



Figure 1. AQCL500MA410DF

FEATURES

- Input Voltage Range: 10V~28V
- Output Voltage Range: 1V ~ $V_{VPS} - 4V$
- Maximum Output Current: 500mA
- Ultra Low Noise: $0.5\mu A_{p,p}@0.1Hz \sim 10Hz$
- Input Voltage Polarity Reverse Protection
- Under-Voltage Protection
- Current Limit
- Over-Temperature Protection

High Absolute Accuracy: $<0.1\%$ @ $0^{\circ}C \sim 50^{\circ}C$ ambient temperature

High Stability: $<20ppm/^{\circ}C$

Control Loop Good Indication: LPGD

Output Current Real Time Monitoring: LIO

Complete Shielding

Compact Size: 49.4mm(L) \times 45mm(W) \times 14mm(H)

100 % Lead (Pb)-Free and RoHS Compliant

APPLICATIONS

This QCL driver can be used to drive QCLs (Quantum Cascade Laser) for radar, medical diagnostics, spectroscopy, chemical analysis, general measurement systems, etc.

DESCRIPTION

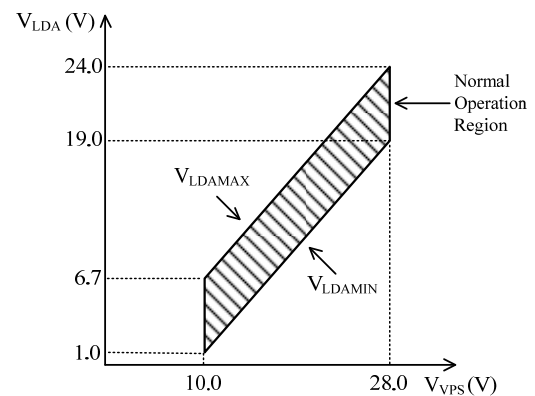
AQCL500MA410DF is a quantum cascade laser driver with differential analog input control. It is different from AQCL500MA410SE, another QCL driver with single ended input control.

The AQCL500MA410DF is a chassis mount electronic module designed for driving QCLs. It delivers ultra-low noise current and still preserves a wide modulation bandwidth. The AQCL500MA410DF comes with protections for over-voltage, under-voltage, over current, and over temperature.

To monitor the working status of the laser driver, there is a control loop good indication pin, LPGD; and the output current monitor pin, LIO.

Figure 1 shows the physical photo of AQCL500MA410DF. The output voltage can swing from 0.5V to $V_{VPS} - 4V$, where $V_{VPS} = V_{OUT} + 5V$, V_{VPS} is the power supply voltage and can be from 10V~28V.

Figure 2 shows the relationship between the output voltage and power supply voltage.



Note: $I_{MAX} = 500mA$

Figure 2. V_{VPS} vs. V_{LDA}



Table 1. Terminal Block Connector 1 Pin Function Descriptions

| Pin # | Pin Name | Port Type | Description |
|-------|----------|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | DATA- | Analog input | The negative node of differential input signal. |
| 2 | DATA+ | Analog input | The positive node of differential input signal. |
| 3 | 1.2VR | Analog output | Internal reference voltage. |
| 4 | GND | Signal ground | Signal ground. Connect this pin to the signal ground of ADCs, DACs, and the signal sources. |
| 5 | LPGD | Digital output | Loop good indication. When outputting a high logic level 5V, it indicates the control loop works properly, i.e. the output current equals the set-point value; outputting a logic low level indicates there is something wrong in the control loop, such as open circuit, output current equals zero, etc. |
| 6 | SBDN | Digital input | This is a duplex pin: when it is pulled down <0.4V, the controller is put into Shut-down Mode; when setting this pin to between 1.2V to 2.5V, the controller is set to Stand-by Mode. In this mode, the voltage reference is still working; when setting it to >2.64V to VPS voltage, the controller goes to On Mode. There is an internal 20MΩ pull up resistor tied to VPS. |
| 7 | GND | Signal ground | Signal ground. Connect this pin to the signal ground of ADCs, DACs, and the signal sources. |
| 8 | 4VR | Analog output | Voltage Reference 4.096V output. It can be used by external POTs (Potentiometer), DACs and/or ADCs for setting the LIS. Under Stand-by Mode, this pin is still working. |
| 9 | ILM | Analog input | Laser current limit set. 0V to 4.096 V sets the laser current limit from 0 to 500mA linearly. The internal input impedance is 1M. |
| 10 | LIS | Analog output | Laser current setting indication. 0V to 4.096 V indicates the laser current is set from 0 to 500mA linearly. |
| 11 | LIO | Analog output | Laser current output indication. 0V to 4.096 V indicates the laser current from 0 to 500mA linearly. |
| 12 | TMO | Analog output | The controller internal temperature indication output. It can be used for sensing the actual temperature of the controller to avoid over-heating. 0V to 4V represents the controller temperature from -55°C to 125°C. |

Table 2. Terminal Block Connector 4 Pin Function Descriptions

| Pin # | Pin Name | Port Type | Description |
|-------|----------|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | LDA | Analog output | Laser diode anode. Connect it to the anode of the laser diode. |
| 2 | LDC | Analog output | Laser diode cathode. Connect it to the cathode of the laser diode. This pin is internally connected to PGND and GND, thus its voltage potential is zero. |
| 3 | GND | Signal ground | Signal ground. Connect this pin to the signal ground of ADCs, DACs, and the signal sources. |
| 4 | PGND | Power ground | Power ground pin. Connect it directly to power supply return rail. |
| 5 | VPS | Power input | Power supply voltage. The driver works from 10V to 28V. |



Table 3. Competition Comparison

| Parameter | Competition QCL driver | ATI QCL driver |
|-----------------------------------|------------------------|-------------------------|
| Number of power supplies required | 2 | 1 |
| Input voltage range | 25V | 10~28V |
| Output voltage range | 5V | 1V~V _{VPS} -4V |
| Over current protection | No | Yes |
| Polarity reverse protection | No | Yes |
| Size | 140×166×58 (mm) | 50×45×14 (mm) |
| Weight | 1,000g | 45g |
| Price | \$1,700 | <Half of above |

SPECIFICATIONS

Table 4. Characteristics (T_A= 25°C)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units |
|--------------------------------------------------------------|-------------------------------------------------------------------------------|-----------------------------------|-------|------|---------------------|-------------------|
| Control SBDN Pin (# 6 of Terminal Block Connector 1) | | | | | | |
| SBDN Voltage | V _{SBDN-ON} | | 2.64 | | V _{VPS} | V |
| | V _{SBDN-STANDBY} | | 1.2 | | 2.5 | V |
| | V _{SBDN-OFF} | | 0 | | 0.4 | V |
| | V _{SBDN-SB-HI} Going up from Standby to On threshold voltage | | 2.508 | | 2.64 | V |
| | V _{SBDN-SB-LOW} Going down from On to Standby threshold voltage | | 2.5 | | 2.6 | V |
| | V _{SBDN-OFF-HI} Going up from Off to Standby threshold voltage | | | | 1.2 | V |
| | V _{SBDN-OFF-LOW} Going down from Standby to Off threshold voltage | | | 0.4 | | V |
| Pull-up Resistor to VPS | | | | 20 | | MΩ |
| Current Setting LIS Pin (# 10 of Terminal Block Connector 1) | | | | | | |
| Current Set Voltage | | | 0 | | 4.096 | V |
| Output LDA Pin (# 1 of Terminal Block Connector 2) | | | | | | |
| Output Voltage | V _{LDA} | | 1 | | V _{VPS} -4 | V |
| Output Current | I _{LDA} | | 0 | | 500 | mA |
| Output Current Noise | I _{NLDA} | Peak-to-peak value, 0.1Hz to 10Hz | | 0.5 | | μA _{P-P} |
| Minimum Dropout Voltage | V _{VPS} - V _{LDA} | | | 4 | | V |

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units |
|----------------------------------------------------------------|--------------------|------------|------|------|------|-------|
| Output LDA Pin (# 1 of Terminal Block Connector 2) | | | | | | |
| Operating Ambient Temperature Range | T_A | | -40 | | 65 | °C |
| Large Signal Bandwidth | f_{lg} | | | 1 | | MHz |
| Small Signal Bandwidth | f_{sm} | | | 1 | | MHz |
| Small Signal Rise and Fall Times | t_{smr}, t_{smf} | | | 350 | | ns |
| Large Signal Rise and Fall Times | t_{lgr}, t_{lgr} | | | 350 | | ns |
| Power Supply Input VPS Pin (# 5 of Terminal Block Connector 2) | | | | | | |
| Input Voltage Range | V_{VPS} | | 10 | | 28 | V |
| Input Current | I_{VPS} | | 0 | | 600 | mA |

APPLICATIONS INFORMATION

Voltage can be input through Mini-USB or LIS. Figure 3 shows the connection for the Mini-USB. Figure 4 shows the pin locations of this QCL driver.

USB Differential Input

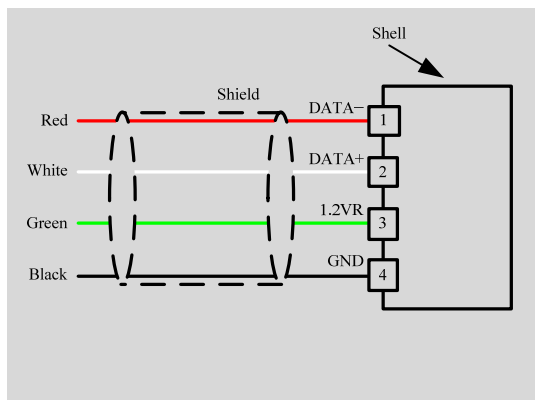


Figure 3. Connecting DAC Board to the QCL Driver AQCL500MA410DF

Table 5. V_{IN+} , V_{IN-} & I_{OUT}

| V_{IN+} | V_{IN-} | V_{LIS} | I_{OUT} |
|-----------|-----------|-----------|-----------|
| 1.2V | 0V | 4.096V | 500mA |
| 0.6V | 0.6V | 2.048V | 250mA |
| 0V | 1.2V | 0V | 0mA |

$$V_{LIS} = \frac{2.048}{1.2} (V_{IN+} - V_{IN-}) + 2.048$$

$$I_{OUT} = \frac{V_{LIS}}{4.096V} \times 500mA$$

V_{LIS} : The voltage for setting the laser current.

V_{IN+} : The positive node of Mini-USB differential input signal.

V_{IN-} : The negative node of Mini-USB differential input signal.

I_{OUT} : The output current.

Insert the screwdriver into the upper card slot, and the lower card slot should be inserted with a power cord with a bare core ($\phi = 1.5mm \pm 0.2mm$; $L = 7.5mm \pm 0.2mm$).

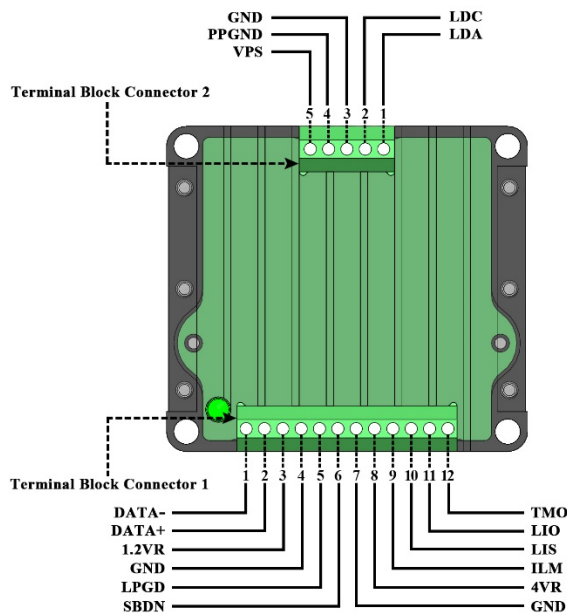


Figure 4. Top View of AQCL500MA410DF

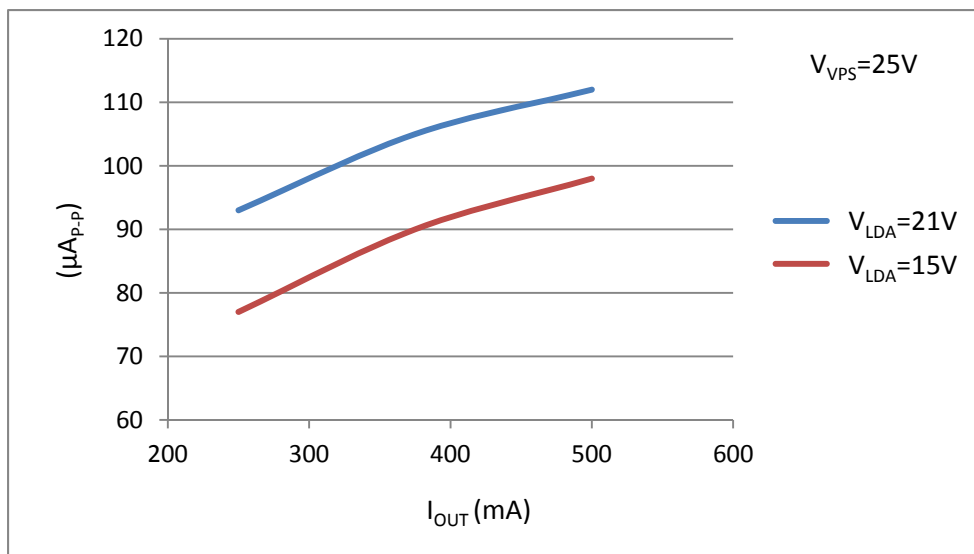


Figure 5. I_{OUT} vs. Output Current Noise@0.1Hz~10Hz

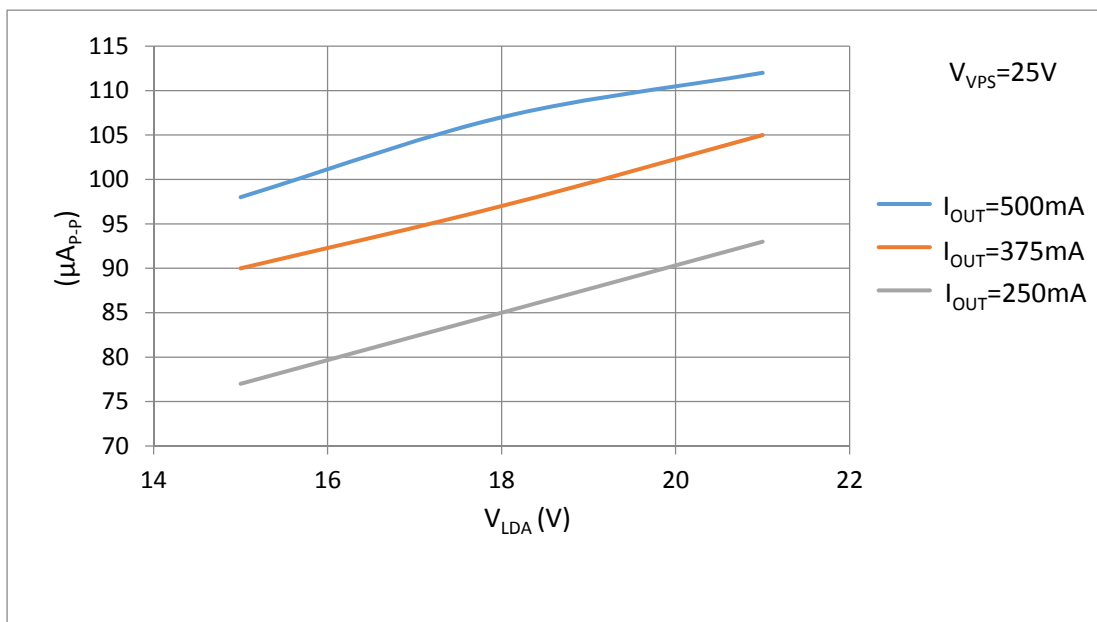


Figure 6. V_{LDA} vs. Output Current Noise@0.1Hz~10Hz



MECHANICAL DIMENSIONS

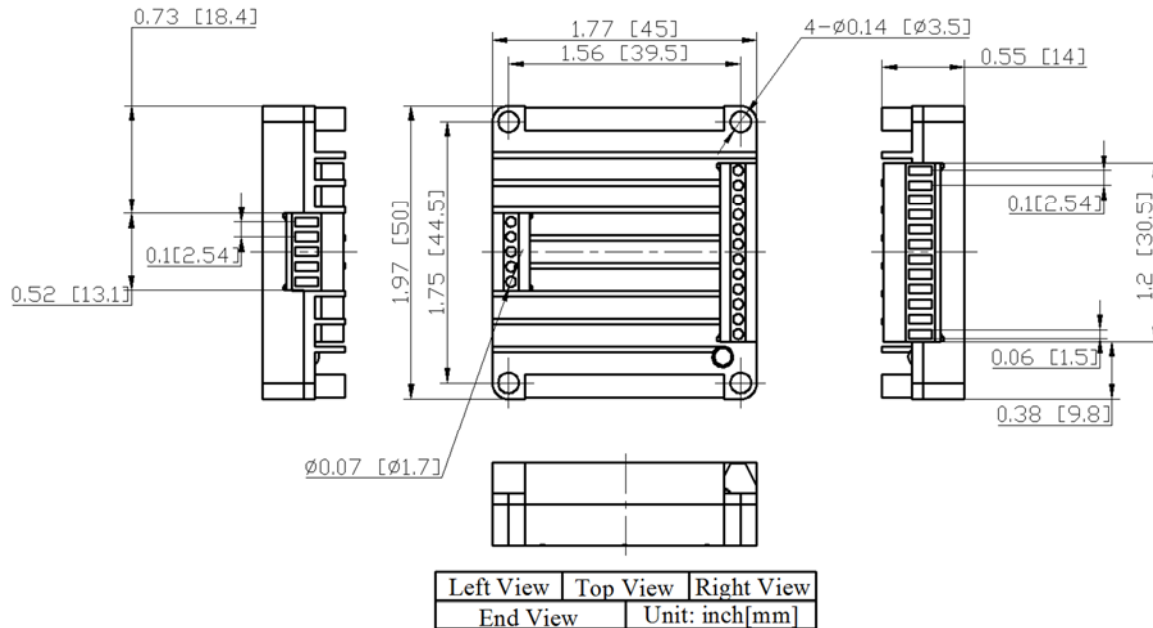


Figure 7. Dimensions of AQCL500MA410DF

ORDERING INFORMATION

Table 6. Unit Price

| Part # | 1 – 9 (pcs) | ≥10 (pcs) |
|----------------|-------------|-----------|
| AQCL500MA410DF | \$499 | \$449 |

NOTICE

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