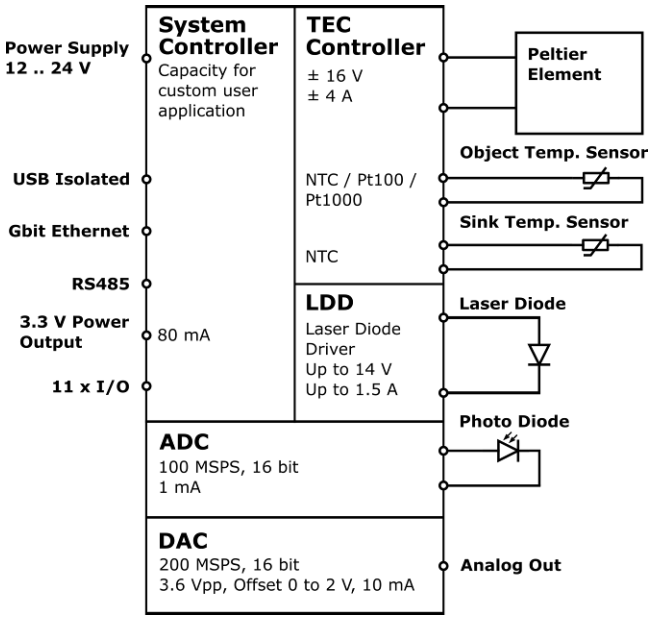
OEM QCL Controller

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: 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 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 °C, V_{IN} = 24 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 $V_{IN\ min}$			TBD	mV_{PP}
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 Ω, R_{MAX}=5 Ω						
U_{OUT}	Output voltage of IO supply on IO connector X3	I_{OUT} = 0 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 °C, V_{IN} = 24 V, U_{LD} = 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
$T_{coefficient}$	Temp. coefficient			TBD	35	ppm/K
U_{LD_MAX}	Laser diode voltage	$U_{LD} \leq U_{IN} \times 0.75 - 4$			14	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 °C, V_{IN} = 24 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	Vpp
$U_{OUT, OFFSET}$			0		2	V
R_{SAMPLE}	Sample rate			200		MSPS
R	Resolution				16	bit

TEC Characteristics

Unless otherwise noted: T_A = 25 °C, V_{IN} = 24 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 ~0.6 × 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 R_{25} 10k temperature sensor.

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

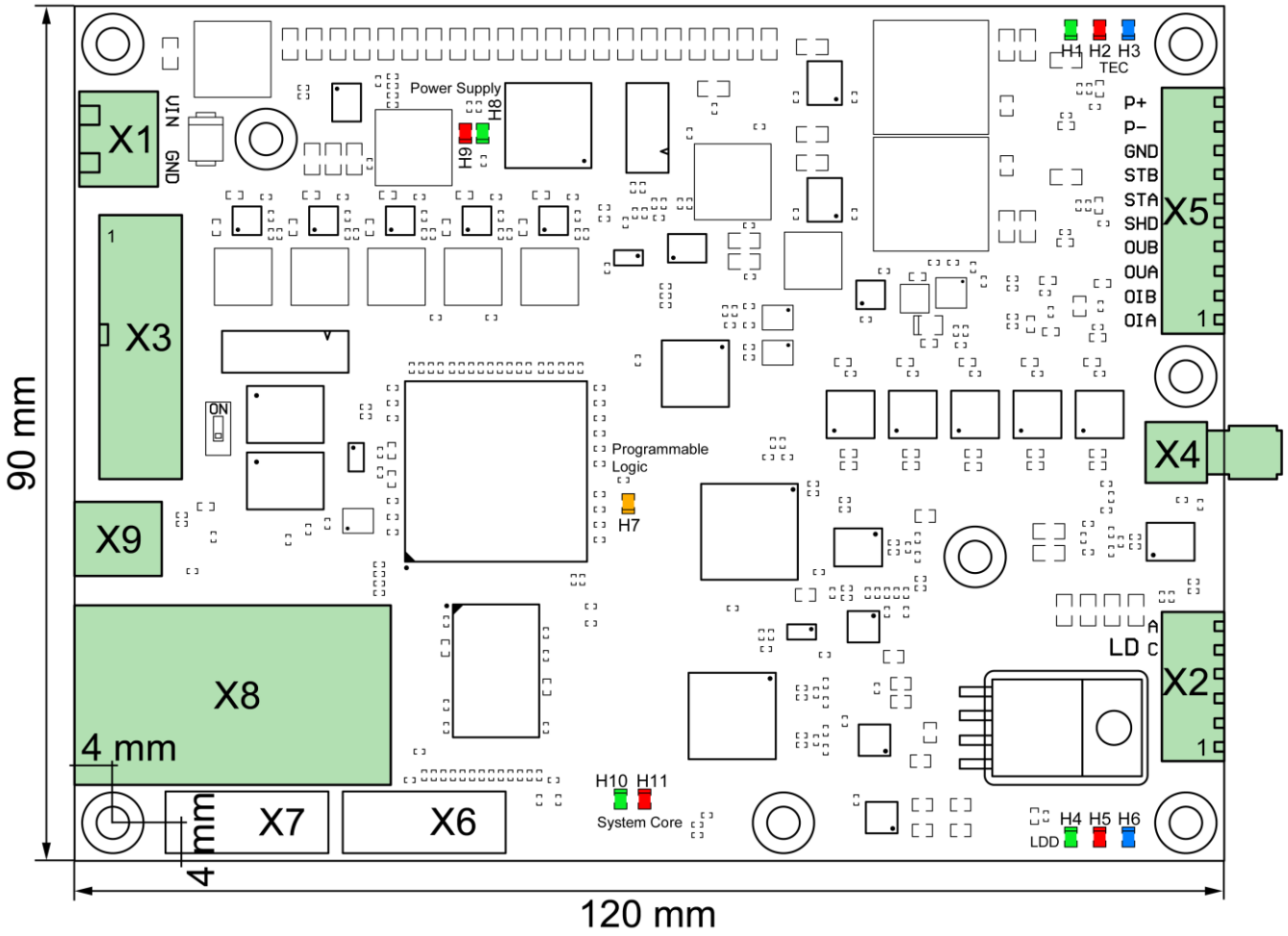
Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
$T_{OBJ, RANGE}$	Range	Range is extendable upon Request	-50		+200	°C
$T_{OBJ, PREC}$	Measuring Error	Device temperature = 25 °C (EN 60751 / IEC 751)		0.005	0.01	°C
$T_{OBJ, COEFF}$	Temp. Coefficient	Relative to device temperature			1.6m	°C/K
$T_{OBJ, NOISE}$	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 = 12 bit / 2-wire / unshielded cable <50 mm, °T probe = NTC $B_{25/100}$ 3988K R_{25} 10k

Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
$R_{SINK, RANGE}$	Range		180		44600	Ω
		Corresponding temperature range	150 to -6.0			°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 (-)
Fast Analog Output		
X4	SMA connector	

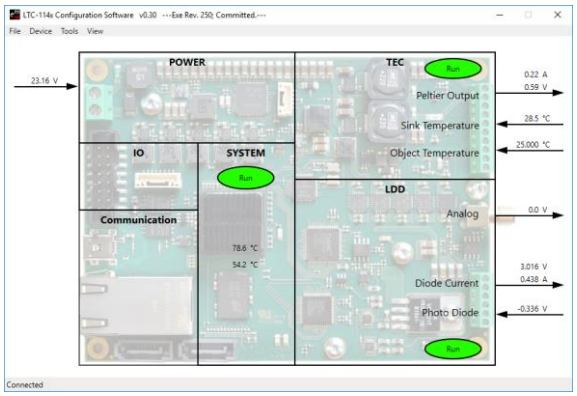
Mounting:
4 × M3 sized bores

Dimensions:
120 mm × 90 mm × 22 mm

Operation-Modes / Theory of Operation / Communication Modes

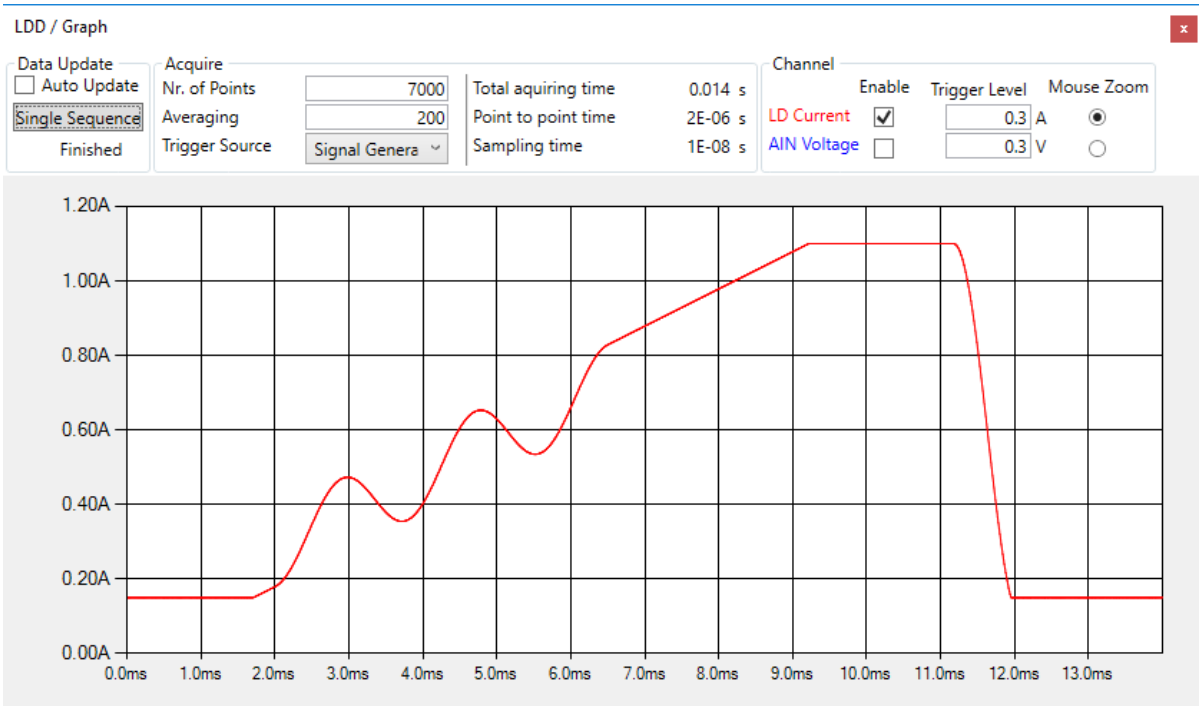
The LTC-1141 is a low noise QCL driver with integrated TEC controller (based on TEC-1091).
The core of the LTC-1141 consists of a system on chip featuring high performance processing capabilities in combination with fast DAC, ADC and memory. This allows fast modulation, sampling as well as onboard data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

LTC Configuration Software



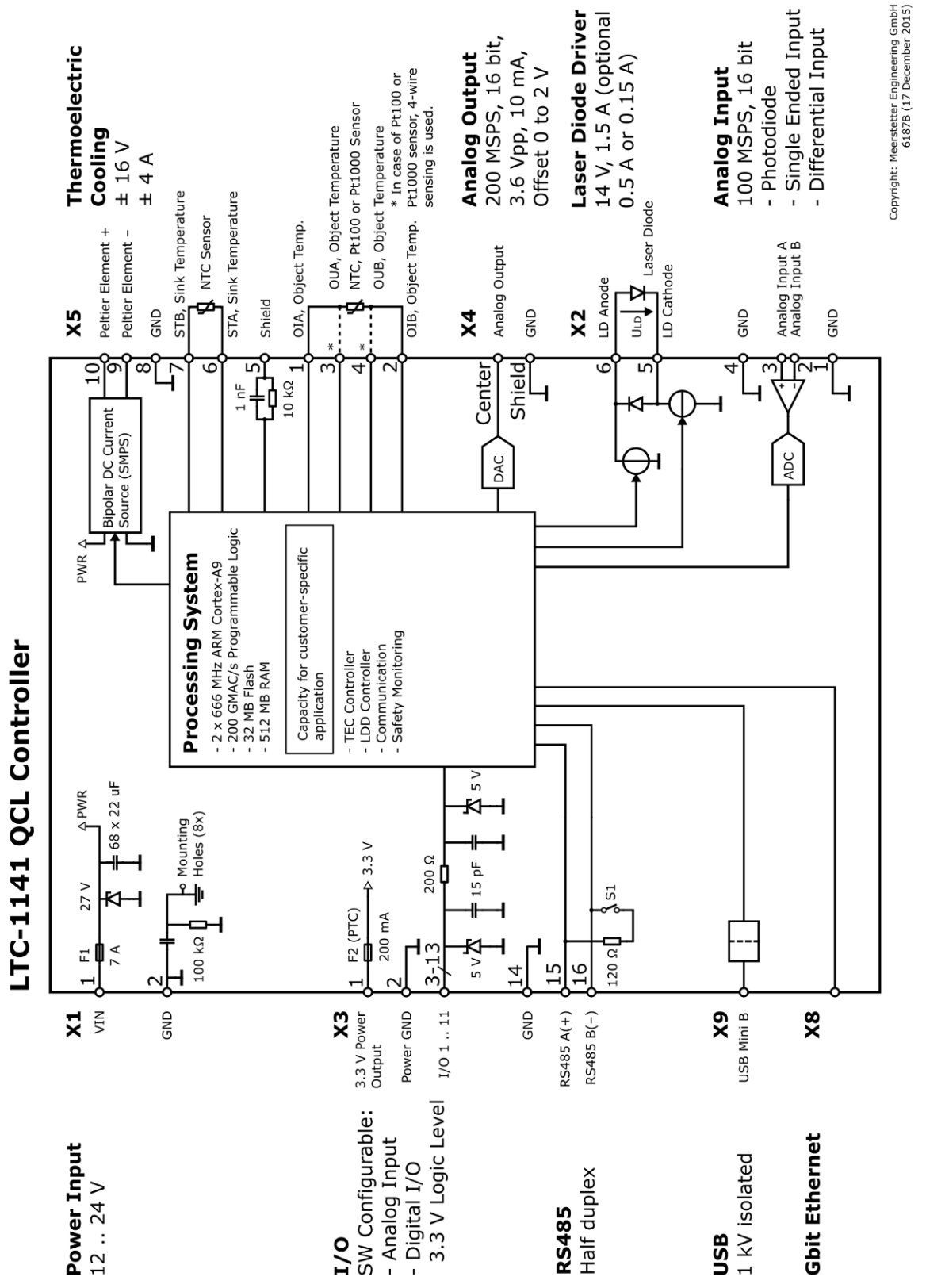
Features:

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



Custom waveforms displayed in the graph with DSO functionality

Detail Block Diagram



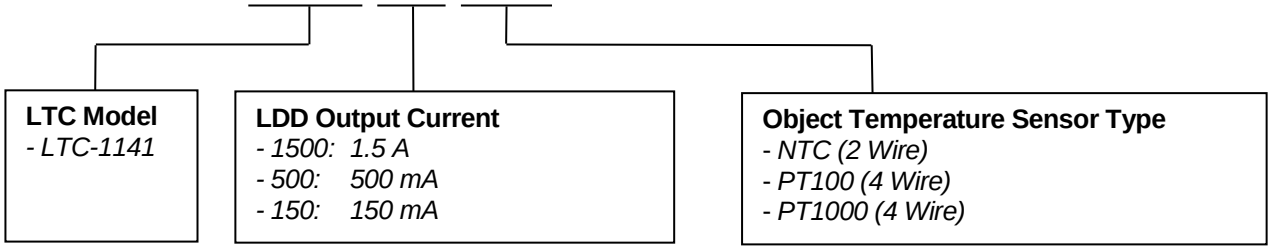
Standard Version Configuration Options / Customization

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**



Meerstetter Engineering GmbH
Schulhausgasse 12
3113 Rubigen, Switzerland

Phone: +41 31 712 01 01
Email: contact@meerstetter.ch
Website: www.meerstetter.ch