

## OEM QCL Controller

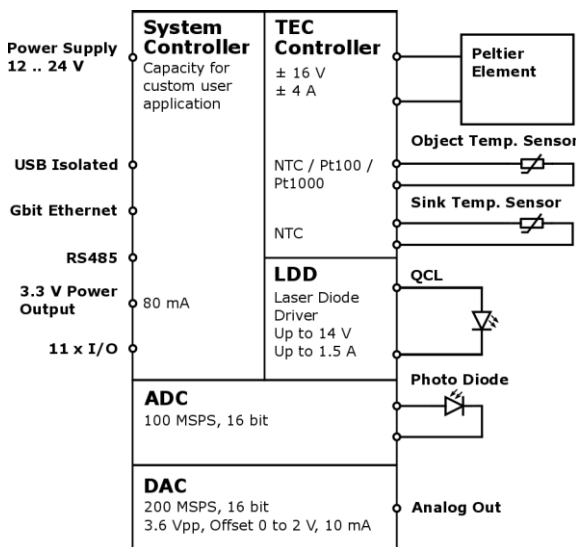


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### General Description:

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

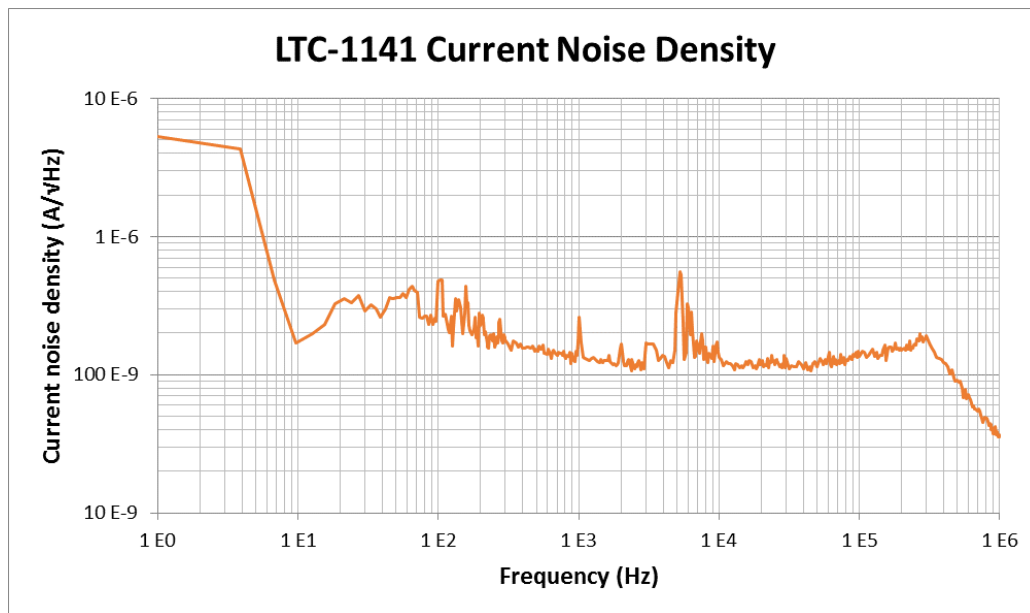
Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<b>DC Power Supply Input:</b>						
$V_{IN}$	Supply voltage		11.5		24	V
<b>X3 Input Characteristics (Digital I/O):</b>						
$U_{IH}$	Logic high input threshold		2		3.45	V
$U_{IL}$	Logic low input threshold				0.8	V
$U_{IMAX}$	Absolut maximum input voltage		-0.4		3.7	V
<b>X3 Output Characteristics (Digital I/O):</b> Including 200 $\Omega$ 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
<b>ESD Protection:</b> (Between Processor and Connector X3)						
$U_{PP}$	ESD discharge	IEC61000-4-2			100	kV
$R_A$	Series resistance		170	200	230	$\Omega$
<b>X3 Power Output:</b> Including 200 mA PTC polyfuse (self-resettable). $R_{MIN}=0.4\ \Omega$ , $R_{MAX}=5\ \Omega$						
$U_{OUT}$	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
<b>Ethernet:</b>						
$U_{PP}$	Electrical isolation				1.5	kV
<b>USB:</b>						
$U_{PP}$	Electrical isolation				1	kV
<b>RS485:</b>						
R	Series resistance	$S_1$ closed		120		$\Omega$

## LDD Characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>Output CW:</b>						
$U_{LD\_MAX}$	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
<b>Fast Analog Input ADC (X2):</b>						
$I_{IN}$	Input current	Photodiode, LTC-1141-???-???-PD10			10	mA
$R_i$	Input resistance	Photodiode, LTC-1141-???-???-PD10		20		$\Omega$
$I_{IN}$	Input current	Photodiode, LTC-1141-???-???-PD1			1	mA
$R_i$	Input resistance	Photodiode, LTC-1141-???-???-PD1		20		$\Omega$
$U_{IN}$	Input voltage	Differential input, LTC-1141-???-???-V1.2			$\pm 1.2$	V
$R_i$	Input resistance	Differential input, LTC-1141-???-???-V1.2		240		$\Omega$
$R_{SAMPLE}$	Sample rate			100		MSPS
R	Resolution				16	bit
<b>Fast Analog Output DAC (X4):</b>						
$I_{OUT}$			0		10	mA
$U_{OUT}$			0		3.6	V <sub>pp</sub>
$U_{OUT, OFFSET}$			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:  $3.75\ \Omega$

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
<b>Output:</b>						
$I_{OUT}$	Bipolar current swing				$\pm 4$	A
$U_{OUT}$	Bipolar voltage swing	$U_{OUT}$ is maximum $\sim 0.6 \times U_{IN}$			$\pm 16$	V
$U_{OUT}$ Ripple	Voltage ripple	@ 4 A		80		mV <sub>PP</sub>
<b>Output Monitoring</b>						
$I_{OUT}$ 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<sub>25/100</sub> 3988K R<sub>25</sub> 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	$\Omega$ $^{\circ}\text{C}$
$R_{OBJ, RANGE}^*$	Extended range (PGA = 1 or 8 or 32)	Standard Configuration Corresponding temperature range	105	176 to -10.1	55742	$\Omega$ $^{\circ}\text{C}$

\*  $R_{OBJ, RANGE}$  is resistance range of the NTC sensor

## Laser Diode Temperature Measurement Characteristics (Pt100 and Pt1000 Probes)

$T_A = 25\text{ °C}$ , 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	$^{\circ}\text{C}$
$T_{OBJ, PREC}$	Measuring Error	Device temperature = $25\text{ °C}$ (EN 60751 / IEC 751)		0.005	0.01	$^{\circ}\text{C}$
$T_{OBJ, COEFF}$	Temp. Coefficient	Relative to device temperature			1.6	m $^{\circ}\text{C}/\text{K}$
$T_{OBJ, NOISE}$	Value Noise	Reference measurement fluctuations while output stage operating @ 70% load		0.003		$^{\circ}\text{C}$
$T_{OBJ, REP}$	Repeatability	Repeated measurements of reference resistors after up to 3 days		0.005		$^{\circ}\text{C}$

## Sink Temperature Measurement Characteristics (NTC only)

$T_A = 25\text{ °C}$ , measurement configuration = 12 bit / 2-wire / unshielded cable <50 mm,  $^{\circ}\text{T}$  probe = NTC B<sub>25/100</sub> 3988K R<sub>25</sub> 10k

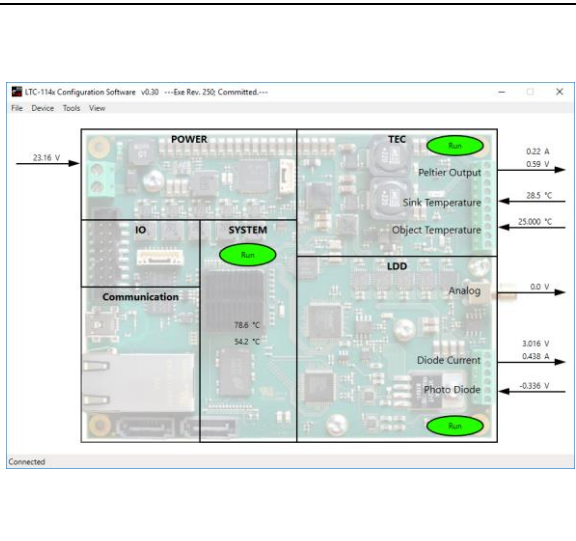
Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
$R_{SINK, RANGE}$	Range	Corresponding temperature range	180	150 to -6.0	44600	$\Omega$ $^{\circ}\text{C}$



## 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

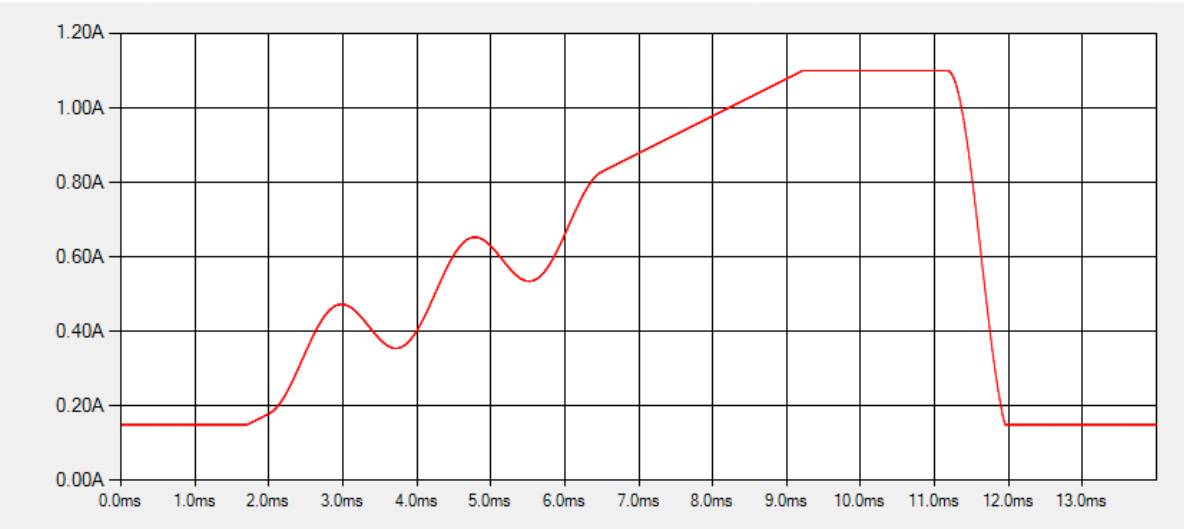


### Features:

- 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
- Lock settings and firmware upgrade with a password

### LDD / Graph

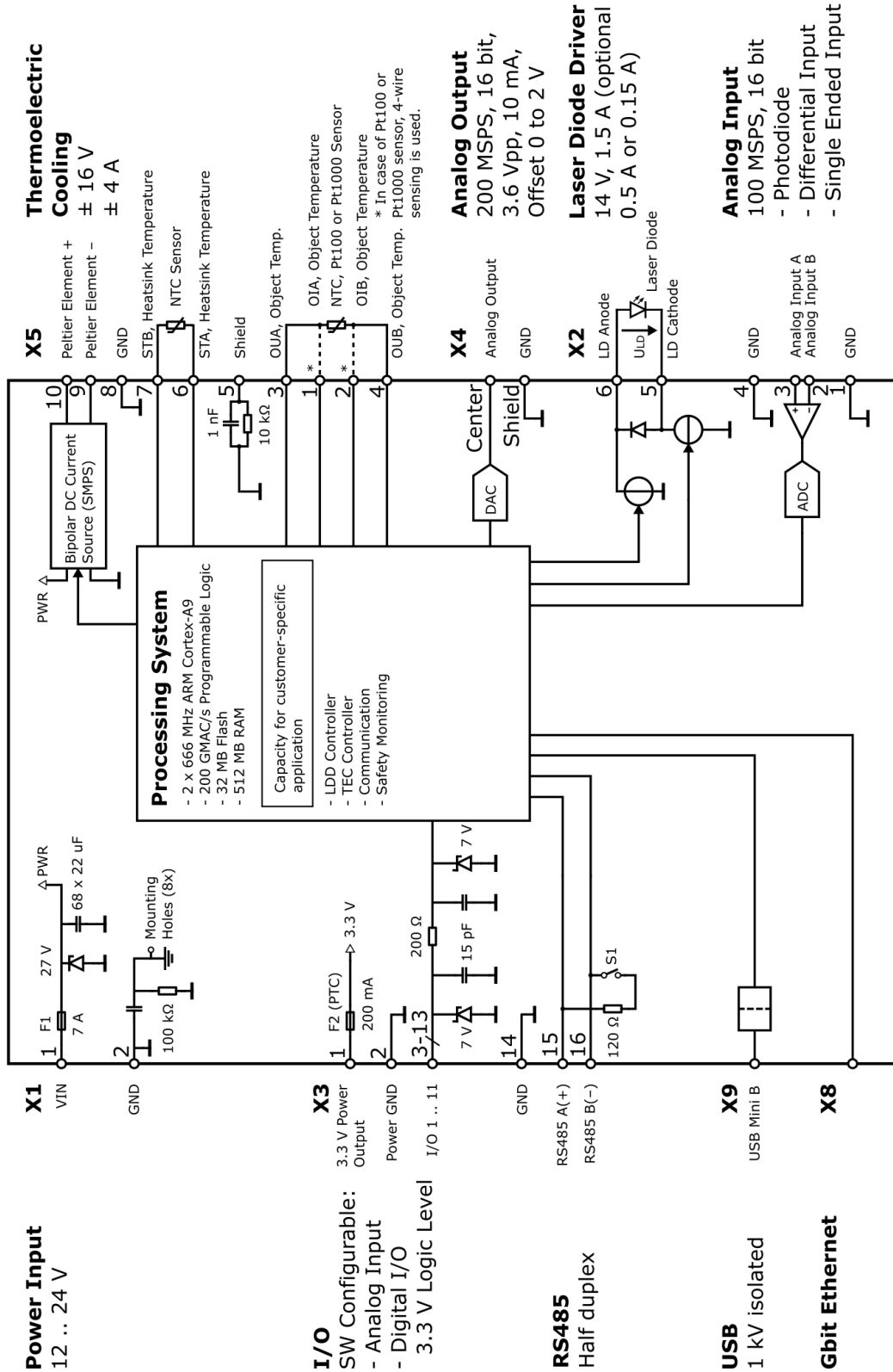
Data Update	Acquire		Total acquiring time	0.014 s	Channel	Enable	Trigger Level	Mouse Zoom
<input type="checkbox"/> Auto Update	Nr. of Points	7000	Point to point time	2E-06 s	LD Current	<input checked="" type="checkbox"/>	0.3 A	<input checked="" type="radio"/>
<input checked="" type="checkbox"/> Single Sequence	Averaging	200	Sampling time	1E-08 s	AIN Voltage	<input type="checkbox"/>	0.3 V	<input type="radio"/>
Finished	Trigger Source	Signal Genera						



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 (see ordering information)**
  - Laser diode current measurement range using the ADC is selectable
  - TEC controller object temperature sensor type is selectable
  - Analog input configuration is selectable between photodiode current measurement and differential voltage measurement
- 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**

