

OEM QCL Controller

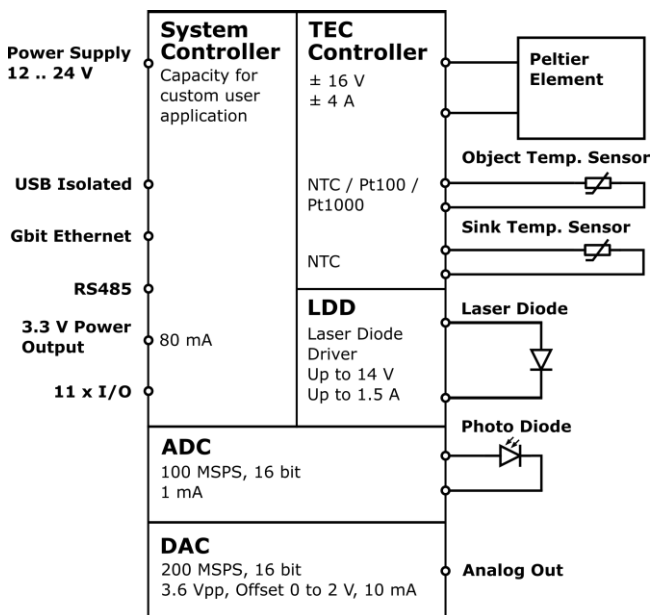


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General Description:

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 efficient TEC controller (DC output)
- Very high temperature precision (0.005 °C)
- Autotuning 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: 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 & TEC full digitally controlled
- Application data processing:
 - 11 digital or 5 analog IOs (X3)
 - 1 fast analog Input reserved for sampling and measurements (X2)
 - 1 fast analog output (X4)
 - 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
- RS485

Special Requirements / More Information:

- Please contact us for additional information or customization.

Absolute Maximum Ratings

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

Operating Ratings

Operation temperature*	0 – 60 °C
Storage	-30 – 70 °C
Humidity	5 – 95%, non-condensing

* Base plate temperature

Electrical Characteristics

Unless otherwise noted: $T_A = 25\text{ °C}$, $V_{IN} = 24\text{ V}$, Load Spec: TBD (Rload etc.)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
DC Power Supply Input:						
V_{IN}	Supply voltage		11.5		24	V
V_{IN} Ripple	Ripple tolerance	V_{IN} never below $V_{IN\text{ min}}$			TBD	mV _{PP}
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). Values below are valid at pins of IO connector X3.						
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)						
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}	ESD discharge				1.5	kV
USB:						
U_{PP}	ESD discharge				1	kV
RS485:						
R	Series resistance	S_1 closed		120		Ω

LDD Characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Output CW:						
I_{LD}	Current range	LTC-1141-1500-NTC configuration	0.4*		1.5	A
I_{LD}	Current range	LTC-1141-500-NTC configuration	100*		500	mA
I_{LD}	Current range	LTC-1141-150-NTC configuration	30*		150	mA
$T_{\text{coefficient}}$	Temp. coefficient			TBD	35	ppm/K
U_{LD_MAX}	Laser Diode voltage				14	V
U_{LD_LIMIT}	Output voltage	$U_{in} \times 0.75 - 4\text{ V}$		9.8		V
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}				1		mA
U_{IN}		Photo diode			1.2	V
U_{IN}		Differential input			TBD	V
U_{IN}		Single ended input			TBD	V
R_{SAMPLE}	Sample rate			100		MSPS
R	Resolution				16	bit
Fast Analog Output DAC (X4):						
I_{OUT}					10	mA
U_{OUT}					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: TBD (Rload etc.)

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} resolution is TBD mA; U_{OUT} resolution is TBD mV)						
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 °C
$R_{OBJ_RANGE}^*$	Extended range (PGA = 1 or 8 or 32)	Standard Configuration Corresponding temperature range	105	176 to -10.1	55742	Ω °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 = 23bit / 4-wire / unshielded cable <50mm

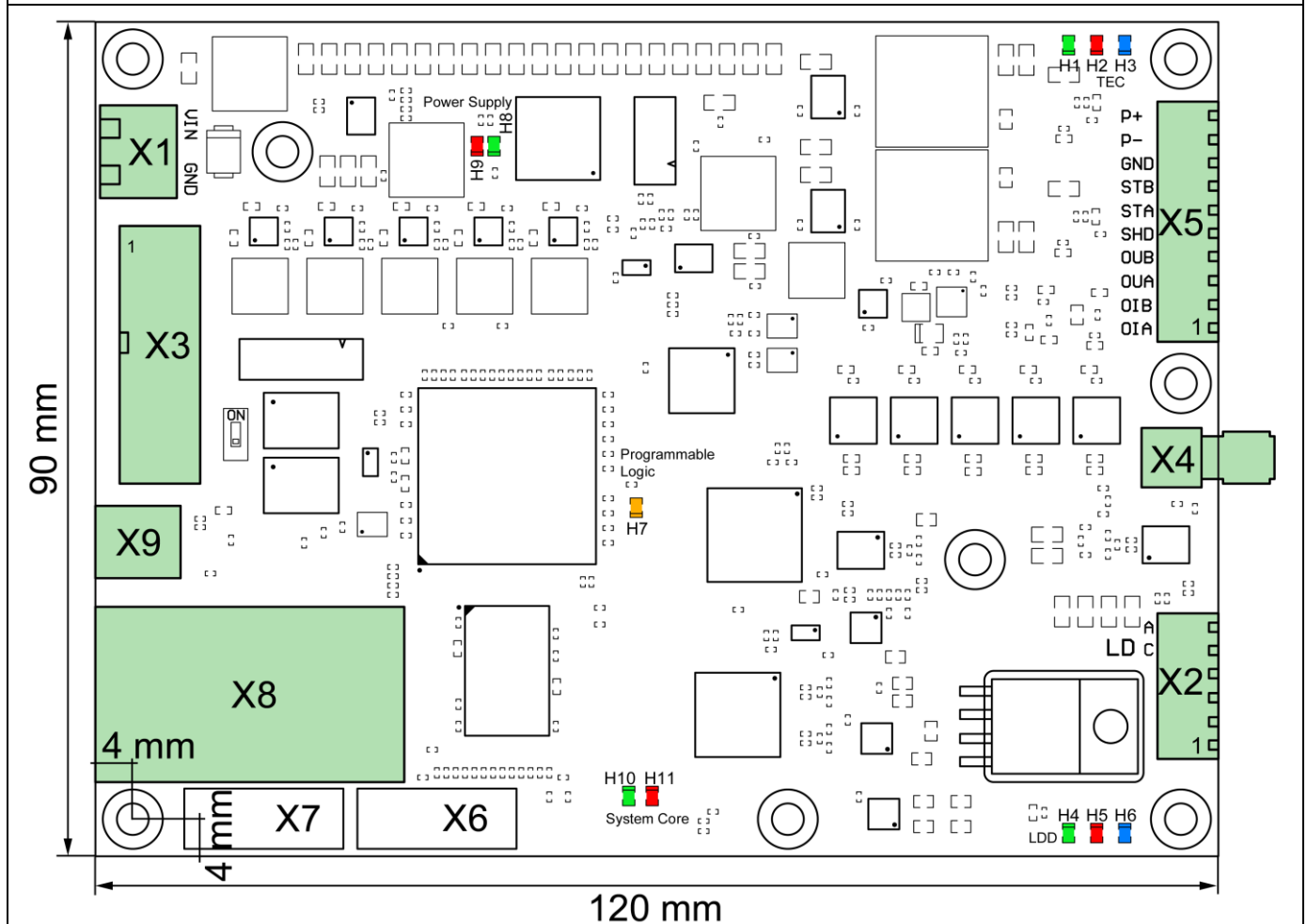
Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
T _{OBJ, RANGE}	Range	Range is extendable upon Request	-50		+200	°C
T _{OBJ, PREC}	Measuring Error	Device temperature = 25°C (EN 60571 / IEC 751)		0.005	0.01	°C
T _{OBJ, COEFF}	Temp. Coefficient	Relative to device temperature			1.6m	°C/K
T _{OBJ, 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 = 12bit / 2-wire / unshielded cable <50mm, °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	A (6) LD anode
	C (5) LD cathode
	4 GND (shield)
	3 Analog input (photo diode anode)
	2 Analog input (photo diode cathode)
	1 Ground (shield)
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 (-)
Fast Analog Output	
X4	SMA connector

Mounting:

4 × M3 sized bores

Dimensions:

120 mm × 90 mm × 22 mm

Pin Configuration and Mechanical Data (cont.)

Programmable Logic and Power Supply LEDs:

Orange steady	Programmable logic starting up
Green steady	Power supply OK*
Red steady	Power supply failure*

* If H8 & H9 steady = Programmable logic running & at least one power supply rail not ready

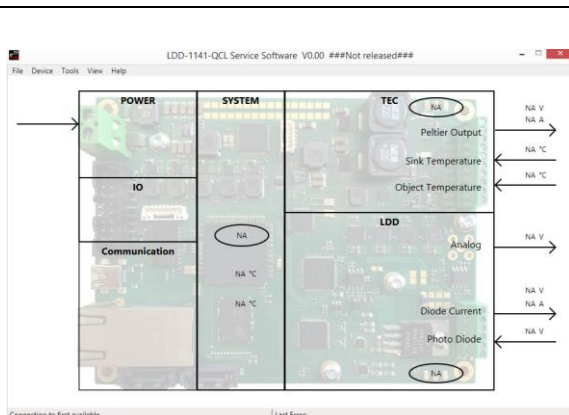
System Core, TEC and LDD LEDs:

Green steady	Initializing
Green slowly blinking	Ready
Green fast blinking	Run
Green & red slowly alternating	System not OK (only LDD und TEC subsystem)
Red steady	Error
Red & green steady*	Other states: - Firmware update (only system core) - Restart
Blue slowly blinking	TEC temperature control off (output can be enabled)
Blue fast blinking	TEC temperature not stable
Blue steady	- TEC temperature stable - LDD run

Operation-Modes / Theory of Operation / Communication Modes

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.

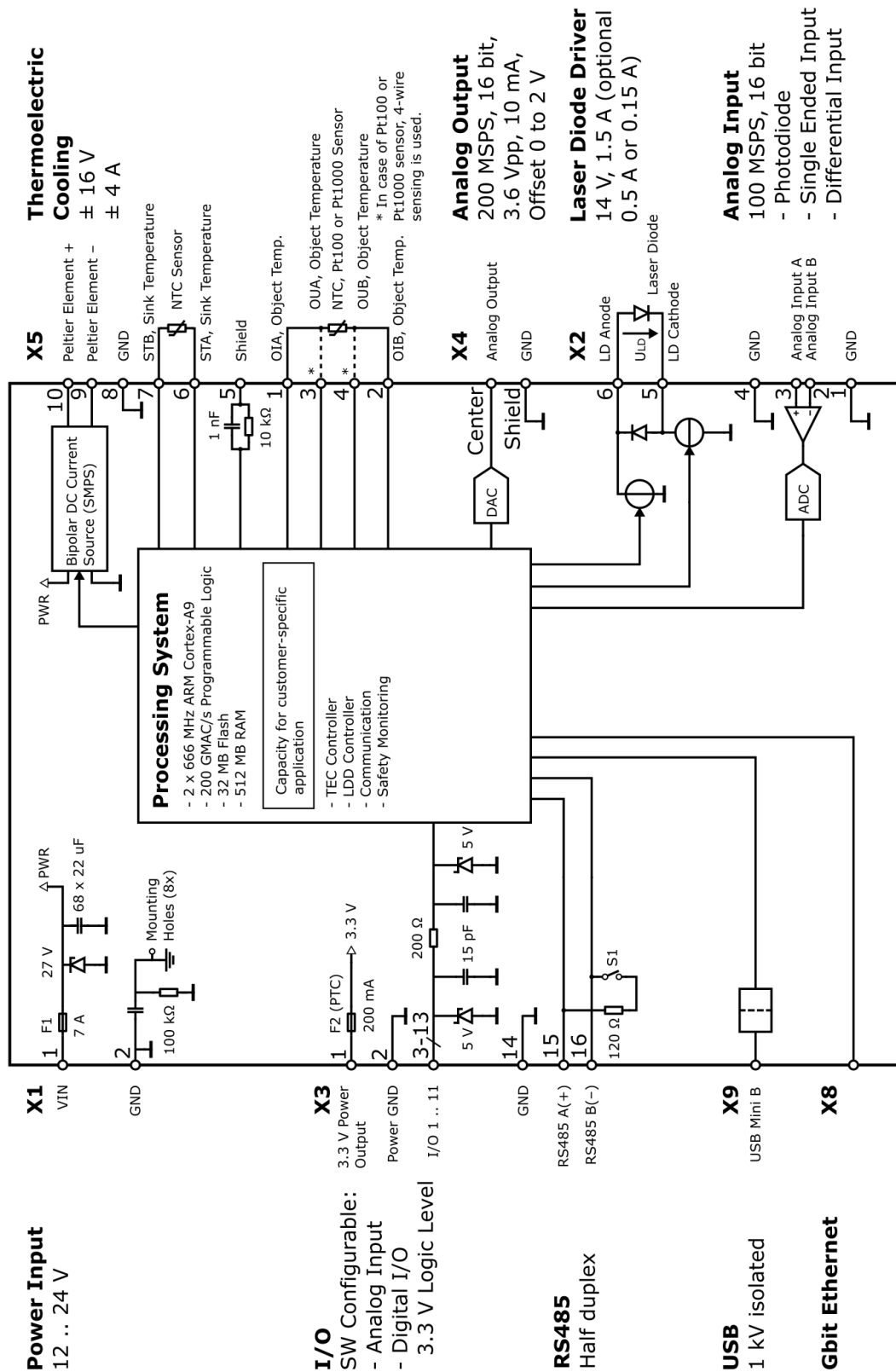
LTC Configuration Software



- Operation control and monitoring
- Limits and error management
- Charting functions
- Auto tuning of PID values

Detail Block Diagram

LTC-1141 QCL 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**

