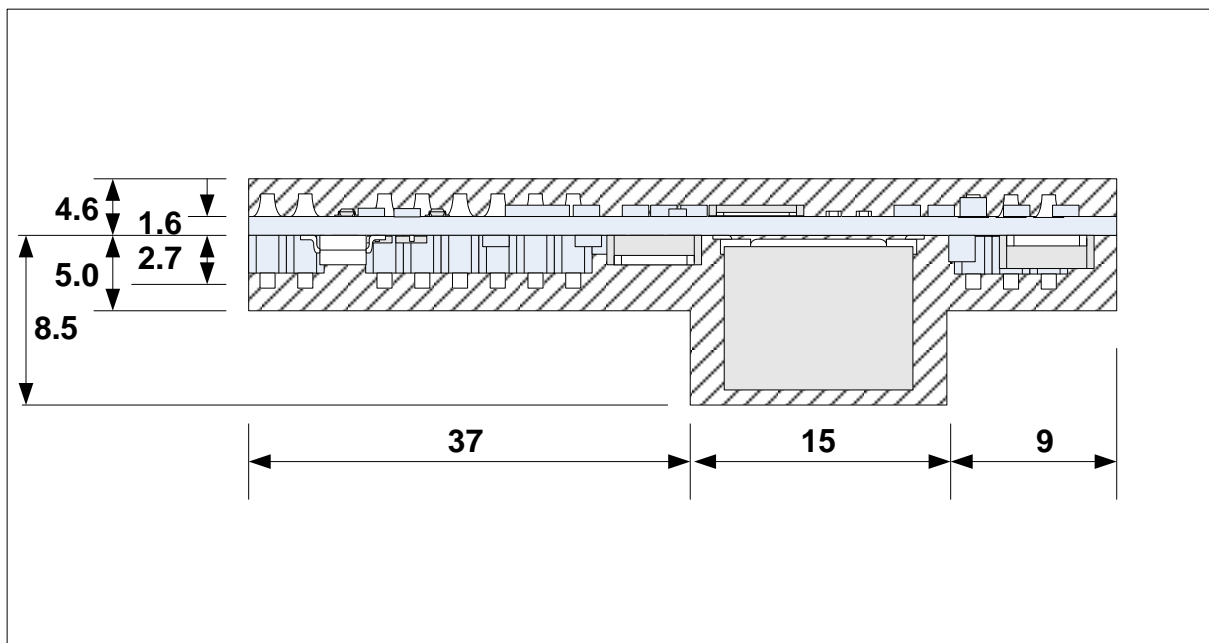
	DC Characteristic	Sym	Min	Typ ¹	Max	Units	Test Comments
12	Output Ripple and Noise ⁴ Ratio	V_{RN}		1:1.11	1:1.15	mVp- I_{AV}	Ratio of peak to average current
13	Dimming Frequency	F_{DIM}		1.25		KHz	
14	Short-Circuit Protection	T_{SC}			I_{out}	A	Current held at set I_{out} via R_s
15	Peak Efficiency	EFF		89.4		%	
16	Isolation Voltage (DALI) ⁵	V_{ISO}			3750	V_{PK}	AC rms

- Note 1: Typical figures are at 25°C with a nominal output voltage = 34V and are for design aid only. Not Guaranteed.
 2: See Table 3
 3: See Section 8
 4: Measurements made on a Picoscope with a 200MHz (x1) probe.
 5. DALI input to all other pins.

12. Package



12.1 Plan View



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