

OEM QCL Controller

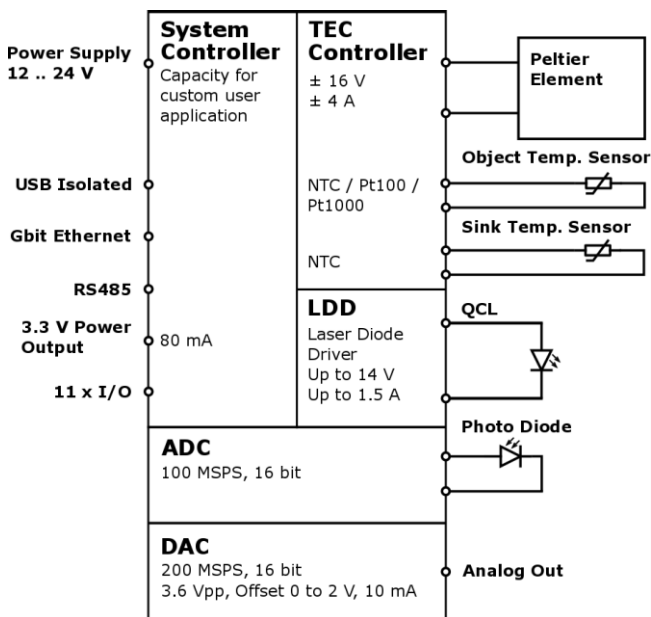


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General Description:

The LTC-1141 contains a highly flexible, ultra-fast Laser Diode Driver (LDD) especially for QCL laser diodes and a TEC/Peltier controller.

The QCL Controller offers high-speed processing and data analysis thanks to a combination of programmable logic and processor as well as 512 MB RAM.



Product Highlights:

- Low noise laser diode current
- High bandwidth (up to 0.5 MHz)
- High efficiency TEC controller (DC output)
- Very high temperature stability (0.005 °C)
- Auto tuning for PID values of TEC controller
- Fast A/D and D/A conversion with 16 bit
- Integrated signal processing

Applications:

- Spectroscopy
- Radar
- Medical diagnostics
- Chemical analysis
- General measurement systems

Features

Input Characteristics:

- DC Input Voltage: 12 – 24 V

Output Stage Laser Diode Driver:

- Laser diode (compliance) voltage: 14 V
- Current ranges:
 - up to 0.15 A
 - up to 0.5 A
 - up to 1.5 A

Output Stage TEC Controller:

- Voltage: 0 to ±16 V
- Current: 0 to ±4 A

Main Features:

- Laser Diode Driver (LDD):
 - 0.5 MHz modulation bandwidth
 - Integrated signal generator
- TEC/Peltier controller (TEC):
 - Fast and high precision temperature control
- LDD and TEC integrated on one board
- LDD and TEC full digitally controlled
- Application data processing:
 - 11 digital or 5 analog IOs (X3)
 - 1 fast analog input (differential) reserved for sampling and measurements (X2)
 - 1 fast analog output (X4)
 - Custom current waveforms
 - Synchronous sampling and measuring
 - Capacity for data processing, sampling, measurement sequences and oscilloscope functionality

Safety Features / LD Protection:

- Current limitation
- Flyback diode
- Overtemperature monitoring

Data Interfaces:

- Gbit Ethernet
- USB 2.0 (UART)
- RS485

Special Requirements / More Information:

- Please contact us for additional information or customization.

Preliminary information. Please refer to the software release notes (document 5203).

Absolute Maximum Ratings

Supply voltage (DC)	25 V
Supply current (DC)	5.8 A (fused)

Operating Ratings

Base Plate Temperature	0 – 60 °C
Storage	-30 – 70 °C
Humidity	5 – 95%, non-condensing

Electrical Characteristics

Unless otherwise noted: $T_A = 25\text{ °C}$, $V_{IN} = 24\text{ V}$

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
DC Power Supply Input:						
V_{IN}	Supply voltage		11.5		24	V
X3 Input Characteristics (Digital I/O):						
U_{IH}	Logic high input threshold		2		3.45	V
U_{IL}	Logic low input threshold				0.8	V
U_{IMAX}	Absolut maximum input voltage		-0.4		3.7	V
X3 Output Characteristics (Digital I/O):						
Including 200 Ω ESD series resistor (see below).						
U_{OH}	Logic high output voltage	Output current 0 mA	2.75			V
U_{OL}	Logic low output voltage	Input current 0 mA			0.4	V
U_{OH}	Logic high output voltage	Output current 4 mA	1.83			V
U_{OL}	Logic low output voltage	Input current 4 mA			1.32	V
ESD Protection:						
(Between Processor and Connector X3)						
U_{PP}	ESD discharge	IEC61000-4-2			100	kV
R_A	Series resistance		170	200	230	Ω
X3 Power Output:						
Including 200 mA PTC polyfuse (self-resettable). $R_{MIN}=0.4\text{ }\Omega$, $R_{MAX}=5\text{ }\Omega$						
U_{OUT}	Output voltage of IO supply on IO connector X3	$I_{OUT} = 0\text{ A}$	3.15	3.3	3.47	V
I_{OUT}	Output current of IO supply on IO connector X3				80	mA
Ethernet:						
U_{PP}	Electrical isolation				1.5	kV
USB:						
U_{PP}	Electrical isolation				1	kV
RS485:						
R	Series resistance	S_1 closed		120		Ω

LDD Characteristics

Unless otherwise noted: $T_A = 25\text{ °C}$, $V_{IN} = 24\text{ V}$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Output CW:						
U_{LD_MAX}	Laser diode voltage	$U_{LD} \leq U_{IN} \times 0.75 - 4$			14	V
Mod	Modulation depth		10		100	%
I_{LD}	Current range	LTC-1141-1500-???-??? configuration	0.4*		1.5	A
I_{LD}	Current range	LTC-1141-500-???-??? configuration	100*		500	mA
I_{LD}	Current range	LTC-1141-150-???-??? configuration	30*		150	mA
$T_{coefficient}$	Temp. coefficient				35	ppm/K
BW	Bandwidth				0.5	MHz

* Minimal recommended I_{LD} . Lower values configurable in software, but may lead to unpredictable behavior.

Analog I/O

Unless otherwise noted: $T_A = 25\text{ °C}$, $V_{IN} = 24\text{ V}$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Fast Analog Input ADC (X2):						
I_{IN}	Input current	Photodiode, LTC-1141-???-???-PD10			10	mA
R_i	Input resistance	Photodiode, LTC-1141-???-???-PD10		20		Ω
I_{IN}	Input current	Photodiode, LTC-1141-???-???-PD1			1	mA
R_i	Input resistance	Photodiode, LTC-1141-???-???-PD1		20		Ω
U_{IN}	Input voltage	Differential input, LTC-1141-???-???-V1.2			± 1.2	V
R_i	Input resistance	Differential input, LTC-1141-???-???-V1.2		240		Ω
R_{SAMPLE}	Sample rate			100		MSPS
R	Resolution				16	bit
Fast Analog Output DAC (X4):						
I_{OUT}			0		10	mA
U_{OUT}			0		3.6	V _{pp}
U_{OUT_OFFSET}			0		2	V
R_{SAMPLE}	Sample rate			200		MSPS
R	Resolution				16	bit

TEC Characteristics

Unless otherwise noted: $T_A = 25\text{ °C}$, $V_{IN} = 24\text{ V}$, Load Spec: 3.75 Ω

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
Output:						
I_{OUT}	Bipolar current swing				± 4	A
U_{OUT}	Bipolar voltage swing	U_{OUT} is maximum $\sim 0.6 \times U_{IN}$			± 16	V
U_{OUT} Ripple	Voltage ripple	@ 4 A		80		mV _{PP}
Output Monitoring						
I_{OUT} Read	Precision	@ 3.8 A		1	5	%
U_{OUT} Read	Precision	@ 15.0 V		1	3	%

Laser Diode Temperature Measurement Characteristics (NTC Probes)

NTC thermistor resistive input characteristics translate into temperature ranges valid for only one type of NTC probe. Below example is given in the case of an NTC B_{25/100} 3988K R₂₅ 10k temperature sensor.

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
$R_{OBJ_RANGE}^*$	Calibrated range (PGA = 1)	Standard Configuration Corresponding temperature range	3338	52.0 to -10.1	55742	Ω $^{\circ}\text{C}$
$R_{OBJ_RANGE}^*$	Extended range (PGA = 1 or 8 or 32)	Standard Configuration Corresponding temperature range	105	176 to -10.1	55742	Ω $^{\circ}\text{C}$

* R_{OBJ_RANGE} is resistance range of the NTC sensor

Laser Diode Temperature Measurement Characteristics (Pt100 and Pt1000 Probes)

T_A = 25 °C, measurement configuration = 23 bit / 4-wire / unshielded cable <50 mm

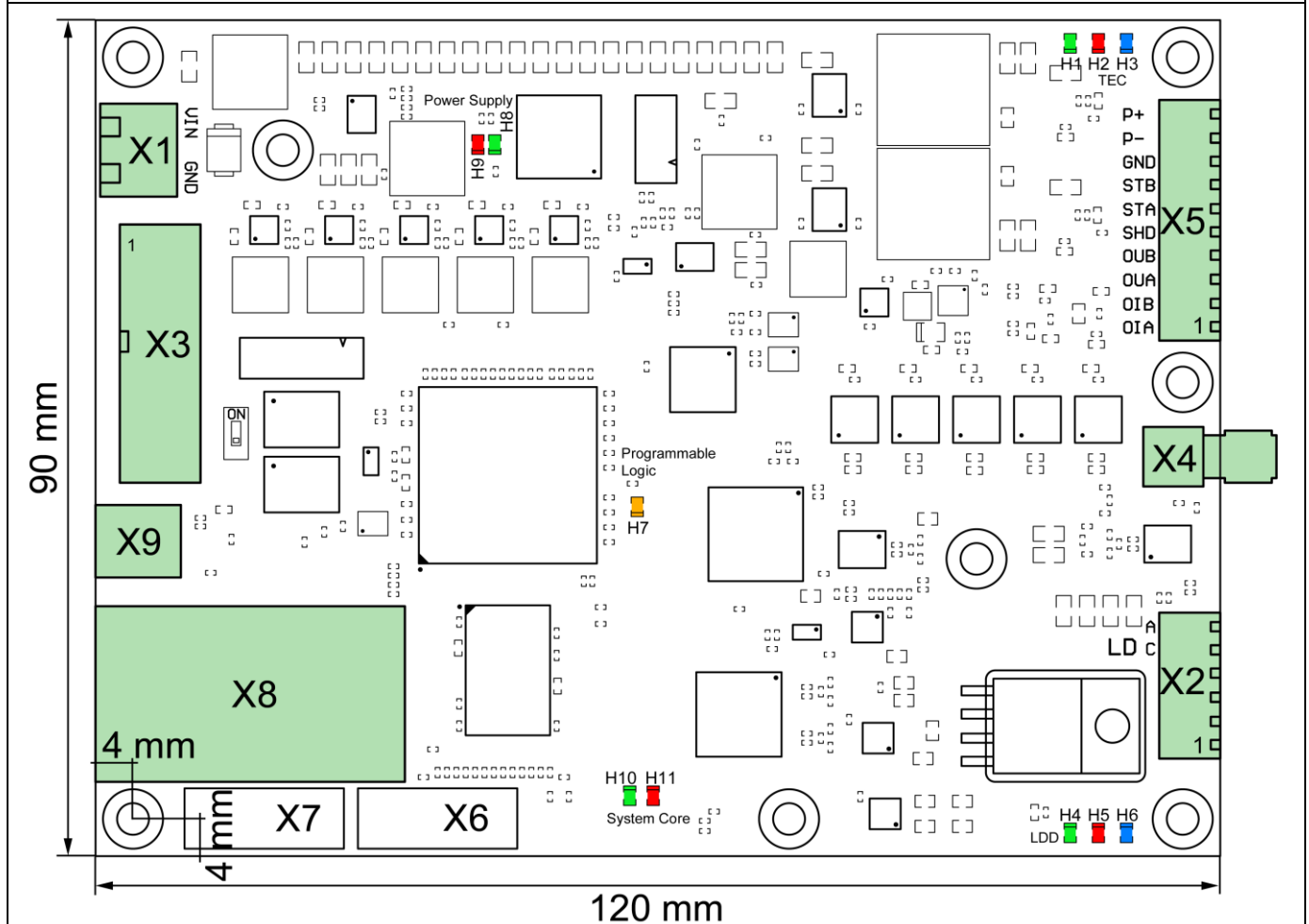
Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
T _{OBJ, RANGE}	Range	Range is extendable upon request	-100		+200	°C
T _{OBJ, PREC}	Measuring Error	Device temperature = 25 °C (EN 60751 / IEC 751)		0.005	0.01	°C
T _{OBJ, COEFF}	Temp. Coefficient	Relative to device temperature			1.6	m°C/K
T _{OBJ, NOISE}	Value Noise	Reference measurement fluctuations while output stage operating @ 70% load		0.003		°C
T _{OBJ, REP}	Repeatability	Repeated measurements of reference resistors after up to 3 days		0.005		°C

Sink Temperature Measurement Characteristics (NTC only)

T_A = 25 °C, measurement configuration = 12 bit / 2-wire / unshielded cable <50 mm, °T probe = NTC B_{25/100} 3988K R₂₅ 10k

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
R _{SINK, RANGE}	Range	Corresponding temperature range	180	150 to -6.0	44600	Ω °C

Pin Configuration and Mechanical Data



Pin Description:

General	
X1	Power
X8	Ethernet
X9	USB mini B
Laser Diode Driver / Fast Analog Input	
X2	6 (A) Laser diode anode
	5 (C) Laser diode cathode
	4 GND (shield)
	3 Analog input* (photo diode anode)
	2 Analog input* (photo diode cathode)
	1 Ground (shield)
	* Differential input
TEC Controller	
X5	P+ Positive current (Peltier element +)
	P- Negative current (Peltier element -)
	GND Ground
	STB Sink temperature sensor B
	STA Sink temperature sensor A
	SHD Shield
	OUB Object temperature sensor UB
	OUA Object temperature sensor UA
	OIB Object temperature sensor IB
	OIA Object temperature sensor IA

I/O	
X3	1 Power output
	2 Power output GND
	3 – 13 Digital IO
	14 GND
	15 RS485 A (+)
	16 RS485 B (-)
	(16 pin connector, PN N2516-6V0C-RB-WD)
Fast Analog Output	
X4	SMA connector

Mounting:

4 × M3 sized bores

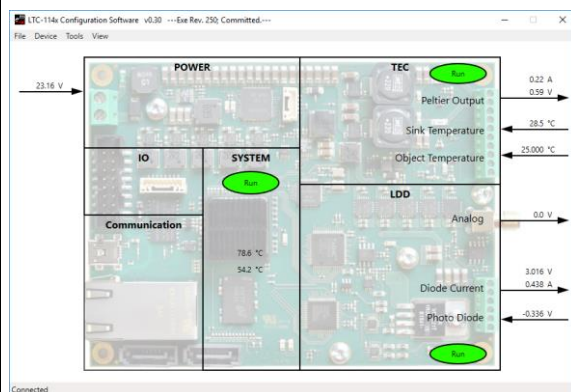
Dimensions:

120 mm × 90 mm × 22 mm

Operation-Modes / Theory of Operation

The LTC-1141 is a low noise QCL driver with integrated TEC controller (based on TEC-1091). The core of the LTC-1141 consists of a system on chip featuring high performance processing capabilities in combination with fast DAC, ADC and memory. This allows fast modulation, sampling as well as onboard data processing. Laser diode cooling is managed by the onboard TEC controller featuring high temperature stability and high measurement precision.

LTC Configuration Software

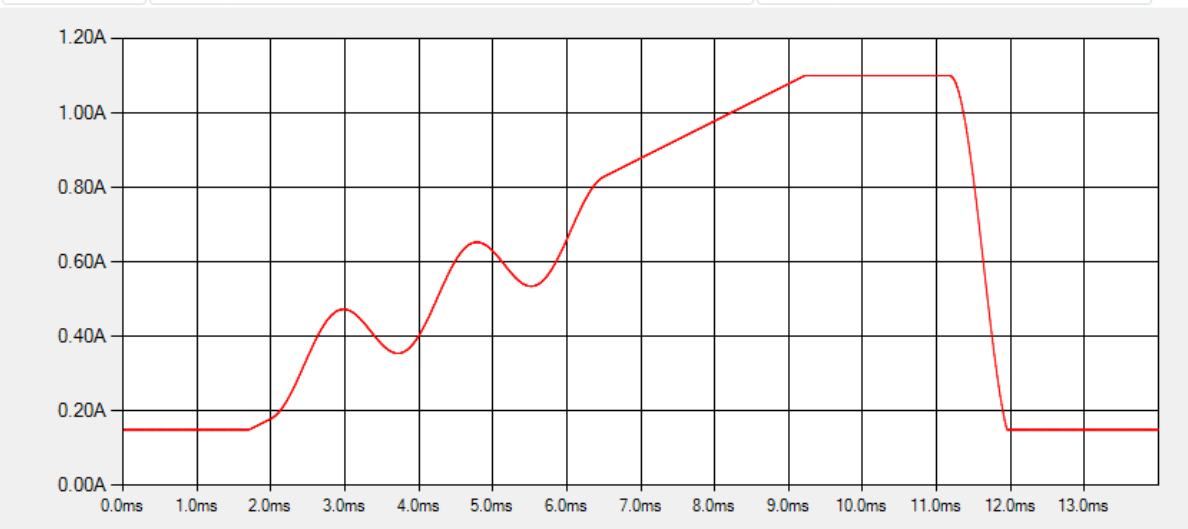


Features:

- Operation control and monitoring
- Limits and error management
- Charting functions for LDD and TEC controller
- Digital storage oscilloscope (DSO) with trigger
- Auto tuning of PID values (only TEC controller)
- Custom current waveforms using signal generator and lookup tables

LDD / Graph

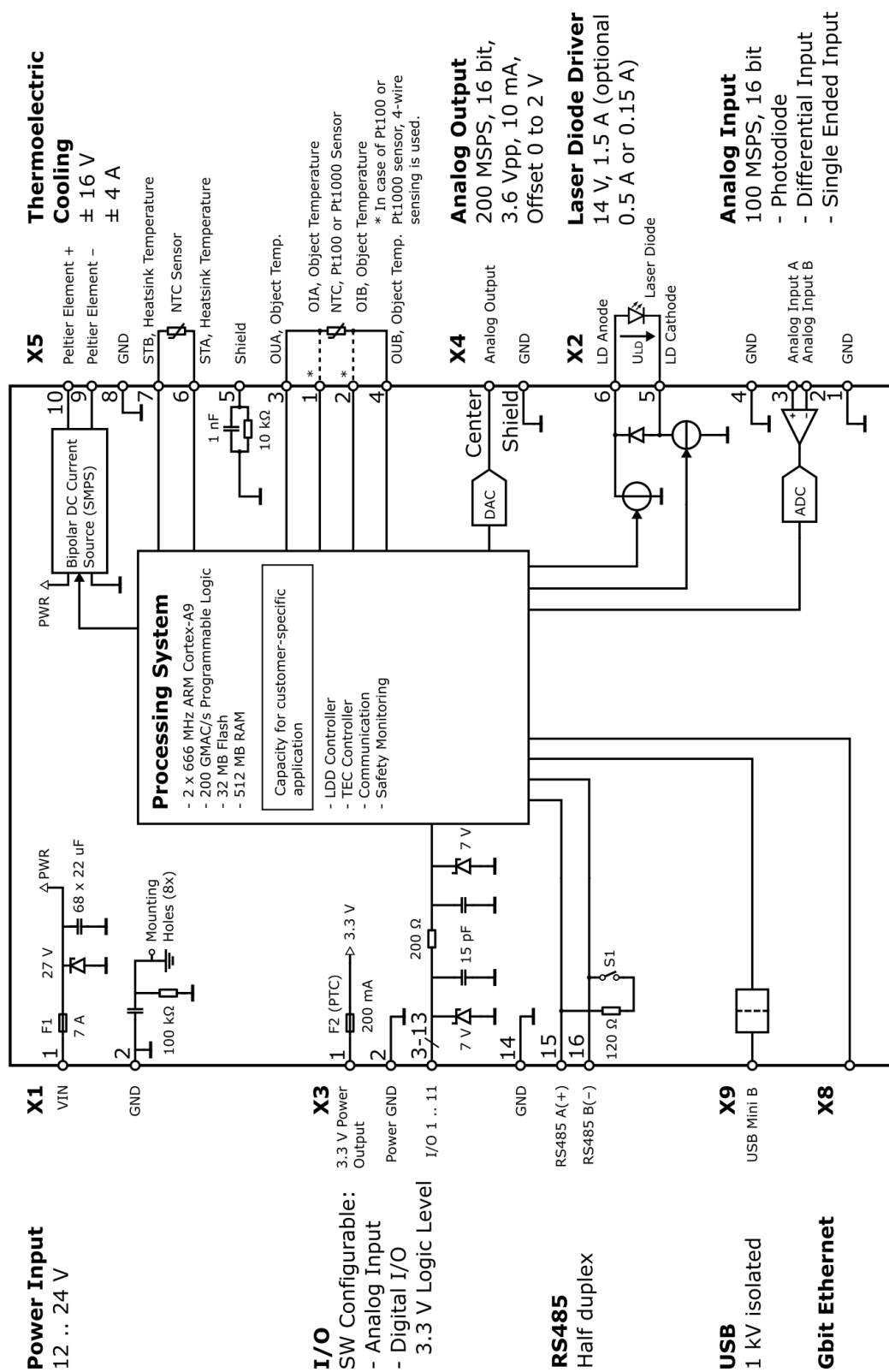
Data Update ☐ Auto Update ☒ Single Sequence Finished		Acquire Nr. of Points: 7000 Averaging: 200 Trigger Source: Signal Genera		Total acquiring time: 0.014 s Point to point time: 2E-06 s Sampling time: 1E-08 s		Channel <table border="1"> <thead> <tr> <th>Channel</th> <th>Enable</th> <th>Trigger Level</th> <th>Mouse Zoom</th> </tr> </thead> <tbody> <tr> <td>LD Current</td> <td>☒</td> <td>0.3 A</td> <td>☒</td> </tr> <tr> <td>AIN Voltage</td> <td>☐</td> <td>0.3 V</td> <td>☐</td> </tr> </tbody> </table>		Channel	Enable	Trigger Level	Mouse Zoom	LD Current	☒	0.3 A	☒	AIN Voltage	☐	0.3 V	☐
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AIN Voltage	☐	0.3 V	☐																



Custom waveforms displayed in the graph with DSO functionality

Detail Block Diagram

LTC Family Laser & TEC Controller



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Standard Version Configuration Options / Customization

The LTC-1141 QCL controller is available in a standard version with configuration options or as a fully customized version.

1. LTC-1141 with standard firmware

- Laser diode current measurement range using the ADC is selectable (see ordering information)
- TEC controller object temperature sensor type is selectable (NTC, Pt100, Pt1000)

2. Customized LTC-1141

- A custom user application on FPGA and processor using subsystems, communication, onboard processing and measurement can be implemented. All onboard control and measurement values are available.
- Customized sampling / measurement using the differential input of the ADC (current and voltage measurement, differential, single ended input etc.)
- Other hardware features and requirements are feasible

LTC-1141 Ordering Information, Hardware Configuration

Example Configuration:

LTC-1141 - 1500 - NTC - PD10

LTC Model - LTC-1141	LDD Output Current - 1500: 1.5 A - 500: 500 mA - 150: 150 mA	Object Temp. Sensor Type - NTC (2 Wire) - PT100 (4 Wire) - PT1000 (4 Wire)	Analog Input - PD10: Photodiode 10 mA (R_i 20 Ω) - PD1: Photodiode 1 mA (R_i 20 Ω) - V1.2: Voltage ± 1.2 V (R_i 240 Ω)
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