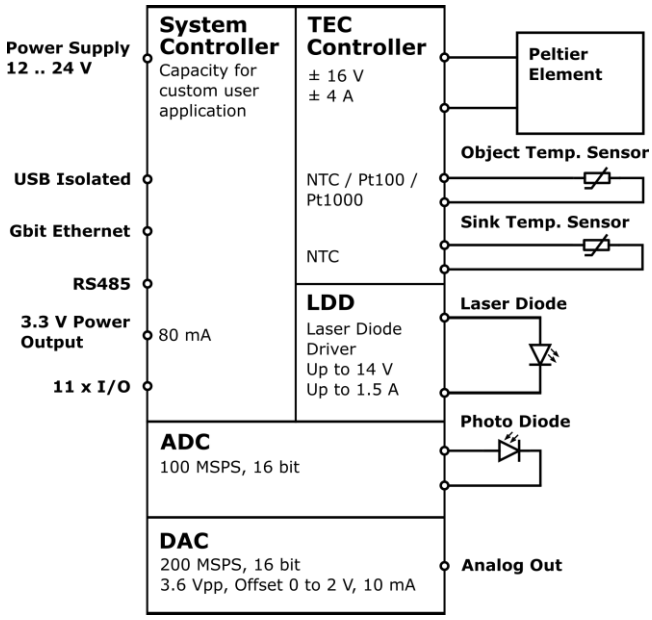
OEM Laser Controller

General Description:

The LTC-1142 combines an ultra-fast laser diode driver and a highly stable TEC/Peltier controller.

The controller offers simultaneous sampling of laser diode current and analog input measurements, as well as the possibility for high-speed digital signal processing and data analysis.



Product Highlights:

- 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:

- Usage as a measurement instrument
- Optical coherence tomography (OCT)
- Cytometry
- Medical imaging
- Laser excited measurements

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 protection

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

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 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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Laser Diode Output:						
U_{LD_MAX}	Laser diode voltage	**$U_{LD} \leq U_{IN} \times 0.75 - 4$ V**			14	V
Mod	Modulation depth		10		100	%
I_{LD}	Current range	LTC-1142-1500-???-??? configuration	0.4*		1.5	A
I_{LD}	Current range	LTC-1142-500-???-??? configuration	100*		500	mA
I_{LD}	Current range	LTC-1142-150-???-??? configuration	30*		150	mA
$I_{LD, PREC}$	Precision				0.5	%
t_r	Current rise time	I_{LD} change from 10% to 90%		1		µs
t_f	Current fall time	I_{LD} change from 90% to 10%		1		µs
$T_{coefficient}$	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 °C, V_{IN} = 24 V

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Fast Analog Input ADC (X2):						
I_{IN}	Input current	Photodiode, LTC-1142-???-???-PD10			10	mA
R_i	Input resistance	Photodiode, LTC-1142-???-???-PD10		20		Ω
I_{IN}	Input current	Photodiode, LTC-1142-???-???-PD1			1	mA
R_i	Input resistance	Photodiode, LTC-1142-???-???-PD1		20		Ω
U_{IN}	Input voltage	Differential input, LTC-1142-???-???-V1.2			±1.2	V
R_i	Input resistance	Differential input, LTC-1142-???-???-V1.2		240		Ω
R_{SAMPLE}	Sample rate			100		MSPS
R	Resolution				16	bit
Fast Analog Output DAC (X4):						
I_{OUT}	Output current		0		10	mA
U_{OUT}	Output voltage		0		3.6	Vpp
$U_{OUT, OFFSET}$	Output voltage 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: 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 ~0.6 × 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 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

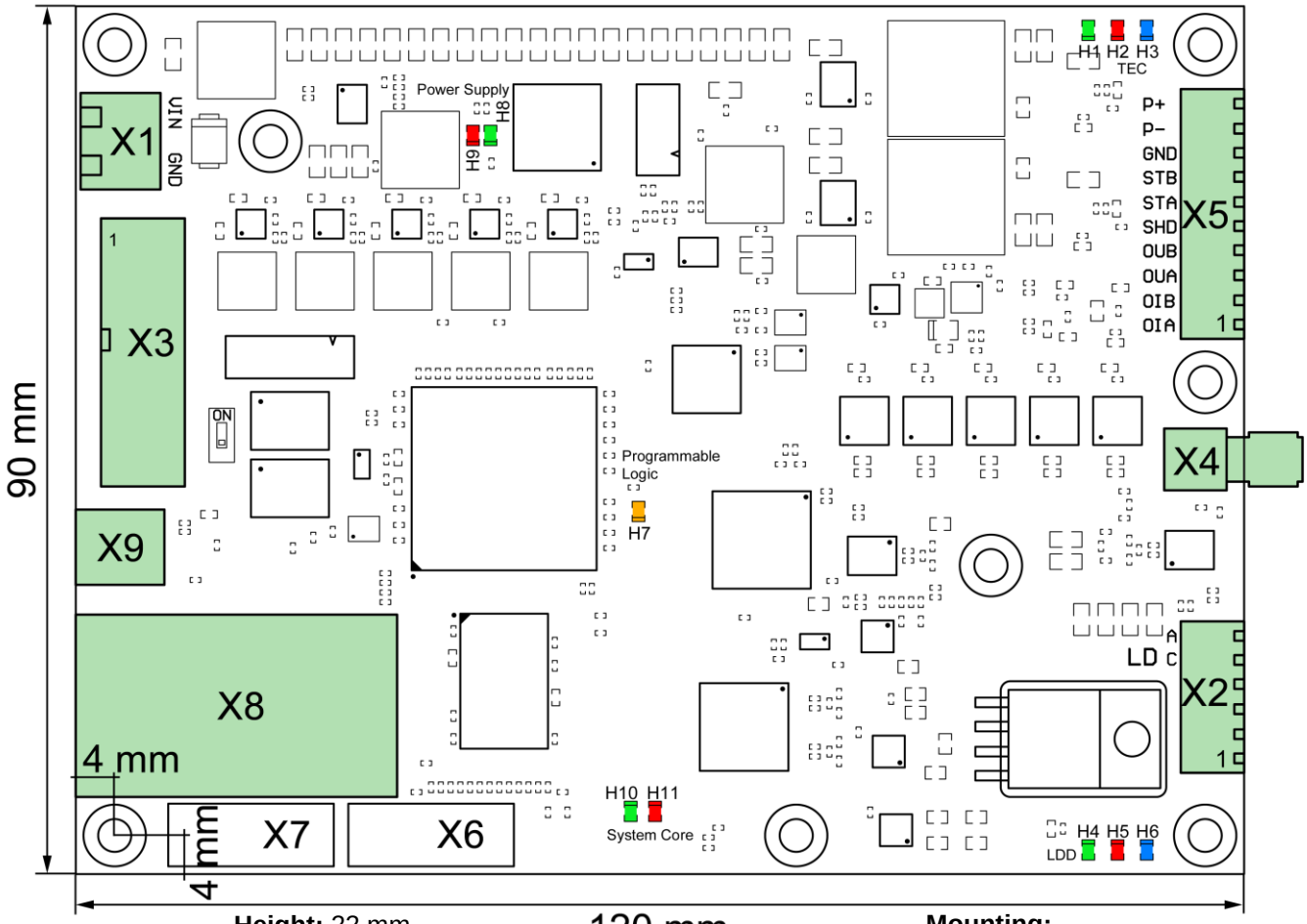
Symbol	Parameter	Test Conditions / Hints	Min	Typ	Max	Units
$T_{OBJ, RANGE}$	Range		-100		+200	°C
$T_{OBJ, PREC}$	Measuring Error	Device temperature = 25 °C (EN 60751 / IEC 751)		0.005	0.01	°C
$T_{OBJ, COEFF}$	Temp. Coefficient	Relative to device temperature			1.6	m°C/K
$T_{OBJ, NOISE}$	Value Noise	Reference 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 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



Height: 22 mm

Mounting:
4 × M3 sized bores

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	3.3V output
	2	GND
	3	IO1
	4	IO2
	5	IO3
	6	IO4
	7	IO5
	8	IO6
	9	IO7
	10	IO8
	11	IO9
	12	IO10
	13	IO11
	14	GND
	15	RS485 A (+)
	16	RS485 B (-)
	(16 pin connector, PN N2516-6V0C-RB-WD)	
Fast Analog Output		
X4	SMA connector	

Operation-Modes / Theory of Operation

The LTC-1142 allows full digital control of both laser diode and TEC/Peltier element current.

Laser diode current modulation is possible using the internal signal generator or by loading a lookup table.

Object temperature control is managed by the onboard TEC controller featuring high temperature stability and high measurement precision. PID optimization for the object to be cooled can be done using the auto tuning function or manual adjustment.

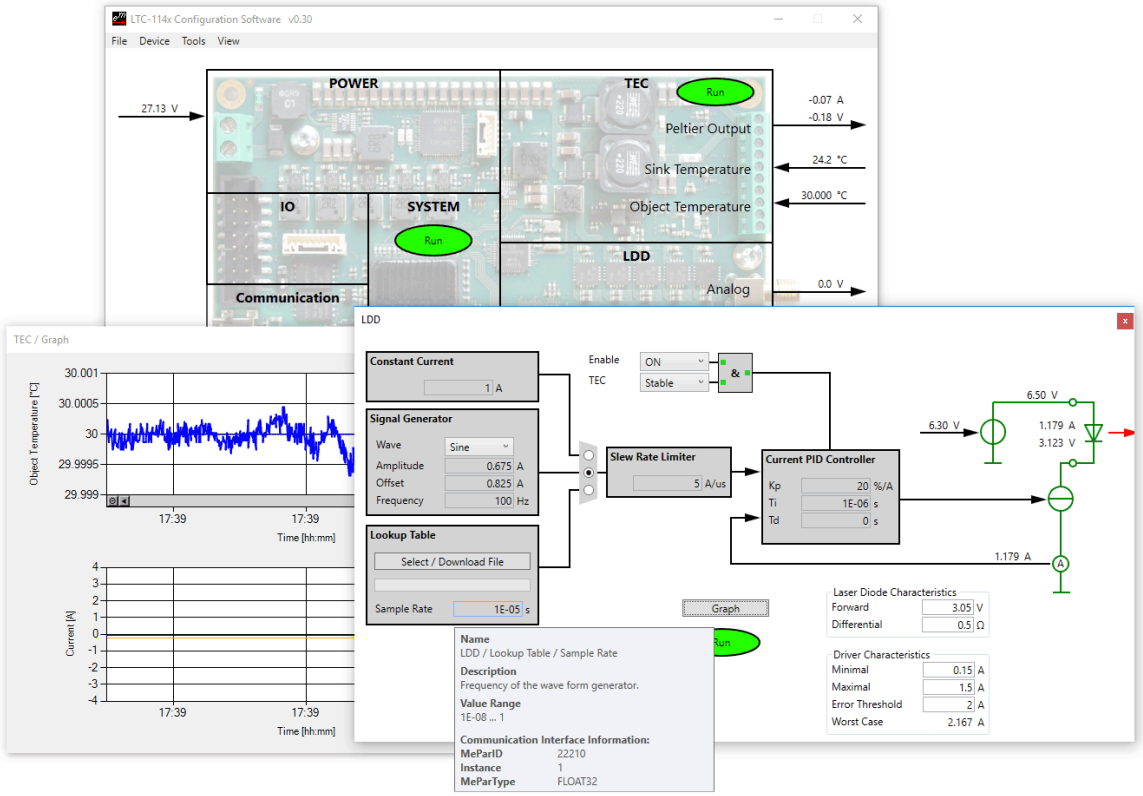
The two analog high speed channels – laser diode current and analog input – are synchronously sampled, processed and stored in the onboard RAM and can be accessed for further signal processing. (Additional onboard signal processing on request)

The LTC-1142 offers several communication interfaces for configuration, data acquisition and integration into a measurement system. Standalone operation is possible and requires no PC to be connected.

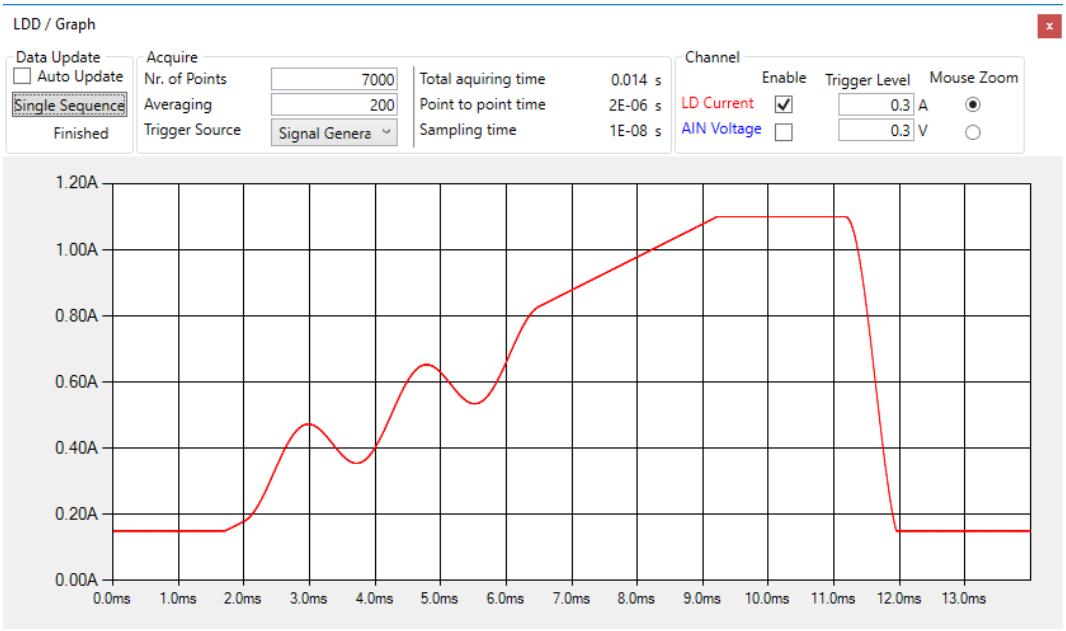
LTC Configuration Software

Features:

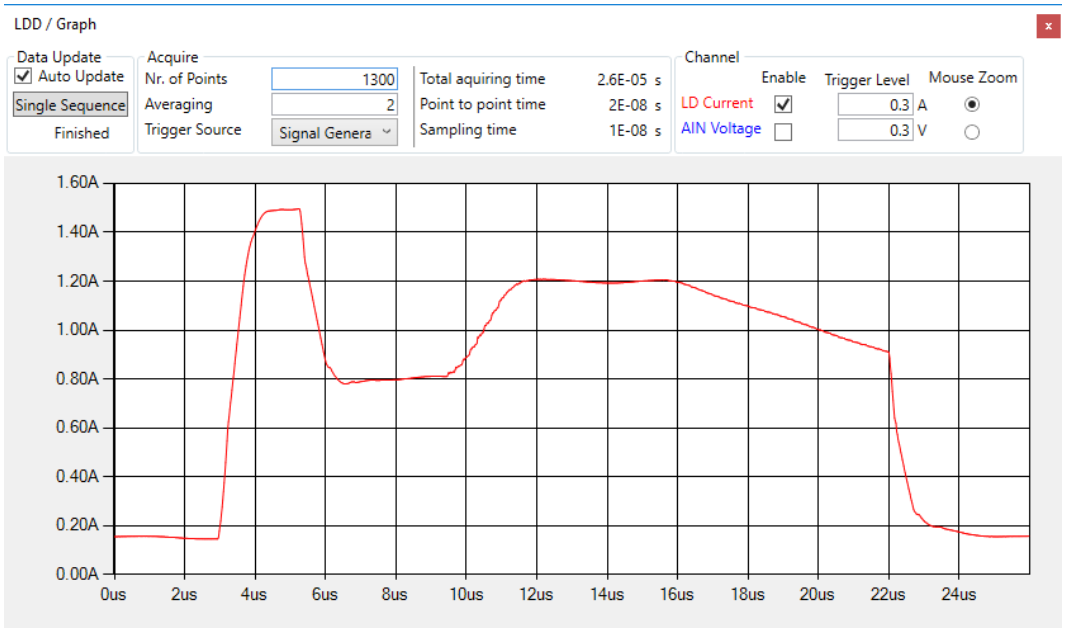
- Operation control and monitoring
- Limits and error management
- Charting functions for LDD and TEC controller
- Digital storage oscilloscope (DSO) with trigger
- Auto tuning of PID values (only TEC controller)
- Lock settings and firmware upgrade with a password
- Custom current waveforms using signal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



Intuitive configuration of the subsystems and graphical monitoring

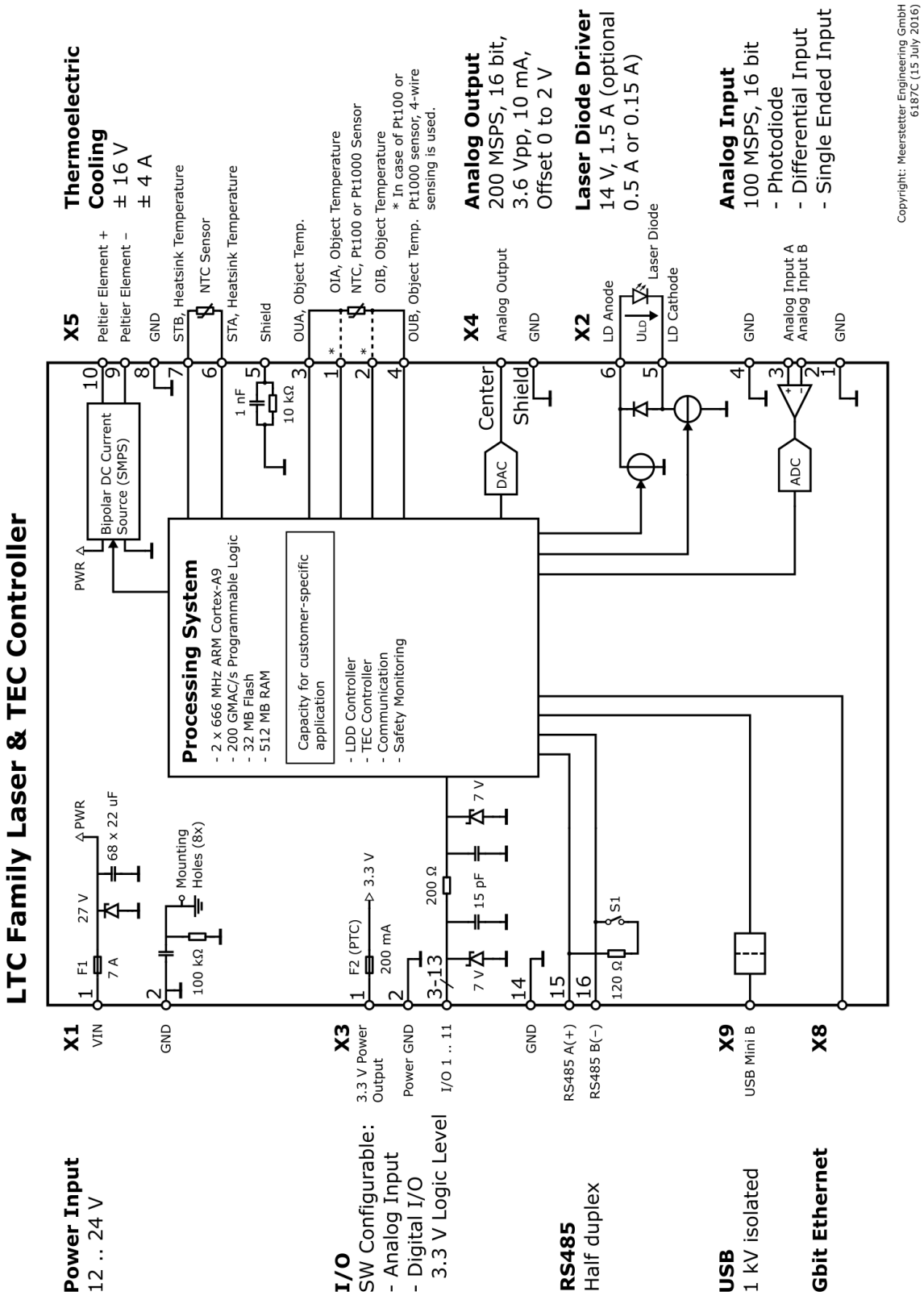


Slow custom waveforms displayed in the graph with DSO functionality



Fast custom waveforms displayed in the graph with DSO functionality

Detail Block Diagram



Standard Version Configuration Options / Customization

The LTC-1142 Laser & TEC Controller is available in a standard version with configuration options or as a fully customized version.

1. **LTC-1142 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-1142**
   - 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-1142 Ordering Information, Hardware Configuration

Example Configuration: **LTC-1142 - 1500 - NTC - PD10**

LTC Model	LDD Output Current	Object Temp. Sensor Type	Analog Input
- LTC-1142	*- 1500: 1.5 A* *- 500: 500 mA* *- 150: 150 mA*	*- NTC (2 Wire)* *- PT100 (4 Wire)* *- PT1000 (4 Wire)*	*- PD10: Photodiode 10 mA (Ri 20 Ω)* *- PD1: Photodiode 1 mA (Ri 20 Ω)* *- V1.2: Voltage ±1.2 V (Ri 240 Ω)*

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