

Shut Down and Restart Procedures: Chameleon Discovery and Discovery TPC

Introduction

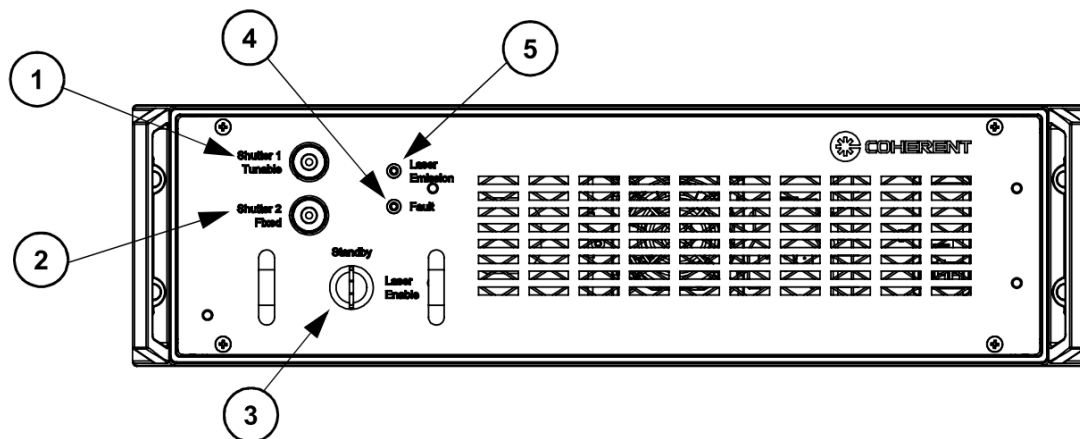
This document defines the switch off procedures appropriate for long-term Discovery laser shut down and those for restarting after a long period of inactivity. These instructions are also found in the Discovery Operator's Manual.

While we refer operators to their vendors for advice on preserving their downstream optical setups during any long-term shut down, but we offer the following general advice:

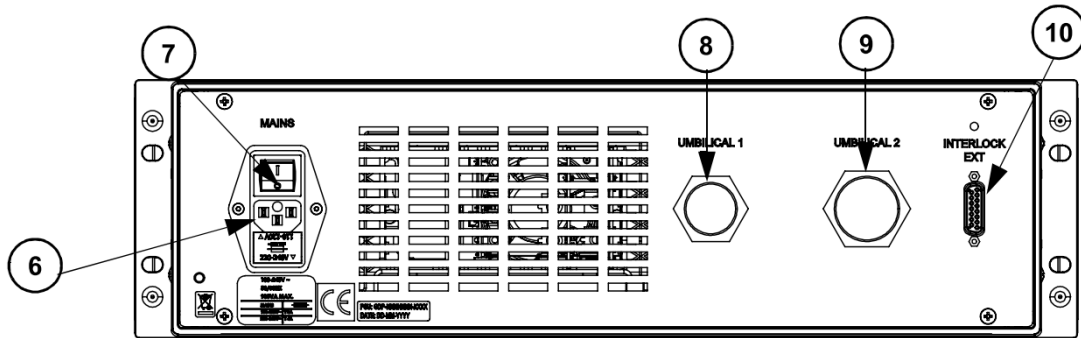
- Downstream optics are likely to shift their pointing over a period of prolonged inactivity, particularly, but not limited to cases where the environmental conditions are not controlled 24-7. Therefore it is very likely that complete re-alignment of optics will be required
- Uncovered optics may degrade over time, particularly, but not exclusively in environments where the humidity, temperature and particle count are left uncontrolled. One possible mitigation can be to inspect the cleanliness of optics prior to direct a laser onto them, removing light absorbing contaminants as required.

Figures and Visual References

The power supply, chiller, MRU and laser head are referenced in the procedure and hence are called out in figures 1, 2,3 and 4 respectively.

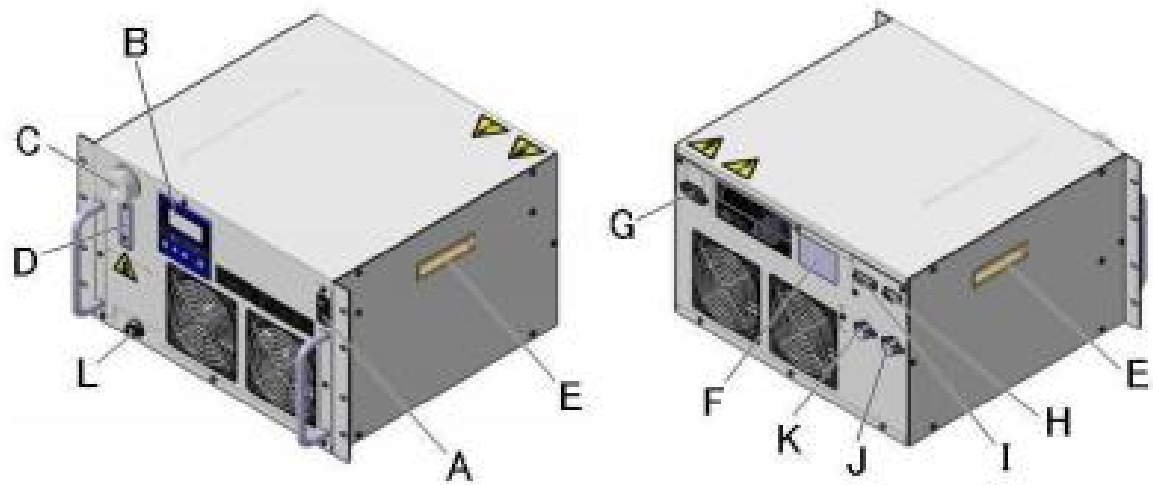


Front View



- Rear View
- 1. Shutter 1 Tunable
 - 2. Shutter 2 Fixed
 - 3. Keyswitch
 - 4. Fault LED
 - 5. Laser Emission LED
 - 6. AC Mains Power Cord
 - 7. Power ON/OFF Switch
 - 8. Umbilical 1
 - 9. Umbilical 2
 - 10. Interlock Connector

Figure 1 PSU rear view



A	Power switch	G	Power supply connector
B	Display/Operation panel	H	Communication connector
C	Reservoir Cap	I	External sensor/Alarm output connector
D	Level gauge	J	Circulating fluid OUT
E	Handle	K	Circulating fluid IN
F	Model No. label	L	DRAIN port

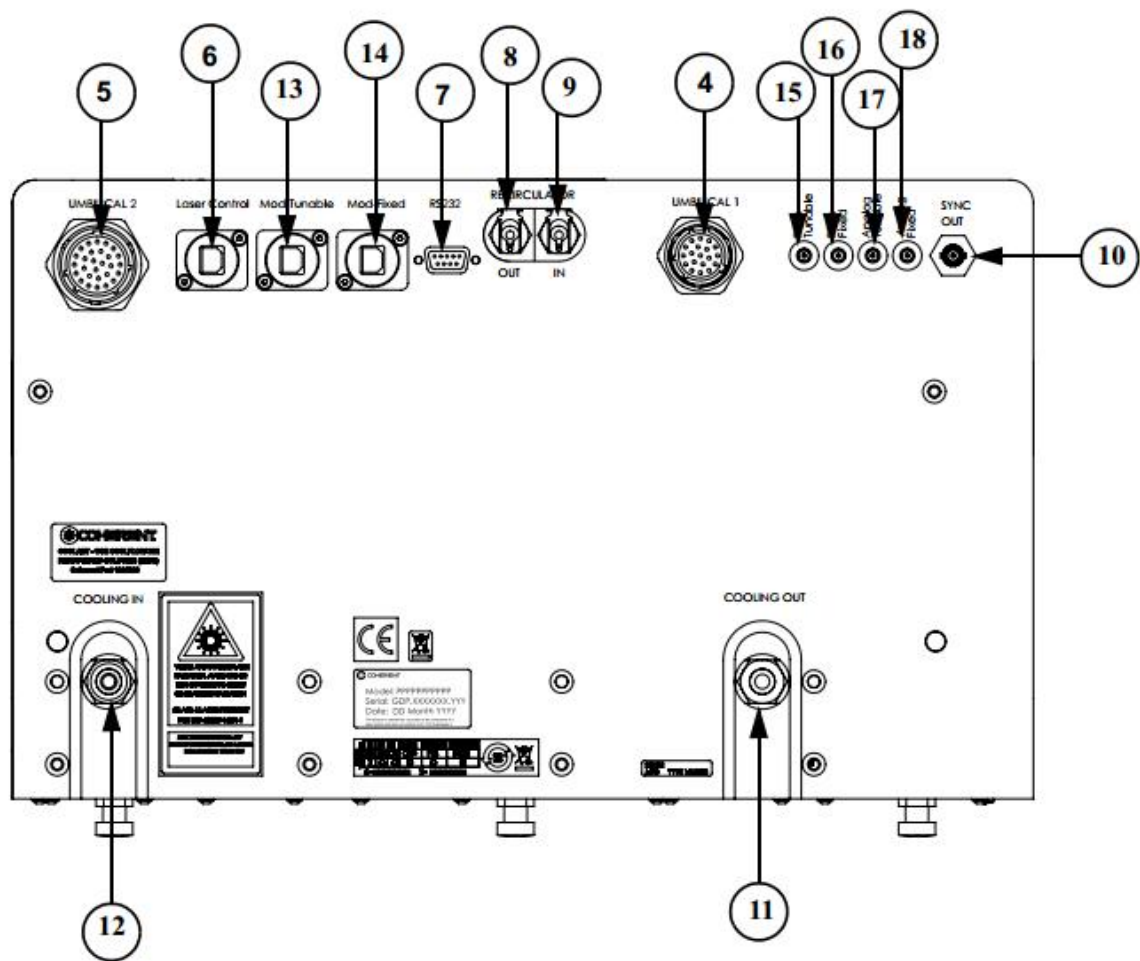
Figure 2:- Chiller



Rear View

Figure 3:- MRU

Power
switch



Rear View

- | | |
|---------------------|----------------------------|
| 4. Umbilical 1 | 12. Cooling In |
| 5. Umbilical 2 | 13. USB Tunable Attenuator |
| 6. USB | 14. USB Fixed Attenuator |
| 7. RS232 | 15. RF In Tunable |
| 8. Recirculator Out | 16. RF In Fixed |
| 9. Recirculator In | 17. Analog Tunable |
| 10. Sync Out | 18. Analog Fixed |
| 11. Cooling Out | |

Figure 4:- Laser Head (Rear View)

Total Laser Shut-off Procedure

We generally recommend that where possible, the chiller and MRU are left running, even when the laser is keyed off and switched off at the power supply ('switch off:- daily use' as referenced Section 5 of the Discovery Operators Manual.) In cases where the laser will be switched off for at least 2 weeks, or it is not practical to leave the chiller and MRU running, the chiller and laser head must also then be drained. Note that the environmental storage limits should be adhered to during this time. The procedure is as follows:

Switch off

1. Key the laser off on the Power Supply as indicated as '3' on figure 1
2. Wait for the fault light ('4' on fig 1) to stop flashing and then toggle the power switch at the rear of the PSU (7 of fig 1) to off
3. Turn the Chiller off using the power switch (A on Fig 2)
4. Switch off MRU (indicated in Fig 3)

Drain chiller

- 1) Refer to figure 2 for designations. Wearing gloves and overalls and using a suitable container to catch the fluid, fit the male draining hose provided to drain fitting 'L', then loosen the filling lid 'C'. Do not remove the filling cap completely (the tightness of this cap determines the flow of the draining coolant.) Once liquid has finished pouring out, re-tighten the drain cap. The step is further illustrated in figure '5' below

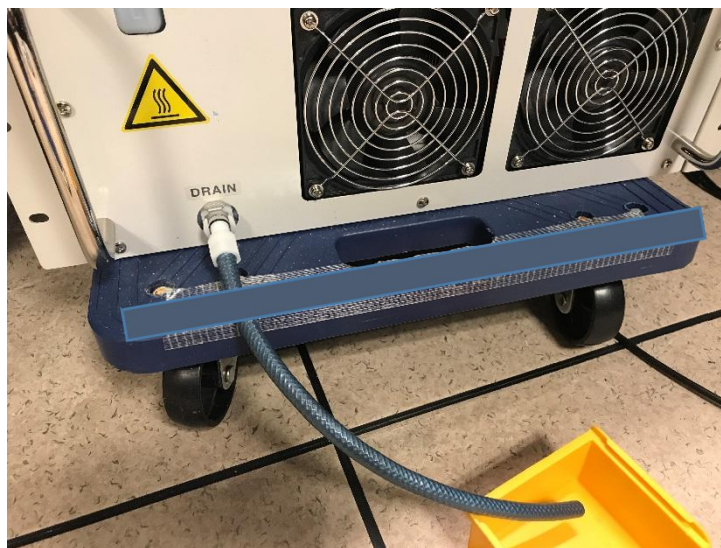


Fig 5:- Photograph of chiller drainage

- 2) The coolant must also be drained from the laser head. Putting some towels in place to catch drips, remove the hoses from the back of the laser head.
- 3) Refer to figure 4. While directing the cut end of the draining hose securely into a suitable container for the old cooling fluid, fit the female draining hoses provided to the inlet and outlet ports on the laser head (11 and 12 of fig 4). Apply 0.1MPa air-pressure to the draining hose connected to the inlet (12) until the fluid has drained out.

- 4) When the fluid has finished emptying into the container, remove the draining hoses from the back of the laser head.
- 5) Dispose of the coolant in a safe and environmentally compliant manner.

Switch-on After Long-Term Shut-Off

Switch on Sequence

In the case of a long-term shut down, where the chiller and MRU have been off, extra precautions may be taken to protect the system from condensation. The switch on would then take one day to ensure that the air inside the laser head is clean and the baseplate temperature has stabilised. This is particularly recommended in cases where the laser may have been kept within environmental (temperature and humidity) storage limits, but outside of operating limits. Users are referred to the latest Discovery datasheet for environmental storage and operating requirements. These have also been stated in Fig 8 at the end of the document for convenience.

The sequence of the switch on is as follows.

- The MRU is switched on first; we recommend for ~3hrs.
- After this initial MRU-only period, the chiller is also switched on so that both the chiller and MRU are then running for a further 3 hours. Refer to fig 6 for reference and the following sections on powering on the MRU and Chiller.
- After the air recirculation and chiller run is complete, the laser can be keyed on

	Hour 1	Hour 2	Hour 3	Hour 4	Hour 5	Hour 6
MRU	✓	✓	✓	✓	✓	✓
Chiller	×	×	×	✓	✓	✓
Laser	×	×	×	×	×	✓

Fig 6: Switch-on timetable guide

Hour 1: Switch on MRU

If the air hoses were disconnected between the back of the MRU (fig 3) and laser head (fig 4), reconnect them ('Air out' and 'Air in' of MRU fig 3 to fig 4, 9: 'Air recirculator in' and 8: 'Air recirculator out' respectively).

If the hoses are connected, power on the MRU using the power switch at the back, as indicated in fig 3. Leave this running without the chiller for 3 hours

Hour 4: Reconnect, Fill and Switch On the Chiller

Gloves and overalls should be worn when working with Coolflow. It might be useful to have towels where filling or connecting to catch any drips.

- 1.) Remove the draining hose if it is still attached and store.
- 2.) Re-attach water hoses:- from the chiller outlet and inlet (fig 2: j and k) to the back of the laser head inlet and outlet (fig 4: 12 and 11 respectively.) They are colour coded for your convenience.
- 3.) Referring to Chiller diagram, fig 2 for call-outs: Remove cap 'C' and using the funnel provided in the Discovery accessory kit or a suitable substitute, gradually pour fresh CoolFlow into the

Chiller's reservoir until level gauge 'D' has reached the 'Full' level. Replace cap over the reservoir

- 4.) Switch on the chiller using power switch 'A' of fig 2. Expect that the chiller will fault out, making a repeated beeping sound indicating that the fluid level is low. This is because the reservoir will drain into the laser head. Switch off the chiller using power switch 'A' after the fault.
- 5.) Repeat step 3 to refill the reservoir
- 6.) Repeat Step 4. If there are further faults, keep following the refilling step while also looking for leaks.
- 7.) The photograph fig 7. Provides further reference for filling the chiller



Fig 7. Photograph of Chiller refilling.

- 8.) The MRU and chiller should now be left running for a further 2 hours to allow full thermalisation.

Hour 6: Key Laser On

Once this process has been completed, the laser can be switched back on

- 1) Re-establish power to the laser using the power switch on the back of the Power Supply ('7' of fig 1)

- 2) Expect that the fault light will flash for several minutes. When it stops flashing, turn the key switch on the power supply ('3' of fig 1.) to 'Enable' and allow the laser to thermalise for 1hr before beginning to realign optics.

Appendix: Environmental Storage and Operating Requirements for Chameleon Discovery Family.

ENVIRONMENTAL REQUIREMENTS	
Operating Temperature Range	15 to 35°C (59 to 95°F)
Storage Temperature Range	0 to 40°C (32 to 104°F)
Humidity	Non-condensing
Altitude (m)	<2000

Fig 8: Environmental requirements table.