



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:  $49.4 \times 45 \times 14$  (mm)

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

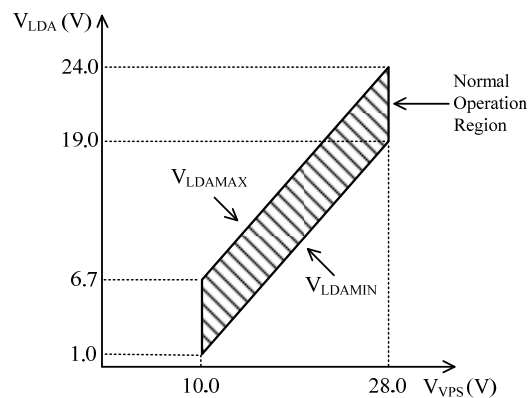
AQCL500MA410DF is a quantum cascade laser driver with differential analog input control. It is different from AQCL500MA410SE, another QCL driver with single ended input control.

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	PPGND	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 <sub>VPS</sub> -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<sub>A</sub>= 25°C)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
Control SBDN Pin (# 6 of Terminal Block Connector 1)						
SBDN Voltage	V <sub>SBDN-ON</sub>		2.64		V <sub>VPS</sub>	V
	V <sub>SBDN-STANDBY</sub>		1.2		2.5	V
	V <sub>SBDN-OFF</sub>		0		0.4	V
	V <sub>SBDN-SB-HI</sub> Going up from Standby to On threshold voltage		2.508		2.64	V
	V <sub>SBDN-SB-LOW</sub> Going down from On to Standby threshold voltage		2.5		2.6	V
	V <sub>SBDN-OFF-HI</sub> Going up from Off to Standby threshold voltage				1.2	V
	V <sub>SBDN-OFF-LOW</sub> 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 <sub>LDA</sub>		1		V <sub>VPS</sub> -4	V
Output Current	I <sub>LDA</sub>		0		500	mA
Output Current Noise	I <sub>NLDA</sub>	Peak-to-peak value, 0.1Hz to 10Hz		0.5		μA <sub>P-P</sub>
Minimum Dropout Voltage	V <sub>VPS</sub> - V <sub>LDA</sub>			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	$t_{lgr}, t_{lgf}$			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

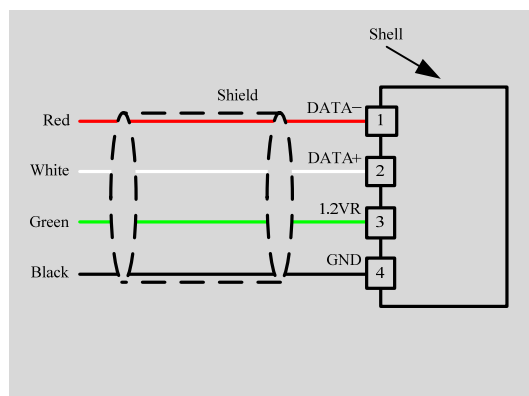


Figure 3. Connecting DAC Board to the QCL Driver AQCL500MA410DF

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 ( $\phi = 1.5mm \pm 0.2mm$ ;  $L = 7.5mm \pm 0.2mm$ ).

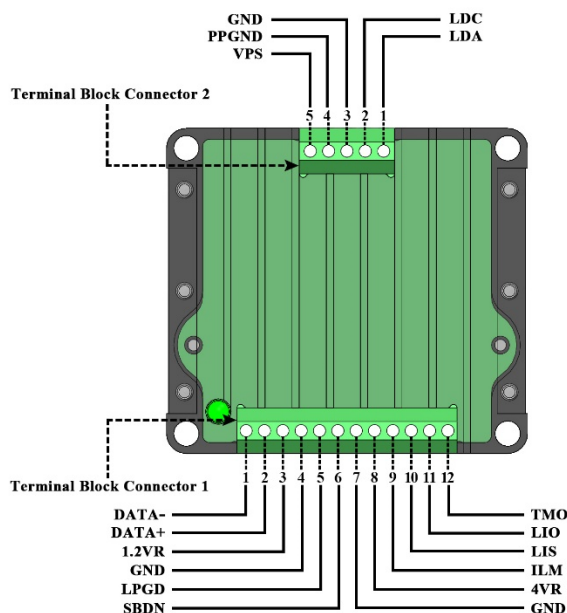


Figure 4. Top View of AQCL500MA410DF

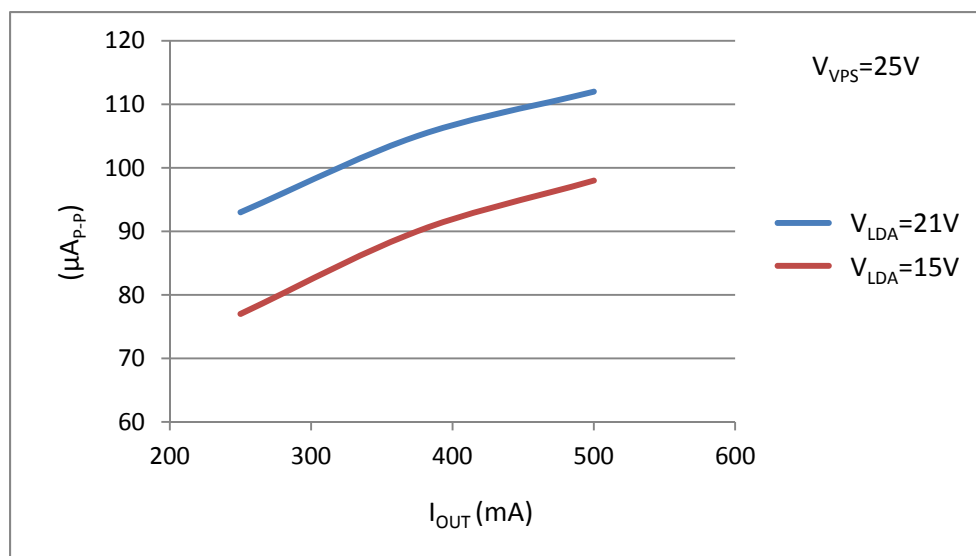


Figure 5.  $I_{OUT}$  vs. Output Current Noise@0.1Hz~10Hz

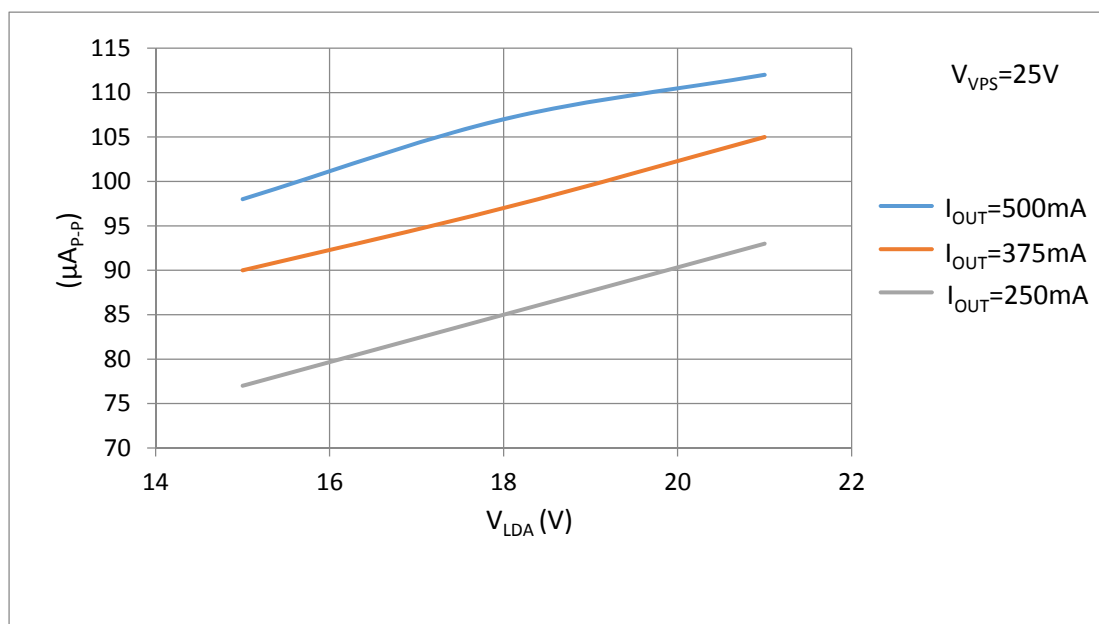


Figure 6.  $V_{LDA}$  vs. Output Current Noise@0.1Hz~10Hz

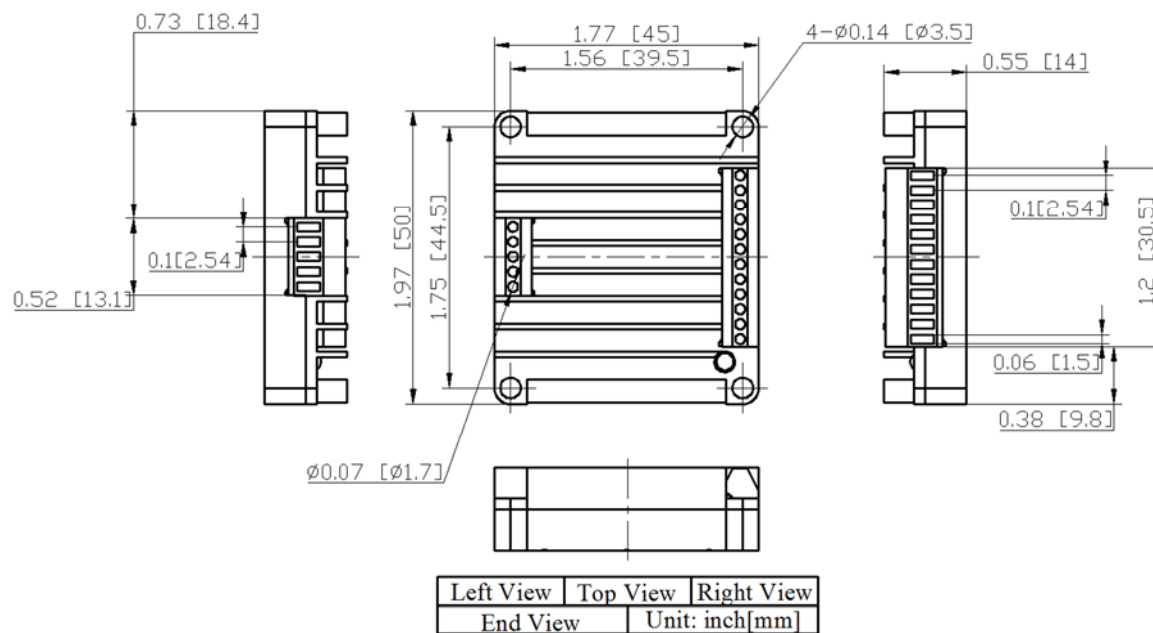
**MECHANICAL DIMENSIONS**


Figure 7. Dimensions of AQCL500MA410DF

**ORDERING INFORMATION**

Table 6. Unit Price

Part #	1 – 9 (pcs)	$\geq 10$ (pcs)
AQCL500MA410DF	\$499	\$449

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