SenseFuture

DLC
Digital Laser Driver
PRODUCT MANUAL

Striving for the Bright Future of Precision Optoelectronic Measurement.

SenseFuture Technologies Co., Ltd.

01 Product Functions

The DLC Digital Laser Driver is designed to drive all types of lasers within 1000 mA (e.g., VCSEL, DBR, DFB, LD, ICL, QCL, and other laser sources).

DLC Product Image (Product features iterate; please refer to the actual unit)

02 Product Features

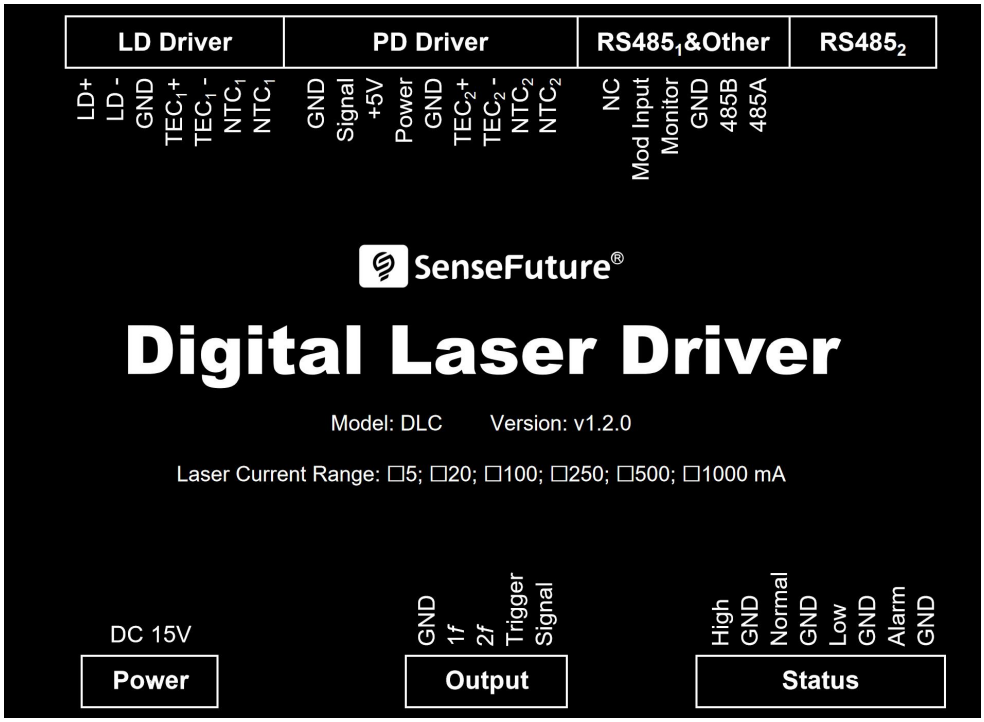
Feature Category	Advantage Description
Core Highlights	● Built-in modulation/demodulation ● ±0.001℃ temperature-control stability, μA-level laser drive current noise ● Supports 10 kHz modulation frequency with fast response ● Compatible with various laser types (VCSEL, DFB, ICL, QCL)
Integration & Functions	On-board integration of laser control interface, DDS signal generator, high-speed high-precision data acquisition, digital lock-in amplifier, error diagnostics, and RS-485 communication.
Signal Processing	High-resolution, high-speed signal acquisition; high-performance digital lock-in amplifier with flexible, configurable parameters.
Ease of Use & Integration	Standard RS-485 interface (Modbus RTU recommended); non-volatile parameter storage; synchronous signal output; industrial-grade design.
Reliability & Diagnostics	Supports laser safety protection (current limiting, soft start, requires matching modules); system self-diagnostics and error status code reporting. Automatically disables the laser output current when the laser temperature exceeds the threshold, protecting the laser. Built-in software watchdog for automatic reset.

03 Technical Specifications

Parameter	Model / Value
Waveform Type	Triangle wave scan + sine modulation wave
Modulation Frequency Range	10 kHz (currently fixed; user-configurable in a future firmware upgrade)
Detector Input Voltage Range	-5 to +5 V
Harmonic Signal Extraction	1f and 2f harmonic signals, with hardware output support
Phase Adjustment Range / Resolution	0 to 360°
Communication Interface	9600 bps, RS-485, half-duplex, Modbus RTU
Supply Voltage Vin	15 V, 24 V (optional), DC-060 connector
Maximum Output Current	**20 mA, 100 mA, 250 mA, 500 mA, 1000 mA** (Matched with VCS20, VCS100, VCS250, VCS500 and VCS1000 current driver modules respectively)
Maximum Output Voltage (Compliance Voltage)	Supply voltage − 5 V
Current Noise (RMS)	**<0.4μA, <2μA, <5μA, <20μA, <40μA** (Matched with VCS20, VCS100, VCS250, VCS500 and VCS1000 current driver modules respectively)
Rise/Fall Time (Tuning)	800 / 500 ns
Modulation Depth	90% @ 500 kHz
Bandwidth	2 MHz
Modulation Input Voltage Range	0 to 5 V
Input Pin Impedance	> 1 MΩ
Current Temperature Drift	~50 ppm/℃
Maximum TEC Output Current	±3 A
Maximum TEC Output Voltage	Vin × 90% V
Temperature-Control Stability	±0.001 ℃

Operating Ambient Temperature Range	-15 to 60 ℃ (additional heat dissipation is required above 250 mA)
Operating Ambient Humidity Range	0 to 98% RH
Dimensions	165.0 × 120.0 × 42.0 mm
Weight	Approx. 250 g

04 Interface Description



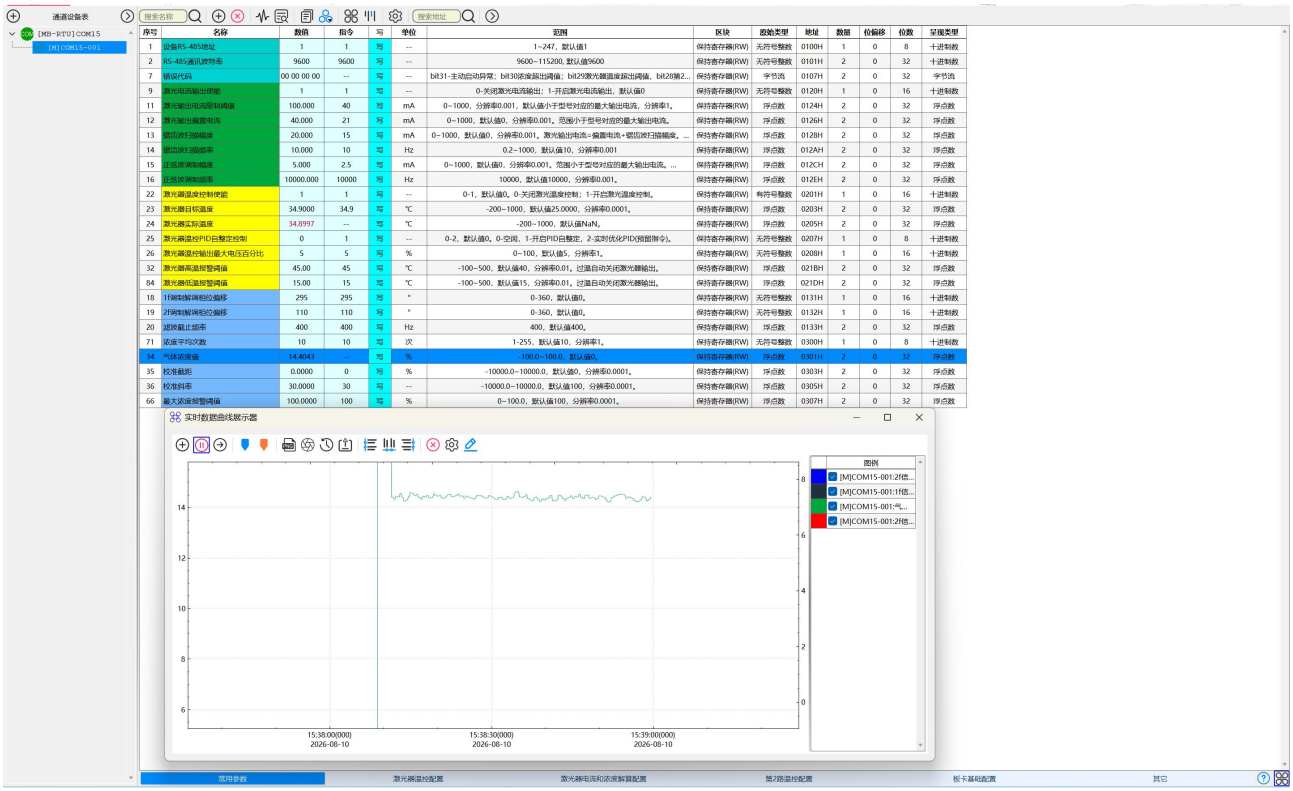
Terminal Definition Table

Terminal	I/O	Function / Description
LD+	Output	Connects to the anode of the laser diode.
LD-	Output	Connects to the cathode of the laser diode. Note: this pin is floating ground.
GND	Output	Negative terminal of the power supply; connect to the laser housing if required.
TEC1+	Output	Connects to the positive terminal of the laser TEC (thermoelectric cooler).
TEC1-	Output	Negative terminal of the laser TEC; note that this pin is floating ground.
NTC1	Input	NTC temperature sensor terminal for the laser temperature control.
NTC1	Input	Negative terminal of the laser thermoelectric cooler; note that this pin is floating ground.

GND	Output	Negative terminal of the power supply; connect to the negative output of the detector signal.
Signal	Input	Detector signal input terminal; connect to the positive output of the detector signal. Input range: -5 to +5 V.
+5V	Output	Provides 5 V output to power the detector if needed.
Power	Output	Direct power-supply output; can be used to power the detector.
GND	Output	Negative terminal of the power supply; can be used to power the detector.
TEC2+	Output	Connects to the positive terminal of the detector TEC (if used).
TEC2-	Output	Connects to the negative terminal of the detector TEC (if used); note that this pin is floating ground.
NTC2	Input	NTC temperature sensor terminal for the detector temperature control.
NTC2	Input	Negative terminal of the detector thermoelectric cooler; note that this pin is floating ground.
NC	I/O	Reserved pin.
Mod Input	Input	External modulation input for the laser current; 0 to 5 V input. Conversion factor = 5 V / laser drive current range.
Monitor	Output	Actual laser current monitor output; 0 to 5 V output. Conversion factor = 5 V / laser drive current range.
GND	Output	Negative terminal of the power supply; connect to the negative of the RS-485 module if required.
RS-485 B	Output	RS-485 communication signal terminal B.
RS-485 A	Input	RS-485 communication signal terminal A.
Power	Input	Main power input, DC-060 connector.
GND	Output	Negative terminal of the power supply.
1f	Output	Demodulated waveform at 1× modulation frequency; output range: -5 to +5 V.
2f	Output	Demodulated waveform at 2× modulation frequency; output range: -5 to +5 V.
Trigger	Output	Spectral scan trigger signal; pulse width 1 μs, high level 3.3 V.
Signal	Output	Detector signal output monitor terminal.
High	Output	Detector signal over-range alarm; active-high, output equals the supply voltage.
GND	Output	Negative terminal of the power supply.
Normal	Output	Detector signal level-normal indicator; active-high, output equals the supply voltage.
GND	Output	Negative terminal of the power supply.
Low	Output	Detector signal under-range alarm; active-high, output equals the supply voltage.

GND	Output	Negative terminal of the power supply.
Alarm	Output	Board operation error alarm; active-high, output equals the supply voltage.
GND	Output	Negative terminal of the power supply.

05 PC Software



TDLAS-01 Laser Spectrum Processing Board Debug Software Interface (Under Upgrade)

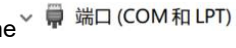
06 Operating Instructions

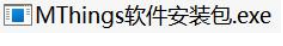
Step 1: Power Supply and Communication Cable Connection

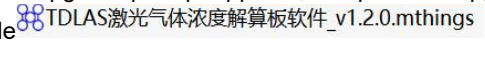
1.1 Connect the RS-485 communication cable following the pinout (A-A, B-B) to the RS-485 port of the processing board.

1.2 Plug the 15 V DC power supply (DC-060 connector) into the Power port.

Step 2: PC Software Communication Configuration

2.1 Right-click the leftmost  icon in the taskbar and select "Device Manager". Expand the  device list, plug the RS-485 adapter into a USB port of the PC, and note the COM port number (e.g., COM8) of the corresponding serial device. If the RS-485 driver is not installed, install the RS-485 driver first.

2.2 Install the host communication software  , accept the agreement, and proceed with the default configuration. Launch the Mthings software; if an upgrade prompt appears, complete the upgrade.

2.3 Double-click to open the communication file  .

2.4 Right-click on the entry  in the "Channel Device Table" and select "Configure Parameters". Set the

correct COM port number from step 2.1, then click OK.

2.5 Right-click on the entry  in the "Channel Device Table" and select "Connect". If the connection is successful, the red icon will turn green.

2.6 Right-click on the entry  in the "Channel Device Table" and select "Start Polling". If polling succeeds, the "Value" column on the right will start reading actual values.

序号	名称	数值	指令	写	单位	范围	区块	原始类型	地址	数量	位偏移	位数	呈现类型
1	设备RS-485地址	--	1	写	--	1~247...	保持寄存器(RW)	无符号整数	0100H	1	0	8	十进制数
2	RS-485通讯波特率	--	9600	写	--	9600~1...	保持寄存器(RW)	无符号整数	0101H	2	0	32	十进制数
7	错误代码	--	--	写	--	bit31-...	保持寄存器(RW)	字节流	0107H	2	0	32	字节流
9	激光电流输出使能	--	0	写	--	0-关闭...	保持寄存器(RW)	无符号整数	0120H	1	0	16	十进制数
11	激光输出电流限制阈值	--	100	写	mA	0~1000...	保持寄存器(RW)	浮点数	0124H	2	0	32	浮点数
12	激光输出偏置电流	--	40	写	mA	0~1000...	保持寄存器(RW)	浮点数	0126H	2	0	32	浮点数
13	锯齿波扫描幅度	--	20	写	mA	0~1000...	保持寄存器(RW)	浮点数	0128H	2	0	32	浮点数
14	锯齿波扫描频率	--	10	写	Hz	0....	保持寄存器(RW)	浮点数	012AH	2	0	32	浮点数
15	正弦波调制幅度	--	5	写	mA	0~1000...	保持寄存器(RW)	浮点数	012CH	2	0	32	浮点数
16	正弦波调制频率	--	10000	写	Hz	10000...	保持寄存器(RW)	浮点数	012EH	2	0	32	浮点数
18	1f调制解调相位偏移	--	295	写	°	0-360，...	保持寄存器(RW)	无符号整数	0131H	1	0	16	十进制数
19	2f调制解调相位偏移	--	232	写	°	0-360，...	保持寄存器(RW)	无符号整数	0132H	1	0	16	十进制数
20	滤波截止频率	--	400	写	Hz	400，默...	保持寄存器(RW)	浮点数	0133H	2	0	32	浮点数
22	激光器温度控制使能	--	1	写	--	0-1，默...	保持寄存器(RW)	有符号整数	0201H	1	0	16	十进制数
23	激光器目标温度	--	35	写	℃	-200~1...	保持寄存器(RW)	浮点数	0203H	2	0	32	浮点数
24	激光器实际温度	--	--	写	℃	-200~1...	保持寄存器(RW)	浮点数	0205H	2	0	32	浮点数
25	激光器温控PID自整定控制	--	1	写	--	0-2，默...	保持寄存器(RW)	无符号整数	0207H	1	0	8	十进制数
26	激光器温控输出最大电压...	--	5	写	%	0~100...	保持寄存器(RW)	无符号整数	0208H	1	0	16	十进制数
32	激光器高温报警阈值	--	45	写	℃	-100~5...	保持寄存器(RW)	浮点数	021BH	2	0	32	浮点数
84	激光器低温报警阈值	--	15	写	℃	-100~5...	保持寄存器(RW)	浮点数	021DH	2	0	32	浮点数
71	浓度平均次数	--	10	写	次	1-255，...	保持寄存器(RW)	无符号整数	0300H	1	0	8	十进制数
34	气体浓度值	--	--	写	%	-100.0~...	保持寄存器(RW)	浮点数	0301H	2	0	32	浮点数
35	校准截距	--	0	写	%	-10000....	保持寄存器(RW)	浮点数	0303H	2	0	32	浮点数
36	校准斜率	--	-200	写	--	-10000....	保持寄存器(RW)	浮点数	0305H	2	0	32	浮点数
66	最大浓度报警阈值	--	100	写	%	0~100....	保持寄存器(RW)	浮点数	0307H	2	0	32	浮点数

2.7 Enter the target value in the command field and double-click "Write" on the right to write it. Detailed descriptions of each register are provided in the "Range" column.

Step 3: Laser Temperature Control Configuration — Temperature Sensor Setup

3.1 To ensure laser safety, switch off the power supply and first connect only the laser temperature-control NTC sensor to the NTC1 port of the "LD Driver" on the processing board. Polarity is not required.

3.2 Click the "Laser Temperature Control Configuration" tab at the bottom of the PC software as shown below. Enter the correct R0 and B values of the laser NTC thermistor.

Verify that the actual laser temperature is read correctly.

Step 4: Laser Temperature Control Configuration — TEC Temperature Control Setup

4.1 To ensure laser safety, confirm that the "Laser Temperature Control Enable" parameter is 0 (Disabled). Enter the correct "Laser TEC Output Maximum Voltage Percentage", calculated as: Laser TEC Output Maximum Voltage Percentage = (Laser TEC rated voltage / Power supply voltage) × 100, leaving an appropriate margin. Then write the "Laser Target Temperature", "Laser High-Temperature Alarm Threshold" and "Laser Low-Temperature Alarm Threshold".

序号	名称	数值	指令	写	单位	范围
22	激光器温度控制使能	--	1	写	--	0-1，默认值0。0-关闭激光温度控制；1-开启激光温度控制。
95	激光器温度上电状态	--	0	写	--	0-1，默认值0。0-上电默认不输出；1-上电默认输出。
23	激光器目标温度	--	35	写	℃	-200~1000，默认值25.0000，分辨率0.0001。
24	激光器实际温度	--	--	写	℃	-200~1000，默认值NaN。
25	激光器温控PID自整定控制	--	1	写	--	0-2，默认值0。0-空闲，1-开启PID自整定，2-实时优化PID(预留指令)。
26	激光器温控输出最大电压...	--	5	写	%	0~100，默认值5，分辨率1。
91	温控实际输出电压百分比	--	--	写	%	0~100，默认值5，分辨率1。
90	温控实际输出电压	--	--	写	V	0~24.00，默认值1.00，（待开发）
89	温控实际输出电流	--	--	写	A	0~3.00，默认值1.00，（待开发）
27	激光器温控允许输出最大...	--	--	写	A	0~3.00，默认值1.00。（待开发）
28	激光器温控PID比例系数P	--	200	写	--	0~9000000，默认值200。
29	激光器温控PID积分系数I	--	80	写	--	0~9000000，默认值80。
30	激光器温控PID微分系数D	--	0	写	--	0~9000000，默认值0。
70	激光器NTC热敏电阻R0值	--	10000	写	Ω	1~9000000，默认值10000，分辨率1。
31	激光器NTC热敏电阻B值	--	3930	写	--	1000~50000，默认值3950.00，分辨率0.01。
32	激光器高温报警阈值	--	45	写	℃	-100~500，默认值40，分辨率0.01。过温自动关闭激光器输出。
84	激光器低温报警阈值	--	15	写	℃	-100~500，默认值15，分辨率0.01。过温自动关闭激光器输出。

4.2 Switch off the processing board power supply, then connect the laser TEC+ and TEC- to the TEC+ and TEC- ports of "LD Driver" on the processing board.

4.3 Switch on the processing board power supply and write 1 to "Laser Temperature Control Enable" to enable laser temperature control.

4.4 Observe the temperature stability. If it does not meet the requirement, write 1 to "Laser TEC PID Auto-Tuning Control" to enable PID auto-tuning. If the result is still unsatisfactory, manually adjust the PID values, or check whether the laser housing has sufficient heat dissipation.

Step 5: Laser Current Drive Configuration

9	激光电流输出使能	--	0	写	--	0-关闭激光电流输出；1-开启激光电流输出，默认值0
11	激光输出电流限制阈值	--	100	写	mA	0~1000，分辨率0.001，默认值小于型号对应的最大输出电流，分辨率1。
12	激光输出偏置电流	--	40	写	mA	0~1000，默认值0，分辨率0.001。范围小于型号对应的最大输出电流。
13	锯齿波扫描幅度	--	20	写	mA	0~1000，默认值0，分辨率0.001。激光输出电流=偏置电流+锯齿波扫描幅度。...
14	锯齿波扫描频率	--	10	写	Hz	0.2~1000，默认值10，分辨率0.001
15	正弦波调制幅度	--	5	写	mA	0~1000，默认值0，分辨率0.001。范围小于型号对应的最大输出电流。...
16	正弦波调制频率	--	10000	写	Hz	10000，默认值10000，分辨率0.001。
18	1f调制解调相位偏移	--	295	写	°	0-360，默认值0。
19	2f调制解调相位偏移	--	232	写	°	0-360，默认值0。
20	滤波截止频率	--	400	写	Hz	400，默认值400。

5.1 Switch to the "Common Parameters" tab. To ensure laser safety, set "Laser Current Output Enable" to 0 (Disabled), and enter the correct values for "Laser Output Current Limit Threshold", "Laser Output Bias Current", "Sawtooth Scan

Frequency", "Sawtooth Scan Amplitude", "Sine Wave Scan Frequency" and "Sine Wave Modulation Amplitude".

Note that the maximum laser drive current is given by:

Maximum Laser Drive Current = Laser Output Bias Current + Sawtooth Scan Amplitude + Sine Wave Modulation Amplitude.

5.2 Switch off the processing board power supply, then connect the laser LD+ and LD- to the LD+ and LD- ports of "LD Driver" on the processing board.

5.3 Switch on the processing board power supply, and write 1 to "Laser Current Output Enable" to enable the laser current output. Use a photodetector or laser viewing card to verify that laser output is present.

Step 6: Modulation/Demodulation Configuration

6.1 Switch off the processing board power supply, then connect the amplified detector signal to the Signal and GND ports of the processing board.

6.2 Switch on the processing board power supply and configure the laser temperature control and current output.

18	1f调制解调相位偏移	295	295	写	°	0-360，默认值0。
19	2f调制解调相位偏移	232	232	写	°	0-360，默认值0。
20	滤波截止频率	400	400	写	Hz	400，默认值400。
71	浓度平均次数	10	10	写	次	1-255，默认值10，分辨率1。
34	气体浓度值	39.3483	--	写	%	-100.0~100.0，默认值0。
35	校准截距	0.0000	0	写	%	-10000.0~10000.0，默认值0，分辨率0.0001。
36	校准斜率	-200.0000	-200	写	--	-10000.0~10000.0，默认值100，分辨率0.0001。
66	最大浓度报警阈值	100.0000	100	写	%	0~100.0，默认值100，分辨率0.0001。

6.3 Observe the 2f waveform at the 2f port with an oscilloscope. Adjust the "2f Modulation/Demodulation Phase Offset" and "Sine Wave Modulation Amplitude" to maximize the 2f signal amplitude while keeping the waveform complete.

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High-Tech Enterprises

Version Change Log

Version	Change description	Change date	Reviewed by
1.0.0	Initial version	2026/9/7	YL/WYR

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SenseFuture

Original Aspiration Shapes the Future;
Innovation Creates Value;
Sharing Brings People Together;

We look forward to win-win cooperation with you!