LDC 37X6

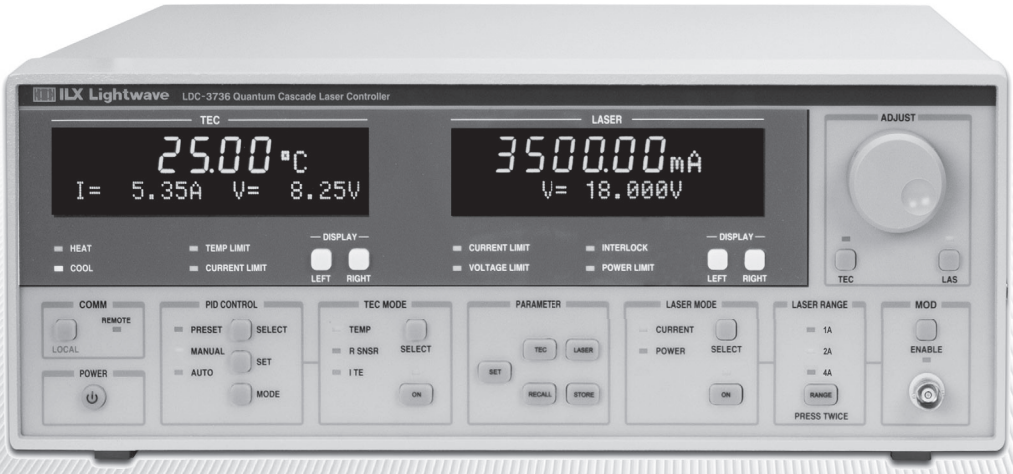
Quantum Cascade Laser Controller

Product Features

- Precision, low noise current source with integrated 128W temperature controller
- Multiple levels of laser protection
- Analog modulation up to 250 kHz
- 4-wire laser forward voltage and TEC voltage measurement
- Temperature controller compatible with thermistor, IC, and RTD temperature sensors
- USB and GPIB computer interfaces
- LabVIEW® drivers

The LDC-3736 Quantum Cascade Laser Controller is an industry leading combination laser current source and temperature controller specifically designed to control quantum cascade lasers. Careful attention to the design allows the LDC-3736 to deliver up to 4A at 18V of low noise current with stability better than 20 ppm. The integrated high power temperature controller was designed to provide up to 128W of cooling power while maintaining the TEC noise and ripple below 2.5 mA. Integrated redundant laser protection circuits ensure safe operation of expensive quantum cascade lasers even during unforeseen power surges.

In addition, the standard features of the LDC-3736 Quantum Cascade Laser Controller include three current ranges, analog current modulation, 4-wire voltage measurement of the laser and TEC, and USB and GPIB remote interface. Furthermore, all of ILX Lightwave's proven laser protection strategies have been designed into each model including slow start, adjustable current limits and compliance voltage, intermittent contact protection, and shorting relays.



Precision Quantum Cascade Laser Controller

Newport®

LDC 37X6

Quantum Cascade Laser Controller

HIGH STABILITY, LOW NOISE LASER CONTROL

Quantum cascade lasers act as a gain medium. Small drive current fluctuations due to noise and drift are amplified optically. Because of this, a controller with a low noise and stable output is required to ensure stable optical output. Since current noise scales with maximum current output, the LDC-3736 includes three current ranges: 1A, 2A, and 4A. This flexibility allows users to select a range close to their maximum output to reduce current noise and provide future expansion when working with different QCLs. This feature allows the LDC-3736 to deliver current stability as low as 20 ppm and <10µA to ensure stable operation in sensitive QCL applications.

Careful attention to the design of the thermoelectric temperature controller allows high power operation with low TEC current RMS noise. This reduces the chance for TEC noise coupling into the QCL, which could potentially cause unstable operation.

SETTING THE STANDARD IN LASER PROTECTION

ILX Lightwave's internal testing and protection standards ensure protection for your quantum cascade lasers under abnormal operating conditions, such as intermittent contact or severe power spikes. These standards have led to advanced protection features such as clamping current limits, even under modulated conditions. In addition, exclusive braid-shielded cables have been specifically designed to suppress radiated noise and transients commonly found in laboratory or production environments.

During AC power-up, careful turn-on sequencing and redundant output shorting circuits protect the laser from current transients. When the output is enabled, the slow-start circuit gradually opens the shorting circuits. Current is shunted through the shorting switch until the control circuits are fully active and all circuit transients have died out.

A feature not found in most controllers - fast output shutoff - provides an additional level of protection from intermittent contacts between the laser and the current source. Intermittent contact can occur by loose or worn cables causing a momentary open in the circuit or by pogo-pins momentarily losing connection to the laser. If intermittent contact is left undetected, a severe voltage transient can occur which will damage sensitive quantum cascade lasers.

These protection features all work in conjunction with all instrument modes of operation, providing worry free, fail-safe control of your laser.

EASE OF OPERATION

The front panel of the LDC-3736 Quantum Cascade Laser Controller was designed for ease of use and readability. The front panel features two large 7-segment displays that also have an integrated dot matrix display. Instrument controls are grouped by mode and function to allow for easy setup. The displays allow for easy viewing of multiple parameters including laser current output, laser voltage, photodiode measurement, measured temperature, set temperature, TEC current, and TEC voltage. Each display can be easily configured to display the most relevant measurements in your application.

Laser control is directly addressable from the front panel "adjust" section. Instrument modes are easily selected or adjusted through discrete push buttons and a rotary digital encoder. Configuration of parameters is quickly accomplished through the "parameter" section.

REMOTE OPERATION

Remote instrument operation in an R&D or production environment is available through a USB or GPIB interface. A trigger output is provided for integration into an automated measurement system where the TTL level output indicates a current step change for initiation of a measurement. A robust and easy to modify LabVIEW driver is available for download.

SAVE AND RECALL SETTINGS

For multiple instrument test configurations, the LDC-3736 Quantum Cascade Laser Controller offers a STORE and RECALL feature. The STORE function allows the user to store all the front panel settings for any given instrument condition. The RECALL function allows the user to retrieve any of the saved conditions at any time. This saves time in instrument re-configuration for different production runs or R&D experiments.

LASER CURRENT SOURCE

DRIVE CURRENT OUTPUT [1]

	LDC-3736			LDC-37620	
Output Current Range:	0–1000mA	0–2000mA	0–4000mA	0–10A	0–20A
Setpoint Resolution (Display):	0.1mA	0.1mA	0.1mA	1mA	1mA
Setpoint Resolution (Remote):[12]	20µA	40µA	80µA	1mA	1mA
Setpoint Accuracy (% of FS):	±0.15% of SP ± 1mA	±0.15% of SP ± 1mA	±0.15% of SP ± 1mA	±0.1% ± 10mA	±0.1% ± 10mA
Compliance Voltage:	0–18V adjustable	0–18V adjustable	0–18V adjustable	0 – 4V adjustable	0 – 4V adjustable
Temperature Coefficient:	<50ppm/°C	<50ppm/°C	<50ppm/°C	<50ppm/°C	<50ppm/°C
Short-Term Stability (one-hour):[2]	<20ppm	<20ppm	<20ppm	<50ppm	<50ppm
Long-Term Stability (24-hour):[3]	<40ppm	<40ppm	<40ppm	<100ppm	<100ppm
Noise and Ripple (rms)[4]					
High Bandwidth Mode (rms):	30µA	60µA	100µA	<5mA	<7mA
Low Bandwidth Mode (rms):	30µA	50µA	90µA	<5mA	<7mA
Low Bandwidth Mode (with LNF-320):	10µA	15µA	50µA	N/A	N/A
Transients					
Operational:[5]	<4mA	<4mA	<4mA	<25mA	<25mA
1 kV EFT/Surge: [6]	<15mA/<8mA	<15mA/<8mA	<15mA/<8mA	<80mA / <150 mA	<80mA / <150 mA

COMPLIANCE VOLTAGE ADJUST

Range:	0–19.8V	0–19.8V	0–19.8V	0 – 4.4V	0 – 4.4V
Setpoint Resolution (Display):	0.1V	0.1V	0.1V	0.1V	0.1V
Setpoint Resolution (Remote):	60mV	60mV	60mV	15mV	15mV
Accuracy:	±2.5% FS	±2.5% FS	±2.5% FS	±2.5% FS	±2.5% FS

DRIVE CURRENT LIMIT SETTINGS

Range:	1–1010mA	1–2020mA	1–4040mA	0 - 10.1A	0 - 20.2A
Resolution:	5mA	10mA	20mA	100mA	100mA
Accuracy:	±10mA	±20mA	±40mA	±101mA	±202mA

PHOTODIODE FEEDBACK

Type:	Differential	Differential	Differential	Differential	Differential
Photodiode Reverse Bias:	0–5V adjustable	0–5V adjustable	0–5V adjustable	0 – 5V adjustable	0 – 5V adjustable
Photodiode Current Range:	5 to 10000µA	5 to 10000µA	5–10000µA	5 to 10000µA	5 to 10000µA
Output Stability:[7]	0.02%	0.02%	0.02%	0.02%	0.02%
Setpoint Accuracy:	±0.05% of FS	±0.05% of FS	±0.05% of FS	±0.05% of FS	±0.05% of FS

EXTERNAL ANALOG MODULATION

Input:	0–10V, 1 kΩ	0–10V, 1 kΩ	0–10V, 1 kΩ	0 – 10V, 1 kΩ	0 – 10V, 1 kΩ
Transfer Function:	100mA/V	200mA/V	400mA/V	1A/V	2A/V
Bandwidth (3dB)					
High Bandwidth:[8]	DC to 250 kHz	DC to 250 kHz	DC to 250 kHz	DC to 100kHz	DC to 100kHz
Low Bandwidth:[9]	DC to 17 kHz	DC to 17 kHz	DC to 17 kHz	DC to 10kHz	DC to 10kHz

TRIGGER OUTPUT

Type:	TTL	TTL	TTL	TTL	TTL
Pulse Width:	10 µs	10 µs	10 µs	13 µs	13 µs
Delay:	2.5 mS	2.5 mS	2.5 mS	2.5 mS	2.5 mS

MEASUREMENT (DISPLAY)

Output Current					
Range:	0–1000.0mA	0–2000.0mA	0–4000mA	0 – 10.000A	0 – 20.000A
Resolution:	0.1mA	0.1mA	0.1mA	0.001A	0.001A
Accuracy:	±0.1% FS	±0.1% FS	±0.1% FS	±0.1% FS + 10mA	±0.1% FS + 10mA
Photodiode Current					
Range:	0–10000µA	0–10000µA	0–10000µA	0 – 10000µA	0 – 10000µA
Resolution:	1µA	1µA	1µA	1µA	1µA
Accuracy:	±4µA	±4µA	±4µA	±4µA	±4µA
Photodiode Responsivity					
Range (µA/mW):[10]	0.00–1000.00	0.00–1000.00	0.00–1000.00	0.00 – 1000.00	0.00 – 1000.00
Resolution:	0.01µA/mW	0.01µA/mW	0.01µA/mW	0.01µA/mW	0.01µA/mW
Optical Power					
Range (mW):	0.00–20000.0	0.00–20000.0	0.00–20000.0	0.00 – 20000.0	0.00 – 20000.0
Resolution:	0.1mW	0.1mW	0.1mW	0.1mW	0.1mW
Forward Voltage					
Range:	0.000–18.000V	0.000–18.000V	0.000–18.000V	0.000 – 4.000V	0.000 – 4.000V
Resolution:	1mV	1mV	1mV	1mV	1mV
Accuracy:[11]	±2mV	±2mV	±2mV	±2mV	±2mV

GENERAL

I/O Connectors	
TEC I/O:	Female, 25-pin, D-sub
Analog Input:	BNC
Remote Interface:	GPIB IEEE 488.1; USB 2.0 (B-Type)
Power Requirements [A,B]	AC Input Selector; 115/230 VAC; 100-120 VAC / 220-240 VAC; 500W; 50-60 Hz
Size (HxWxD):	5.0" x 13.9" x 13.6"; 127 mm x 353 mm x 345 mm
Weight:	26.3 lbs.; 11.93 kg.
Operating Temperature:	10°C to 40°C
Storage Temperature:	-30°C to 70°C
Humidity:	<85% relative, non-condensing
Compliance:	CE

A Output De-Rating (3736) = 0.3V and 0.04A per input Volt AC below 100 VAC to a minimum of 90 VAC
B Output De-Rating (3726) = 3.7 mA/V below 103VAC to 90 VAC (Laser)
Output De-Rating (3726) = 3.7 m/V below 103 VAC to 90 VAC (TEC)

CURRENT SOURCE NOTES

1 All values relate to a one-hour warm-up period.
2 Over any one-hour period, half-scale output.
3 Over any 24-hour period, half-scale output.
4 Measured electrically with a frequency range of 100Hz to 340kHz (High Bandwidth), 100Hz to 17kHz (Low Bandwidth).
5 Maximum output current transient resulting from normal operational situations (e.g., power on-off, current on-off), as well as accidental situations (e.g., power line plug removal). In the LDC-37620 there is a potential for up to 100mA operational transient when the laser is enabled and then the TEC output is enabled. To protect the laser in all condition it is recommend setting both the current and voltage limit just above typical operating conditions and enabling the TEC output prior to the laser current output.
6 Maximum output current transient resulting from a 1000V power line transient spike. Tested to ILX Technical Standard #LDC-00196; request ILX App Note #13.
7 Maximum monitor photodiode current drift over any 30 minute period. Assumes zero drift in responsivity of photodiode.
8 50% modulation at mid-scale output. Higher bandwidth is possible with smaller modulation signal.
9 Small signal specification is for typical 10% modulation depth. Large signal specification assumes 50% modulation depth at mid-scale output.
10 Responsivity value is user-defined and is used to calculate the optical power.
11 Four wire voltage measurement at the load. Voltage measurement accuracy while driving calibration load. Accuracy is dependent upon load and cable used.
12 Based on resolution of digital to analog converters used in circuit.
13 3726 high bandwidth achieved with load impedances less than 4 ohms.
14 Under factory testing conditions. Single resistance test load.

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Specifications

TEMPERATURE CONTROL

LDC-3736 / 37620

Temperature Control Range:[2]	
Thermistor Sensor:	–100°C to +200°C
IC Sensor:	–100°C to +150°C
RTD Sensor:	–100°C to +200°C
Temperature Setpoint and Measurement Repeatability and Accuracy:[3]	
0°C:	±0.001°C / ±0.01°C
25°C:	±0.002°C / ±0.04°C
50°C:	±0.007°C / ±0.15°C
75°C:	±0.05°C / ±0.9°C
Temperature Stability:[4]	
1 Hour:	±0.002°C
24 Hours:[4]	±0.003°C

TEMPERATURE SENSOR

Types:	
Thermistor:	NTC (2-wire)
IC-V Semiconductor IC Sensor:	LM-335 voltage output; 5 to 14 mV/K
IC-I Semiconductor IC Sensor:	AD-590 current output; 1 µA/K
RTD Sensor	Platinum 100Ω / 1000Ω (2-wire)
Thermistor Sensor Resistance	
10 µA Bias Setting	
Range:	0 to 450 kΩ
Resolution (Display):[6]	0.01 kΩ
Accuracy:	±180 Ω
100 µA Bias Setting	
Range:	0 to 45 kΩ
Resolution (Display):[6]	0.001 kΩ
Accuracy:	±18 Ω
IC-V Sensor Voltage	
Nominal Bias:	1 mA
Range:	0 to 6V
Resolution (Display):[6]	0.0001 V
Accuracy:	±2 mV
IC-I Sensor Current	
Nominal Bias:	5 to 15 V
Range:	0 to 600 µA
Resolution (Display):[6]	0.001 µA
Accuracy:	±0.18 µA
RTD Sensor Resistance	
1 mA Bias Setting	
Range:	0 to 1500 Ω
Resolution (Display):[6]	0.01 Ω
Accuracy:	±0.8 Ω
2.5 mA Bias Setting	
Range:	0 to 200 Ω
Resolution (Display):[6]	0.001 Ω
Accuracy:	±0.1 Ω
User Sensor Calibration	
Thermistor:	Steinhart-Hart, 3 constants
IC Sensors:	Slope, Offset
RTD	R_0, A, B, C

TEC OUTPUT

Output Type:	Bi-directional, switching
Isolation:	Floating with respect to earth ground
Current Setpoint	
Range:	-8.00A to +8.00A
Resolution (Display):[6]	0.01A
Accuracy:	±0.05A
Current Limit	
Range:	-8.05A to +8.05A
Accuracy:	±0.05A
Voltage Measurement [7]	
Range:	-16.00V to +16.00V
Resolution (Display):[6]	0.01V
Accuracy:	±0.01V
Compliance Voltage:	±16V
Maximum Output Power:	128W
Current Noise and Ripple:[5]	<2.5 mA rms

AUXILIARY I/O SPECIFICATIONS

Analog Control Input	
Input Voltage Range:	-5V to +5V
Input Resistance:	>100 kΩ
Gain:[9]	2 °C/V
Bandwidth:	5 Hz
External Fan Control Output [8]	
Output Voltage Range:	0 to +12V
Maximum Current:	500 mA

TEMPERATURE CONTROL NOTES

1 All values are specified for an ambient temperature of 23±5°C after a 1 hour warm up unless otherwise specified.

2 Software limits of range. Actual range depends on the physical load, sensor type, and TEC module used.

3 Accuracy figures represent the uncertainty that the LDC-3706 series adds to the measurement. This figure does not include the sensor calibration uncertainties. Thermistor accuracy figures are quoted for a typical 10 kΩ thermistor and 100 µA current setting for -5°C to 50°C.

4 Temperature stability measurements made in a stable, ambient environment ±0.5°C with a 10 kΩ thermistor on the 100 µA setting after a 2 hour warm up period. Stability is defined as ±(Tmax-Tmin)/2 over the measurement period.

5 Measured over the full DC current range into a 1Ω load.

6 Maximum resolution available when operating in the control mode (using the 7-segment display) resolution will be reduced when displayed on the lower display. In remote operation, six significant digits of resolution are reported.

7. Measured at the output connector. Users may enter in cable resistance to provide an accurate voltage measurement at the load.

8. Unregulated output and requires a minimum of a 120mA current draw.

ORDERING INFORMATION

LDC-3726	Quantum Cascade Laser Controller
LDC-3736	Quantum Cascade Laser Controller
LDM-487201	Quantum Cascade Laser Mount, C-Mount
LDM-487202	Quantum Cascade Laser Mount, Alpes COC
CC-305S	Current Source/Laser Diode Mount Interconnect Cable
CC-306S	Current Source/Unterminated Interconnect Cable
CC-594H	TE Controller/Unterminated Interconnect Cable
CC-595S	TE Controller / Laser Diode Mount Interconnect Cable
CC-596H	TE Controller/High Power Laser Diode Mount Interconnect Cable

LabVIEW® Instrument Driver

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