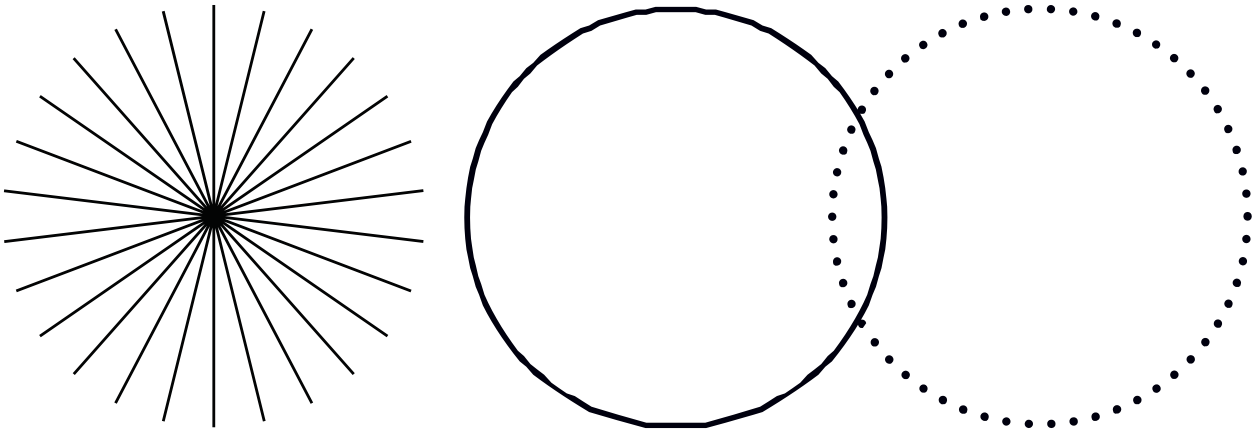
SureLock™ BT Series Mini-Benchtop Laser System

Operator's Manual



INNOVATIONS THAT RESONATE

COHERENT

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In the U.S.:

Should you experience any difficulties with your laser or need any technical information, please go to our web site www.Coherent.com. Should you need further assistance, please contact Coherent Technical Support by e-mail customer.support@coherent.com or telephone, +1-734-456-3100. Please be prepared to supply the model and laser head serial number of your laser system, the description of the problem, and any attempted corrective steps to the Product Support Engineer responding to your request.

Telephone coverage is available Monday through Friday (except U.S. holidays and company shutdowns). Inquiries received outside of normal office hours will be captured by our automatic answering system and will be quickly returned the next business day.

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TABLE OF CONTENTS

1 Safety Precautions

This instruction manual contains user information and instructions for the Coherent SureLock™ Mini-Benchtop Laser System.

Before use, please thoroughly read this manual. Pay special attention to the material in Section One: "Laser Safety". After reading, keep it together with the product for reference when necessary. Please retain all original packaging material in the event the unit is stored or shipped in the future.

For non-OEM applications, we recommend following safety protocols for Class 3B products according to latest ANSI Z136.1 Standard for the Safe Use of Lasers.

Use protective eyewear to eliminate potential eye exposure in excess of the maximum permissible exposure levels as stated in either ANSI Z136.1 or IEC-60825-1.

CAUTION – ***Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.***
The Classification Label on the Left side (facing Front Panel) of the unit contains information specifying wavelength and maximum emitted power.

1.1 Export Control Laws Compliance

It is the policy of Coherent to strictly comply with U.S. export control laws.

Export and re-export of lasers manufactured by Coherent are subject to U.S. Export Administration Regulations, which are administered by the Commerce Department. In addition, shipments of certain components are regulated by the State Department under the International Traffic in Arms Regulations.

The applicable restrictions vary depending on the specific product involved and its destination. In some cases, U.S. law requires that U.S. Government approval be obtained prior to resale, export or re-export of certain articles. When there is uncertainty about the obligations imposed by U.S. law, clarification must be obtained from Coherent or an appropriate U.S. Government agency.

Products manufactured in the European Union, Singapore, Malaysia, Thailand: These commodities, technology, or software are subject to local export regulations and local laws. Diversion contrary to local law is prohibited. The use, sale, re-export, or re-transfer directly or indirectly in any prohibited activities are strictly prohibited

1.2 Explanation of Warning Symbols

This documentation may contain sections in which particular hazards are defined or special attention is drawn to particular conditions. These sections are indicated with signal words in accordance with ANSI Z-535.6 and safety symbols (pictorial hazard alerts) in accordance with ANSI Z-535.3 and ISO 7010.

Warning messages are intended to prevent accidents to operating personnel such as burns and electrical shocks.

1.3 Signal Words

Three signal words with color-coded call outs are used in this documentation: **WARNING!**, **CAUTION**, and ***NOTICE***.

The signal words **WARNING** and **CAUTION** designate the degree or level of a hazard when there is a risk of user injury:

WARNING!
Indicates a hazardous situation that, if not avoided, could result in serious injury to eyes and/or skin.

CAUTION
Indicates a hazardous situation that, if not avoided, could result in minor to moderate injury to eyes and/or skin.

The signal word **NOTICE** is used when there is the risk of product or property damage:

NOTICE
Indicates information important to take special note of, but is not hazard-related.

1.4 Symbols

The signal words **WARNING**, and **CAUTION** are always emphasized with a safety symbol that indicates a special hazard, regardless of the hazard level:

This symbol is intended to alert the operator to the presence of highly-important operating and maintenance instructions.

This symbol is intended to alert the operator to the danger of exposure to hazardous visible and invisible laser radiation.

This symbol is intended to alert the operator to the danger of Electro-Static Discharge (ESD) susceptibility.

This symbol is intended to alert the operator to the presence of additional important information.

2 Laser and Operational Safety Precautions

2.1 Laser Safety

Laser light, because of its special properties, can cause safety hazards not present in light from typical sources. The safe use of lasers requires that all laser users and all persons near the laser system understand the possible dangers. The safe use of the laser depends on the operator understanding both the instrument, and the properties of coherent laser light.

While all of the laser light produced by the Mini-Benchtop is highly divergent ('spreads out' quickly from the Output Aperture) and is solely designed to be positively coupled into a delivery fiber via the FC connector, the laser output, nonetheless, can be hazardous when the 'Safety Shutter Cap' is removed and the output is directed toward the eyes.

WARNING! – ***Direct eye contact with the laser output from the unit can cause both injury to the eye and damage to vision. This can be true even more-so with wavelengths that are not 'visible' to the naked eye, but may be more readily absorbed by ocular tissues and/or the skin (i.e.: 1064 nm). Therefore:***

Never direct the laser output into or even at the eyes, nor place the output in direct contact with skin. Never use the eyes to 'verify' laser emission, gauge power levels, or evaluate 'Fiber-tip cleanliness' while the laser is operating.

2.2 Optical Safety

Because laser light can maintain a high degree of coherence when reflected off highly polished or mirrored surfaces (and at higher powers, can still be a hazard at certain wavelengths even when 'scattered'), it is highly recommended to establish a set of 'Best Practices' for the operational area, lab, etc.,regarding optical safety when using lasers. Follow these precautions at a minimum:

1. Follow all safety precautions detailed in this manual.
2. Limit laser access to qualified users who are familiar with the associated hazards, understand basic laser safety practices, and will adhere to protocols.
3. Operate the laser in a room with controlled and restricted access, and always post proper caution signage in the area of the laser operation.
4. Never introduce reflective-surface instruments (i.e.: hemostats or chromed alignment tools) into the laser output without proper attenuative eyewear.
5. Additionally, if laser output needs to be 'de-coupled' from the end-point or instrument, DO NOT wear items with reflective surfaces (i.e.: a watch or jewelry) while handling the delivery fiber and laser emission is occurring.
6. Keep experimental setups at low heights to prevent accidental exposure near or at eye level.
7. As a protection against accidental eye exposure to laser output or reflections from the unit, all users should wear approved laser safety eyewear appropriate for the wavelengths and power levels being generated. ***Note special caution on eyewear on the next page.***

CAUTION – ***Laser safety eyewear can be both a benefit and a hazard. While glasses or goggles protect the eyes from possible damaging-levels of exposure, they can also hinder the user from clearly seeing the propagation of the output (the 'beam'). Additionally, care must be taken to choose room/lab, enclosure, and/or work-area Emission Indicator colors that are not also blocked by the eyewear's wavelength-attenuation (i.e.: eyewear that blocks near-IR wavelengths might also dim the visibility of a 'red' LED or lamp-based indicator). Thus, always use extra caution when wearing laser safety eyewear.***

2.3 Electrical Safety

While the Mini-Benchtop system does not operate on hazardous levels of AC or DC voltages to power the unit, care must be taken with the rear-side 'Terminal Block' interface, as some pins (i.e.: 5, 6) will have active DC voltage present at the terminals when the unit is plugged in via the DC 'Power jack' and powered on. Care should be taken to not allow any conductive debris (i.e.: metal shavings from a milling-machine or other-such industrial / manufacturing environment) to 'short' these pins, as damage may occur to the unit, and subsequently void its warranty. Likewise, care should be taken to not allow any liquid or solvent to contact these pins while unit is operating as this could result in a short circuit and damage to the system.

CAUTION – ***Electrostatic charges as high as 4000 volts easily collect on the human body and equipment and can discharge without detection. Although the electronics in the unit feature substantial input protection against electrostatic discharge (ESD), permanent damage can occur on devices subjected to high levels of ESD. The most common ESD damage occurs when handling the device during installation (i.e.: connecting wired connections to the Terminal Block interface with the unit placed on an un-earthed (grounded) surface while the Main Power switch is left 'On', etc.)***

Take special precautions and/or install shielding for work areas or other settings where dry air and carpet are common (i.e.: onsite customer demonstrations or trade show exhibitions, etc.) since such environments create a higher potential for ESD. Proper ESD-safe workstations and working protocols are highly recommended to prevent system-performance degradation.

2.4 Safety Features for Compliance with U.S.21 CFR

The Mini-Benchtop Laser System complies with the United States Code of Federal Regulations (CFR) 21 CFR 1040.10 and 1040.11, except for deviations pursuant to CDRH (Center for Devices and Radiological Health) Laser Notice 50, dated July 24, 2007. The laser system is harmonized with both CDRH and International Electrotechnical Commission (IEC) 60825-1 standards, as a Class 3B (or, IIIb) laser product, and it may emit Visible or Invisible Laser Radiation in wavelengths from 0.4 to 1.064 µm from the output aperture in the front.

The required Classification, Warning Logotype, Aperture, and Information labels are permanently affixed to (or screen-printed on) the housing, along with the Model Number, a unique Serial Number, Date Manufactured, and the units' maximum Output Power and Wavelength. Additionally, the wavelength is also found in the Model Number-graphic on the Top-cover label, which also seals the cover completely and prevents easy access to the fasteners.

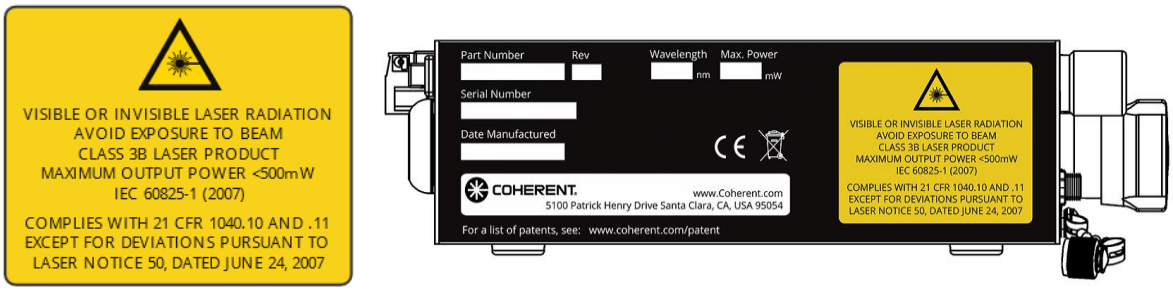


Figure 2.4-1: IEC-style Classification / Warning Logotype, and Manufacturer / Product-info Label, and Location illustration of left-side (facing the front panel) of the unit.

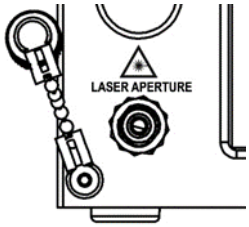


Figure 2.4-2: Warning Logotype and Laser Aperture graphic, just above the output aperture on the front of the unit. The 'Safety Shutter-Cap' is also illustrated (shown un-capped).

The Regulations-compliant safety controls include a 'lockout' Keyswitch, (key non-removable when 'On') a dual-function Laser On/Off Button / Emission Indicator, which features a 'white' LED (to enable use of wavelength-tuned laser safety eyewear) a Touchscreen LCD Control display, which features laser-emission status, power level and 20-second, emission-delay 'countdown' messages. The prominent 'mushroom-head' style Front-panel Emergency-Stop button instantly terminates all laser emission, and ties into the rear-side Terminal Block interface, to enable Remote Interlock connections (i.e.: lab door, enclosure, or instrument interlocks, etc.)

In addition, the FC fiber coupler, serving as the Output Aperture on the front, features a permanently affixed, threaded 'Safety Shutter-Cap,' secured to the unit on a short 'pull chain,' which aids the user in preventing accidental laser exposure prior to inserting and securing the working fiber.

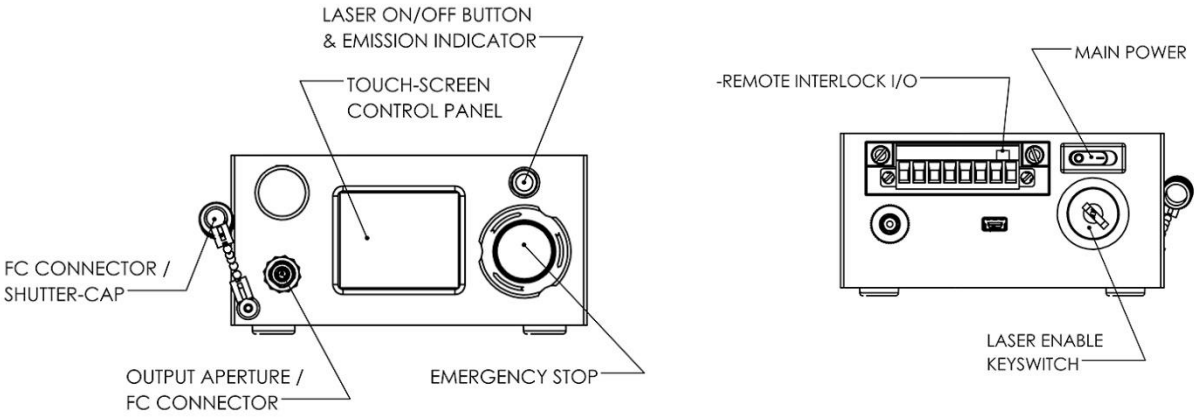


Figure 2.4-3: Overview of the Regulations-compliant Safety Features

3 Description and Specifications

3.1 System Description

The Mini-Benchtop is an ultra-compact, rugged, and easy-to-use turnkey Laser System solution, incorporating a Coherent SureLock™ laser diode, wavelength-stabilized by a Coherent PowerLocker® Volume Holographic Grating (VHG), which ensures precise, ultra-stable center wavelengths, low temperature dependence, and consistent optical performance over the locked region. The Mini-Benchtop is perfect for OEM, Lab, or Raman spectroscopy applications.

The Mini-Benchtop includes the laser diode, pre-locked to one of several available wavelengths (selected by the user when the unit is ordered) current and temperature-stabilization electronics, both manual and software terminal-based controls, a touchscreen interface, and an FC fiber output coupler in the front panel, with a dust-blocking / safety shutter-cap. An optional jacketed-fiber cable with either FC/PC end connector for multimode source or FC/APC for single mode sources is available.

Front view **Rear view**

Figure 3.1-1: Front and rear views of unit

Figure 3.1-2: Standard Package includes Accessories

3.2 Specifications

OPTICAL	
Center Wavelength (nm)	Typical 638, 785, 830, 976, 1064
Center Wavelength Tolerance (nm)	±1
Output Power (Max, mW)	Configuration dependent. Typically, 350 or <500 for multimode sources.
Warm-up Time (min)	< 1
Fiber-size (recommended)	Configuration dependent. Typically, 105 µm core/ 900 µm jacket for multimode sources.
Fiber-connector	FC / PC for multimode. FC/APC for single mode
ELECTRICAL	
Input Voltage	90-240V AC, 50-60 Hz
Operating Voltage	5-12V DC
Operating Current	1 A
MECHANICAL	
Laser Dimensions (LxWxH)	150 mm x 105 mm x 50 mm (5.91 x 4.13 x 1.97 in.)
Weight	< 1 kg (2.2 lbs)
ENVIRONMENTAL	
Ambient Operating Temp (C)	+10º to +40°
Storage Temperature (C)	-20º to +60°

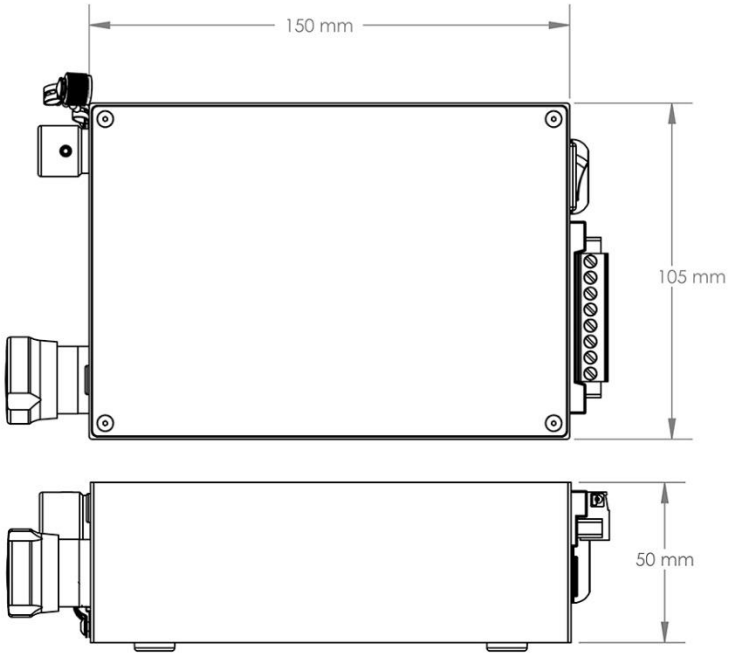


Figure 3.2-1: Mechanical Illustrations with Dimensions

3.3 Simplified interlocks block-diagram

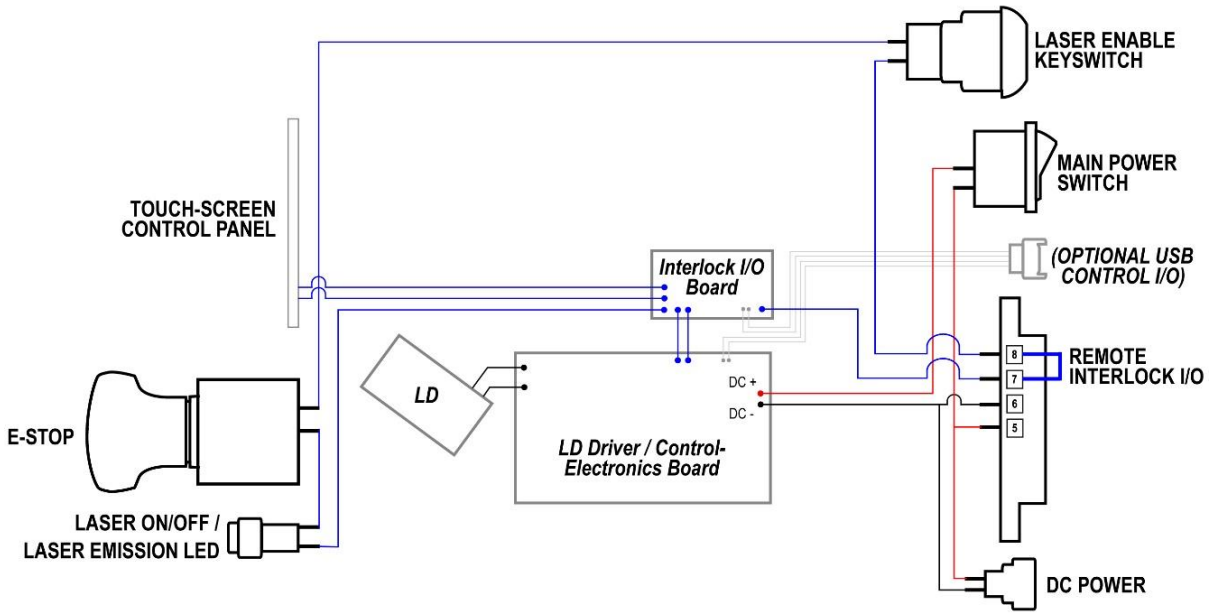
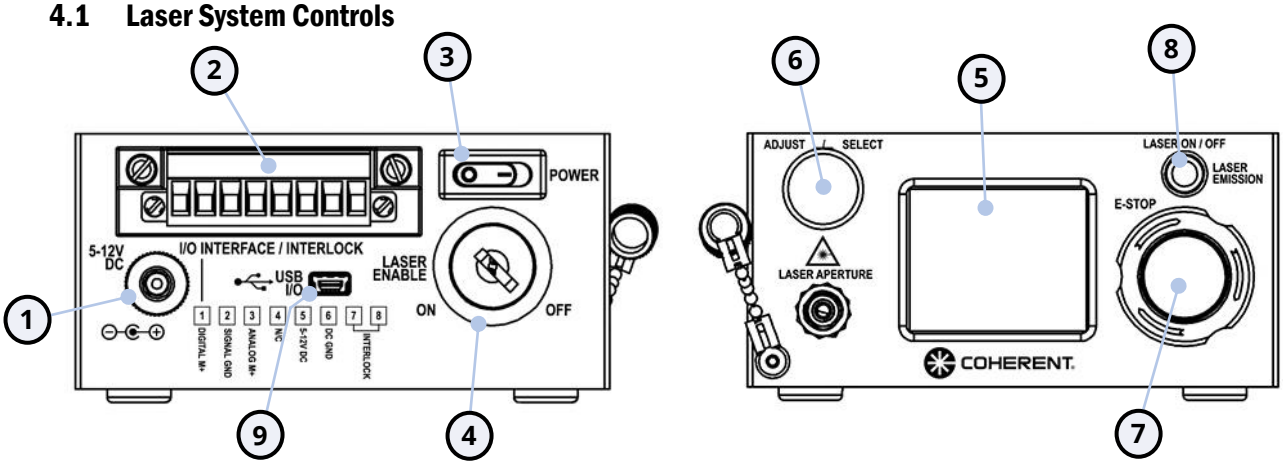


Figure 3.3-1: Simplified Interlocks Block Diagram

4 Controls, Indicators, and Features

4.1 Laser System Controls



Rear Panel **Front Panel**

① - DC Power Input Jack
② - Wired-DC Power, Modulation Signal Inputs, and Remote Interlock I/O Terminal Block
③ - Main Power On/Off Switch
④ - Laser Enable / Lockout Keyswitch
⑤ - LCD Touchscreen Control Panel
⑥ - System Settings Adjust / Select Knob
⑦ - Emergency Stop Button
⑧ - Laser On/Off Button and Emission Indicator
⑨ - USB 'Mini-B' I/O for optional API / Terminal-program Control

Figure 4.1-1: Laser System Controls and Signal I/O Connections

- DC Power Input Jack
- Wired-DC Power Modulation Signal Inputs, and Remote Interlock I/O Terminal Block. (See Terminal-Block Pin-out Table (Figure 4.1-2, page 14)
- Main Power On/Off Switch: This switch is located on the Rear Panel above the Keyswitch, and turns on the Main Power to the unit.
- Laser Enable / Lockout Keyswitch: This key-switch is located in the Rear Panel and is a necessary part of the interlock / safety-circuit. When activated, the system initiates a 20-second 'countdown' delay before laser emission can occur, also a necessary part of the safety controls. Key is non-removable when On (for compliance with 21 CFR and IEC 60825-1) and conveniently removable when Off, to allow the user to 'lockout' the system, which enhances laser lab safety protocol considerably.
- LCD Touchscreen Control Panel: The LCD touchscreen control panel is located prominently in the center of the Front Panel, and features laser On/Off control and status, feedback on Interlock-circuit status, laser emission-delay countdown, and relative power levels displayed as a percentage of total power available.

  It also allows for custom configuration of some 'advanced' system features (via the 'Main Menu' button) which is passcode protected to prevent any accidental or unauthorized changes. ***See Section 5 ("System Operations") for passcode and special cautions on using this specific feature***.

- System Settings Adjust / Select Knob: This dial varies the laser output power, and when in 'Menu-mode' (see above) allows user to select / assign desired settings to memory.
- Emergency Stop Button: This Front Panel 'E-Stop' instantly stops laser emission when pressed in. The button will remain depressed (and laser emission disabled) until manually 'resetting' via a ¼-rotation clockwise of the button, waiting the 20-second 'safety delay,' and pressing the Laser On/Off button. (see below) – where, exactly? (need a page and/or reference to a figure)
- Laser On/Off Button and Emission Indicator: This Front Panel control activates (or terminates) laser emission immediately, once all Interlocks are satisfied, (including the Keyswitch, 'On', and E-Stop 'out') and 20-second 'safety delay' countdown is complete. This button also serves as the front-panel Emission Indicator, and is only 'lit' when the unit is actually lasing.
- USB 'Mini-B' I/O for optional External API / Terminal-program Control.
- A 'virtual' serial port is formed by the internal controller when connecting the unit to a PC using a standard USB to Mini-B cable.

① - Digital Modulation Positive (+) Input
② - Modulation Common (GND)
③ - Analog Modulation Positive (+) Input
⑤ - Wired 5-12V DC Positive (+) Input
⑥ - Wired DC Ground (-)
⑦ - Remote Interlock OUT
⑧ - Remote Interlock RETURN

Figure 4.1-2: Terminal Block DC Power (wired), Modulation Inputs, and Remote Interlock I/O

Note: Special Caution for Pins 5 & 6 detailed in Section 5 "System Operations"

4.2 Laser Safety Indicators

The Mini-Benchtop utilizes three types of indicators to communicate the System Status: 1. Powered On (but laser emission is disabled), 2.Powered On and Ready to lase, and 3. Powered On, and actively Emitting laser light. Section 5, Figure 5.2-2, highlights these indicators and their location on the unit.

4.3 Additional Features

- Robust ESD Protection
- Relative Power Display (% relative to Total Power available)
- Return to last used operating conditions after power loss / Off
- Passcode-protected 'Sub-Menu' for advanced operating parameter adjustments and system controls

5 System Operations

5.1 Setting Up The System

After unpacking the unit, read this Manual, and familiarize yourself with the system / controls. Select a location for the unit that addresses both the ESD, laser safety precautions, and will also provide the unit ambient operating temperatures within specified specifications.

Prior to connecting power to the unit and powering it on for the first time, it is highly recommended to connect a delivery fiber – first to the unit, then positively terminate that fiber into the end instrument, etc. This 'all-connections-made-first-before-powering-on' protocol ensures maximum safety with laser emissions.

Prior to connecting a delivery fiber to the Front Panel FC connector, clean the connector and the delivery-fiber tip according to the instructions detailed in the Appendix. This ensures both the connector and delivery-fiber tip are free of dust / debris, avoiding poor performance or possible damage to the unit.

NOTICE - ***Damage to fiber optic receptacle is not covered by Warranty. It is strongly recommended to clean both the FC connector, and the delivery-fiber tip before use. Please review Appendix A-1 for recommended equipment and procedures for cleaning.***

Connect any planned Remote Interlock tie-ins (i.e.: lab door, project-enclosure, instrument or external-system door-interlocks, etc.) to the Remote Interlock Inputs (Pins 7, 8 – See diagram, Figure 4.1-2) and verify tight connections and external-circuit continuity. Additionally, ensure that any part of the Interlock circuit is electrically isolated and ***not*** tied to 'Earth Ground', or any Earth grounds found in equipment chassis.

CAUTION – ***The unit is shipped with the Remote Interlock pins shorted with a wire 'jumper' as the default state. Laser emission will occur when all other laser controls in the Interlock circuit (i.e.: Keyswitch, 'On', E-Stop, 'out') are satisfied, and Laser On/Off button is pressed. Ensure that all safety protocols are in place, and laser output is positively terminated and coupled by delivery fiber.***

Connect any external modulation sources to the appropriate Input pins on the Terminal Block (as per Figure 4.1-2). Modulation-source voltages (both TLL and/or Analog) should be at or below 5V DC maximum to ensure proper performance of the system, and to avoid damage to system-control electronics. Ensure Modulation signal sources are at 'zero' (not signal High) prior to turning the unit on.

Connect the provided AC/DC adapter Power Adapter to wall-plug power and plug in to the DC Power jack on the Rear Panel of the unit. If utilizing the optional 'hard-wired' DC-inputs, found on Terminal Block Pins 5, 6 *(as-per Figure 4.1-2),* ***take note of special caution on page 16.***

CAUTION – ***Never connect both DC Power Adapter plug into the Power Input jack, and hardwired DC into Terminal Block inputs at the same time, as damage to the unit may occur, and void its Warranty. Only one input is to be connected at any time. Also, take note of the Cautions in Section 2.3 (never allow any liquids or other conductive debris to short across wired-DC pins, and take special precautions to ensure ESD does not occur into any of the Terminal Block input pins.***

The unit should now be ready for Operation so, once again, ensure all laser safety protocols are in place (i.e.: room interlocks, caution signage in place, external emission indicators ready, etc.) and working environment is stable, secure, and free from external distractions.

5.2 Powering On and Operating the Unit

1. Switch the Main Power toggle switch to the 'On' position (towards "Power" text) and verify on Front LCD Touchscreen that the "Coherent" Logotype and Name are displayed while it initializes. The Main Startup Screen by default displays the last used power setting expressed as a % of Total-power available (i.e.: "10%", etc.). The laser emission status is noted on the right side of the screen. The unit requires <1 minute to initialize. However, it is recommended to allow an additional 3 minutes to achieve optimal stabilization.

Figure 5.2-1: Coherent Logotype 'startup-screen' displays during system initialization

2. Insert one of the provided System Keys into the "Laser Enable" keyswitch on the Rear Panel and turn clockwise to the "On" position. Depending on the state of the emergency button, the touchscreen control panel on the front may indicate "Check Emergency Button!" in a red bordered alert box at the bottom of the screen.
3. If emergency stop button is activated, turning the E-Stop button ¼-turn clockwise will pop out the button and allow the laser to initialize with 20-second, safety-delay countdown, displayed at the bottom of the screen.
4. Press the Laser On/Off button / Emission Indicator on the Front Panel, above the E-Stop, to immediately enable or disable laser emission. Note there are no further delays given all Interlocks are now satisfied.
5. Alternatively, the "Laser ON" box at the upper-right corner of the Touchscreen may be used to initiate laser emission. Note that using this 'touchscreen-button' will initiate a brief 3-second delay unlike the instant on/off control of the physical On/Off button.

6. The Laser Emission indicator will illuminate white, and the Touchscreen display will also indicate laser emission by turning the white border around the "Laser ON" status box, to green. The system is now emitting laser light into the connected delivery fiber.
7. The dual-function 'Adjust / Select" knob on the Front Panel may be used to adjust the laser output power. The Touchscreen display will show 'relative power' (expressed as a % of Total-power available, ie: "10%", etc.).

LCD Control Panel, indicating status of Remote Interlock I/O,and/or Keyswitch is disabled. Thus, no laser emission can occur until those controls are satisfied.

LCD Control Panel indicating both Remote Interlock I/O and Keyswitch are satisfied, but the E-Stop is not. Thus, no laser emission can occur until that control is also satisfied.

Green 'color-band' exposed on E-Stop indicating emission can occur when all laser controls are activated and all other interlocks are satisfied.

Laser On/Off Button / Emission Indicator-LED, lit, indicating all interlocks are satisfied, laser "ON" controls have been activated and laser emission is occurring.

LCD Control Panel, indicating all interlocks are satisfied, laser "ON" controls have been activated, and laser emission will occur after the 20 second delay has counted out.

All Front Panel indicators active, indicating all interlocks are satisfied, laser "ON" controls have been activated and laser emission is occurring.

Figure 5.2-2: System Safety / Status Indicators and Messages

For shut-down, simply press the Laser On/Off button again (or, the "Laser OFF" button on the Touchscreen display) to instantly terminate all laser emission. Alternatively, the E-Stop may be pressed 'in,' or the Laser Enable key may be turned counter-clockwise to the 'Off' position. Remove key to 'lockout' the system and store in a safe location to prevent unauthorized use.

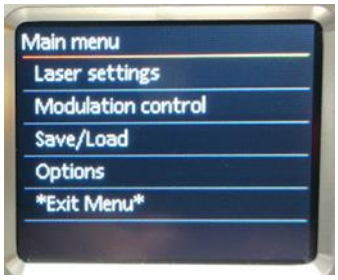
NOTICE *- Power will continue to be fed to the Thermo-Electric Cooler (TEC) inside the unit while Main Power switch is left in the 'On' position. It is recommended that the unit be switched fully Off when left in a non-lasing state for extended periods of time. Simply having DC power connected to the unit (with the Main Power switch Off) does not pose any concern for the unit.*

5.3 Advanced Features and Controls

The "Main Menu" button on the LCD Touchscreen provides access to laser diode current parameters and other advanced system features and controls. These sub-menus and screens are password protected to prevent accidental or unauthorized changes. The passcode is 1979. The advance menus are subject to change and this manual may not thoroughly reflect those changes. ***See Notice, below***.

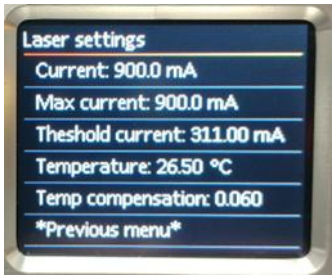
NOTICE *- It is strongly recommended to contact your Coherent Sales Rep for guidance in using these Menus, as incorrectly used values in certain settings can permanently damage the laser diode, which is not covered by Warranty.*

Pressing the "Main Menu" button in the lower-right corner of the LCD Touchscreen will call up a 'Passcode prompt.' See your Coherent Rep for menu-specific guidance before attempting to access and use these features. Note that once password is used to advance the menu system, the deeper-level sub-menu navigation and elections may be initiated by touch or by using the dual-function "Adjust / Select" knob on the Front Panel.



1. Main Menu / Sub Menus:

Laser Settings
Modulation Control
Save/Load Settings
Options
Exit Menu



2. Laser Settings:

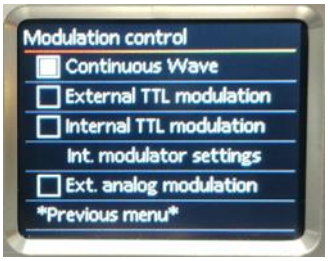
Current: ***Displays the 'current' diode-current value***

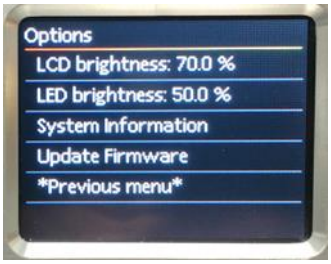
Max Current: ***Defines and sets the "100%" set-point value***

Threshold Current: ***Defines and sets the "0%" set-point value***

Temperature: ***Defines and sets the diode-temperature via adjusting the TEC set-point***

Temp Compensation: ***Internal, factory-set value***





Modulation Settings:

Continuous Wave (CW): ***Default setting to operate CW with no modulation.***

External TTL: ***Enables the laser to be modulated via external TTL Low/High signals, through the "Digital Modulation Input" Pins 1, 2 of the Terminal-Block (see Figure 4.1-2) Digital "High" is 2-5V DC, 100 KHz max rate.***

Internal TTL: ***Enables the laser to be modulated via internally- driven, user-variable TTL signal.***

External Analog: ***Enables the laser to be modulated via an external Analog signal, through the "Analog Modulation Input" Pins 3, 2 of the Terminal-Block (see Figure 4.1-2).***

Save / Load Options:

Save Settings: ***Saves current settings as the default for next Power-on cycle. Note: Use of this function will replace all 'as-shipped' settings. Note all as-shipped settings before using this feature.***

Load Saved Settings: ***Loads user-configured / saved settings as the 'current set' upon start-up.***

Restore Factory Defaults: ***Resets-unit to factory-defaults Note: Contact your Coherent Sales Rep prior to use, as the "factory-defaults" may differ from 'as-shipped' settings.***

Auto-save Power: ***Enables unit to boot into last-used Power-setting (vs. the default of 100%).***

Additional Options:

LCD Brightness: ***Allows user-variable levels for LCD-screen brightness.***

LED Brightness: ***Allows user-variable levels for the Laser Emission LED in the Laser On/Off button on the Front Panel, above the E-Stop.***

System Information: ***Simple info pop-up that displays the system Firmware Rev. and unit Serial Number.***

Update Firmware: ***To be used by factory / Coherent Service Techs only!***

Figure 5.3-1: Advanced features and Controls found under the "Main Menu"

6 External System Control

6.1 Modulation

NOTICE *- While the Mini-Benchtop System can operate under Modulation (via Digital (TTL) or Analog Modulation inputs on the Rear Panel Terminal Block, (See Figure 4.1-2) the unit is shipped operating in 'CW' mode. Suitable operation of wavelength stabilized lasers in modulated modes is application dependent. Contact your Coherent Sales Rep for more information and guidance if you are planning to use the unit under Modulation.*

6.2 External Control Via The USB Port

The Mini-Benchtops' Rear Panel USB 'Mini-B' I/O port is to control the laser from a computer operating a terminal or software program. A virtual serial port is formed by the computer when connecting the unit to a PC using a standard USB to Mini-B cable.

CAUTION – ***Never attempt to 'power the unit' via the USB port – it is not an 'alternate' power input! Damage or unexpected laser radiation may occur with commands sent outside the described protocol.***

Each controller in the unit is shipped from the factory with a fixed comm-speed of 9600 baud, which cannot be changed. The other serial port parameters are:

- Data Bits: 8
- Stop Bits: 1
- Parity: None
- Flow-control: None (Note: hardware flow-control is not supported)

Under no circumstances will the controller initiate a handshake, as it can only reply to commands that are queries. In the event the controller receives a message it cannot interpret, it will not respond.

Each command to the controller must be terminated by a carriage return and line feed pair (ASCII 13 followed by ASCII 10). Note that all commands are case sensitive. Command arguments are immediately followed by the parameter without spacing.

Command	Parameter	Response	Units	Description
slcv	XXX.X		mA	Set laser current
rlcv		XXX.X	mA	Read laser current setpoint
rlmc		XXX.X	mA	Read measured laser current
sltv	XXX.X		degC	Set laser temperature setting
rltv		XXX.X	degC	Read laser temperature setpoint
rlmt		XXX.X	degC	Read measured laser temperature
sgen1				Enable laser
sgen0				Disable laser
rgen		1 or 0		Read enable laser state
sgmd1				CW mode (TTL mode off)
sgmd2				External TTL Mode
sgmd3				Internal TTL Mode
rgmd		1,2 or 3		Read TLL mode

sgma1				Enable external analog modulation
sgma0				Disable external analog modulation
rgma		1 or 0		Read analog modulation mode
slcm	XXX.X		mA	100% current setpoint
sltc	XXX.X			Set temperature compensation value
rltc		XXX.X		Read temperature compensation value

Figure 6.2-1: Command formatting and Termination characters

Example Commands:

slcv123.1

(sets laser current to be 123.1 mA)

rlmc

(responds 900.0 = 900mA)

***NOTE*-Settings entered via terminal are not automatically stored in the unit's memory to be used after a power cycle. To preserve terminal driven settings, use the 'Save Settings' option in the sub-menu on the LCD Control Panel.**

7 Maintenance And Troubleshooting

7.1 Maintenance

The Mini-Benchtop was carefully engineered and crafted to provide many years of superior reliability and performance, with an absolute minimum of user maintenance. Maintenance is limited to external cleaning of the surfaces. Note: use of solvents or any other liquids to clean the unit are not recommended! A dry, lint-free lens-cleaning-type cloth is all that is recommended or should be needed. For the fiber-connector, follow the instructions found in Appendix 10.1.

Nonetheless, the following suggestions / precautions will aid in maintaining the unit in a trouble-free state of operation and at peak performance:

- ***The instrument is vibration sensitive. Handle with care. Do Not Drop. Permanent damage can result if subjected to extreme shock or vibration.***
- ***Do not operate the unit at extreme temperatures or humidity. Adhere closely to all operational Cautions and Warnings listed herein.***
- ***Only use supplied AC/DC power supply or a power supply strictly adhering to the Specifications listed herein.***

DO NOT open the unit's enclosure or attempt to disassemble it for any reason! There are no user-serviceable components inside. Operate all units only as-assembled. The Warranty will be voided if the enclosure is opened and may even expose the user to hazardous levels of laser radiation.

7.2 Troubleshooting

If the Mini-Benchtop system appears to be operating incorrectly or producing low power prior to calling into Coherent for service, please carefully check:

- Closely inspect the unit for dings, dents, or other signs of damage due to handling (i.e.: obviously having-been dropped, etc.)
- Verify that the enclosure has not been opened and the factory-sealed, product-graphics label is intact.
- Verify all power supply connections to the unit (power jack or 'wired' into the Terminal Block) and that all supplies are performing to specifications.
- Verify Remote Interlock connections (or jumper across Pins 7, 8 of the Terminal Block, if no Remote Interlock is in use) are solid and all Interlock circuits are closed.
- Verify "Main Power" switch and "Laser Enable" keyswitch are On.
- Verify the "E-Stop" button is not pressed in.
- Verify proper displays and responses of the LCD Touchscreen.
- Ensure that the Operating Environment is within specifications.
- Verify cleanliness of the fiber coupler and fibers used. Check fiber for damage.

8 Service and Warranty

8.1 Service

If your Mini-Benchtop system continues to malfunction and none of the 'Troubleshooting' steps have yielded satisfactory results, or if the unit ceases operating entirely (i.e.: black LCD Touchscreen, etc.) or is clearly severely damaged due to mishandling and/or an accident while operating (i.e.: dropped, soaked by a liquid, etc.) contact your Coherent Sales Rep for a Returned Material Authorization ('RMA') number, and further instructions. If you need more immediate assistance, contact Coherent Technical Support (specific to this Product) by telephone at 626-357-9600 (+01-626-357-9600 Outside the US) or by e-mail at sales.monrovia@coherent.com.

8.2 Warranty

Coherent, Inc. warrants SureLock™ Mini-Benchtop Laser Systems to the original purchaser (the Buyer) only; that the laser system that is the subject of this sale,

(a) conforms to Coherent's published specifications, and (b) is free from defects in materials and workmanship.

Laser systems are warranted to conform to Coherent's published specifications and to be free from defects in materials and workmanship for a period of twelve (12) months.* Replacement units shipped within warranty carry the remainder warranty of the failed unit.

Responsibilities of the Buyer

The Buyer is responsible for providing the appropriate utilities and an operating environment as outlined in the product literature. Damage to the laser system caused by failure of Buyer's utilities or failure to maintain an appropriate operating environment, is solely the responsibility of the Buyer and is specifically excluded from any warranty, warranty extension, or service agreement.

The Buyer is responsible for prompt notification to Coherent of any claims made under warranty. In no event will Coherent be responsible for warranty claims made later than seven (7) days after the expiration of warranty.

Limitations of Warranty

The foregoing warranty shall not apply to defects resulting from any of the following conditions:

- Components and accessories manufactured by companies other than Coherent, which have separate warranties
- Improper or inadequate maintenance by the Buyer
- Buyer-supplied interfacing
- Operation outside the environmental specifications of the product
- Unauthorized modification or misuse
- Improper site preparation and maintenance
- Opening the housing
- Fiber tip and fiber damage due to mishandling and cleaniness

Coherent assumes no responsibility for customer-supplied material. The obligations of Coherent are limited to repairing or replacing, without charge, equipment that proves to be defective during the warranty period. Replacement sub-assemblies may contain reconditioned parts. Repaired or replaced parts are warranted for the duration of the original warranty period only. The warranty on parts purchased after expiration of system warranty is ninety (90) days.

This warranty does not cover damage due to misuse, negligence, or accidents, or damage due to installations, repairs or adjustments not authorized specifically by Coherent.

This warranty applies only to the original purchaser at the initial installation point in the country of purchase, unless otherwise specified in the sales contract. The warranty is transferable to another location or to another customer only by special agreement, which will include additional inspection or installation at the new site. Coherent disclaims any responsibility to provide product warranty, technical or service support to a customer that acquires products from someone other than Coherent or an authorized representative.

THIS WARRANTY IS EXCLUSIVE IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL OR IMPLIED, AND DOES NOT COVER INCIDENTAL OR CONSEQUENTIAL LOSS. COHERENT SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

9 Parts List and Accessories

9.1 Packing List and Re-Packaging for Shipping

The Mini-Benchtop system should arrive (for standard-order configurations) with the following items:

- Hard-shell plastic carry case / shipping shuttle (inside larger cardboard shipping box)
- Coherent SureLock™ Mini-Benchtop Laser System at user-selected wavelength (Product graphics label will read: "BT-[wavelength], i.e.: 785)
- Set Laser Enable / Lockout Keys
- AC/DC Power Supply, 90-230V AC to 5V DC, 2.1mm DC plug
- Standard US Wall-power Adapter (110-120V AC)
- Standard EU Wall-power Adapter (220V AC)
- Coherent SureLock™ Mini-Benchtop Laser Operator's Manual.

NOTICE *- **It is strongly recommended that the original shipping box and packing materials be saved after initial purchase. These packing materials are required when the laser needs to be stored in a non-lab environment, shipped elsewhere, or if ever returned to Coherent. Additionally, ensure the protective 'Shutter-Cap' is snugly on the FC/PC connector, and that all ESD protection-protocols are used while re-packing the unit.***

9.2 Optional Accessories And Fibers

While the Mini-Benchtop is well suited for many various applications, and each may utilize a variety of fiber-optic cables, Coherent recommends use of only certain specific jacketed fibers that are optimal for the applications the system was engineered for. Thus, no delivery fibers are shipped 'standard' with the unit. All are optional and typically specified under guidance from your Coherent Sales Rep. One such is a 105 µm jacketed fiber cable with either an FC/PC or SMA end connector. If none were ordered with your purchase, it is recommended to contact your Coherent Sales Rep to get info on all recommended fibers optimal for your application.

10 Appendix

10.1 Importance of Maintaining Clean Fiber Connections

To ensure optimal performance of the laser system, it is crucial to maintain a pristine FC/PC connector on the unit and at the tips of the delivery fiber. Any contamination on the ends of the fiber connections can lead to undesirable performance outcomes and, if not addressed, may ultimately result in the failure of components or the entire system. There are also less apparent or even invisible contaminants that can cause unwanted attenuation, optical noise, or subpar performance. Examples include oils (e.g., from fingerprints), film coatings (e.g., condensates from vapors in a test chamber), and other residues (e.g., after the evaporation of water or solvents, dust, etc.). Furthermore, the laser output intensity at the very end of a fiber tip is so high that an small contaminant can be burned onto the end if it obstructs the core during operation at higher powers. This burn can damage the optical surface to the extent that it cannot be adequately cleaned, necessitating the replacement of the delivery fiber.

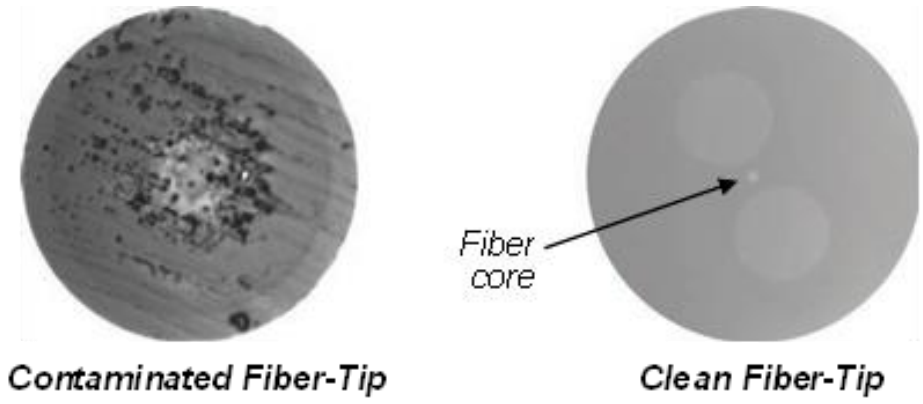


Figure 10.1-1: Contrast between a contaminated and clean fiber tip, as viewed under magnification

NOTICE *- When cleaning fiber components, always complete the steps carefully, and wear nitrile gloves when handling fiber ends. NEVER touch the fiber end face with bare fingertips, even if "clean." The goal is to remove all dust and contamination to provide the cleanest mating surfaces possible for the optical connections. Remember that inspection, cleaning, and re-inspection are very important steps which* ***must*** *be done before you make any fiber connections.*

WARNING! *– Always turn the unit OFF before you inspect a connected fiber tip and/or clean the unit FC/PC connector:*

Never look into a fiber end or the output aperture while the Laser Enable keyswitch is in the ON position, even if the 'E-Stop' and/or other safety-interlocks are open and laser emission is not occurring.

Never attempt to inspect a fiber end with a fiberscope while the laser is ON or operating.

Never use the eyes to verify laser emission, gauge power levels, or evaluate fiber tip cleanliness once the laser is ON and operating.

10.2 Cleaning the Fiber Connector

NOTE *- The product recommendations presented here are provided for convenience and reference purposes only. Coherent explicitly disclaims any responsibility or implication of warranty or guarantee regarding the performance, durability, or availability of these products. Moreover, the instructions given herein are intended as general guidelines and should not be considered exhaustive or comprehensive. It is important to note that fiber-cleaning methods and recommendations may vary between manufacturers and tools. As Coherent cannot dictate the choice of cleaning products or tools a customer may select, it is strongly advised to carefully adhere to the fiber tip cleaning instructions outlined in the User Manual for each specific product.*

Coherent recommends use of either the US Conec IBC™ Brand Model 9392 (or, alternatively, Model M250) 'one-click' style FC/PC connector-cleaners each time before freshly mating a new delivery fiber to the unit.

Figure 10.2-1: US Conec IBC™ Brand Model 9392 and M250 FC-connector cleaning tools

NOTICE *- No known cleaning method is absolutely 100% effective. Thus, it is imperative that inspection is included as an 'integral part' of your cleaning process and protocol. Incorrect cleaning can damage the fiber and/or the laser internally.*

10.3 Inspecting and Cleaning Delivery-Fiber Ends

Inspection of delivery-fiber ends are done with either a desktop-video fiberscope or a hand-held fiberscope. Both tools are specialized microscopes used for inspecting optical fibers. Any scope chosen should provide at least 200x total magnification. ***Specific adapters may be needed for FC/PC connectors*** to properly inspect the Fiber-tip. Figure 10.3-1 provides examples of popular scopes.

Handheld Fiber-Optic Inspection Scope

Desktop-Video Microscope Fiber Inspection Scope

Fiber-Optic Inspection-Scope Adapters

E-2000 Service Adapter 1019034 to hold spring-loaded cap open

Figure 10.3-1: Examples of Fiber-tip inspection scopes and tools

To inspect a delivery-fiber tip:

1. Make certain that the laser is turned OFF before starting inspection.
2. Put the applicable inspection adapter or probe on your equipment.
3. Unscrew and remove the delivery fibers' dust cap.
4. Insert the delivery-fiber connector into the fiberscope adapter and adjust the focus ring until you see a clear fiber tip image.
5. Clean the fiber tip and re-inspect, as necessary. See below for an overview on fiber tip cleaning.
6. Immediately plug the clean connector into the connector it will be mating to decrease the risk of re-contamination.

Dry Cleaning Technique

The recommended dry-cleaning technique utilizes a 'cartridge' cleaning tool. Coherent recommends use of the following cartridge cleaning tools and associated techniques. (Source: websites, valid at the time of this writing).

Figure 10.3-2 shows examples of these tools

OPTIPOP R, P/N ATC-RE-02
-
http://www.ntt-at.com/product/optipop/

CLETOP-S TYPE A, P/N 14110501
-
http://www.cletop.com/html/products.html

Figure 10.3-2: Examples of recommended Cartridge Fiber-tip cleaning tools

NOTE-Since fiber-cleaning techniques and advice can vary from manufacturer to manufacturer (and tool to tool), and Coherent cannot 'control' what cleaning product or tool a customer may choose to purchase, it is simply recommended to closely follow the fiber-tip cleaning instructions provided in each products' User Manual.

Wet Cleaning Technique

1. Make certain that the laser is turned OFF before starting cleaning.
2. Carefully remove the delivery-fibers' dust cap.
3. Inspect the fiber tips with a fiberscope. (See Figure 10.2-1)
4. If a tip is dirty, clean with a cartridge cleaner, as per the manufacturer's instructions – or – follow a simple 'Wet-to-Dry wipe' technique, as-follows: (See Figure 10.3-3).

CAUTION – ***Follow all safety instructions when using isopropyl alcohol and/or methanol (used for wet cleaning of the fiber tip). If you do not have a copy of the safety instructions and MSDS sheets for using IPA or methanol, contact your Industrial Safety Dept. before following the cleaning information described in this document.***

1. Start with a fresh sheet of lint-free, optical-grade lens paper, folded 3 times, to yield a cleaning surface with '8 layers' of folded material.
2. Be careful not to touch or contaminate this cleaning 'pad.'
3. Carefully drop spectroscopic-grade isopropyl alcohol ('IPA') or methanol onto the pad until the 'wet area' is approximately the size of a penny.
4. Ensure that an area of the cleaning pad remains dry.
5. Place the 'pad' just created on a clean, smooth work-surface, and bring the fiber tip to a perpendicular angle to the pad, and lightly contact it against the surface of the pad.

6. With very light pressure, and holding the tip to the cloth, 'wipe' the fiber tip lightly across the wet area of the pad, using a 'scalloped Figure 8' motion. Do Not 'scrub' back and forth! At the same time, gently rotate the fiber tip 90 – 180 degrees maximum.
7. Immediately repeat this same action on a clean, dry section of the pad to remove any traces of solvent. Again, do Not 'scrub' back and forth!

NOTICE ***- Improper 'wet' techniques can complicate fiber tip cleaning and should only be used when all dry, 'cartridge-tool based' techniques have failed to clean the tip sufficiently. The primary concern with using solvents is if it is not removed completely from the tip, residual liquid acts as a transport mechanism for loose debris elsewhere on the end-face. If the solvent is simply allowed to evaporate slowly off the end, it can leave residual contaminant on the fiber core. This is extremely difficult to clean off without another wet cleaning and usually more difficult to remove than the original contaminant. Excess solvent can also remain in tiny 'surface pits' where it can re-emerge upon fiber connection.***

Additionally, 'scrubbing' the fiber back and forth on the pad or wiping over the same area more than once can re-contaminate or damage the fiber tip.

(See technique-steps illustrated in Figure 10.3-3)

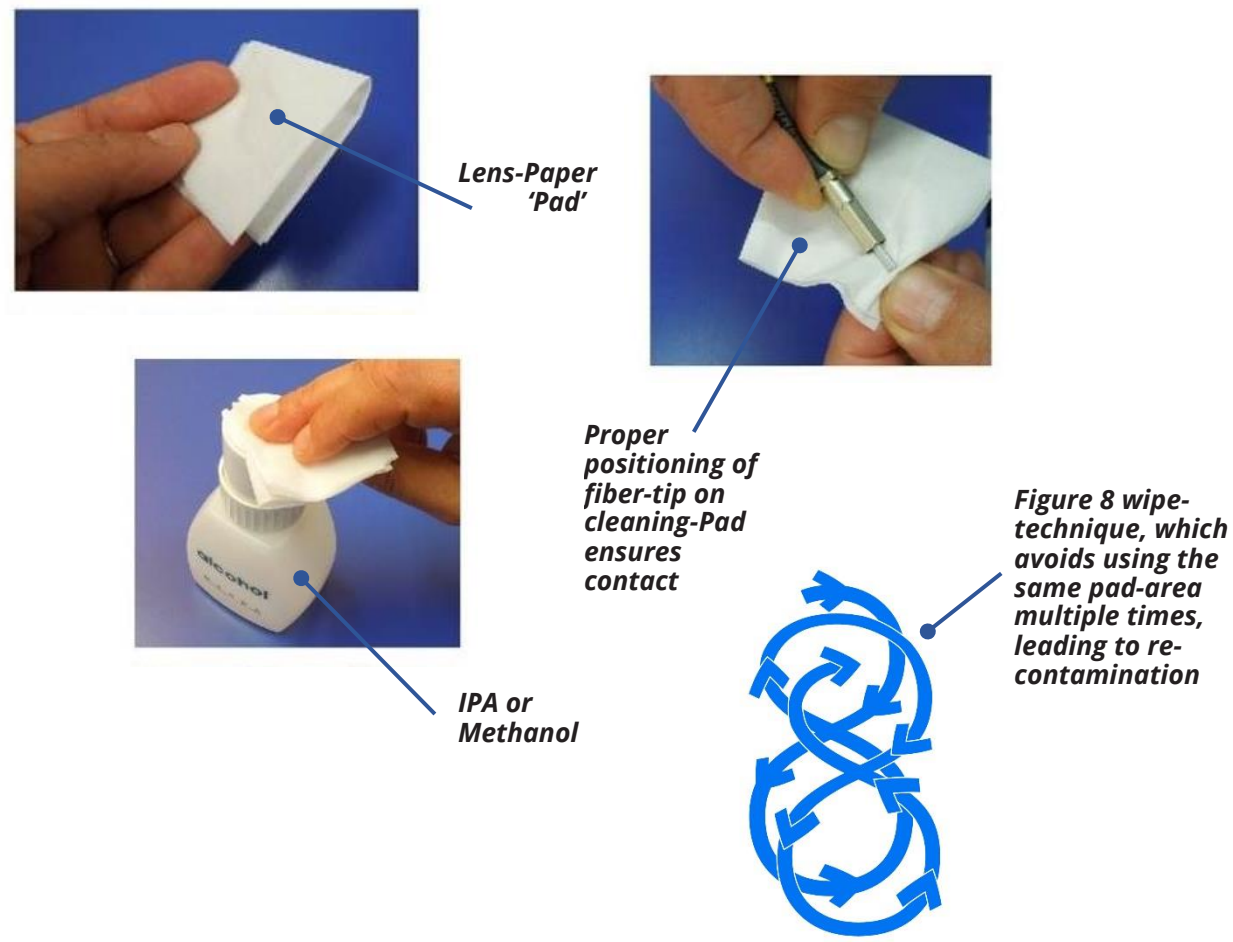


Figure 10.3-3: 'Figure 8' Wet-cleaning a fiber-tip with a 'cleaning pad' made from optical-grade lens paper.

Summary:

1. Inspect the delivery fiber tip with a fiberscope or microscope, as per the above instructions. If the tip is dirty, use the dry-cleaning technique to clean it.
2. Re-inspect the fiber tip. If the connector is still dirty, repeat the dry-cleaning technique a second time.
3. Re-inspect the fiber tip again. If the connector is *still* contaminated, clean it with the wet cleaning technique.
4. Re-inspect the fiber tip again. If the contaminate is still present, repeat the wet cleaning process until the fiber tip is clean.

If the delivery-fiber tip is *still* contaminated after several cleaning attempts using both the dry and wet cleaning techniques, contact Technical Support.

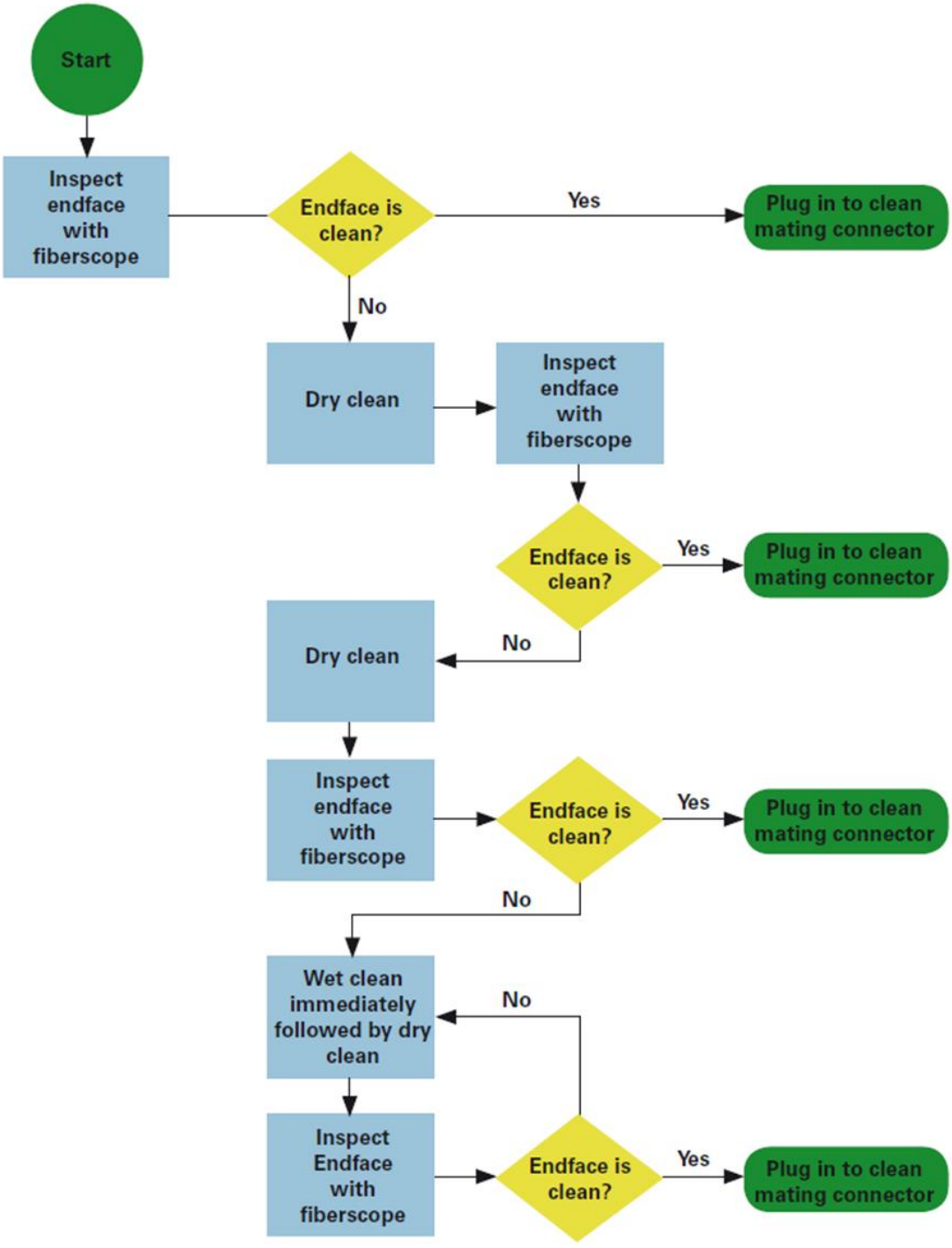


Figure 10.3-4: An example of a fiber-cleaning process flow

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INNOVATIONS THAT RESONATE

SureLock™ BT Series Mini-Benchtop Laser System Operator'sManual

Part No. 115-80063-002 Rev. AA 16 February 2024