Analog Technologies

Constant Current Laser Driver ATLS202D
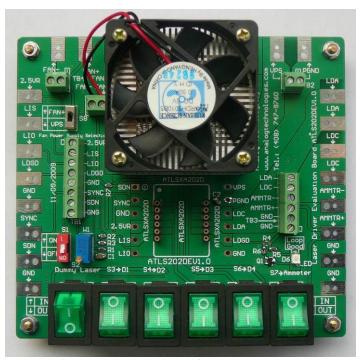# Evaluation board Rev. 1.0

By Gang Liu

Figure 1. Physical Photo of ATLS202DEV1.0

INTORDUCTION

The ATLS202D is a series of high efficiency electronic modules designed for driving diode lasers with low noise constant current. It has high reliability, zero EMI (Electro-Magnetic Interference), and is packed in small DIP package. The series includes ATLS2A202D, ATLS3A202D and ATLS4A202D. The output voltage range is from 0V to 4V when powered by a 5V power supply.

The evaluation board introduced by this application note, ATLS202DEV1.0, is designed for evaluating these laser driver modules conveniently.

It is recommended to read this application note with the ATLS202D datasheet which provides more detail information about the specifications and application guidelines for the laser driver modules.

The main purpose of using the evaluation board is to drive a voltage configurable and unbreakable dummy laser diode by using the laser driver with a programmable current. The dummy laser on the board emulates the users' expensive real laser diode so that in case there is a fault in the circuit or an improper operation, the real laser would not be damaged. After making sure the driver works properly and all the features and the set-values meet the requirements of the application, the users can disconnect the dummy laser from the driver by flipping a switch and connect a real diode laser

onto proper connections of the board. At the same time, the user can set and monitor the output current, monitor the working status of the driver, etc.

BOARD DESCRIPTION

The ATLS202DEV1.0 Evaluation Board is consisted of a complete application circuit for driving laser diodes. It can set and monitor the output current, has an LED for indicating the working status of the driver, and has numerous connection pads and terminal connectors for making connections with external components and instruments. Its physical photo is shown in Figure 1.

The silkscreen layer of the evaluation board is shown in Figure 2 with other top layers, including top silkscreen, top copper, top solder mask, and multilayer (vias). Figure 3 only shows the image of top silkscreen layer. There is no component in the bottom side of the board, so that there is no bottom silkscreen layer image.
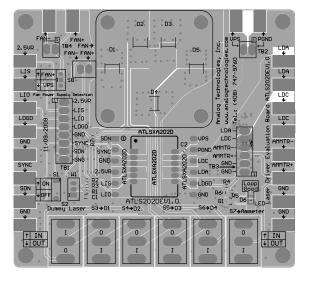

Figure 2. Top Silkscreen Layer with Other Top Layers

There are solder pads on the left, top and the right edges of the board. These pads can be used for connecting the external instruments or components and the connections can be made by either soldering wires or clipping by alligator clips.

There are 4 terminal blocks located on the board, their connectors are for the same nodes of the solder pads. You can see the silkscreen image in Figure 3. There is a switch bank on the bottom center of the board. On the left side of the switch bank, there are 2 potentiometers.

When the driver works perfectly, the LED on the bottom right location will be lit up.
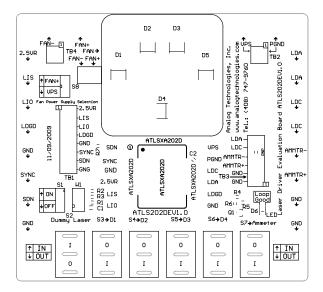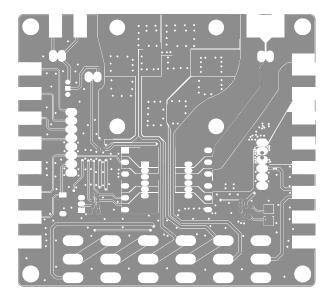

Figure 3. Top Silkscreen

Figure 4. Top Layers without Top Screen Layer

Figure 4 shows the top layers without the silkscreen layer. Figure 5 below shows the bottom layers, including bottom copper, bottom solder mask, and multilayer (vias). Please notice that it is a "see through" image from the top side.

Figures 4 and 5 can be used as a layout reference for designing a system when using the ATLS202D in the system. The main points are shown below:

1. Connect the power supply return node directly to the

PGND pin of the driver before connecting it to any other nodes. For thermal management purpose, the return node on the evaluation board was not done in this way.

2. Use as large copper area as possible for the PCB traces of the solder pads of all the pins so that these copper areas become heat-sinks which can help dissipate the heat generated by the driver.
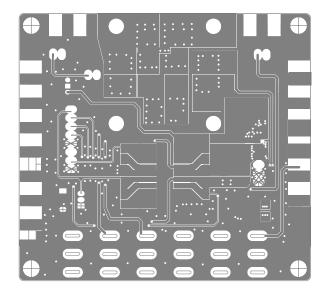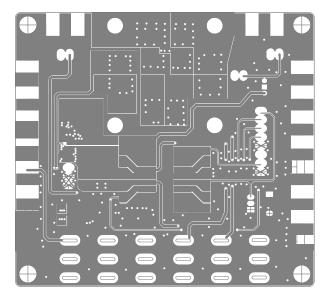

Figure 5. Bottom Layers

Figure 6. Mirrored Bottom Layers

Figure 6 shows the mirrored bottom layers which is a directly-seen image from the bottom side.

The ATLS202D laser driver module is located in the center of the ATLS202DEV1.0 Evaluation Board. The voltages of all its pins can be measured directly by probing the vias on

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the left and right side of the module sockets which are connected directly with the pins of the electronic module. Some of the pins are also connected to the connectors of the 4 terminal blocks, and/or the soldering pads on the edges of the board. The names of all these nodes are marked on the board.

Please notice that when the board is working, the 5 diodes on the top center may get hot, therefore, avoid touching them with your fingers.
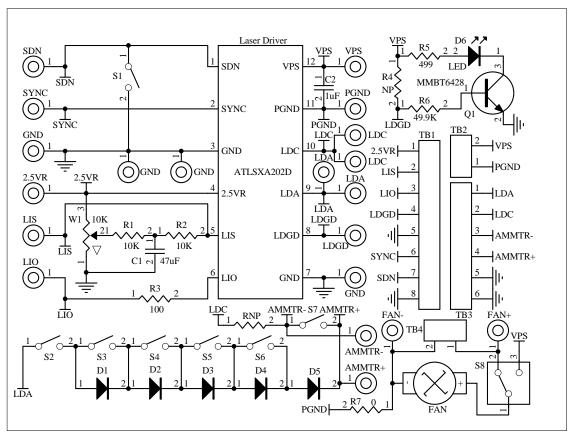
The schematic is shown in Figure 7 below.

Figure 7. Schematic of Laser Driver ATLS202D Evaluation Board Rev. 1.0

GETTING STARTED

1. Hook up the power supply. There are 2 solder pads in the upper center area on the edge for connecting the power supply. The connection can be done by clipping or soldering on the pads, or locking in 2 wires through the terminal block TB2 by using the screws, see Figure 1. Usually the power supply is set to 5V. If the output maximum voltage is sure to be always at a low value, such as 2.5V, a power supply with a voltage of about 1V higher than the maximum output voltage, i.e. 3.5V, can be used. When using a lower voltage power supply, the power consumption of the driver will get smaller, thus, the driver will be working under lower temperature rise.

2. Check the voltage reference. Use a voltmeter to check the voltage reference pin 2.5VR having an accurate 2.5V.

3. Turn up and down the driver. This can be done by either turning off the power supply or turning off the shut-down pin of the driver. To do the latter, turn the switch S1 up to

turn on the driver, or turn the switch S1 down to turn off the driver, which shorts circuit the shut-down pin SDN to the ground.

4. Monitor the output current by using the LIO pin voltage. Measuring the voltage of the LIO pin by using a voltmeter (measure between the LIO pin and the ground node) will allow monitoring the output current. The relationship between the LIO voltage and the output current is linear:

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

where I_{OUT} is the output current in Ampere;

X is maximum output current, 2A, 3A or 4A;

V_{LIO} stands for the voltage at the LIO pin.

5. Monitoring the output current directly by using an Ammeter. Measure the voltage of LIO pin as described above, then compare the approach with the measured current. Measuring the output current directly by using an Ammeter is not recommended when a real laser is

connected, because of these potential problems:

A. The Ammeter brings in EMI (Electro-Magnetic Interference) noise.

B. The Ammeter has voltage drop, which decreases the maximum output voltage.

C. **If the Ammeter is not connected well or there is an intermittent disconnection at any portion of the circuit, the real laser may be damaged permanently.**

If the user really needs to do it in this way, this is the procedure:

A. Use the terminal block on the right side, the 3rd and the 4th conductors, insert the Ammeter between AMMTR+ pin and AMMTR− pin.

B. Turn the switch S7 to its upper on position, thus the output current can go through the ammeter and be measured by reading Ammeter's value.; when the switch S7 is placed in the lower off position, the ampere meter is shorted, thus, it does not measure the output current, see the schematic shown in Figure 7.

C. Set the Ammeter to a fixed gain or a high value, such as 10A. Otherwise, the automatic ranging setting circuit of the Ammeter may cause some noise to the laser when the current range setting is switched inside the Ammeter.

6. Test the driver with the "dummy laser". The 5 diodes on the board, D1 to D5, can form a "dummy laser" to act as the laser diode in place of a real laser so that in case there is a problem in the circuit, the expensive laser would not be damaged, see schematic in Figure 7. Turn the switch S2 to the on position (upper), to connect the "dummy laser" to the driver. Turning switches S3, S4, S5 and S6, up and down will increase (turning down the switches) and decrease (turning up the switches) the forward voltage of the "dummy laser" which can be measured by a volt meter between the LDA and the ground. Each diode can increase or decrease the output forward voltage by about 0.7V when the output current is 4A. **Warning: when output 4A current, the diodes may get very hot, don't touch them with your fingers.** The switch bank and their corresponding diodes are shown in the table below. The diode D5 is always activated so that the total forward voltage range is from 0.7V to 0.7V + 0.7×4 = 3.5V. Please be aware of this fact: when the output voltage is low by shorting circuit all the diodes, the driver will consume a lot of power and may get too hot that the internal temperature protection circuit will shut off the driver automatically. When this happens, wait a few seconds, let the driver cool down, the driver will restart by itself again after the temperature is lowered to certain level. This is the way to calculate the power consumption of the driver:

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

where P_{DRIVER} is the power consumption of the driver, I_out is the output current, I_input is the power supply's input current, V_{VPS} is the power supply voltage applied onto the VPS pin of the driver, V_{LDA} is the output voltage which is also the voltage across the laser diode.

Switch Name	Corresponding Diode
S3	Diode D1
S4	Diode D2
S5	Diode D3
S6	Diode D4

7. Disconnect the dummy laser from the driver. This can be simply done by turning switch S2 to its lower off position.

8. Monitor the output voltage. This can be done by measuring the voltage between LDA and ground with a volt meter. This node is available at the edge pad (upper right corner), the terminal block conductor, and the driver pin via. **If the driver works well, the output current should remain the same as the output voltage changes.**

9. Set the output current. Adjusting the potentiometer W1 will set the output current from 0 to 1A by changing the voltage on the LIS pin. Due to the low noise nature of the driver, the actual controllable minimum current is about 10nA, the lowest one available on the market to our knowledge. The relationship between the LIS voltage and the output current is:

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

where I_out is the output current;

X is maximum output current, 2A, 3A or 4A;

LIS stands for the voltage at the LIS pin.

10. Modulate the output current by an external signal source. This can be done by connecting the external signal source to the LIS node, which is accessible by the LIS solder pad or the LIS conductor on the terminal block TB1, both on the left side of the board. Make sure:

A. The peak of the signal will not set the output current to too high a value that may damage the laser diode, if a real laser is connected to the output.

B. The current limit is set to a proper value, thus, the driver will not be shut-off by the current limit circuit because the output current exceeds the current limit.

11. Loop good indication. When the driver works perfectly, i.e., the output current equals the set-point current set by LIS pin, the LED on the lower right corner of the board will be lit up. Otherwise, it will be dark when the power supply is on and the driver is being shut off or the output voltage is beyond 4V at the current set by the LIS pin.

12. Connecting external ADCs (Analog to Digital Converters) and DACs (Digital to Analog Converters) together. The ADCs can be utilized for monitoring the analog voltages on certain pins, for example LIO, and the DACs can also be utilized for setting the LIS and/or LDGD pin voltages. The voltage reference from the driver can be used as the voltage reference for the ADCs and DACs.

13. Connecting a real laser diode to the evaluation board. After making sure that the driver works properly after going through the steps above, a real laser diode can be connected to the evaluation board. This is the procedure:

   A. Solder the laser diode terminal wires to the LDA and LDC solder pads, or use the LDA and LDC conductors on the terminal block TB3 and lock the wires by using the screws. Make sure that the connections are tight and secure, no intermittent disconnection will occur. Set the output forward voltage to 1.4V by switching S3, S4, S5 and S6 to the upper on position. Turn on the power supply, and see if everything works perfectly as described above.

   B. Turn off the power, turn the switch S2 to the lower off position and turn on the power again. After this moment, be more careful in doing anything on the board, because any mistake in operating the board or any intermittent disconnections for connections on the board may result in damaging the laser diode permanently.

   C. If everything still works fine after step C above, the user can proceed to testing the laser itself. The output current and current limit can be adjusted while the laser is turned on, but make sure that the output current will never exceed the laser's current limit.

   D. In case there are any suspicious or real problems, disconnect the real laser and use the dummy laser instead for debugging.
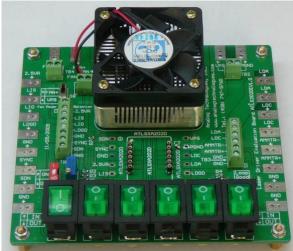
OTHER VIEW PHOTOS

Figure 8. Side View of Actual ATLS202DEV1.0 (1)

Figure 10. Side View of Actual ATLS202DEV1.0 (3)

Figure 9. Side View of Actual ATLS202DEV1.0 (2)

Figure 11. Side View of Actual ATLS202DEV1.0 (4)

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ORDERING INFORMATION

Part #	Description	1 – 9	≥10
ATLS202DEV1.0	Laser driver ATLS202D evaluation board Rev. 1.0	$36.8	$35.7

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