



dDLC Digital Diode Laser Controller



The Santec Digital Diode Laser Controller is our next-generation controller for precision tunable lasers. It combines the ergonomic ease-of-use of our classic analogue DLC, with the flexibility and performance of a fully digital system.

It offers a combination of impressive performance and ease-of-use, using the front panel with high resolution display, or our comprehensive Windows app, or your own code using the simple text-based command language that Santec is famous for.

The dDLC is designed for the ultimate applications in quantum computing, quantum sensing, time and frequency standards, gas sensing, and spectroscopy.

Features

- Intuitive fully-feature controls for standalone operation
- FFT spectrum analyser
- Oscilloscope functionality built-in
- Ultra-low noise current source
- Temperature controller
- Demodulator (lock-in amplifier)
- Feedback servos: locking is **included**
- Auto-lock and auto-relock (in development)
- Modulator driver (dual channel DDS)
- Sweep ramp generator
- TCP/IP, USB2
- LabVIEW, MATLAB and python drivers

Digital Diode Laser Controller

Specifications dDLC 1.1

Current		B1150 single-channel driver (Primary laser)
Output current		0 to 800 mA ± 5 uA setpoint (display ± 10 uA), control ± 8 nA
Noise		240 pA/VHz @1 kHz, 250 nA (rms) 1 Hz – 1 MHz
Stability and accuracy		± 0.2 ppm/ $^{\circ}$ C and 0.1 % from setpoint
Compliance voltage		8 V at 400 mA, 4 V at 800 mA
Current modulation		1. ± 25 mA Direct analogue, Sweep 2. ± 1 mA Direct analogue, Dither, Control DAC1, Control DAC2 3. ± 250 uA Dither, Control DAC 2 4. ± 2 mA Direct analogue, headboard DAC1, DAC2: 16 bits at 3.125 MHz
Current modulation bandwidth		Direct analogue mode (dDLC): 1.2 MHz (-3 dB) Direct analogue mode (headboard): >30 MHz (-3 dB) DAC control (fast): 3.2 MHz (28-bit depth)

Current		B1170 single-channel driver (Secondary laser)
Output current		0 to 800 mA ± 5 uA setpoint (display ± 10 uA), control ± 8 nA
Noise		240 pA/VHz @1 kHz, 250 nA (rms) 1 Hz – 1 MHz
Stability and accuracy		± 0.2 ppm/ $^{\circ}$ C and 0.1 % from setpoint
Compliance voltage		8 V at 400 mA, 4 V at 800 mA
Current modulation		1. ± 25 mA Direct analogue, Sweep 2. ± 1 mA Direct analogue, headboard
Current modulation bandwidth		Direct analogue (headboard): >30 MHz (-3 dB) DAC control (fast): 30 kHz (28-bit depth)

Temperature		B1182 dual-channel TEC driver
Range		7.5 – 49.5 $^{\circ}$ C ± 1 mK resolution
Stability		Better than ± 1 mK/ $^{\circ}$ C
TEC power		± 2 A, ± 12 V (24 W)
Sensor		NTC 10 k Ω
Control		PID with variable sample rate, bandwidth 50 Hz
Protection		PCB over temp, TEC over current, open/short circuit

Piezo		B1190 dual-channel piezo driver
Piezo output		Two independent channels 0 – 150 V, ± 10 mA (charge and discharge)
Piezo Sweep/Control DAC		Individual Sweep and Control DACs, 16 bits unipolar
Resolution		Sweep: 2.5 mV resolution at maximum range Control: variable gain from 240 μ V per LSB
Noise		80 nV/VHz
Sweep		Internal 0.1 Hz to 62.5 Hz; auxiliary inputs ChA, ChB; programmable
Monitoring		Voltage and current measurement for each channel
Protection		Leakage, PCB over temperature

Frequency stabilisation		B1110 core
Dither for AC locking	0 to 2.5 MHz ± 0.058 Hz (default 250 kHz) Dither to diode current (± 250 μ A or ± 1 mA) or external (± 150 mA or ± 4 V)	
Bandwidth	3.2 MHz (DAC control)	
Phase	0 – 360°, 0.022° resolution	
Error signal	32-bits signed, sampling at 6.25 MHz	
Post demodulator filter	5 stage IIR and user adjustable response including bypass option	
Servo Controls	Slow (piezo) and Fast (current) servo controllers with individual offset	
Gain Controls	± 18 dB master plus ± 18 dB on slow, fast channels	
Slow Controller Inputs	1. Slow Error Signal (after offset and master gain) 2. Auxiliary A 3. Auxiliary B 4. Photodetector DC Input 5. Fast controller Output	
Slow Controller Action	PI with 20 dB/dec gain with user-adjustable response	
Fast Controller Input Selection	1. Fast Error Signal (after offset and master gain) 2. DC Block Output (AC coupled error signal)	
Fast Controller Action	PI with 20 dB/dec gain with user-adjustable response	
Signal input/output		B1120 rear panel
Signal input/output	8 BNC connectors 1 Santec DVI-D DL socket Option: Toptica DL Pro	4 analogue inputs 2 analogue outputs Trigger out Mod out
Analogue inputs (4)	Signal range ± 4.096 V (protected to ± 15 V) <i>Photodetector</i> AC: 12.5 MHz > 150 dB dynamic range DC: 1 MHz > 110 dB dynamic range <i>Auxiliary A and B</i> : DC 1 MHz > 110 dB dynamic range <i>Direct</i> : analogue input direct to diode current modulation	
Analogue outputs (2)	Monitor A and B, 16 user-selectable signals; output range ± 4 V. Sampling up to 3.25 MHz @ 16 bits / BW 1 MHz Dither Voltage/Current Driver (user selectable): output ± 4.096 V ± 150 mA BW 1 MHz	
Digital inputs	TTL compatible, 0 – 6.5 V tolerant and protected, active low <0.8 V: a) 3.5 mm stereo jack (external Fast/Slow Lock inputs) b) 3.5 mm stereo jack (External Laser1/Laser2 interlocks)	
Digital outputs	TTL compatible, 0 – 6.5 V tolerant and protected, active high >2.4 V: a) Trigger (sweep mid-point) b) 3.5 mm stereo jack (Fast/Slow Lock outputs)	

Front panel user interface**B1118 front panel**

Operator controls	1 key switch STANDBY/RUN 6 dedicated rotary encoders: diode current, input offset, frequency, span, slow gain, fast gain, each with press-function 3 dedicated pushbuttons: diode on/off, slow lock, fast lock 1 menu adjust encoder 2 menu step pushbuttons
LED indicators	Four 3-colour LEDs: standby/run, laser diode, slow lock, fast lock
Display	127 mm, 800x480 pixels, full colour

Connectivity

Communications	TCP/IP ethernet (10/100); USB 2.0 Type B
Laser	Standard: Santec DVI-D DL socket; Option: Toptica DLPro
Power out	Photodetector supply (M8-3 Thorlabs-compatible), ± 15 V

Power and dimensions

IEC input	90 – 264 Vac @ 47 – 63 Hz
Power	28 W (laser off)
Dimensions	19" 2U, 88x422x270 mm (H x W x D), optional rack-mount ears, 3.5 kg
Operating Temperature	10 - 35°C



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