

Figure 1. The Photos of ATLS14M5V3R5AS

### FEATURES

- Compact Size: 0.55"×0.55"×0.08" (14.0mm×14.0mm×2.1mm)
- Low Profile: 0.08" (2.1mm)
- High Reliability: fully molded
- Surface Mount
- Bottom Thermal Pad: allows high power heat sinking
- Efficiency: 90%
- Maximum Output Current: 3.5A
- Current Output Noise: 3.97  $\mu\text{A}_{\text{p-p}}$ @0.1Hz ~10Hz
- High Stability: 100ppm/°C
- Loop Good Indication

Table 1. Pin Function Descriptions

Pin #	Name	Type	Description
1	SBDN	Digital Input	Shut down control. Negative logic, at the internal chip control input: >1.4V = enable, <0.95V = shut down.
2	LPGD	Digital Output	Laser diode good. When this pin is high, >2V, the control loop is working properly. When this pin is low, <0.3V, the laser diode is bad, or there is a short or open circuit at the laser diode.
3	GND	Signal Ground	Signal ground pin. Connect ADC and DAC grounds to here.

- Low Cost
- 100 % lead (Pb)-free and RoHS compliant

### APPLICATIONS

Driving laser diodes with low noise, including DPSSL, EDFA, fiber laser, direct diode lasers, etc.

### DESCRIPTION

The ATLS14M5V3R5AS is an ultra compact, low profile, and fully molded laser driver for driving diode lasers with up to 3.5A constant current, high efficiency, low noise, high reliability, zero EMI, and small package. Figure 1 shows the photos of ATLS14M5V3R5AS.

It provides these the functions: laser constant current control, laser current monitoring, over current and thermal protection, laser current control indication, laser diode status indication, soft start, and shut down.

It comes with a high stability low noise 2.5V voltage reference output which can be used for setting the output current. The reference output can also be used for the ADCs (Analog to Digital Converters) and/or DACs (Digital to Analog Converters).

Figure 2 is the real size top view of the controller showing the pin names and locations with the actual size. The pin functions are shown in Table 1.

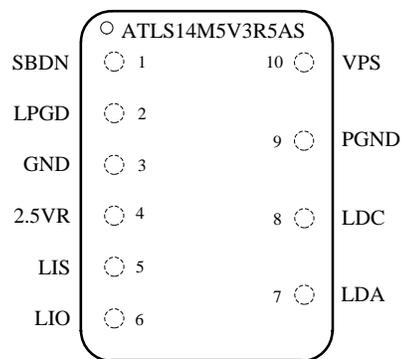


Figure 2. Pin Names and Locations



4	2.5VR	Analog Output	Reference voltage. It can source 3mA max, with 5 $\mu$ V <sub>P-P</sub> noise @ 0.1 to 10Hz and 25ppm/°C stability max.
5	LIS	Analog Input	Laser current set-point voltage. There is an input resistor of 10M tied to GND. Setting it from 0V to 2.5V will set the laser current from 0A to 3.5A linearly.
6	LIO	Analog Output	Laser current output indication. 0V to 2.5V indicates the laser current of from 0A to 3.5A linearly.
7	LDA	Analog Output	Laser diode anode. Connect it to the anode of the laser diode.
8	LDC	Analog Output	Laser diode cathode. Connect it to the cathode of the laser diode.
9	PGND	Power Ground	Power ground pin. Connect this pin directly to power supply return pass.
10	VPS	Power Input	Power supply voltage. The driver will work from V <sub>VPS</sub> = 3.1V to 6V.

### SPECIFICATIONS

Table 2 Characteristics (T<sub>ambient</sub> = 25°C)

Parameter	Test Condition	Value	Unit
Laser driver efficiency	I <sub>OUT</sub> = 1A, V <sub>OUT</sub> = 2.5V, & V <sub>VPS</sub> = 5V	≥90	%
Maximum output current	V <sub>LDA</sub> ≤ V <sub>LDAMAX</sub>	3.5	A
Output current noise (V <sub>IN</sub> = 5V; V <sub>OUT</sub> = 2.5V; I <sub>OUT</sub> = 500mA)	V <sub>IN</sub> = 5V; V <sub>OUT</sub> = 2.5V; I <sub>OUT</sub> = 500mA	3.97	μA <sub>P-P</sub> @0.1Hz- 10Hz
Stability @ 1A	The range of T <sub>A</sub> is 20°C ~ 80°C	±0.2	%
Laser current control signal range at LIS	V <sub>VPS</sub> = 3.1V ~ 6V	0 ~ V <sub>VPS</sub> - 0.2	V
LIS control accuracy	Relative accuracy = (accuracy current - set point current) / set point temp.	±0.2	%
Laser current indication signal range at LIO	V <sub>VPS</sub> = 3.1V ~ 6V	0 ~ 2.5	V
LIO indication accuracy	V <sub>VPS</sub> = 3.1V ~ 6V	±0.2	%
Reference voltage	V <sub>VPS</sub> = 3.1V ~ 6V	2.5	V
Reference Voltage temperature co efficiency	V <sub>VPS</sub> = 3.1V ~ 6V		
Output voltage range at LDA	V <sub>VPS</sub> = 3.1V ~ 6V	Depending on V <sub>VPS</sub>	V
PWM frequency		500	kHz
Power supply voltage range		3.1 ~ 6	V
Maximum power supply voltage	-	6	V
Start-up time		4	ms
Typical pull-down current at LPGD		6	mA
Operating case temperature	I = 1A, V <sub>IN</sub> = 3.3V or 5V, V <sub>OUT</sub> = 2.5V	-40 ~ 85	°C
Rise times of small signal	I <sub>OUT</sub> = 1A, V <sub>OUT</sub> = 2.5V, & V <sub>VPS</sub> = 5V	70	μS
Fall times of small signal	I <sub>OUT</sub> = 1A, V <sub>OUT</sub> = 2.5V, & V <sub>VPS</sub> = 5V	70	μS
Rise times of large signal		352	μS
Fall times of large signal		184	μS

### OPERATION PRINCIPLE

The block diagram of the driver is shown in Figure 3. The shut down control circuit accept signals from 3 sources: external shut down, over current and over temperature signals. When one of these signals is activated, the driver is shut down. Only when all these 3 signals go up, the soft start circuit starts enabling the low noise driver.

An internal soft start circuit allows a slow start up and a quick shut down.

The high stability low noise 2.5V voltage reference can be used for setting the output current, and also be used for the ADCs and/or DACs.

It comes with a laser diode status indication circuit. When LPGD pin is high,  $>2V$ , the control loop is working properly. When this pin is low,  $<0.3V$ , the laser diode is bad, or there is a short or open circuit at the laser diode.

It comes with a laser current control indication. This pin has a similar function as Pin 2 LPGD, except that this pin is of an analog output and Pin 2 is of a digital output.

The current measurement circuit monitors the output current and shuts down the driver upon detecting the output current exceeds the pre-set value.

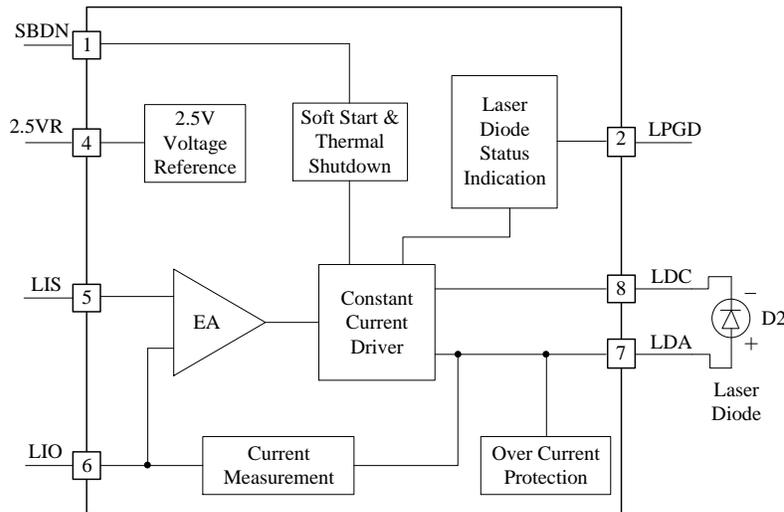


Figure 3. Block Diagram

### APPLICATION INFORMATION

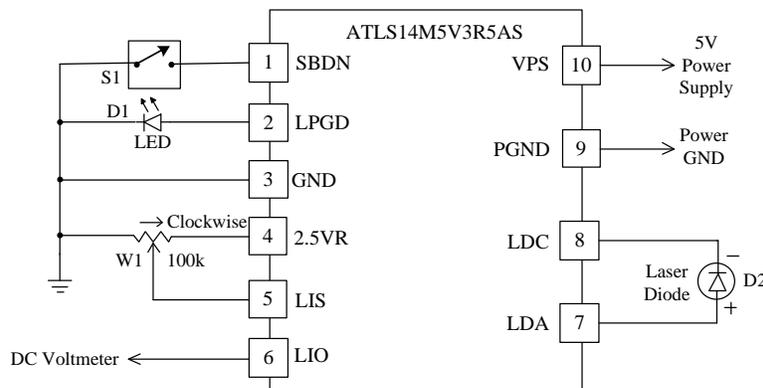


Figure 4. A Typical Stand-alone Application Schematic for ATLS14M5V3R5AS

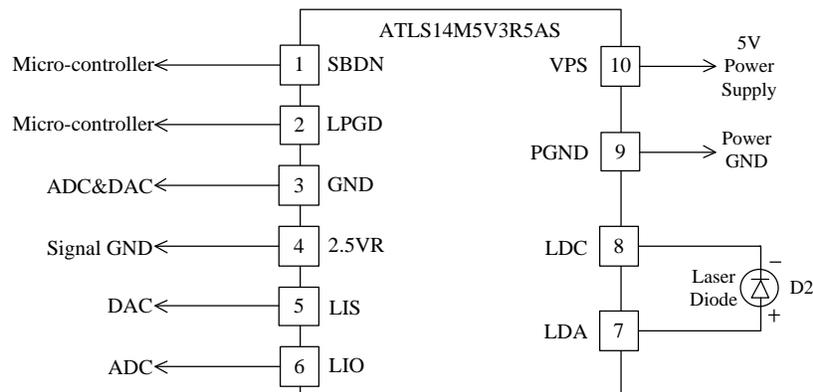


Figure 5. A Typical Micro-processor-based Application

Figure 4 shows a typical stand-alone application circuit.

In Figure 4, the switch S1 is external shut down switch, it can turn on and off the driver with the SDN pin high and lower respectively, at the internal chip control input:  $>1.4V = \text{enable}$ ,  $<0.95V = \text{shut down}$ , normal threshold voltage =  $1.2V$ . The switch S1 can also be an electronic switch, such as an I/O pin of a micro-driver, with an either open drain or push/pull output. See Figure 5. If not using a switch (S1) to control the laser, leave the SDN pin unconnected.

In Figure 4, the LED D1 is used to indicating laser diode status. When LPGD pin is high,  $>2V$ , the laser diode control loop is working properly. When LPGD pin is low,  $<0.3V$ , the laser diode is bad, or there is a short or open circuit at the laser diode. The LPGD pin can also be connected to a digital input pin of a micro-driver, when software/firmware is utilized in the system. See Figure 5.

Figure 5 shows a typical micro-processor-based application circuit.

In Figure 4, the adjustable resistor W1 is used to setting the output current. Setting LIS from  $0V$  to  $2.5V$  will set the laser current from  $0A$  to  $3.5A$  linearly.

The laser diode D2 is connected between LDA and LDC. It is worth mentioning that the power supply return terminal should be connected to the pin 11 PGND and the cathode of the laser diode should be connected to the pin 10 LDC. These 2 nodes should not be connected together externally and they are connected together internally already by the driver.

### Typical Characteristic

The curve of the  $V_{VPS}$  vs.  $V_{LDAMAX}$  is shown as below, when the  $V_{VPS}$  equals to  $3.1V$ ,  $3.3V$ ,  $5V$  and  $6V$ , the corresponding  $V_{LDAMAX}$  is  $2.6V$ ,  $2.8V$ ,  $4.28V$  and  $5.37V$  respectively.

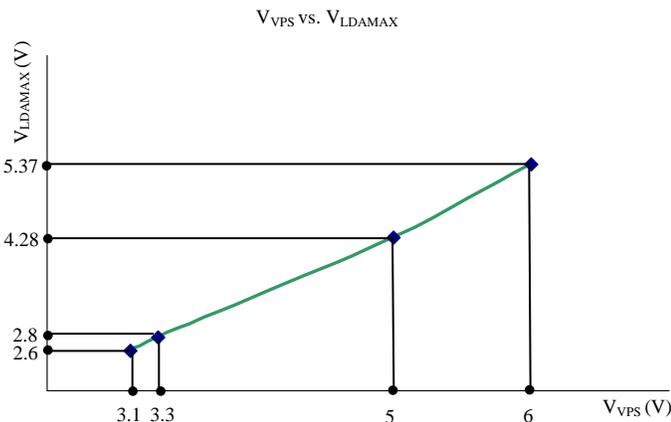


Figure 6.  $V_{VPS}$  vs.  $V_{LDAMAX}$

Figure 7 shows the relationship between Pin VPS and LDA.

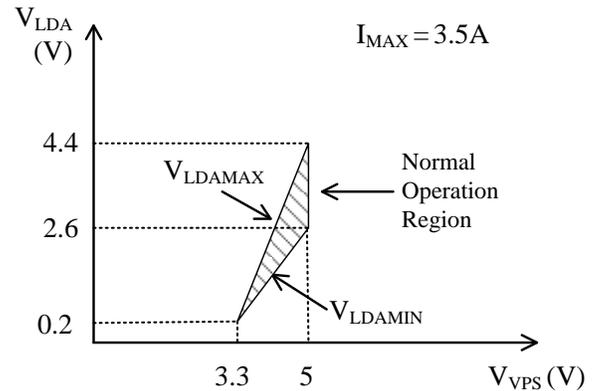


Figure 7.  $V_{VPS}$  vs.  $V_{LDA}$

### Turning the Driver On and Off

The driver can be turned on and off by setting the SDN pin high and lower respectively. It is recommended to turn the driver on by this sequence:

To turn on: turn on the power by providing the power supply voltage to the driver, turn on the driver by releasing the SDN pin.

To turn off: turn off the driver by lowering the voltage of SDN pin, turn off the power by stopping the voltage supply on the VPS pin.

When not controlling by the SDN pin: leave it unconnected and turn on and off the driver by the power supply.

### Adjusting the Output Current

The output current is set by adjusting W1, which sets input voltages of LIS, pin 5. See Figure 4.1. The output current will be:

$$I_{OUT} (A) = 3.5 (A) \times V_{LIS} (V) / 2.5 (V).$$

LIS can be configured by using a DAC, to replace the W1 in Figure 4.1. Make sure that the DAC has output low noise, or, if no modulation is needed, an RC low pass filtered by be inserted between the DAC and the LIS pin. See Figure 5.

The LIO can still be used to monitor the output current when the LIS is adjusted.  $0V$  to  $2.5V$  indicates the laser current of from  $0A$  to  $3.5A$  linearly.

### Monitoring the Output Current

The output current of the driver can be monitored by measuring the voltage on the LIO pin. This feature is very useful for micro-driver based system where the ADC is available and monitoring the current in real time is required. This pin provides a very low noise voltage signal which is proportional to the output current:

$$V_{LIO} (V) = 2.5 (V) \times I_{OUT} (A) / 3.5 (A).$$

For example, when the output signal equals to 2.5V, the output current is 3.5A.

LIO can be used to drive an ADC directly, and also be measured by a multimeter during debugging process.

### Driver Power Consumption

The power consumption of the driver can be calculated by:

$$P_{DRIVER} = I_{IN} \times V_{VPS} - I_{OUT} \times V_{LDA},$$

where  $P_{DRIVER}$  is the power consumed by the driver itself;  $I_{OUT}$  is the output current;

$I_{IN}$  is the power supply's input current;

$V_{VPS}$  is the power supply voltage;

$V_{LDA}$  is the voltage across the laser diode;

$$\eta = (I_{OUT} \times V_{LDA}) / (I_{IN} \times V_{VPS}).$$

To reduce the power consumed by the driver, we recommend using a power supply with its voltage being only about 0.5V (approximately, see below for a more accurate estimate) above the maximum output voltage. For example, for most diode lasers at 3.5A, the maximum forward voltage across the laser is about 2.8V, thus, using a 3.3V power supply would result in a much lower power consumption compared with

using a 5V power supply. Please make sure:

$$V_{VPS} \geq V_{LDAMAX} + 0.15V_{VPS},$$

where  $V_{LDAMAX}$  is the maximum possible laser diode voltage.

### First Time Power Up

Laser is a high value and vulnerable device. Faults in connections and damages done to the driver during soldering process may damage the laser permanently.

To protect the laser, it is highly recommend to use 2 to 4 regular diodes of >1A to form a “dummy laser” and insert it in the place of the real laser diode, when powering up the driver for the first time. Use an oscilloscope to monitor the LDA voltage at times of power-up and power-down, make sure that there is not over-shoot in voltage. At the same time, use an ammeter in serious with the dummy laser, to make sure that the output current is correct.

After thorough checking free of faults, disconnect the dummy laser and connect the real laser in place.

The driver output voltage range for the laser is between 0.5 to 4V when powered by a 5V power supply.

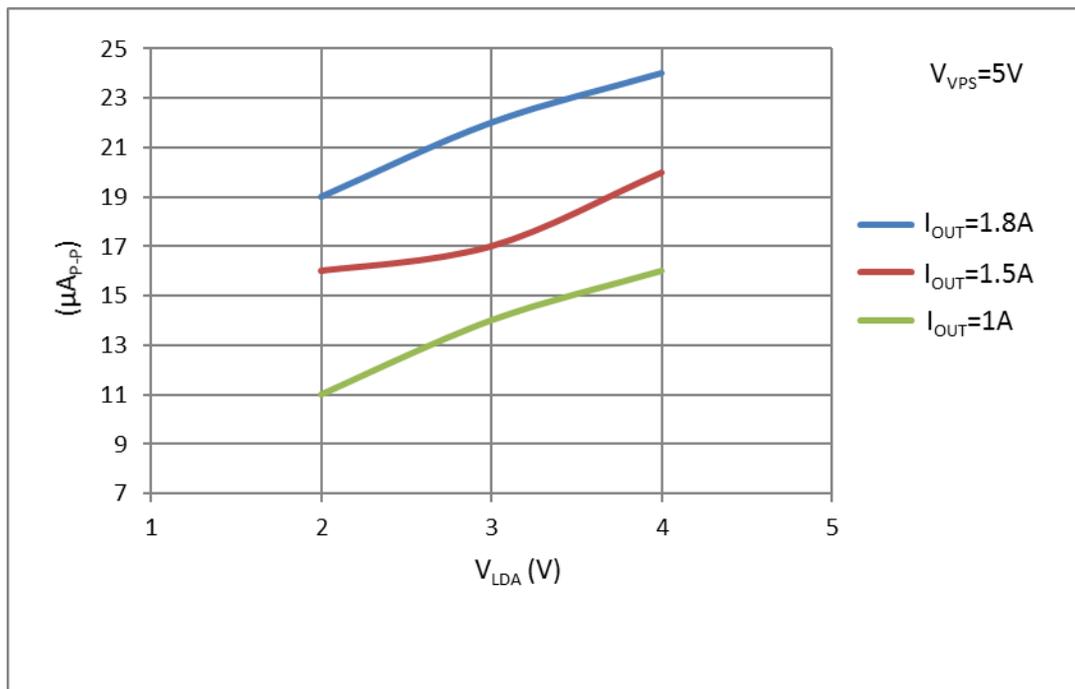


Figure 8.  $V_{LDA}$  vs. Output Current Noise@0.1Hz~10Hz

### Driving High Voltage Laser Diodes

Some laser diodes have high forward voltage, such as 7V, while the laser driver ATLS14M5V3R5AS has a maximum output voltage of 4V. This section tells a way to drive such laser diodes by using this laser driver.

The schematic is show as in Figure 9. Where Power Supply 1 is the power supply for the laser driver, Power Supply 2 is for increasing the laser driver's maximum output voltage.

Please notice that the power on sequence has to be in this way:

turn on Power Supply 1, turn on Power Supply 2, then turn on the laser driver by driving SDN (Shutdown) pin to logic high.

The sequence for turning off the laser circuit is: turn off the SDN pin by pulling it down to the logic low, turn off Power Supply 1, then, turn off power supply 2.

To make sure the circuit works ok: turn on the laser, measure LDA voltage, it should be between 1V to 3V, at room temperature, the ideal LDA voltage is around 2V.

### MECHANICAL DIMENSIONS

The dimensions of the ATLS14M5V3R5AS is shown in Figure 9. A recommended PCB layout is shown in Figure 10.

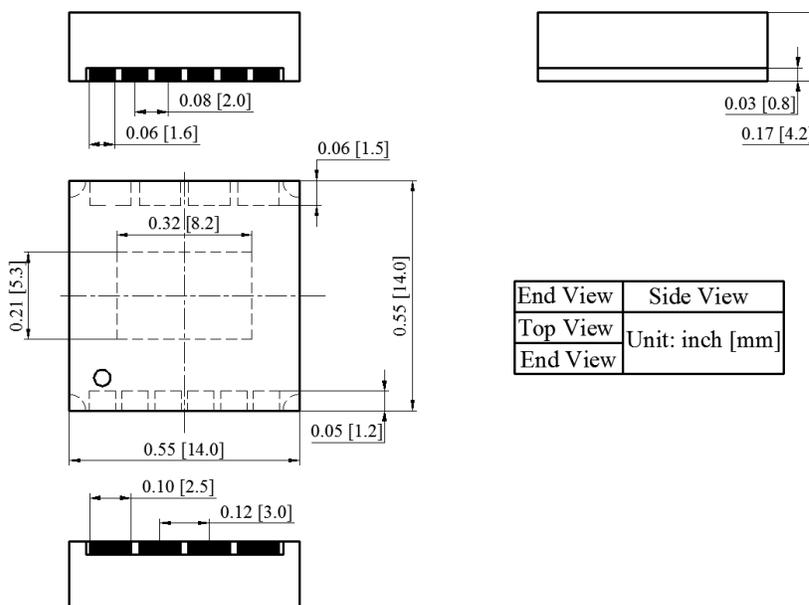


Figure 9. Dimensions of the ATLS14M5V3R5AS

### Recommended PCB Layout (Top Side) (PCB Board Tolerance $\pm 0.05$ )

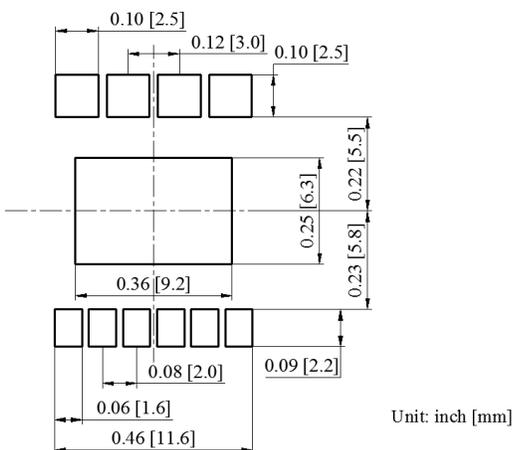


Figure 10. Recommended PCB Layout (Top Side)



**NOTE:** The power supply may have overshoot, when happens, it may exceed the maximum allowed input voltage, 6V, of the controller and damage the controller permanently. To avoid this from happening, do the following:

1. Connect the controller solid well with the power supply before turning on the power.
2. Make sure that the power supply has sufficient output current. It is suggested that the power supply can supply 1.2 to 1.5 times the maximum current the controller requires.
3. When using a bench top power supply, set the current limit to >1.5 times higher than the maximum current the controller requires.

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