

Integrated Current & TEC Driver for
QCLs with Touchscreen
Model: QC750-Touch™

User's Manual



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Safety

Thank you for choosing QC750-Touch.

Please read this manual carefully before using this product.

All statements and technical parameters involved in this document are only applicable to a safe working environment and standard operating procedure.

If any of the following conditions exists, report them to the manufacturer or the distributor.

- There are visible damages, including units damage or transport damage;
- The ambient temperature exceeds the working range of the product, or is corroded due to long-term storage in a humid environment;
- The product does not work properly.

Disclaimer

The laser transmitting module can output invisible laser with hundreds of milliwatts of power! Improper operations will cause serious damage to your eyes! Specific safety measures are recommended in the standards for control of hazards with this laser class! Read and follow the safety precautions described on the web!

https://www.iecee.org/dyn/www/f?p=106:49:0:::FSP_STD_ID:3587

https://www.rp-photonics.com/laser_safety.html

1. It is forbidden to directly plug and unplug the drive power cable or the connection cable between the laser and the driver while the laser is running.
2. Do not look directly at the laser!
3. The power supply must have a ground reference. Before turning on, make sure the power supply meets the requirements of the device.
4. It is forbidden to disassemble or modify the equipment in any way.
5. It is forbidden to operate the device beyond specified ranges.
7. QC750-Touch is only compatible with HealthyPhoton's QC Laser Module. Please contact us if you use it to control lasers from other manufacturers.

Caution

Equipment damage caused by non-compliance with the above-mentioned safety specifications and standards will not be covered by the equipment warranty. We do not assume any responsibility or liability for loss or damage caused by failure to follow instructions in this manual.

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1. Introduction

HealthyPhoton introduced a new generation of QC750-Touch driver that integrates a newly designed touchscreen UI, which greatly facilitates user operations and measurement. The independently developed circuit features extremely low current noise and temperature drift. The all-in-one driver includes a TEC temperature controller and low noise current driver. It supports external analog signal modulation and displays real-time working status on the touchscreen. Considering the high cost of the QCL chip, our specially designed maximum current soft clamping can avoid damage to the laser chip caused by a large current in an unexpected situation. The driver also has a variety of protection mechanisms to maximize the security of the laser chip. The product is stable, reliable, and suitable for various QCL systems in university laboratories or R&D development.

Below are the product features:

- All-in-one module includes both current driver and temperature controller;
- Linear output to TEC greatly extends the Peltier device lifetime;
- Output protection mechanisms ensure the safety of QCL chip: adjustable current clamp, output ramp start, overvoltage and undervoltage protection, overtemperature protection and short-circuit output protection;
- Touchscreen UI is convenient for user operation and status monitoring;
- It is easy to set up and fully compatible with HealthyPhoton's QCL emitter module (HPQCL-Q).



Figure 1. QC750-Touch

2. Specifications

Table 1. Specifications

Current Drive	
Driving current	0 - 750mA
Current drift (24hr @25°C)	<1mA
Max bias voltage	>15V
Current noise	<3uA
Analog modulation bandwidth	DC – 1MHz
Slow start time	3-4s
Current noise density (1kHz~100kHz@500mA)	<2 nA/(Hz) ^{1/2}
TEC temperature controller	
Max TEC driving current	±4A
Max TEC driving voltage	6V
Max thermal power dissipation	48W
Temperature control range (fan cooling)	20 ~ 50°C (no condensation)
Temperature control accuracy	0.01°C
Temperature control stability	0.01°C
Temperature sensor required	10 kΩ, 20 kΩ NTC thermistors
Analog modulation	
Input resistance	2 kΩ
Modulation coefficient	100mA/V ±1%
3dB bandwidth	DC – 1MHz
Max input voltage	±2.5V
General specifications	
Power supply	220 VAC (176-265 V),60W
Work temperature	10 ~ 40°C
Storage temperature	-10 ~ 85°C
Digital output	RS232
Analog output	9-pin QCL emitter connector (cable included)
HMI interface	LCD touchscreen display and control, alarm, and historical data storage
Dimension (L*W*H)	21.4×15.4×5.9 cm ³
Weight	<2kg

3. Cable Interface

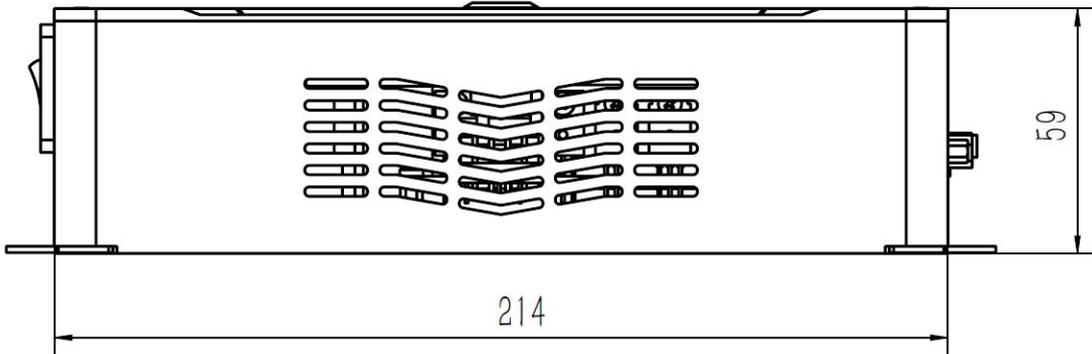


Figure 3.1. QC750-Touch front panel

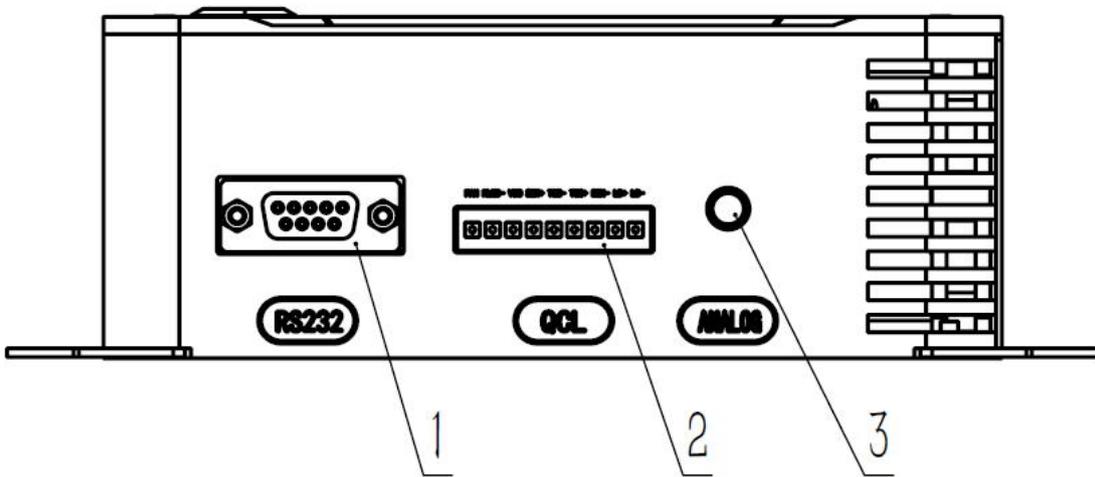


Figure 3.2. QC750-Touch right panel

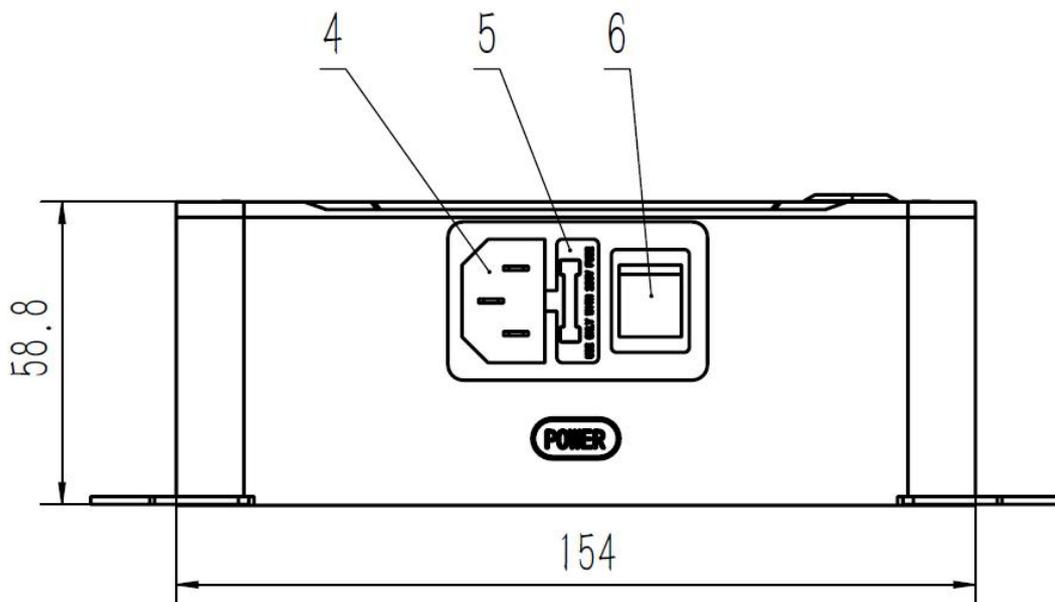


Figure 3.3. QC750-Touch left panel

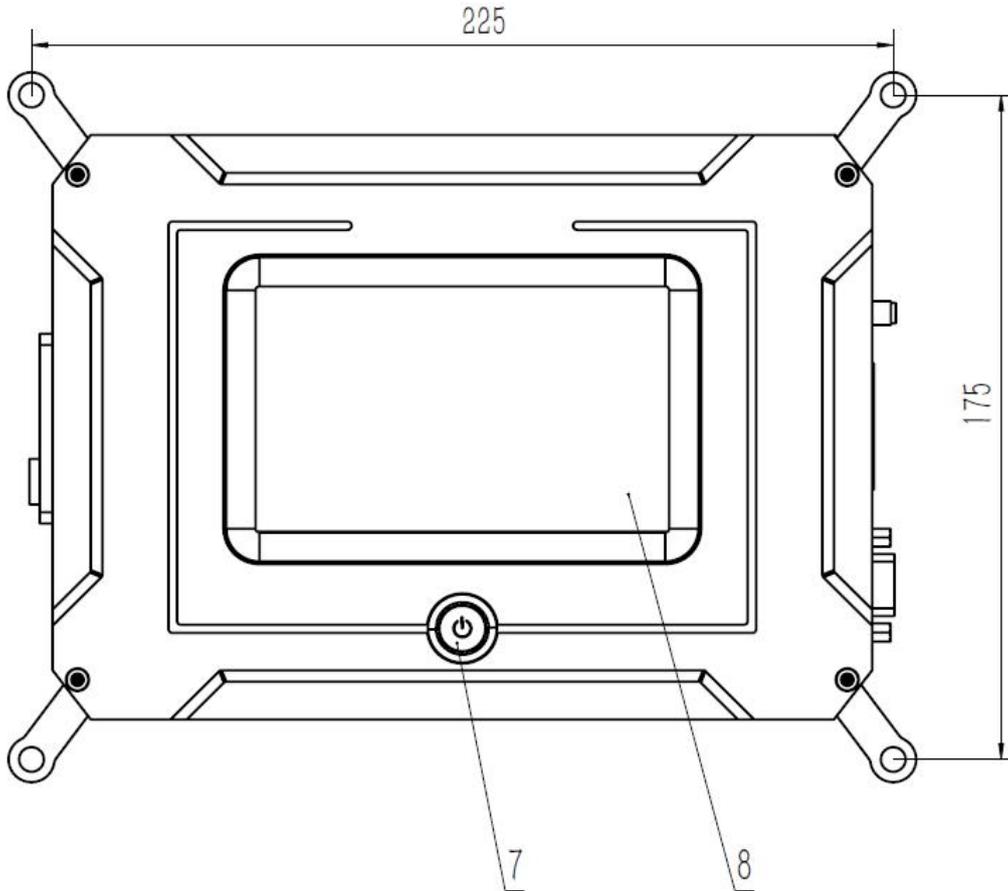


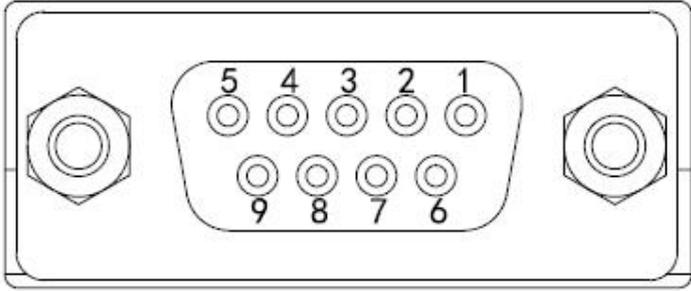
Figure 3.4. QC750-Touch top panel

Note: All dimensions are in mm.

Table 2. Port descriptions

PORT	NAME	DESCRIPTION
1	RS232	DB-9 female connector for RS-232 (Table 3)
2	QCL	9-pin female connector for the QCL (Table 4)
3	ANALOG	Connector (Table 5)
4	Power Connector	
5	Power Fuse	Current rating: 5A
6	Power switch	Note: The red button must be switched to "1" for power supply
7	Drive switch	Note: The indicator light turns blue when the driver is turned on
8	LDC	(Details are provided in Sec. 4)

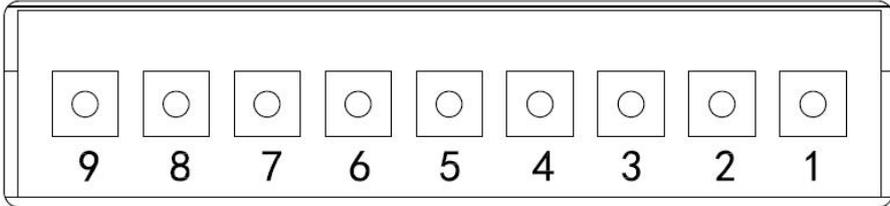
Table 3. RS232 pin diagram and specifications



1/4/7/8/9	No connection
2	RX_232
3	TX_232
5/6	Signal ground

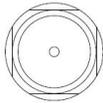
Table 4. QCL pin assignments

FAN RLED- VDD SEN+ TEC- TEC+ SEN- LD+ LD-



1	Laser cathode
2	Laser anode
3	Thermistor, 10 kΩ/20 kΩ
4	TEC (+)
5	TEC (-)
6	Thermistor, 10 kΩ/20 kΩ
7	+5V, RedBeam (+)\Fan (+)
8	RedBeam (-)
9	Fan (-)

Table 5. ANALOG pin specifications



	SMA connector
Input requirements	Frequency: DC-1MHz; Voltage: 0 ~±2.5V

4. User Interface

There are five pages in the UI: Main, Set, Log, Help, and System. The functionalities are described in the following subsections.

4.1 “Main” page

The page is used to turn on the laser and the guiding light. The laser current and TEC temperature can be set.

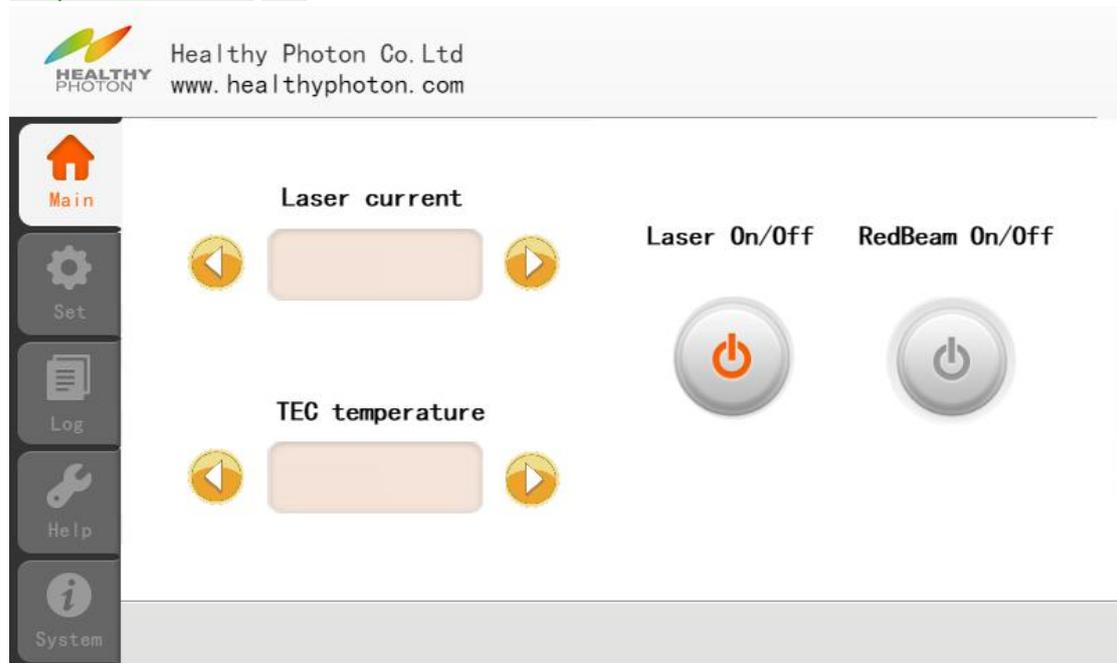


Figure 4.1.1. “Main” page

Descriptions:

- Laser current: Actual laser current reading.
- TEC temperature: Actual TEC temperature reading.
- ◀/▶ buttons: To fine tune the laser current and TEC temperature.
- Laser On/Off button: To toggle the laser diode current source between on and off. The button turns orange/gray when laser is on/off.
- RedBeam On/Off button: To turn guiding light on/off.

Operations:

After pressing the [Laser On/Off] button, you should see the message shown in Figure 4.1.2 Turn on the laser driver by selecting “Yes”.

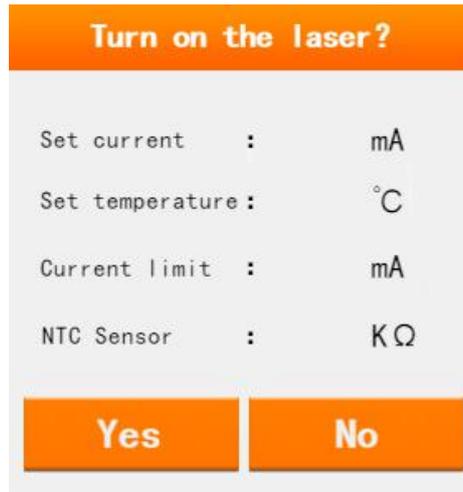


Figure 4.1.2. Dialog to turn on laser driver

4.2 “Set” page

The page allows user to set the important parameters and view the actual parameter values during operation.

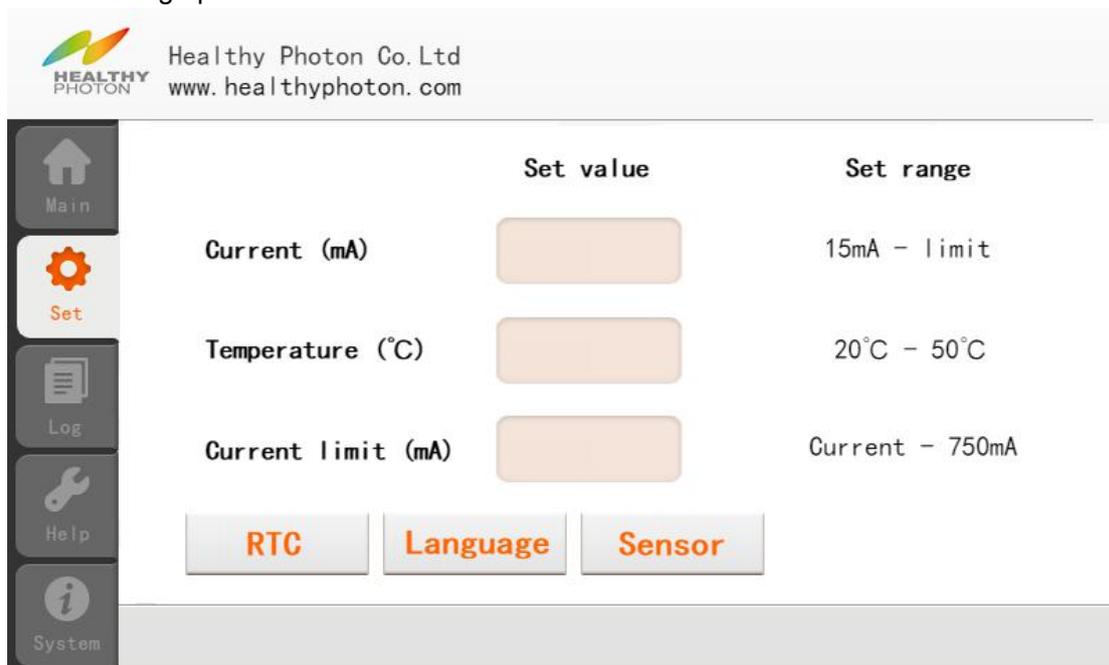


Figure 4.2. “Set” page

Descriptions:

- Set value: The column is used to set the values for laser current, TEC temperature, and the upper current limit for the QCL. Note that the laser driver will be unconditionally shut down if the laser current exceeds the limit. Table 6 describes the requirements for the parameters.

- Table 6. Parameter requirements

Parameter	Range
Laser current	<limit and >15mA
Temperature	20°C - 50°C
Current limit	<750mA

- Real Time Clock (RTC) Calibration: Press the [RTC] button to calibrate the current local time.
- Language: Press the [Language] button to select your preferred language.
- Sensor type: Press the [Sensor] button to choose the NTC sensor between 10 and 20 KΩ.

4.3 “Log” page



Figure 4.3. “Log” page

The alarm log page displays various error and status messages, such as over current and over temperature. Once an alarming message is sent, the laser current driver and TEC controller are turned off. Each item in the log includes the time, alarm types, and related parameters.

4.4 “Help” page

The page describes all the displayed items in UI. Refer to the page for any problem during operations.

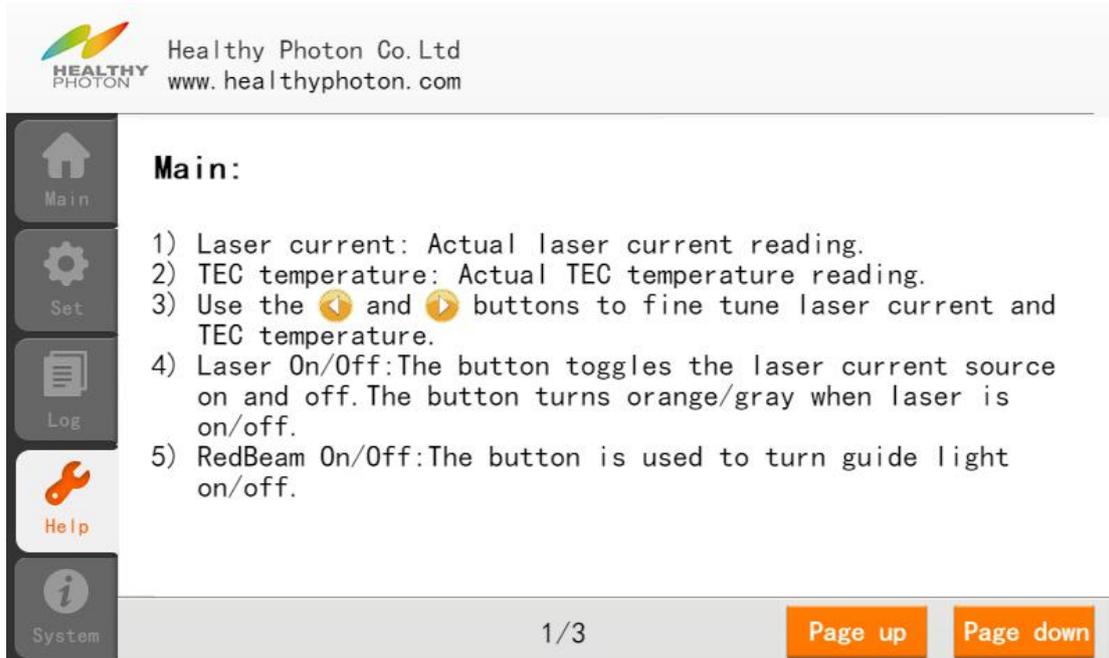


Figure 4.4. "Help" page

4.5 "System" page

This page displays the system information.

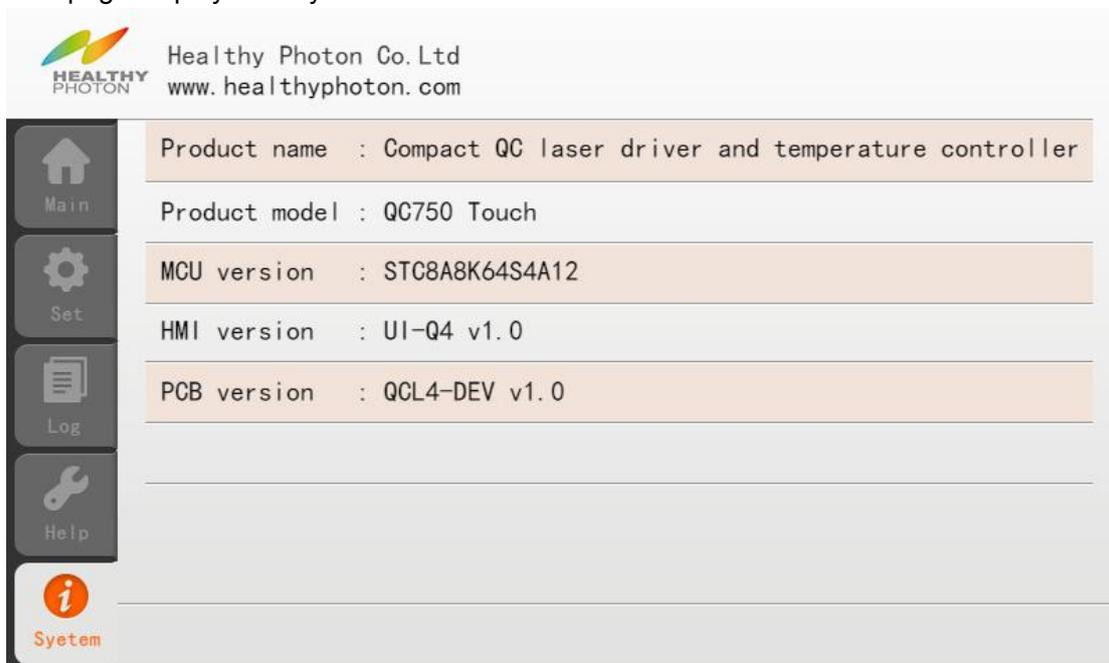


Figure 4.5. "System" page

5. Standard Operation Procedures

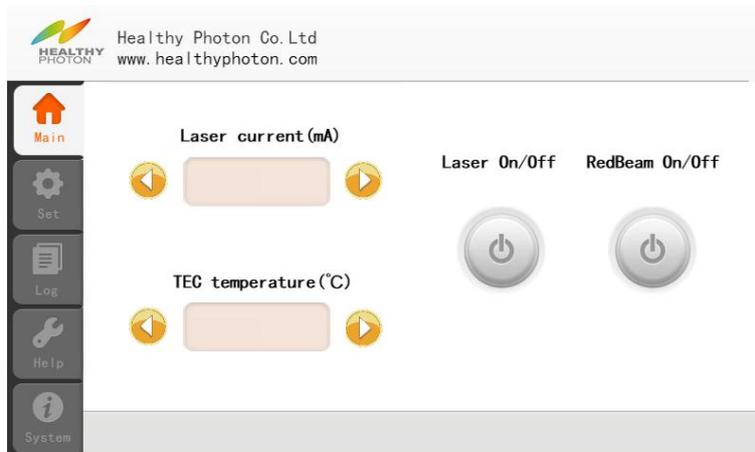
1. Preparations before use

1) Check the thermistor resistance. QC750-Touch only supports 10 K Ω and 20 K Ω NTC thermistors.

2) Check the power supply voltage and connection between QC750-Touch and the laser.

2. Turn on power

Press the power button and the indicator light turns red. Turn on the drive switch in the front panel and the switch button turns blue LCD display lights up and the following picture appears.



3. Confirm the NTC thermistor

Click the setting button as shown below:



Check whether the set value of NTC thermistor is the same as the thermistor used in the laser package. If they are different, click the Sensor button to choose the right thermistor. For example, press [OK] to switch the thermistor from 20 K Ω to 10 K Ω as shown in the following screenshot:



4. Laser settings and TEC settings

Click the input box on the right of the Current limit (mA) and enter the desired current limit for your laser. The laser current will be limited to this value at all times, including when adding analog modulation. The laser current and TEC temperature can be set in the same way.

5. Turn on the Laser and red light

Press the laser ON/OFF button in the main interface to turn the laser on. When the laser is on, the LASER ON/OFF button will turn orange. The red light will be turned on in the same way.

Caution

Note 1: Changing the current limit after turning on the laser will cause the laser to turn off.

Note 2: Forbidden to short the LD+ to LD- of the laser.

Note 3: Forbidden to short the TEC+ to TEC-.



Figure 5. Device connection

6. Appendix

6.1 RS232 Command List

This section defines the RS232 communications for control of QC750 Touch.
The baud rate setting is 115200 bps with 8 data bits and 1 stop bit (no parity bit).

Read command

Send package format			
ID	function code	register address	CRC16
1 byte	1 byte	2 byte	2 byte

Return package format					
ID	function code	register address	data length	data	CRC16
1 byte	1 byte	2 byte	1 byte	data length	2 byte

Note:

1. The ID is fixed as **0x88**;
2. The function codes and register address are shown in Table 7 and Table 8;
3. The data width of returned variables:
 - current and temperature are 4 bytes;
 - switch class is 1 byte.

The returned data value is 100 times of the variable itself. For example, **0x000121A3** which is equal to the decimal 74147, means the variable is actually 741.47. The returned switch value **0x00** indicates the switch is off, and **0x01** indicates the switch is on. When all items are returned, the returned data sequence is as shown in Table 8.

Example 1:

Return command **0x88 0x03 0x0001 0x04 0x00000D54 0x9DB9** indicates that the laser temperature is 34.12 °C.

Example 2:

Return command **0x88 0x03 0x0020 0x01 0x01 0x099B** indicates that the laser is on.

Example 3:

Return command **0x88 0x03 0x00FF 0x18 0x01 0x01 0x01 0x00 0x0000C63B 0x00000D90 0x0000C432 0x00000D92 0x0000EAAF 0xC8FB** indicates all data returned in sequence as follows:

Laser switch: on,

TEC switch: on,

Fan switch: on,

RedBeam switch: off,

Laser current: 507.47 mA,

TEC temperature: 34.72 °C,

Laser current setpoint: 502.26 mA,
 TEC temperature setpoint: 34.74 °C,
 Current limit: 600.79 mA.

Write command

Send package format for parameter setting*				
ID	function code	register address	data	CRC16
1 byte	1 byte	2 byte	4 byte	2 byte

* The send package is used for the parameter setting. Return package format is the same as send package.

Note:

1. The ID is fixed as **0x88**;
2. The function codes and register address are shown in Table 7 and Table 8.

Example:

Set the laser current to 741.47 mA: **0x88 0x10 0x0010 0x000121A3 0x2690**

Send package format for switch control*				
ID	function code	register address	data	CRC16
1 byte	1 byte	2 byte	1 byte	2 byte

*The send package is used for the switch control. Return package format is the same as send package.

Example:

Set the laser excitation source off: **0x88 0x06 0x0020 0x00 0x57DD**

Note:

The time range for data collection periods can be as short as one second or as long as 255 seconds.

Example1:

Specify the time range of one second: **0x88 0x06 0x0030 0x01 0x5711**

Example2:

Specify the time range of 255 seconds: **0x88 0x06 0x0030 0xFF 0x5711**

For the format of the returned data, please refer to Example 3 of **Read command**.

Table 7. Function Code Table

Function Code	Function
0x03	Read data and switch status
0x06	Control switch
0x10	Set parameters

Table 8. Register Address Table

Register address	Item	Function Code Compatibility
0x0020	laser switch	0x03,0x06
0x0021	TEC switch	0x03,0x06

0x0022	fan switch	0x03,0x06
0x0023	RedBeam switch	0x03,0x06
0x0000	laser current	0x03,0x10
0x0001	TEC temperature	0x03,0x10
0x0010	laser current setpoint	0x03,0x10
0x0011	TEC temperature setpoint	0x03,0x10
0x0012	current limit	0x03,0x10
0x0030	automatic data collection periods	0x06
0x00FF	all data	0x03

6.2 Additional technical notes

This section describes the following technical information:

- Passive and active interlock
- Firmware update
- Current soft clamping
- Square wave response

Passive and active interlocking

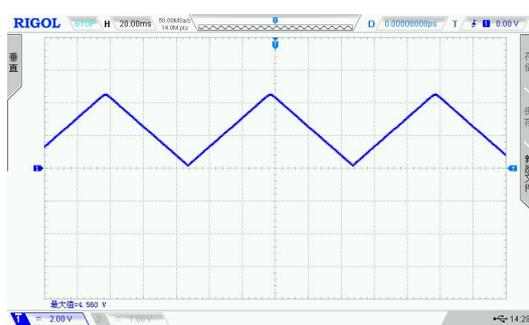
The driver has an active lock protection mechanism inside. When an unreliable external connection is detected, the drive circuit will be cut off immediately in order to protect the laser.

Firmware update

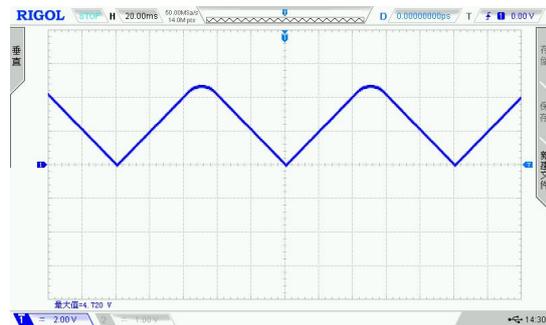
Contact us for the firmware updates.

Current soft clamping

A hardware circuit is specially designed to soft-clamp the current. The clamping current is 10% lower than the limit current. As shown in the figures below, the set limit current is 500 mA. When the clamping works, the current is clamped at 450 mA.



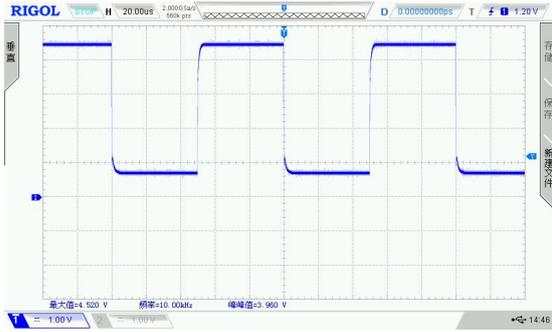
No clamping



With clamping

Square wave response

The following two figures illustrate the square wave response measurement of the driver at different modulation frequencies with a driving current of 450 mA and a load of 10 Ω.



Square wave response at 10 kHz



Square wave response at 340 kHz

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