**MANUAL REGISTRATION FORM** 

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***Optical Safety*** Laser light, because of its special properties, poses safety hazards not associated with light from conventional sources. The safe use of

lasers requires that all laser users, and everyone near the laser

system, are aware of the dangers involved. The safe use of the laser

depends upon the user being familiar with the instrument and the

properties of coherent, intense beams of light.

**Direct eye contact with the output beam from the laser will cause**

**serious damage and possible blindness.**

The greatest concern when using a laser is eye safety. In addition to

the main beam, there are often many smaller beams present at

various angles near the laser system. These beams are formed by

specular reflections of the main beam at polished surfaces such as

lenses or beamsplitters. While weaker than the main beam, such

beams may still be sufficiently intense to cause eye damage.

Laser beams are powerful enough to burn skin, clothing or paint.

They can ignite volatile substances such as alcohol, gasoline, ether

and other solvents, and can damage light-sensitive elements in video

cameras, photomultipliers and photodiodes. The laser beam can

ignite substances in its path, even at some distance. The beam may

also cause damage if contacted indirectly from reflective surfaces.

For these reasons, and others, the user is advised to follow the

precautions below.

1. Observe all safety precautions in the pre-installation and oper

ator’s manual.

2. Extreme caution should be exercised when using solvents in

the area of the laser.

3. Limit access to the laser to qualified users who are familiar

with laser safety practices and who are aware of the dangers

involved.

4. Never look directly into the laser light source or at scattered

laser light from any reflective surface. Never sight down the

beam into the source.

**GENERAL** 

**LASER SAFETY**

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***Safety Features and***

***Compliance to Government Requirements***

5. Maintain experimental setups at low heights to prevent inad vertent beam-eye encounter at eye level.

6. As a precaution against accidental exposure to the output beam or its reflection, those using the system should wear laser safety glasses as required by the wavelength being generated.

7. Avoid direct exposure to the laser light. The intensity of the beam can easily cause flesh burns or ignite clothing.

8. Use the laser in an enclosed room. Laser light will remain collimated over long distances and therefore presents a poten tial hazard if not confined.

9. Post warning signs in the area of the laser beam to alert those present.

10. Advise all those using the laser of these precautions. It is good practice to operate the laser in a room with controlled and restricted access.

**Laser safety glasses can present a hazard as well as a benefit; while they protect the eye from potentially damaging exposure, they block light at the laser wavelengths, which prevents the operator from seeing the beam. Therefore, use extreme caution even when using safety glasses.**

The following features are incorporated into the instrument to conform to several government requirements. The applicable United States Government requirements are contained in 21 CFR, subchapter J, part II administered by the Center for Devices and Radiological Health (CDRH). The European Community require ments for product safety are specified in the Low Voltage Directive (LVD) (published in 73/23/EEC and amended in 93/68/EEC). The Low Voltage Directive requires that lasers comply with the standard EN 61010-1 “Safety Requirements For Electrical Equipment For Measurement, Control and Laboratory Use” and EN 60825-1 “Radi ation Safety of Laser Products”. Compliance of this laser with the (LVD) requirements is certified by the CE mark.

**GENERAL** 

**LASER SAFETY**

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**Laser**

**Classification**

The governmental standards and requirements specify that the laser must be classified according to the output power or energy and the laser wavelength. The Chameleon is classified as Class IV based on 21 CFR, subchapter J, part II, section 1040-10 (d). According to the European Community standards, Chameleon lasers are classified as Class 4 based on EN 60825-1, clause 9. In this manual, the classifi cation will be referred to as Class 4.

**Protective Housing** The laser head is enclosed in a protective housing that prevents human access to radiation in excess of the limits of Class I radiation

as specified in the Federal Register, July 31, 1975, Part II, Section

1040.10 (f) (1) and Table 1-A/EN 60825-1, clause 4.2 except for the

output beam, which is Class IV.

**Laser Radiation Emission**

**Indicators**

The appropriately labeled lights on both the power supply and the laser head illuminate approximately 30 seconds before laser emis sion can occur. Amber lights are used so that they will be seen when the proper type of safety glasses are used [CFR 1040.10(f)(5)/EN 60825-1, clause 4.6].

**Beam Attenuator** A beam attenuator, or shutter, prevents contact with laser radiation without the need to switch off the laser [CFR 1040.10 (f)(6)/EN

60825-1, clause 4.7].

**Operating Controls**

The laser controls are positioned so that the operator is not exposed to laser emission while manipulating the controls [CFR 1040.10(f)(7)/EN 60825-1, clause 4.8].

**Use of controls or adjustments or performance of procedures other than those specified in the manual may result in hazardous radiation exposure.**

**GENERAL** 

**LASER SAFETY**

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**Location of**

**Safety Labels**

***Electromagnetic Compatibility***

**Use of the system in a manner other than that described herein may impair the protection provided by the system.**

Refer to Figure 1.1-1 for a description and location of all safety labels. These include warning labels indicating removable or displaceable protective housings, apertures through which laser radiation is emitted and labels of certification and identification [CFR 1040.10(g), CFR 1040.2, and CFR 1010.3/ EN 60825-1, Clause 5]].

The European requirements for Electromagnetic Compliance (EMC) are specified in the EMC Directive (published in 89/336/EEC).

Conformance (EMC) is achieved through compliance with the harmonized standards EN 55011 and/or EN 55022 (1998) for emis sion and EN 50082-1 (1998) for immunity.

The laser meets the emission requirements for Class B, group 1 as specified in EN 55011 (1991).

Compliance of this laser with the (EMC) requirements is certified by the CE mark.



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**2**

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**GENERAL**

**LASER SAFETY**

**LASER HEAD**

**10 116** 

**7 9 8**

**POWER SUPPLY**

***Figure 1.1-1. Safety Features and Labels (Sheet 1 of 4)***

**GENERAL** 

**LASER SAFETY**

**1.**

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***Figure 1.1-1. Safety Features and Labels (Sheet 2 of 4)***

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**LASER SAFETY**

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***Figure 1.1-1. Safety Features and Labels (Sheet 3 of 4)***

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**LASER SAFETY**

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***Figure 1.1-1. Safety Features and Labels (Sheet 4 of 4)***

**CHAMELEON** 

**INSTALLATION AND ON-SITE**

**CUSTOMER TRAINING**

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***Installation /***

***Maintenance***

***Equipment***

**Personal Equipment**

1. Safety glasses rated to protect for wavelengths for the specific Chameleon models, at a minimum:

a. Chameleon (210) 720 to 950 nm

b. Chameleon XR 705 to 980 nm

c. Chameleon Ultra 690 to 1040 nm

d. Chameleon Ultra II 680 to 1080 nm

e. Including appropriate OD for 22 W of 532 nm; and OD = 7 at 1064 nm

2. Laptop PC with Win2000, or later, with RS-232 and USB I/O ports for communication with the Chameleon. Windows HyperTerminal installed, or equiv (optional).

3. Installed software with revision appropriate for the Chameleon model and internal spectrometer:

a. Chameleon GUI

b. Chameleon PC

c. Bootloader PC

d. Chameleon Data Run

e. Chameleon Datalogger

f. Ocean Optics software (optional)

4. Latex or Nitrile Gloves (non-powdered)

**CHAMELEON** 

**INSTALLATION AND ON-SITE**

**CUSTOMER TRAINING**

**Test Equipment** 1. Spectrum Analyzer w/ BNC cables

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IST/Rees Model E201LSA03A (Visible)

2. ND Attenuator (for Spectrum Analyzer)

3. Oscilloscope, > 100 MHz

4. Power Meter, LM-10 or LM-45 (if Verdi cal required)

5. IR Viewer

6. Fiber Microscope (ie: Fiberscope)

Westover, FM-C w/ Coherent adaptor P/N 1110925

or Noyes, OFS 300-200C w/ Coherent adaptor P/N 1111484

7. DC Current Clamp (w/ DMM)

8. DMM w/ mini-hook clip leads

**Tools, Etc.** 1. Chameleon 45° 532 nm Pick-off Mirror, P/N 1058622 2. Chameleon Ultra IBS Shim, 2 ea. required, P/N 1125843

3. 45° Uncoated Fused Silica Beam Split

(1 to 5% reflectivity per surface)

4. PLCC IC Extractor Tool

5. Misc Tools: Allen wrenches/drivers, screw drivers, pliers, etc.

6. ESD Wrist Strap

7. Fiber Cleaning Supplies, (Lens Cleaning Swabs,

Spectroscopic / Reagent Grade Methanol)

8. Other Cleaning Supplies

(Hemostat, Lens Cleaning Paper, Acetone)

**Adaptors, Cables, Parts, Etc.**

1. Adaptor Ring for LM-45 Detector, P/N 33-9432-000 2. SMA Type Connector, P/N 1098589

3. Fiber Optic Test Cable, 1 m, P/N 1005923 4. RS-232 Serial Cable, 2 m, P/N 1115727

5. USB Cable, Type A-A, 3 m, P/N 1116322 6. FAP-I Shorting Clip, 2 ea. required, P/N 0171-588-00 7. FAP-I Dust Cap w/ Chain, 2 ea. required, P/N 2105-0161

**CHAMELEON** 

**INSTALLATION AND ON-SITE CUSTOMER TRAINING**

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***Shipment***

***Inspection***

***Environmental Requirements***

***Electrical***

***Requirements***

8. Fiber Optic Cable End Cap, 2 ea. required, P/N 1404-0169 9. Fiber Optic Cable Ferrule Nut, 2 ea. req. P/N 0170-839-00

1. Inspect the shipping crates/containers for signs of rough handling or damage. Also check any impact detectors (i.e. shock watches) to see if the dye has been released into the tube. Also inspect any tilt indicators. Inspect each component as it is uncrated.

2. Coherent recommends that a minimum of two people unpack, lift, or move the Chameleon laser.

3. Verify that the shipment is complete by checking items received against the items listed on the invoice or sales order. A system will typically include the laser head, power supply, MRU (Miniature Recirculator Unit), and water chiller. Inter connecting umbilical or harness, air hoses, water hoses, power cords, and the laser accessory kit will also be included.

4. If any discrepancies or noticeable damage, immediately report this to Coherent Service Product Support to initiate the claims process with the carrier.

5. Retain all shipping crates/containers. These will be required if the system is returned to the factory for service. They may also be needed to support a shipping damage claim.

1. The surface on which the laser is to be mounted should be capable of supporting the laser head safely.

2. The Chameleon is designed for use on an optical table in a temperature- and humidity-controlled, dust-free environment. Operating Temperature is 15 to 35ºC (59 to 95ºF).

Standard line voltage (90-250 VAC, 50/60 Hz) is required for the power supply, water chiller, and MRU Air Recirculator.

**CHAMELEON** 

**INSTALLATION AND ON-SITE CUSTOMER TRAINING**

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***Unpacking the Power Supply and Laser Head***

***Unpacking and Set Up of the Water Chiller***

1. Carefully lift the power supply from the crate; pay particular attention to the two fiber optic cables.

An excessively tight bend of the fiber optic cable, at less than a 15 cm (6 in.) radius, can cause permanent damage.

Place the power supply in an upright position, with a minimum of 15 cm (6 in.) front and rear for adequate airflow, and be sure to allow access for removal the power supply cover. Make sure that the fiber optic cables are not stressed or trapped under the power supply.

2. Carefully lift the laser head from the crate once again paying close attention to the two fiber optic cables. Locate the laser head to allow access for removal of the cover and room for a beam split, power meter, and spectrometer.

3. During shipping the laser may have stabilized at a temperature outside of the recommended operating temperature. Once the power supply and laser head are unpacked, allow them to reach ambient temperature prior to operation.

1. If not already done so, remove the water chiller, power cables, and hose fittings from the shipping box.

**It is important that only the water chiller shipped with the system is used, and that only a chiller authorized by Coherent can be used as a substitute. Use of any other chiller will void the warranty.**

2. For ThermoTek chillers, make sure that the chiller is installed in the upright position. There must be a minimum of 15 cm (6 in.) clearance around the sides and top of the chiller where no obstructions will interfere with the air flow.

3. Check to make sure that the power switch is in the Off position. The power entry module on the ThermoTek T255P is a stan dard IEC connector and will accept 100-240 VAC 50/60 Hz. Do not connect the power cable at this time.

**CHAMELEON** 

**INSTALLATION AND ON-SITE CUSTOMER TRAINING**

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4. The water hose kit for a new system will be complete with the proper connections for the chiller and the Chameleon head. If this is a replacement chiller, and hoses are not included, the Coherent part number for the hose kits are: 1039965 for the older Chameleon 210 / XR and 1094710 for the Chameleon XR / Ultra / Ultra II. The length of the water hoses should not be longer than 6 m (19.7 ft.).

5. Prior to connecting the water chiller, inspect the o-ring seals on the hose fittings and at the rear of the laser head for damage. If the o-rings or fittings are damaged, they should be replaced before operating the water chiller.

6. Connect the chiller to the laser head. Chiller Out to Head Cooling In; Head Cooling Out to Chiller In.



***Figure 1.2-1. ThermoTek T255P Chiller***

7. The water chiller is shipped completely drained of water. Fill the reservoir with steam-distilled water only; do not use de-ionized water. For the Chameleon Ultra, premix a solution of 90% steam-distilled water and 10% Optishield Plus Corro sion Inhibitor in a separate container, then pour into the chiller reservoir. Fluid capacity for the chiller is 444 ml (15 oz.). Additional fluid will be required for the laser head and hoses.

**CHAMELEON** 

**INSTALLATION AND ON-SITE CUSTOMER TRAINING**

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**Do NOT overfill the reservoir. Make sure that any water that is spilled around the filler cap or on the outside of the chiller is wiped dry.**

8. Attach the power cable to the chiller unit and connect it to AC power. Once connected, turn the power switch on the chiller to the On (1) position.

9. Verify that the chiller software revision is version C05 or later. FSB 491 discusses upgrade to version D05; this should be considered. Verify that the RUN/STANDBY button can turn the pump on and off.

10. Run the pump for about one minute, or until a Low water Fault. Check for leaks in the plumbing and around the laser head. A Low Water Fault is okay since water from the chiller reservoir is now distributed throughout the hoses and laser head Base plate.

11. Turn the chiller off and refill the reservoir.

12. Turn the chiller back on; Press the RUN/STANBY button to select STANDBY. It must be in STANDBY for step 13..

13. Press the MENU button until “CONTROL MODE” is displayed. If it displays Default, press the UP arrow until Low Flow is displayed. Press MENU until return to STANDBY.

14. Press the RUN/STANDBY button to return from STANDBY to RUN.

15. Press the MENU button and set the temperature for the Chameleon 210 / XR to 25ºC and for the Chameleon XR / Ultra / Ultra II to 20ºC. Press the MENU button to return to display mode.

Note that changing the operational mode from Default to Low Flow can sometimes start the Temperature Cycle mode. This can cause an undesirable cycling of the chiller temperature if the chiller Set Temperature has not been set.

16. Leave the chiller running for the remainder of the installation.

**CHAMELEON** 

**INSTALLATION AND ON-SITE CUSTOMER TRAINING**

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***Unpacking and Set Up of the MRU (Miniature Recirculator Unit)***

The MRU X1 is the standard air recirculator shipped with the Chameleon system. If, at time of shipment, a MRU X1 is not avail able then the MRU X2 may be shipped instead. The MRU X2 is readily identified because of the front window showing the DrieRite filter and that it contains two DrieRite filters instead of a single filter used for the MRU X1.

1. If not already done so, remove the MRU power cable and air hoses from the shipping box. Keep the hoses in the protective packaging until they are about to be connected.

2. The MRU and laser head are shipped with protective caps over the inlet and outlet connectors for the clean air hose. The caps prevent debris and contaminants from being deposited on the front surface of the fittings. The connectors feature an internal valve (even with the protective caps removed) so that the fitting is automatically sealed when a hose is not connected.

3. It is important that the MRU is not switched on before the air hoses are properly connected. The power entry module for the MRU is a standard IEC connector and will accept 100-240 VAC 50/60 Hz. Do not connect the power cable at this time. The back pressure from the closed valve can damage the internal air pump.

4. Remove the top cover from the MRU and verify that the desic cant is blue (i.e.: not pink) and the molecular sieve is clean. Correct / replace if needed and replace the cover.

5. The MRU can be mounted into a 19-inch rack by attaching the two brackets supplied in the accessory kit. The brackets are secured to both sides of the MRU with the four supplied screws using a 1/8” Allen wrench.

6. It is important that the connectors for the MRU are not contam inated during the handling and set up of the Recirculator fittings. These ports provide a direct line into the interior of the laser head.

**The connectors and hoses of the MRU are to be considered part of the interior of the laser cavity. No chemicals should be sprayed or allowed to come in contact with the fittings.**

**CHAMELEON** 

**INSTALLATION AND ON-SITE CUSTOMER TRAINING**

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7. Remove the protective caps from the inlet and outlet ports at the back of the laser head, and from the front of the MRU.

8. Remove the clean air hoses from the packaging and remove the protective caps as needed to protect the fittings from contami nation when making connections. The length of the air hoses should not be longer than 2 m (6.5 ft.).

9. Connect the outlet port from the MRU (Blue) to the inlet port of the laser head with the Blue tagged air hose. Then connect the inlet port of the MRU (Red) to the outlet port of the laser head with the Red tagged air hose. Use only the connectors, hoses, and fittings provided from Coherent.

***Figure 1.2-2. Partial Rear View of MRU***

10. Attach the power cable to the MRU and connect to the AC power. Once connected, turn the power switch on the MRU to the On position.

11. The green LED on the front panel of the MRU should illumi nate and a quiet humming should be heard indicating that the air pump is operating normally.

12. To make use of the interlock feature on the MRU, connect the PSU interlock cable to the PSU interlock connection (mini-DIN) located on the back of the MRU. Connect the other end of the PSU cable to the external interlock connection (mini-DIN) on the back of the power supply. Then connect the external interlock connector to the MRU external interlock

**CHAMELEON** 

**INSTALLATION AND ON-SITE CUSTOMER TRAINING**

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***System and***

***Test Equipment Set UP***

connector. If the customer uses the external interlock feature, it is their responsibility to conform to any and all electrical codes that their government, local agency, or facility may require.

13. Keep the MRU running for the remainder of the installation. It will take approximately two hours for the relative humidity (RH) to be low enough for good modelock at all wavelengths.

1. Before running the laser, allow the system to stabilize with the room temperature for at least one hour. If the system has been brought in from an unconditioned location, Coherent recom mends that the system be allowed to stabilize with the room environment for a period of 24 hours.

2. Connect the remaining harness between the Chameleon power supply and laser head. Also connect the Ground Strap to the stud located just above the Power Switch.

**If the Chameleon system is shipped from the factory with the fiber optic cables already connected to the FAP-Is in the power supply, DO NOT disconnect these and perform a fiber inspec tion.**

3. If the fiber optic cables are not already connected, inspect and clean if necessary, following the latest available fiber inspec tion and cleaning procedure.

***Figure 1.2-3. Rear View of Chameleon Laser Head***

**CHAMELEON** 

**INSTALLATION AND ON-SITE CUSTOMER TRAINING**

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4. Connect the supplied RS-232 cable between the Chameleon power supply and the Service Engineers' computer. Connect the supplied USB cable between the Chameleon laser head and the Service Engineers' computer. Note that this computer must already have all required software installed. Installation of the GUI software for the customers' computer is covered later in this procedure.

5. The power entry module for the power supply is a standard IEC connector and will accept 100-240 VAC 50/60 Hz. Verify that the fuse type for the AC voltage is correct for the facility power. Connect the power supply to the facility AC power.



***Figure 1.2-4. Rear View of 80 MHz Chameleon Power Supply***

6. Turn the power switch located at the rear of the Chameleon power supply to the On (1) position. Verify that the power supply turns on and no faults are displayed on the power supply front panel LCD.

7. Verify that the shutter is closed. Some systems will have this marked on the front panel as Full Power/Alignment Mode; verify that the LED is Off.

8. Secure the Chameleon head in place, place the 45º beam split at the output port of the Chameleon laser head at about 8 to 20 cm (3 to 8 in.), and appropriately locate the power meter and spectrometer.

**CHAMELEON** 

**INSTALLATION AND ON-SITE CUSTOMER TRAINING**

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***Figure 1.2-5. Test Set Up with Beam Split, IST/Rees Spectrometer, and Power Supply***

9. Complete the electrical connection of the IST/Rees spectrom

eter to the oscilloscope, etc. Common set up is:

a. Rees Signal connected to 'scope Channel 1

(DC coupled, 200 mV/div; adjust as required)

b. Rees Trigger connected to 'scope Ext Trigger

(DC coupled, 1 mSec/div; adjust as required)

c. Rees Markers connected to 'scope Channel 2

(DC coupled, 2 V/div; adjust as required)

10. Verify that the system Status is Standby. If the servo tempera

tures are not up to temperature the status will be displayed as

Warming (xx.x%).

11. Turn the keys witch to the ON position. Wait for the system to

ramp up current (A), then power (%), and achieve modelock;

the status should change from Power Ramping (xx.x) to

Starting and then to OK.

**Before opening the shutter ensure that the beam path(s) have**

**been made safe.**

12. Tune the laser to 720 nm.

**CHAMELEON** 

**INSTALLATION AND ON-SITE CUSTOMER TRAINING**

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***System***

***Acceptance Test***

13. Using appropriate laser safety glasses, open the shutter and align the 45º beam split, spectrum analyzer, and power meter. Ensure that the beam is aligned perfectly into the IST/Rees spectrometer. Secure in place.

**If the output of the Chameleon saturates the IST/Rees detector use a ND filter to attenuate the beam. Do not mis-align the beam to the input of the spectrometer. The spectrometers are very alignment sensitive and if misaligned can cause the displayed pulse to appear distorted and/or unstable.**

14. Close the shutter.

A properly operating Chameleon should tune from one end of the specified tuning range to the other, and back, without losing mode lock, or exhibiting signs of Q-Switching or CW Breakthrough.

After shipment where the laser had been subjected to harsh shocks or temperature variations, it is possible that there has been a slight change to the cavity alignment. It is good practice to then make sure that the mirrors are in their optimum position by using the Chame leon Datalogger program to perform a wavelength sweep. The purpose of the sweep is to let the Cavity and Pump mirrors “walk” against each other to find the optimum alignment. Once this align ment is found, it is stored in the Chameleon head EEPROM.

The system acceptance test does not use the Sync Out from the laser head as part of the acceptance criteria. The Sync Out signal is just that, a way of synchronizing external equipment with the pulses. It is not a way of looking at the characteristics of the pulses and cannot be used to determine whether the optical output is stable or not.

1. Run the Chameleon Datalogger program and verify that the program can communicate through the RS-232 to the power supply, and through the USB to the internal spectrometer.

**The Chameleon system should be lasing for at least one hour to allow for thermal equilibrium before checking modelock across the tuning range.**

2. Open the shutter.

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3. Tune the system to 800 nm. 4. Using the Datalogger program: a. Record Data is not required. b. For Wavelength Sweep:

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**•** λ Change Interval. Set to 30 Seconds.

**•** λ Min. & λ Max. Set the wavelengths for minimum to 790 and for maximum to 810.

**•** λ Steps. Set to 4.

c. Click the Spectrometer button to enable viewing of the wavelength from the internal spectrometer.

If, at lower power levels, the internal spectrometer is not displaying the correct wavelength, click on the “Internal Spectrometer” tab, change the Integration Time to a lower value such as 30, and click on the “Main Screen” tab.

d. d. Click on Wavelength Sweep

**•** During the sweep, verify that the Pump and Cavity PZTs do not drift to either rail (0 or 5 V).

**•** Let the sweep run until the PZT positions, and hence output power, have stabilized.

5. Click on Wavelength Sweep to turn it off.

6. Manually tune the laser across the entire tuning range in 10 nm steps.

a. Chameleon (210) 720 to 950 nm

b. Chameleon XR 705 to 980 nm

c. Chameleon Ultra 690 to 1040 nm

d. Chameleon Ultra II 680 to 1080 nm

At each wavelength, verify:

**•** The internal wavelength is within 5 nm of the Set Wave length.

**•** The external wavelength is within 5 nm of the Set Wave length.

**•** The output of the external spectrometer and note any instability, not modelocking, Q-Switching, or CW Breakthrough.

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***Figure 1.2-6. Example of Acceptable Modelocked Laser Output ***

***Figure 1.2-7. Example of Unacceptable Laser Output (Q-Switching) ***

***Figure 1.2-8. Example of Laser Output with CW Breakthrough***

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7. Tune the wavelength over the operating range verifying that

the system tunes smoothly without losing modelock, show

signs of pulse wavelength or amplitude instability, or exhibit

signs of Q-Switching or CW Breakthrough.

8. Verify laser output power at the specified wavelengths per the

following table:

***Table 1.2-1. Specified Output Power by Model***

| **MODEL** | **TUNING RANGE** | **SPECIFIED OUTPUT POWER** | |
| --- | --- | --- | --- |
| 210 | 720 to 950 nm | > 1.0 W | Peak |
| XR | 705 to 980 nm | > 1.5 W | Peak |
| Ultra | 690 to 1020 nm | > 2.5 W | 800 nm |
| Ultra I | 690 to 1040 nm | > 600 mW  > 800 mW  > 2.9 W  > 1.1 W  > 400 mW  > 300 mW | 690 nm  700 nm  800 nm  920 nm  1020 nm  1040 nm |
| Ultra II | 680 to 1080 nm | > 600 mW  > 1.5 W  > 3.5 W  > 1.5 W  > 500 mW  > 200 mW | 680 nm  700 nm  800 nm  920 nm  1020 nm  1080 nm |
| Vision I | 690 to 1040 nm | > 640 mW  > 1.07 W  > 2.5 W  > 920 mW  > 260 mW | 690 nm  710 nm  800 nm  920 nm  1040 nm |
| Vision II | 680 to 1080 nm | > 500 mW  > 1.5 W  > 3.0 W  > 1.35 W  > 400 mW  > 180 mW | 680 nm  710 nm  800 nm  920 nm  1040 nm  1080 nm |

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9. Close the Datalogger program.

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10. Run the Chameleon Data Run program.

a. Enter serial numbers and FSE name.

b. Specify appropriate Start and Finish Wavelengths with 10 nm Steps.

c. Check box for “This is a Field Data Run”. This will cause a dialog box to open at the end of the run requesting information about RH, modelocked, CW Breakthrough, Q-Switch, etc. RH level will be available from Service mode.

d. Click OK. Click GO.

e. Select folder and enter filename. The filename should include four digit system serial number, that this is a Data Run, present date, maybe time, and Install. Example: 6281\_DR\_061207\_1400\_Install.

f. Click OK.

11. Verify that the system stays modelocked with no CW Break through or Q-Switching during the run.

12. If the laser output as viewed with an IST/Rees spectrometer exhibits signs of CW Breakthrough or Q-Switch, then a correction of the QS Verdi Power and CW Verdi Power within the Wavelength Calibration may be necessary.

13. If the internal or externally measured wavelength differs by more than 5 nm of the set wavelength, then a correction of the tuning stepper position within the Wavelength Calibration may be necessary.

14. If the Chameleon output power differs by more than 10% of the externally measured power at any specific wavelength, then a correction in the internal power measurement within the Wavelength Calibration may be necessary.

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***Customer Training***

For this training, the system should be restored to Customer mode. An external spectrum analyzer and power meter is not required, but a suitable beam block needs to be in place.

1. Discuss with the customer laser safety, including the use of laser safety glasses appropriate for their system. Refer to the Laser Safety section in the Chameleon Operator's Manual.

2. Describe the components of the laser system and general oper ation, including the Verdi as the pump laser. Instruct the customer on the importance of thermal management (chiller set and actual water temperature, room temperature, power supply fans) and the use of the MRU, and to leave the chiller and MRU running anytime that the laser power supply is turned on.

a. ThermoTek recommends changing the chiller water every 3 months. Drain and refill the chiller with a pre-mix solution of 10% Optishield Corrosion Inhibitor and 90% steam-distilled water.

b. The MRU desiccant filter should be changed when the desiccant starts to change from blue to pink. Based on local humidity, check the filter in 3 to 6 month intervals. Change the Molecular Sieve filter every 5000 hours or when the indicator band of blue beads (half way along the length of the filter) changes color to tan.

c. The MRU HEPA filter should be replaced after 3 years or 25,000 hours.

3. Encourage customer to read the Chameleon Operator's Manual.

4. Turn-on and Turn-off Procedures. Refer to the Daily Operation section of the Operator's Manual.

a. Turn-on (Cold Start)

b. Daily Turn-on (Warm Start)

c. Daily Turn-off (Standby)

d. Turn-off (Long Term or Complete Shut-down)

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***Installation of the Chameleon GUI Program***

5. Using the FSE's computer, demonstrate the Chameleon GUI program.

a. For customers with a Zeiss microscope, etc., explain that they would be using software that comes with the micro scope but want to give to them an overview of operating the laser.

b. Demonstrate and explain the functions of the GUI program including Lock/Unlock of the power supply front panel, “Dither Hold” function, programmed presets.

6. Show the customer the operation of the front panel controls. Explain navigating through the available menus including the Initialise (or the Recovery) function. To explain the Cavity and Pump PZTs on the System Information screen using the laser cavity diagram in Section One of the Chameleon Operator's Manual. Also explain that they will only need to access this information if there is a problem with the laser.

7. Review the available RS-232 Commands and Queries in the Chameleon Operator's Manual.

8. Review the Fault List and Troubleshooting Charts in the Chameleon Operator's Manual.

9. If a customer's computer is available, and they wish to install to GUI software, work with the customer to install this. Ref: Chameleon GUI CD shipped with Chameleon system.

10. Review the system installation with the customer.

1. Do not connect the customer's computer to the Chameleon yet.

2. Insert the latest version of the Chameleon GUI CD into the customer's computer. The program should auto-start and launch the Chameleon CD User Guide.

3. Scroll down to the Table of Contents and click on the latest version of the Chameleon GUI. Then click on the link to install, and follow the on-screen prompts.

4. Now connect the RS-232 and USB cables from the Chameleon to the customer's computer.

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***Closing the Installation***

5. Windows should recognize that the new hardware (USB spec trometer). Make sure to select the option to locate the USB driver from the Chameleon GUI CD.

6. Execute the Chameleon GUI program. Verify that the program can communicate with the Chameleon including the spectrom eter.

1. Fill in the pertinent areas of the service report.

2. Note any irregularities about the system, the environment, the utilities or any other factor that might limit the useful lifetime of the system.

3. Sign the service report and have the customer do the same. Explain that by signing they accept the performance of the system as demonstrated.

4. Give the customer their copy of the service report and survey card. Explain how to contact Coherent Service should they have a question or concern about the laser or its' operation: FC3 (800) 367-7890, (408) 764-4557, or email to **product.support@coherent.com**.

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***Chameleon Ti:Sapphire Oscillator***

The Coherent Chameleon laser is an 80 MHz or 90 MHz (depending on model/manufacture date) Titanium Sapphire oscillator capable of producing pulses in excess of 40 nJ (300 kW peak power). Depending on the model and manufacturing date, the tunable wave length range can cover 400 nm (680 nm – 1080 nm). Typical band width is 5 nm to 9 nm at the peak with pulse widths ~ 140 fs providing near transform limited performance. Time-bandwidth products are below 1.3 near the peak of the tuning curve. The system is designed to be a fully automated, hands-free oscillator providing the user with front panel or software selected modelocked pulses with a highly circular beam and very low astigmatism. Circu larity better than 90% is typical and changes in pointing angle are less than 50 µrad per 100 nm. With a specified stability of less than ± 0.5%, the Coherent Chameleon is one of the most stable UF oscil lators available.

**Warning! Fluence levels can be extremely high throughout the wavelength range of the Chameleon laser. Refer to the Svc-Cham-1.1 “Laser Safety” before operating or servicing this laser. Even indirect reflected energy can pose an eye or skin hazard. Most wavelengths emitted from this system are not visible, an IR-Viewer is highly recommended.**

***System Layout*** The Chameleon has four (4) basic system components (see Figure 1.3-1). The two main components, the head and power

supply are shipped together for quality and performance reasons.

The chiller and air recirculator are shipped separately, but should be

kept with original system they where shipped with, so installation

records are kept valid.

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***Figure 1.3-1. Chameleon System***

**MRU 1000 and X1** The MRU 1000 was the first generation in air recalculating units from Coherent. They were required to not only provide clean air for

the sealed cavity, inside the laser systems such as the Chameleon,

but also to eliminate moisture. Moisture will inhibit modelocking

performance at certain wavelengths. Water vapor absorbs light

(energy) at specific discrete wavelengths. This causes losses inside

the cavity for certain phase related longitudinal modes within the

gain curve of the modelocked spectrum. Such disturbance will cause

a modelocked laser to become unstable and even fail to modelock.

The MRU X1 effectively does the same thing as the MRU 1000 by

providing clean moisture free air, however some components were

changed to minimize noise, and allow for ease of servicing in the

X1. In addition to this, the MRU X1 has an added interlock feature

that can be incorporated with the external interlock serial loop from

the Chameleon controller, allowing failure of the MRU to interrupt

laser operation.

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It is important to know that the MRU contains two main chemicals:

DrieRite and Molecular Sieve 4A. In normal operation, you should

not come into contact with these chemicals. These materials present

no risk to health, providing that their sealed containers are not

opened. For additional information to these chemicals, reference the

MSDS information located in Appendix A in the Operators Manual.

***Figure 1.3-2. MRU X1***

There are three filter stages within the Chameleon:

**•** The first stage removes moisture via a replaceable desiccant

filter.

**•** The second stage removes other molecular contaminants,

particularly small polar compounds.

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**•** The final stage is a 0.3 µm-particulate high-efficiency

particulate air (HEPA) filter, removing any dust and debris

emanating from the preceding filter stages.

The air in the MRU is circulated by means of a clean, oil-free

diaphragm pump. The flow rate and pressure are intentionally low in

order to prevent air currents from developing inside the Chameleon

head. The typical pressure from the MRU is 30 kPa. Although

repairs on the MRU itself will be rare, regular inspection of the

desiccant filter is recommended. All parts inside the MRU are field

replaceable.

Hardware is also provided to mount the MRU into a standard 19”

rack mount.

**Chiller** Coherent continually makes efforts to improve system performance, chillers are usually manufactured for Coherent by other companies

to meet our strict guidelines. Because of this, only chillers recom

mended by Coherent should be used with the Chameleon laser

system.

Currently Coherent recommends the ThermoTek T255P Chiller

revision C05 or later for ALL Chameleon laser systems. These

chillers are private labeled with the Coherent logo, and should be

serviced through Coherent under our current agreement with Ther

motek, Inc.

The Thermotek T255P chiller uses thermoelectric heating and

cooling technology (TEC), it has 444 ml reservoir and a cooling

capacity of 200 W. The display is an LCD backlit 2-line 20 character

alphanumeric screen angled for easy viewing if the unit is installed

in the recommended floor location. It uses a centrifugal pump that

provides 0.8 lpm to 1.2 lpm when configured with the Chameleon.

Typical pump pressure under these conditions is 65 kPa. It is

designed to provide the Chameleon with a temperature regulation

better than ± 0.3ºC under normal environmental conditions.

Run/Standby mode

Menu selection and navigation

Power on/off

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***Figure 1.3-3. Thermotek Model T255P***

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RS232 interface

Cooling

connections

The Thermotek chiller is designed to run with distilled water, but

certain approved chemicals can be added. Coherent strongly recom

mends a 90% distilled water with a 10% Optishield-Plus corrosion

inhibitor when connected to a Chameleon. Cooling water other than

distilled water, or additives that are not approved by Coherent will

VOID the warranty!

**Pump Laser** The Coherent Verdi model V-10, V-12 and V-18 are the pump lasers used for the Chameleon 210, XR, and Ultra/Ultra II(80MHz) respec

tively. These Verdis are custom tested and manufactured for integra

tion with the Chameleon system.

The Verdi laser system is a compact solid-state diode-pumped,

frequency-doubled Nd:Vanadate (Nd:YVO4) laser that provides

single-frequency green (532 nm) output. Low noise performance is

characteristic throughout all power levels. The Verdi laser consists

of the laser head and power supply connected by an umbilical or

harness, depending on the version and manufacture date of the

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Chameleon. The head itself is completely contained within the Chameleon head. The umbilical or harness contains fiber optic cables and electrical cables. The electrical cables provide control and monitoring signals between the laser head and power supply and the fiber optic cables transmit light from the diode bars in the power supply to the laser head. Additional cables are used for controlling the VPUF cavity.

The pump laser head is integrated and matched with the VPUF cavity at the factory (field replacement of the head is currently not possible). All control of the Verdi is handled by the Chameleon hard ware. Under normal conditions, certain service features will allow direct control of the Verdi, thus bypassing the Chameleon entirely.

The major optical elements are in a hermetically sealed head and include:

**•** Vanadate as the gain medium

**•** LBO as the frequency doubling crystal

**•** An etalon as the single-frequency optic

**•** Optical diode

**•** Astigmatic compensator and two cavity mirrors

All optical components are mounted on proprietary Super Invar for strength and stability.

***Figure 1.3-4. Pump Head Optical Schematic***

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**Power Supply/ Controller**

The temperature of the Vanadate(s) and etalon are controlled by thermo-electric coolers (TECs), which are capable of heating or cooling the optical element. The temperature of the lithium triborate (doubling generator, or LBO) is controlled by a resistive heater. Accumulated heat in the laser head is dissipated by a water-cooled riser/heat sink mounted on the laser head baseplate, which is mounted to a single monolithic aluminum baseplate that the pump laser and the VPUF share. Baseplate temperature is monitored by the CPU board in the power supply and on the Chameleon Head board. Temperatures above specified software limits will shut the system down. Typical baseplate heat load is less than 140 W, although in some cases, V-18 pumped Chameleons operating with pump powers below 8.0 W, the heat load can be somewhat higher.

The pump laser head utilizes a Neodymium Vanadate (Nd:YVO4) crystal with the pump power provided by fiber delivery. The nonlinear medium is a Type I, non-critically phase matched LBO crystal held at approximately 150°C. Unidirectional operation is achieved by using an optical diode (see Figure 1.3-4). Since the laser is an unidirectional, homogeneously broadened system, it tends to naturally run single frequency with the etalon reinforcing this behavior.

All temperatures are tightly controlled by the Verdi CPU, even though standard servo screens are not visible to the operator. Overall pump laser stability is typically much better than ± 0.05% throughout the required power range for modelocked operation.

The Chameleon laser uses the standard Verdi power supply with some necessary modifications. The most important change to the power supply is the addition of the Interface board. In older Chame leon systems, this Interface board was the same Interface or Control board used in the Coherent Vitesse systems. It was designed to handle the additional data flow, command and query traffic the Chameleon required during its operation. The latest generation of Chameleons, the 80 MHZ systems, uses an Interface board that has a bit more control over the Verdi and is designed to coordinate hand shaking between two separate microprocessors. Both the Verdi CPU board and the Chameleon Head board have their own micropro cessor.

The software in the Verdi controller has also been changed to allow the system to function as a Chameleon. Older Chameleons required that the software be combined with the Verdi software on the CPU board, adding routines designed to work with the Chameleon

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Analog board in addition to the Verdi Head board. The newest Chameleons use the Verdi software in its present state. Minimal soft ware is needed on the Interface board to work with the Verdi CPU. The Chameleon has its own program running on the Chameleon Head board that controls the Chameleon VPUF along with control ling the Verdi through serial commands. The Verdi relinquishes control of the front panel and display to the Chameleon allowing the Chameleon software to take the foreground.

The Verdi power is requested by the Chameleon, depending on the requirements at a given wavelength, but maintaining this power level is ultimately handled by the Verdi power supply. The light loop routine is still utilized in the Verdi software, and the green photo diode signal is still fed back to the Noise Reduction board. The power supply is designed for maximum filtration of line noise, and the Power Piggy board is included with the Power Distribution board assembly. All of the features that make the Verdi power supply one of the most stable in the industry are all still incorporated with the Chameleon system.

The main functions of the power supply include:

**•** Supplying DC power for the laser diode system that pumps the gain medium in the laser head

**•** Controlling six servo loops

**•** Interfacing with the Chameleon microprocessor **•** Cooling for the laser diode assemblies

**•** Controlling and monitoring the laser output

**•** Storing data

**•** Providing a user interface.

Two laser diode assemblies are located in the power supply. Each assembly is controlled and monitored by the CPU. The FAP-I™ (fiber array package- integrated) assembly houses a diode bar and a TEC. Servo routines in the Verdi software monitor and maintain diode current, power and temperatures. Typical diode currents for the V-10 and V-12 systems are 22 A to 28 A. In V-18 pumped systems, diode currents can fluctuate quite a lot more due to the range used for the pump power. Typical V-18 diode currents can range from 44 A to 52 A. Older systems, systems with diode hours in excess of 5000 hours, can expect to have higher diode currents.

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Housed within the FAP-I are the following components:

**•** A sealed diode bar sub-assembly, incorporating a

close-coupled array of 19 optical fibers. These optical fibers

efficiently address the light output from the various discrete

emitters on the bar and into a single output port

**•** Several large thermo-electric coolers to control the tempera

ture and therefore the emission wavelength of the diode bar

**•** Various signal conditioning and monitoring electronics

**•** Several other essential electrical connectors.

The laser diode bar within the FAP-I efficiently converts

low-voltage high-current electrical power into tunable laser light.

Electrical-to-optical conversion efficiencies typically approach 50%

with the non-radiated power contributing primarily to heating of the

device. The coupling efficiency obtained in launching light from the

bar through the fiber array and into a single transport fiber is conser

vatively specified to be no less than 80% with typical values

exceeding 90%.

**Fiber optics coming from the power supply require extreme care**

**and should be kept as clean as possible. Systems should be**

**shipped with the fibers installed into the FAP-I to avoid any**

**chance of damage. A fiber scope should always be available**

**during any service call that requires the removal of a fiber.**

All the standard Verdi optimization routines are available such as the

diode and LBO optimization routines, although they must be

accessed through RS-232.

**VPUF Head** The VPUF head is an ultrafast laser cavity that uses a Ti:Sapphire crystal as the gain medium. Modelocking is obtained using the

Kerr-lens modelocking (KLM) technique with an automatic starter

triggering the initiation of modelocking. The laser cavity is built on

an aluminum plate for both mechanical strength and stability and is

sealed to minimize environmental contamination. The desired

output wavelength is tuned automatically on command. Accumu

lated heat in the laser head is dissipated by the water-cooled base

plate. Baseplate temperature is monitored by the CPU in the power

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supply and by the Chameleon software on later 80 MHz Chame leons. More detailed information can be obtained from the oper ator’s manual in Section Seven: “Theory of Operation”.

The Chameleon cavity blends novel and field-proven technology, providing it with unsurpassed performance:

**•** Solid, monolithic cavity structure for reliability

**•** Power Pulse™ system ensures that Power and Pulse Width are optimized at all wavelengths, at all times.

**•** Incorporates:

- PowerTrack™ active mirror stabilization

- Patent-pending dispersion-balanced tuning mechanism **•** Verdi™ – industry-leading CW green pump laser

**•** Kerr-lens modelocking – the most straightforward method for producing passive ultrafast pulses.

The Chameleon VPUF cavity controls the modelocking state of the laser by balancing the losses and gain in the cavity just like any other passively modelocked ultrafast system. Where the Chameleon breaks away from the common method of doing this is by main taining a constant slit width (some slit adjustment is done on the 80 MHz versions) and using the Verdi power to establish the threshold where only phase related modes can exist in the cavity. Slow and Fast photodetectors are used to monitor and establish cavity energy states where lasing and modelocking occurs. Tuning is accomplished by moving one of the dispersion compensating prisms in combination with another slit to select a discrete band width and frequency range that can exist in the cavity. Starting is accomplished by using the custom precision coil. This coil moves a mirror in line with the standing cavity beam to create enough pertur bation to allow the longitudinal modes to easily find phase relation ship to both the cavity length, and temporally with each other. Generally modelocking is maintained as the system changes wave lengths, but if modelocking is lost, the starter will once again turn on to regain the modelocked condition. The Coherent Chameleon is a state-of-the-art system using an exclusive Coherent design, all service must be performed by Coherent certified service engineers.

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| **S**  **E**  **G**  **N**  **A**  **H**  **C** | R  X    r  o  f    e  s  a  e  l  e  R    • |  | o  v  r  e  s    O  B  L    e  v  o  r  p  m  I    • | s  e  u  l  a  v    r  e  t  e  m  a  r  a  p    O  B  L    s  u  o  i  v  e  r  p    o  t    k  c  a  b    d  e  g  n  a  h  C    • |
| --- | --- | --- | --- | --- |
| **B**  **S**  **F** | a  n | a  n | a  n | a  n |
| **E**  **S**  **A**  **E**  **L**  **E**  **R**    **O**  **C**  **E** | 4  0  0  2  -  r  a  M  -  9  0    ,  1  7  2  6  1  0  E | 4  0  0  2  -  v  o  N  -  0  2    ,  0  0  8  1  2  0  E | 5  0  0  2  -  r  p  A  -  8  2    ,  7  2  3  7  2  0  E | 5  0  0  2  -  p  e  S  -  9  2    ,  9  4  0  2  3  0  E |
| **M**  **O**  **R**  **R**  **E**  **P**  **B**  **E**  **M**  **E**    **U**  **D**  **N**  **R**    **T**  **A**  **R**  **O**  **A**  **B**    **P**  **U**  **P**  **C** | 0  2  4  4  6  0  1 | 8  1  6  2  7  0  1 | 3  5  4  6  8  0  1 | 5  0  7  0  0  1  1 |
| **N**  **O**  **I**  **S**  **N**  **R**  **O**  **E**  **E**  **V**  **L**    **E**  **E**  **R**  **M**  **A**  **A**  **H**  **W**  **T**  **C**  **F**  **O**  **S** | T  0  .  7 | T  1  .  7 | T  4  .  7 | T  5  .  7 |

***y***

***r***

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***m***

***a***

***h***

***C***

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***iv***

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***z***

***H***

***M***

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***lba***

***T***

| **S**  **E**  **G**  **N**  **A**  **H**  **C** | s  n  o  i  t  i  d  d  a    /    s  e  g  n  a  h  c    .  c  s  i  M    • | y  r  t  e  r    e  m  o  h    t  i  l  s    d  e  d  d  A    • | y  t  i  l  i  b  a  p  a  c    g  n  i  k  c  o  l  e  d  o  m    d  e  v  o  r  p  m  I    • | e  s  u  o  h  -  n  i    e  v  i  s  n  e  t  x  e    d  n  a    s  t  l  u  s  e  r    d  l  e  i  f    n  o    d  e  s  a  b    s  e  g  n  a  h  c    s  u  o  r  .  e  g  m  n  i  u  t  s  N    e  •  t |
| --- | --- | --- | --- | --- |
| **B**  **S**  **F** | a  n | a  n | a  n | a  n |
| **E**  **S**  **A**  **E**  **L**  **E**  **R**    **O**  **C**  **E** | 5  0  0  2  -  g  u  A  -  1  3    ,  6  3  6  0  3  0  E | 5  0  0  2  -  t  c  O  -  4  2    ,  5  3  9  2  3  0  E | 5  0  0  2  -  t  c  O  -  8  2    ,  1  7  0  3  3  0  0  E | 5  0  0  2  -  v  o  N  -  1  2    ,  2  7  5  2  3  0  E |
| **M**  **E**  **O**  **R**  **R**  **A**  **P**  **W**  **E**  **T**  **E**    **F**  **D**  **O**  **R**  **S**    **A**  **I**  **O**  **D**  **R**  **B**    **E**  **U**  **V**  **P**  **C** | 2  0  1  0  8  0  1    ,  3  8  .  8 | 2  0  1  0  8  0  1    ,  3  8  .  8 | 2  0  1  0  8  0  1    ,  3  8  .  8 | 2  0  1  0  8  0  1    ,  3  8  .  8 |
| **N**  **O**  **I**  **S**  **N**  **R**  **O**  **E**  **E**  **V**  **L**    **E**  **E**  **R**  **M**  **A**  **A**  **H**  **W**  **T**  **C**  **F**  **O**  **S** | 4  8  .  7 | A  4  8  .  7 | B  4  8  .  7 | 6  8  .  7 |

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| **S**  **E**  **G**  **N**  **A**  **H**  **C** | M  O  R  P  E  .  E  )    4  d  5  r  (  a    t  o  l  u  B    a  e  F  c    a  f  m  r  e  m  t  o  .  n  I  a  C    t    n  a  d  i  d    a    a  e  t  t  l  a  H  u    d  a    g  f  n  e  i  M  d  s    O  u  a  M  R  .  c  P    a  O  t  e  E  a  R  u  E  d  s  P      s  d  E  d  i    a  e  E  t    e  N  p  d  H  A  u  a    r  i  e  C  r  d    o  H  r  d    c  e  e    d  t  f  V  e    c  t  o  s    e  a  e  r  e  d  r  s  v  p  o  a  a  c  S  C  U        n  •  •  i  • | .  .  g  n  %  i  0  s  0  a  l  1      g  o  t  n    i  .  d  t  %  n  n  1  i    e  f    r  n  r  e  e  u  v  e  c  o    w  r  t  e  p  e  d  b  o  m    i  i    o  d  t    o    r  t    d  e  n  e  s  a  d  w  l  n    o  e  e  d  t    g  x  a  d  e  r  e    e  s  w  v  e  o  a  g    l  n  s  s    a  y  r  r  a    e  l  t  d  p  s  l  s  a  o  i  r    h  d    s  p  e  w  r  m  o  h  u  N  P  T        •  •  • | .  s  e  d  o  i  .  d  s  o  e  t  i  r  o  e  h  u  p    q  t    s  d  a  n  f    a    d  s  .  n  F  d  a    n  L  a  w  R  o  m  C  l    s  m    h  f  t  o  i  o  c      w  e  g    s  s  n  i  o  e  l  i  b  r  d  r  e  n  e  u  a  v    q  h      d  d  d  e  t  e  e  t  a  v  c  t  o  s  e  r  r  n  r  i  p  e  o  m  R  C  I        •  •  • | s  D  .  C  n  L    o  i  y  l  s  i  p  v  .  p  e  p  u  r    s  u      d  r  t  r  r  e  a  a  t  o  w  s  o    B    p  g    d  n  S  i  a  r  e  H  u  H  o  d      R  n  r    e  o  h  e  t  w  l  i  e  o  w  p      m  i  n  a  d  o  h  i  r  t  e  C  a    V  r  f    e  t  o    p  c  g  e  o    r  n  r  i  r  e  d  o  p  a  c  e  o  n  r  r  i      p  s  s    t  t  s  c  c  e  e  w  r  r  o  r  r  l  l  o  o  C  C  A        •  •  • | f  e  i    d  e  o  n  i  m    r  m  r  o  e  f    t  e  g  d  n    i  o  k  t  .  c    e  P  A  h  ?    B  c  f    t  C  o    o  P    d  n  t    a  n  y  e  t  e  b  s    t  m  n  r  i  e    a  c  t  S  s  a    l  R  g  p  L  e  n  i  ?  r      r  r  g  u  o  n  d  f  i      t  s  s  l  r  u  u    u  y  a  y  f  .  o  d    b  r  h    a  k    e  e  g  c  d  r  n  w    o  a  i  l  o  e  p  m  e  P  h  e      d  m  t  t  t  o  s  a  e  e  y  s  S  m  R    s          t  s  s  l  w  a  t  t  i    t  o  c  c  s  n  n  e  e  i      r  r  u  i  r  r    n  d  a  o  o  k  r  c  e  C  C  C        o  •  V  •  l  • | n  o    d  e  s  u    M  O  R  P  E  E    ’  d  e  n  g  i  s  e  d  e  r  ‘    f  o    y  .  t  i  d  l  r  i  a  b  i  o  t  a  B    p  d  a  m  e  o  c  H    n  i  n    s  o  t  e  c  l  e  e  r  r  m  o  a  h  C    •  C |
| --- | --- | --- | --- | --- | --- | --- |
| **B**  **S**  **F** | a  n | 6  0  0  2  -  v  o  N  -  6  0    ,  3  9  4 | 6  0  0  2  -  v  o  N  -  6  0    ,  3  9  4 | 7  0  0  2  -  n  a  J  -  3  0    ,  8  9  4 | 7  0  0  2  -  y  a  M  -  9  0    ,  6  0  5 | 7  0  0  2  -  l  u  J  -  9  1    ,  1  1  5 |
| **E**  **S**  **A**  **E**  **L**  **E**  **R**    **O**  **C**  **E** | 6  0  0  2  -  b  e  F  -  9  0    ,  1  0  1  7  3  0  E | 6  0  0  2  -  g  u  A  -  7  1    ,  1  6  6  3  4  0  E | 6  0  0  2  -  p  e  S  -  9  2    ,  9  7  7  4  4  0  E | 7  0  0  2  -  v  o  N  -  6  1    ,  3  4  7  7  4  0  E | 7  0  0  2  -  y  a  M  -  7  0    ,  0  5  3  3  5  0  E | 7  0  0  2  -  n  u  J  -  7  2    ,  1  5  4  5  5  0  E |
| **M**  **E**  **O**  **R**  **R**  **A**  **P**  **W**  **E**  **T**  **E**    **F**  **D**  **O**  **R**  **S**    **A**  **I**  **O**  **D**  **R**  **B**    **E**  **U**  **V**  **P**  **C** | 2  0  1  0  8  0  1    ,  3  8  .  8 | 2  0  1  0  8  0  1    ,  3  8  .  8 | 2  0  1  0  8  0  1    ,  3  8  .  8 | 2  0  1  0  8  0  1    ,  3  8  .  8 | 8  5  0  6  3  1  1    ,  3  5  .  9 | 8  5  0  6  3  1  1    ,  3  5  .  9 |
| **N**  **O**  **I**  **S**  **N**  **R**  **O**  **E**  **E**  **V**  **L**    **E**  **E**  **R**  **M**  **A**  **A**  **H**  **W**  **T**  **C**  **F**  **O**  **S** | 7  8  .  7 | 0  9  .  7 | 1  9  .  7 | 2  9  .  7 | 3  9  .  7 | 4  9  .  7 |

***)***

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***e***

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| **S**  **E**  **G**  **N**  **A**  **H**  **C** | n  o  i  s  r  e  v    d  e  s  a  e  l  e  R    • | e  s  r  e  u  u  s  d  s  e  i  c    o  n  r  o  i  p    s  r  n  e  o  i  p  t  s  a  i  r  d    b  i  n  l  o  a  i  c  t  -  a  e  r  r  b    i  h  l  t  a  g  c    n  s  e  l  u  e  o  i  v  r  a  a  w  v      s  s  t  t  c  c  e  e  r  r  r  r  o  o  C  C      •  • |
| --- | --- | --- |
| **B**  **S**  **F** | -  -  - | 9  0  0  2  -  t  c  O  -  9  0    ,  7  8  5 |
| **E**  **S**  **A**  **E**  **L**  **E**  **R**    **O**  **C**  **E** | -  -  - | 0  7  3  3  7  0  E |
| **M**  **E**  **O**  **R**  **R**  **A**  **P**  **W**  **E**  **T**  **E**    **F**  **D**  **O**  **R**  **S**    **A**  **I**  **O**  **D**  **R**  **B**    **E**  **U**  **V**  **P**  **C** | 7  5  .  9 | 7  5  .  9 |
| **N**  **O**  **I**  **S**  **N**  **R**  **O**  **E**  **E**  **V**  **L**    **E**  **E**  **R**  **M**  **A**  **A**  **H**  **W**  **T**  **C**  **F**  **O**  **S** | 5  2  0  .  8 | 1  1  .  8 |

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**TROUBLESHOOTING**

**FAULT MESSAGES** Product Support Engineer: Effective: Page:

**SVC-CHAM-2.1 REV. C**

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***Introduction*** This section provides troubleshooting information for specific performance limiting conditions that do not necessarily generate

faults and a numerical listing of Chameleon software fault messages.

For each fault, the condition which prompted the fault, the action

taken by the software, and a troubleshooting outline is presented.

The Chameleon has an integrated Verdi laser head and power supply.

It may be necessary to reference the Verdi Service Manual for addi

tional troubleshooting information.

**All of the circuits in the power supply are biased (driven) by low**

**voltages from the Power Piggy board. As a first step in the**

**troubleshooting process, unless the procedure specifies**

**otherwise, the health of these voltages (±5 V and ±12 V) should**

**always be verified.**

***CPU Board, Top Edge***

**Low Voltage Test Points (GND = TP1):**

**+5 V TP2, –5 V TP5**

**+12 V TP3, –12 V TP4**

**Voltages are available on the PDB. Refer to the appropriate**

**Power Distribution board schematic.**

**In addition to the low voltages generated in the power supply,**

**the circuits in the laser head generate several low voltages from**

**higher voltages supplied by the P/S. Note that these voltages**

**have unique labels.**

***Chameleon Pump Board***

**Refer to the appropriate Head board schematic for where to**

**check +5 V, –5 V, +12 V, –12 V, +48 V, and the**

**THERM\_REF\_HEAD.**

**After verifying the health of the low voltages, check the health of**

**the +48 V. This can be accomplished by measuring the voltage**

**on J83 of the Signal Interconnect board, pins 1 and 2.**

**TROUBLESHOOTING FAULT MESSAGES** 

**SVC-CHAM-2.1 REV. C 10/05/2009**

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***Performance Limiting***

***Conditions***

The following performance limiting conditions may exist without the laser reporting the condition as a specific fault. To help identify the cause and resolve the problem, refer to the checklist provided below.

**Low Output Power** Tune wavelength to 800 nm, measure output power and compare to published specifications. If the power is below specification, check

the following:

1. Check the Pump and Cavity PZT values. If PZT values are less

than 0.3 V or greater than 4.4 V, use the recovery function.

2. Verify that the baseplate temperature is below 32°C, which

normally corresponds to a chiller temperature of 20°C. If the

baseplate temperature is too high, check that the chiller is

turned on, that the set-point temperature is 20°C, the pump is

on and coolant is flowing through the tubing.

3. Check that the Verdi Power on the front panel (Pump Laser

Menu / Power Adjustment screen) has reached the correct set

point. If the read power is more than 0.05 W below set point,

then the low Chameleon power may be due to a problem with

the Verdi. Turn the laser to standby and cycle the AC power off

and on.

4. If the Verdi read power is still below the set point following the

AC power cycle, set the Verdi to standby and install the Verdi

HR diagnostic mirror (remove laser cover, bellows, etc.). Set

up an external power meter to monitor the Verdi output. If

measured power is different than set point, follow the Verdi

Vxx Service Manual to fix the calibration.

5. Verify the Verdi mode to ensure that this is TEM00.

6. If the power is still low, measure the wavelength accuracy, and

turn the power supply off and on, then use Home Motor. If the

wavelength accuracy is off by more than 5 nm, perform a

wavelength calibration.

7. Increase the Verdi power level, and if the Chameleon output

power increases in the manner expected and maintains

mode-locking, then increase the Pump Power Percentage level

accordingly.

**TROUBLESHOOTING FAULT MESSAGES** 

**SVC-CHAM-2.1 REV. C 10/05/2009**

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**No Mode-Lock at Water Absorption Wavelengths**

Laser wavelengths of 940 nm and 760 nm are highly absorbed by water (water vapor in air). If the laser makes spec power at 800 mn and mode-locks at all wavelengths other than 940 nm and/or 760 nm, perform the following:

1. Ensure that the MRU has been operating for at least 2 hours.

2. Check the RH value on the front panel of the power supply. If >3%, service the MRU.

**•** Check the DrieRite cartridge. If particles are all pink, replace the cartridge.

**•** Check all internal and external air lines, connections and fittings for leaks.

3. Again confirm spec output power at 800 nm. While at this wavelength, check to see if any PZT values are at extremes. If any at extreme, use Recovery option.

4. Ensure that there are no back-reflections into the laser (from external equipment). Place a power sensor or beam block at the Chameleon output aperture to separate optical systems.

5. Check the electronics as described in the Service manual, to verify that the starter circuit electronics are working and mode-lock detection circuit electronics are working.

6. Set wavelength to 800 nm and adjust Verdi power to see if modelocking is initiated. Recalibrate the power band Q-switch and CW settings at the problem wavelengths.

7. With wavelength set to 800 nm, place the Pump PZT in dither and put the Cavity PZT in manual. Adjust both Cx and Cy indi vidually and monitor Mode-locked Power and Chameleon output power. If the peak mode-locked signal and power occur at a different PZT value from that which occurs from the Recovery Options, then the recovery values at 800 nm need to be changed using the REQX and REQY RS232 commands. After the change, use the recovery option at the required wave length. If there is no peaking of the mode-locked signal or power when the Cx and Cy settings are adjusted, then the system is mis-aligned.

**TROUBLESHOOTING FAULT MESSAGES** 

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**Chameleon Will Not Modelock at Certain**

**Wavelengths**

1. Ensure that the MRU has been operating for at least 2 hours.

2. Check the RH value on the front panel of the power supply. If >3%, service the MRU.

**•** Check the DrieRite cartridge. If particles are all pink, replace the cartridge.

**•** Check all internal and external air lines, connections and fittings for leaks.

3. Again confirm spec output power at 800 nm. While at this wavelength, check to see if any PZT values are at extremes. If any at extreme, use Recovery option.

4. Ensure that there are no back-reflections into the laser (from external equipment). Place a power sensor or beam block at the Chameleon output aperture to separate optical systems.

5. Check the electronics as described in the Vitesse manual, to verify that the starter circuit electronics are working and mode-lock detection circuit electronics are working.

6. Set wavelength to 800 nm and adjust Verdi power to see if modelocking is initiated. Recalibrate the power band Q-switch and CW settings at the problem wavelengths.

7. With wavelength set to 800 nm, place the Pump PZT in dither and put the Cavity PZT in manual. Adjust both Cx and Cy indi vidually and monitor Mode-locked Power and Chameleon output power. If the peak mode-locked signal and power occur at a different PZT value from that which occurs from the Recovery Options, then the recovery values at 800 nm need to be changed using the REQX and REQY RS232 commands. After the change, use the recovery option at the required wave length. If there is no peaking of the mode-locked signal or power when the Cx and Cy settings are adjusted, then the system is mis-aligned.

**TROUBLESHOOTING FAULT MESSAGES** 

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**Wavelength**

**Accuracy is OFF by >3 nm**

**Chameleon Mode is Not TEM00**

1. Turn the power supply off and back on again. 2. Home the Motor.

3. Check the values of Cx and Cy, as these values change during tuning. If these values are at the limits of the range, use the Recovery Option.

4. Select 800 nm wavelength and check if the original recovery PZT values are still valid. If not, change the values at 800 nm and use the recovery at the required wavelength.

5. Assess if the wavelength accuracy is out at one wavelength or across the entire tuning range. Perform a wavelength calibra tion as required.

1. If any of the PZT values are out of range, use the Recovery Option.

2. Go to 800 nm and check if the original recovery PZT values are still valid. If not, change these values at 800 nm and use recovery at the required wavelength.

3. Clean the output window.

4. Check the Verdi mode.

**General Note** During the tuning operation there can be CW spikes. Under normal operation these spikes will not be present when the system is fixed

at a specific wavelength.

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***Power Supply***

***Faults***

**TROUBLESHOOTING FAULT MESSAGES**

**No 48 V PS AC Voltage**

**No 48 V PS DC Voltage**

**Definition:** The AC fault line from the Lambda or Pioneer Magnets (PMI) power supply to the Signal Interconnect board (J88-3) has gone from a low state to a high state. This signal is filtered and inverted on the Signal Interconnect board before being sent to the CPU board.

This signal is not currently acted on by the CPU. If it occurs, 15 to 40 msec later the CPU will loose power and no fault will be displayed. The diode current will fall to zero and the shutter will close all due to a lack of power.

**Action:** If this fault occurs check the following:

5. Corcom assembly fuse, facility power and breaker.

6. Facility power connection on both the primary and secondary side of the Corcom switch/fuse/filter assembly.

7. Cable/plug connection problems between the 48 V supply and the Signal Interconnect board.

8. This can also be caused by failure of the 48 V supply itself.

**Definition:** The DC fault line from the Lambda or Pioneer Magnetics power supply to the Signal Interconnect board (J88-5) has gone from a high state to a low state. This signal is filtered and inverted on the Signal Interconnect board before being sent to the CPU board.

This signal is not currently acted on by the CPU. If it occurs, 15 to 40 msec later the CPU will loose power and no fault will be displayed. The diode current will fall to zero and the shutter will close all due to a lack of power.

**Action:** If this fault occurs check the following:

1. Verify for 48 V PS AC fault first.

2. Cable/plug connection problems between the 48 V supply and the Signal Interconnect board.

3. This can also be caused by failure of the 48 V supply itself.

**TROUBLESHOOTING FAULT MESSAGES** 

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**High 48 V PS**

**Temperature (Lambda only)**

***Verdi Faults***

**Verdi Laser Head Interlock Fault, Fault #1**

**Definition:** The temperature fault line from the Lambda power supply to the Signal Interconnect board (J88-7) has gone from a high state to a low state. This signal is filtered on the Signal Interconnect board before being sent to the CPU board.

This signal is not currently acted on by the CPU. If it occurs, 15 to 40 msec later the CPU will loose power and no fault will be displayed. The diode current will fall to zero and the shutter will close all due to a lack of power.

**Action:** If this fault occurs check the following:

1. 48 V supply fans are working.

2. Power supply fans are working and the air filter is clean and not obstructed.

3. Facility power voltage and stability.

4. Cable/plug connection problems between the Lambda power supply and the Signal Interconnect board.

**Definition:** The Verdi head interlock circuit is open.

If this fault occurs the laser diode current is terminated, the fault message is displayed, and the system shutter is closed.

**Action:** If this fault message appears check the following:

1. Verify the interlock connection, J103, on the Head board.

2. Verify the “Laser Emission” LED is operational. If the LED fails the fault will be triggered.

**TROUBLESHOOTING FAULT MESSAGES** 

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**External Interlock Fault, Fault #2**

**Power Supply Interlock Fault, Fault #3**

**Definition:** The external interlock circuit is open.

If this fault occurs the laser diode current is terminated, the fault message is displayed, and the system shutter is closed.

**Action:** If this fault message appears check the following:

1. Verify that the interlock defeat is fully inserted in the receptor of the Signal Interconnect board. If the customer is using an external interlock circuit, verify the power supply circuit with the factory defeat plug.

2. Verify continuity between the two lower pins, on each side of alignment tab, of the external interlock plug. See Figure 2.1-1 below.

Continuity

Test Pins

Alignment

Tab

***Figure 2.1-1. External Interlock Plug***

3. Verify the connections between the Signal Interconnect and the Display PCB, and the Display PCB and the CPU board.

**Definition:** The power supply interlock circuit is open.

If this fault occurs the laser diode current is terminated, the fault message is displayed, and the system shutter is closed.

**Action:** If this fault message appears check the following:

1. Verify that power supply cover is properly in place and secure.

2. Verify the operation of the P/S interlock and the connection to the Display PCB.

3. Verify the connection between the Display PCB and the CPU BD.

**TROUBLESHOOTING FAULT MESSAGES** 

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**LBO Temperature Fault, Fault #4**

**LBO Not Locked at Temperature Fault, Fault #5**

**Definition:** The LBO temperature has moved out of the range: –12°C < T < 180°C.

If this fault occurs the laser diode current is terminated, the LBO drive voltage is held at the last value previous to the fault, the fault message is displayed, and the system shutter is closed.

**Action:** If this fault message appears check the following:

1. Verify the LBO temperature set point.

2. Verify the health of the LBO temperature thermistor. The resis tance should be 100 kΩ at 25°C.

3. Verify Head connections, and drive signal connection on the Signal Interconnect board.

4. Verify drive signal connections between the Signal Intercon nect BD and the Display PCB.

5. Verify drive signal connections between the Display PCB and the Mother BD.

6. Verify LBO heater drive.

**Definition:** The key is in the “On” position but the LBO is not locked at its operational temperature.

If this fault occurs the laser diode current is terminated, the fault message is displayed, and the system shutter is closed.

**Action:** If this fault message appears check the following:

1. Verify the LBO temperature set point.

2. In the software “Status Screen”, verify that the LBO heating loop is “closed”. If status screen reads “open”, go to the LBO servo screen and close the loop using the Menu Up/Menu Down push button keys on the front panel of the power supply

3. Wait for the LBO to reach operational temperature, approxi mately 60 minutes from cold start.

**TROUBLESHOOTING FAULT MESSAGES** 

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**Vanadate**

**Temperature Fault, Fault #6**

**Etalon**

**Temperature Fault, Fault #7**

**Definition:** The Vanadate temperature has moved out of the range: –12°C <T < 55°C.

If this fault occurs the laser diode current is terminated, the Vanadate drive voltage is set to zero, the fault message is displayed, and the system shutter is closed.

**Action:** If this fault message appears check the following:

1. Verify the Vanadate temperature set point, 35°C typically.

2. Verify the health of the Vanadate temperature thermistor. The resistance should be 10 kΩ at 25°C.

3. Verify Head connections and drive signal connection on the Signal Interconnect board.

4. Verify drive signal connections between the Signal Intercon nect BD and the Display PCB.

5. Verify drive signal connections between the Display PCB and the Mother BD.

6. Verify Vanadate TEC drive.

**Definition:** The etalon temperature has moved out of the range: –12°C <T < 80°C.

If this fault occurs the laser diode current is terminated, the fault message is displayed, and the system shutter is closed.

**Action:** If this fault message appears check the following:

1. Verify Etalon temperature set point.

2. Verify the health of the etalon thermistor. At 25°C the resis tance should be 10 kΩ.

3. Verify laser Head board connections.

4. Verify the operation of the etalon drive power signal (circuit on Power Piggy BD).

**TROUBLESHOOTING FAULT MESSAGES** 

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**Diode 1 or 2**

**Temperature Fault, Fault # 8/9**

**Baseplate**

**Temperature Fault, Fault #10**

**Definition:** The FAP baseplate temperature has moved out of the range: –12°C <T < 45°C.

If this fault occurs the laser diode current is terminated, the drive voltage is set to zero, the fault message is displayed, and the system shutter is closed.

**Action:** If these fault messages appear check the following:

1. Environment of laser system.

2. Power supply fans are working and the air filter is clean and not obstructed.

3. Verify the heat sink temperature.

4. Verify that the cables to the FAP-I are properly connected and that the Diode Temperature set point is properly set.

5. Verify the continuity of the Personality Module cable.

6. Verify the health of the diode (FAP) thermistor. At 25°C the resistance should be 10 kΩ.

**FAP-I #1**: 12-pin black molex connector J41, pins 5 and 7. **FAP-I #2**: 12-pin black molex connector J42, pins 5 and 7. 7. Verify thermal compound between FAP and heat sink.

**Definition:** The laser head baseplate temperature has moved out of the range: –12°C <T < 55°C.

If this fault occurs the laser diode current is terminated, the fault message is displayed, and the system shutter is closed.

**Action:** If this fault messages appears check the following:

1. Chiller is set to the correct temperature. Cooling water flow is unobstructed to and from the laser head.

2. System operating parameters are properly set.

3. Verify the health of the baseplate thermistor. At 25°C the resis tance on the Head board should be 10 kΩ.

4. Verify connectors on Head board and +5 V reference voltage.

**TROUBLESHOOTING FAULT MESSAGES** 

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**Heat Sink 1 or 2 Temperature Fault, Fault #11/12**

**Diode 1 or 2**

**Over Current**

**Fault #16/17**

**Definition:** The FAP heat sink temperature has moved out of the range: –12°C <T < 65°C.

If this fault occurs the laser diode current is terminated, the fault message is displayed, and the system shutter is closed.

**Action:** If this fault messages appears check the following:

1. Verify the connection between the FAP assembly and the Mother BD.

2. Verify the connection between the Mother BD and the CPU BD.

3. Verify the health of the heat sink thermistor. At 25°C the resis tance should be 10 kΩ.

**FAP-I #1**, 12-pin black molex connector J41, pins 6 and 8. **FAP-I #2**, 12-pin black molex connector J42, pins 6 and 8.

4. Verify that the PS fans are working and the air filter is clean and not obstructed.

**Definition:** The read current is greater than 32 A in Light Regula tion.

**Note: No fault is generated in Current Regulation mode**.

If fault occurs; the laser diode current is terminated, the fault message is displayed, and the system shutter is closed.

A diode over-current fault is generally caused by insufficient output power to meet set power requested. The power will continue to increase FAP current until a maximum value is reached. The low power issue may be correctable by temperature optimization or FAP replacement.

**Action:** If this fault message appears check the following:

1. Using an IR viewer verify that light is being emitted from the FAP assembly (i.e., look at the fiber optic cable).

2. Verify the Anode and Cathode connections on the Power Distribution board, on both the primary and secondary side of the Noise Reduction board, and the FAP assembly.

3. Verify the Anode to FAP case ground connection.

**TROUBLESHOOTING FAULT MESSAGES** 

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**Diode 1 or 2 Under Voltage Fault, Fault #19/20**

**Diode 1 or 2 Over Voltage Fault, Fault #21/22**

**Diode 1 or 2**

**EEPROM Fault, Fault #25/26**

4. Measure the actual diode current (gray lead) on both the primary and secondary side of the Noise Reduction board and the FAP assembly.

5. Verify diode drive circuit.

**Definition:** The voltage across the anode and cathode is less than 0.5 V when the current is greater than 10 A.

1. Verify J1 is connected on the CPU board.

**Definition:** The voltage across the anode and cathode is greater than 2.0 V when the current is greater than 10 A.

If these faults occur the laser diode current is terminated, the fault message is displayed, and the system shutter is closed.

**Action:** If these fault messages appear check the following:

1. Verify the anode and cathode connections on the Power Distri bution board, on both the primary and secondary side of the Noise Reduction board, and the FAP assembly.

2. Verify that J1 is connected on the CPU board, and that the laser diode anode is properly grounded to the FAP-I case.

3. Perform a diode voltage calibration.

**Definition:** The CPU was unable to read the diode EEPROM. These faults will only occur during a power up or after a manual reset of the CPU board.

**Action:** If these fault messages appear check the following:

1. Power down and try restarting system.

2. Verify the connection between the FAP assembly cable and the Mother board. Verify the continuity of the cable.

3. Verify the connection between the Mother board and the CPU board.

4. Replace FAP assembly, EEPROM has failed.

**TROUBLESHOOTING FAULT MESSAGES** 

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**Verdi Head**

**EEPROM Fault, Fault #27**

**P/S EEPROM Fault, Fault #28**

**Verdi Head/PS Mismatch Fault, Fault #29**

**LBO Battery Fault, Fault #30**

**Definition:** The CPU was unable to read the Head board EEPROM. This fault will only occur during a power up or after a manual reset of the CPU board.

**Action:** If this fault message appears check the following:

1. Power down and try restarting system.

2. Verify the connection between the laser head and the power supply.

3. Verify +5 V on the Head board.

**Definition:** The CPU was unable to read the power supply EEPROM. This fault will only occur during a power up or after a manual reset of the CPU board.

Note: P/S EEPROM is located on CPU BD.

**Action:** If this fault message appears check the following:

1. Power down and try restarting system.

2. Verify +5 V on CPU board.

**Definition:** The head and power supply are not the same system type. This fault will only occur during a power up and may be related to an EEPROM failure.

**Action:** If this fault message appears check the following:

1. Verify match of software Head Setup and power supply setup menus. For example:

a. 2 W head is selected for 1-FAP power supply. b. 5 W head is selected for 2-FAP power supply. 2. See Head and power supply EEPROM fault messages.

**Definition:** The battery has failed the power supply battery test.

If this fault occurs the laser diode current is terminated, the LBO cool-down process is started, the fault message is displayed, and the system shutter is closed.

**TROUBLESHOOTING FAULT MESSAGES** 

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**Action:** If this fault messages appears check the following:

1. Verify that connections between +12 V battery and the Mother

BD.

2. Verify the connection between the Mother BD and the CPU

BD.

3. Inspect battery for visual signs of damage (cracked case,

leakage,...)

4. Verify operation of battery charge circuit by attaching a DVM

across R8 (90 MHz Chameleon) or R9 (80 MHz Chameleon)

on the Mother board, polarity of hookup is not important. The

voltage read will depend on battery charge, see Table 2.1-1.

With the facility power on, the voltage across the battery termi

nals should read between 13 and 14.6 V.

***Table 2.1-1. Battery Charge Circuit Voltages***

| **BATTERY STATE** | **BATTERY VOLTAGE** | **CHARGE CIRCUIT VOLTAGE** |
| --- | --- | --- |
| Very Low | 9 V to 11 V | 245 mV |
| Low | 11 V to 12 V | 245 mV to 200 mV |
| Moderate | 12 V to 13 V | 160 mV to 100 mV |
| Fully Charged | 13 V to 13.4 V | 60 mV to 10 mV |
| Over Charged | Over 13.4 V | 0 mV |

**Shutter State Mismatch Fault, Fault #31**

**Definition:** The drive state for the shutter solenoid disagrees with the position of the shutter sensor.

If this fault occurs the laser diode current is terminated, the fault message is displayed, and the system shutter is closed.

1. Verify shutter connection to Verdi Head board. 2. Verify that the shutter solenoid can move freely. 3. Verify the shutter drive voltage.

**TROUBLESHOOTING FAULT MESSAGES** 

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**CPU EEPROM Checksum Fault, Fault #32**

**Verdi Head**

**EEPROM**

**Checksum Fault, Fault #33**

**Diode 1or 2**

**EEPROM**

**Checksum Fault, Fault #34/35**

**Definition:** EEPROM contents have changed since the CPU EEPROM was last written to.

If this fault occurs the Error is displayed and the system will beep. This fault will not cause the system to shut down.

**Actions:** If this fault message appears check the following:

1. Press Exit button to clear fault.

2. If fault remains, Cycle the power.

3. If the fault remains, write down all relevant data (temperature set points and Current Delta) and clear the CPU EEPROM in the EEPROM Diagnostics menu. **The current to the diodes will have to be recalibrated and the Current Delta re-entered following this procedure.**

**Definition:** EEPROM contents have changed since the Head EEPROM was last written to.

If this fault occurs the Error is displayed and the system will beep. This fault will not cause the system to shut down.

**Action:** If this fault message appears check the following:

1. Press Exit button to clear fault.

2. If fault remains, Cycle the power.

3. If the fault remains, write down all relevant data (temperature set points and head hours) and clear the HEAD EEPROM in the EEPROM Diagnostics menu. **All temperatures and head hours will have to be re-entered following this procedure and the photocell will need to be recalibrated.**

**Definition:** The EEPROM contents have changed since the Diode EEPROM was last written to.

If this fault occurs the Error is displayed and the system will beep. This fault will not cause the system to shut down.

**Action:** If this fault message appears check the following:

1. Press Exit button to clear fault.

2. If fault remains, Cycle the power.

**TROUBLESHOOTING FAULT MESSAGES** 

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**CPU EEPROM Range Fault, Fault #36**

**Verdi Head EEPROM Range Fault, Fault #37**

3. If the fault remains, write down all relevant data (all tempera ture set points and diode hours) and clear the Diode EEPROM in the EEPROM Diagnostics menu. **The Diode set tempera ture and hours will have to be re-entered following this procedure.**

**Definition:** A value stored in the CPU EEPROM is out of specified range.

If this fault occurs the Error is displayed and the system will beep. This fault will not cause the system to shut down.

**Action:** If this fault message appears check the following:

1. Press Exit button to clear fault.

2. If fault remains, Cycle the power.

3. If the fault remains, write down all relevant data (temperature set points and Current Delta) and clear the CPU EEPROM in the EEPROM Diagnostics menu. **The current to the diodes will have to be recalibrated and the Current Delta re-entered following this procedure.**

**Definition:** A value stored in the Head EEPROM is out of specified range.

If this fault occurs the Error is displayed and the system will beep. This fault will not cause the system to shut down.

**Action:** If this fault message appears check the following:

1. Press Exit button to clear fault.

2. If the fault remains, Cycle the power.

3. If the fault remains, write down all relevant data (temperature set points and head hours) and clear the Head EEPROM in the EEPROM Diagnostics menu. **All temperatures and head hours will have to be re-entered following this procedure and the photocell will need to be recalibrated.**

**TROUBLESHOOTING FAULT MESSAGES** 

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**Diode 1 or 2**

**EEPROM Range Fault, Fault #38/39**

**Head-Diode**

**Mismatch Fault, Fault #40**

**Definition:** A value stored in the Diode EEPROM is out of specified range.

If this fault occurs the Error is displayed and the system will beep. This fault will not cause the system to shut down.

**Action:** If this fault message appears check the following:

1. Press Exit button to clear fault.

2. If fault remains, Cycle the power.

3. If the fault remains, write down all relevant data (all tempera ture set points and diode hours) and clear the Diode EEPROM in the EEPROM Diagnostics menu. **The Diode set tempera ture and hours will have to be re-entered following this procedure.**

**Definition:** The diode initialization does not match the head initial ization.

If this fault occurs the Error is displayed and the system will beep. This fault will not cause the system to shut down.

**Action:** If this fault message appears check the following:

1. Press Exit button to clear fault.

2. If fault remains, cycle the power.

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***90 MHz***

***Chameleon***

***Faults***

**TROUBLESHOOTING FAULT MESSAGES**

**Lost Modelock Fault, Fault #43**

**Definition:** The “Modelocked” status is monitored every 1 second provided that:

**•** the system is not in Standby

**•** “automodelock” is enabled

**•** the system is not on the process of turning-on the Chame leon light loop mode

**•** Starter does not turn-off after laser is modelocked.

If it is detected that the system is not Modelocked for a continuous period of 60 seconds auto modelocking is disabled, the fault is indi cated on the display, and the fault code (number) is reported in the RS-232 fault queries. This fault will “not” cause a Verdi system shut down.

**Action:** If this fault message appears check/adjust the following:

1. Use PZT Recovery function.

2. Place the laser system in Standby, verify that the Automode locking function is enabled, and attempt to restart the system.

3. Place the laser system in Standby, enable the PowerTrack func tion and disable the Automodelocking function.

a. Verify that the baseplate temperature is stable and that the chiller is set to 25ºC (90 MHz).

b. Using an external power meter, verify that the system is able to achieve **specified** output power at 800 nm.

c. Verify that the internal power reading matches that of the external meter, recalibrate if required.

d. Through the front panel of the power supply enable the AutoModelocking function.

If the system does not modelock or stay modelocked after completing step 2, continue troubleshooting as outlined in the Modelock Detection circuit description.

**TROUBLESHOOTING FAULT MESSAGES** 

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**Lost Power Track Fault, Fault #44**

**Definition:** The “PowerTrack” status is monitored every 1 second provided that:

**•** the system is not in Standby

**•** “Power Tracking” is enabled

**•** the system is not on the process of turning-on the Chame leon light loop mode

If it is detected that the system is not Power Tracking for a contin uous period of 60 seconds the fault is indicated on the display, and the fault code (number) is reported in the RS-232 fault queries. This fault will “not” cause a Verdi system shut down.

**Action:** If this fault message appears check/adjust the following:

1. Perform PZT Recovery.

2. Place the laser system in Standby. Through the front panel of the power supply, verify that the system is setup for automated operation.

a. the Power Track Function is enabled

b. the manual control of the PZTs is not enabled c. the Peak Hold function is not enabled.

3. Verify that the chiller is on and that the Chameleon baseplate is at operational temperature, typically 25°C. The exact manu facturing set temperature can be found on the Customer Data sheet.

4. Verify that all of the Verdi servo’s are initially locked, and from the front panel of the power supply verify that the 532 nm power reaches the typical range for pumping the VPUF cavity:

Note that some of the servos will go into seek as the diode current increases and the cavity/component temperatures increase. All Verdi servos should re-lock after a short period of time.

If the Verdi is not reaching typical or maximum output power there is most likely a problem with the Verdi pump laser.

If the system does not achieve stable PowerTrack operation after completing step 3, and the Verdi seems to be operating properly, continue troubleshooting as outline in the Power Track circuit description (SVC-CHAM-3.2).

**TROUBLESHOOTING FAULT MESSAGES** 

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**Below QSwitch Power Fault, Fault #46**

**Ti-Sapph Temp., Fault #47**

**Definition:** This fault is currently inactive.

If this fault occurs a warning message is displayed and the corre sponding fault code (number) is reported in the RS-232 fault queries. This fault will “not” cause a Verdi system shut down.

**Action:** None

**Definition:** The Ti-Sapphire temperature reading is monitored every 1 second if the system is not in Standby. The operational range (no fault condition) is 10°C <T < 70°C.

If the crystal temperature is out of range for a continuous period of 10 seconds the fault is indicated on the front panel display and the fault code (number) is reported in the RS-232 fault queries. This fault will “not” cause a Verdi system shut down.

**Action:** If this fault message appears check/adjust the following:

1. With the laser system enabled, through the front panel of the power supply, verify that the “base plate temp” is stable and set at approximately 35°C.

If the baseplate temperature is too high, low, or unstable; the appropriate chiller and/or cooling line adjustments or repairs should be made before proceeding.

**TROUBLESHOOTING FAULT MESSAGES** 

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**Pump PZT X or Y Fault, Fault #49/50**

***80 MHz***

***Chameleon Faults***

**Cavity Humidity Fault, Fault #50**

**Definition:** The Pump PZT X and Y voltages are monitored every 1 second provided that:

**•** the system is not in Standby

**•** the system is Power Tracking

**•** the system is lasing (UF)

If the detected voltage is out of the range 0.5 < V < 4.7 for a contin uous period of 60 seconds, the fault is indicated on the front panel display and the corresponding fault code (number) is reported in the RS-232 fault queries. This fault will “not” cause a Verdi system shut down.

**Action:** If this fault message appears check/adjust the following:

1. With the laser system enabled, through the front panel of the power supply, verify that the “base plate temp” is stable and set at approximately 25°C.

2. Through the front panel of the power supply, verify that the system is setup for automated operation.

a. the Power Track Function is enabled

b. the manual control of the PZTs is not enabled c. the Peak Hold function is not enabled.

Attempt to restart the laser system.

3. Perform PZR Recovery.

**Definition:** The cavity humidity fault occurs when the relative humidity (RH) is > 5%.

The Chameleon may be unable to remain modelocked across its tuning range, in particular 920 to 980 nm, because of excessive moisture in the VPUF cavity. The cavity should be a closed loop consisting of the VPUF cavity, MRU, and air hoses. Typically, the humidity should measure about 0% RH. If it measures above 5%