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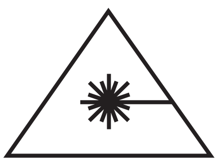
Optical Safety

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.



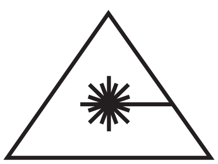
Direct eye contact with the output beam from the laser will cause serious damage and possible blindness.

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 operator'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.

5. Maintain experimental setups at low heights to prevent inadvertent 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 potential 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.

Safety Features and Compliance to Government Requirements

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 requirements 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 “Radiation Safety of Laser Products”. Compliance of this laser with the (LVD) requirements is certified by the CE mark.

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 classification 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

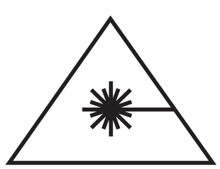
The appropriately labeled lights on both the power supply and the laser head illuminate approximately 30 seconds before laser emission can occur. Amber lights are used so that they will be seen when the proper type of safety glasses are used [CFR 1040.10(f)(5)/EN 60825-1, clause 4.6].

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.

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

Location of Safety Labels

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]].

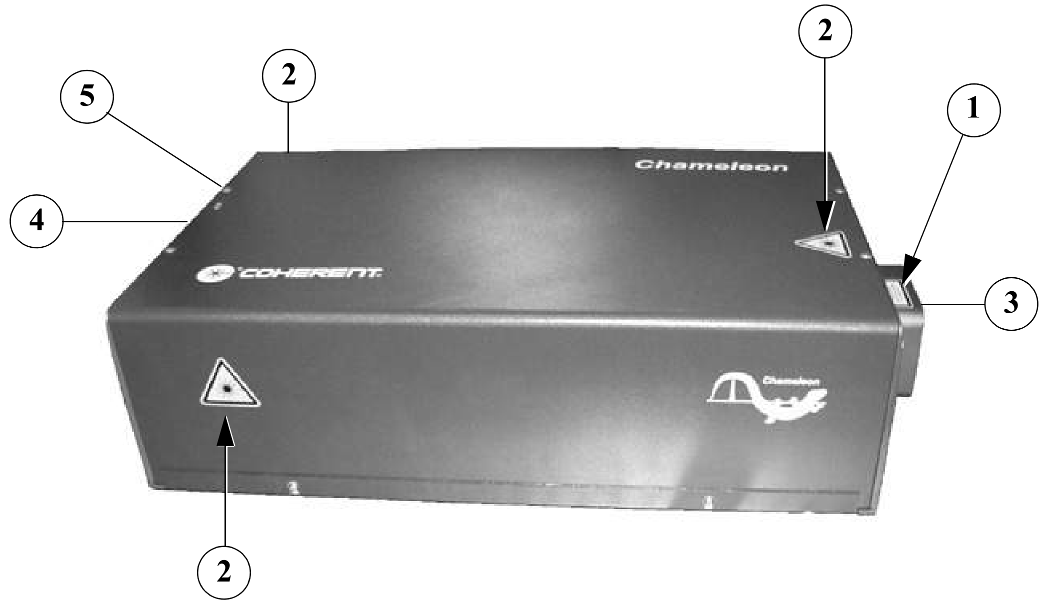
Electromagnetic Compatibility

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

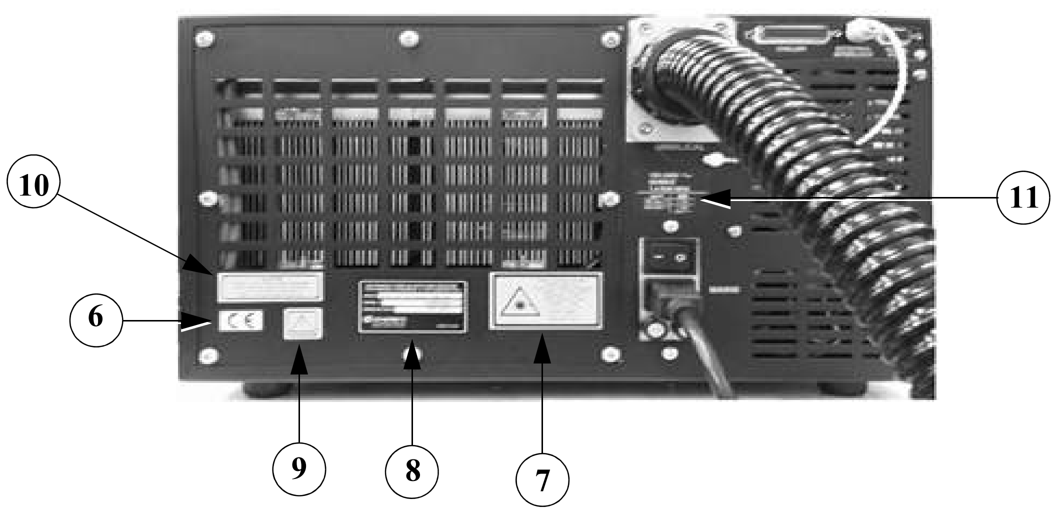
Conformance (EMC) is achieved through compliance with the harmonized standards EN 55011 and/or EN 55022 (1998) for emission and EN 50082-1 (1998) for immunity.

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.

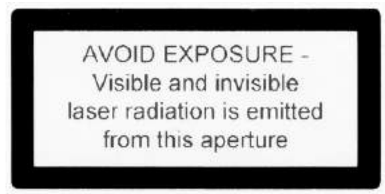


LASER HEAD



POWER SUPPLY

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



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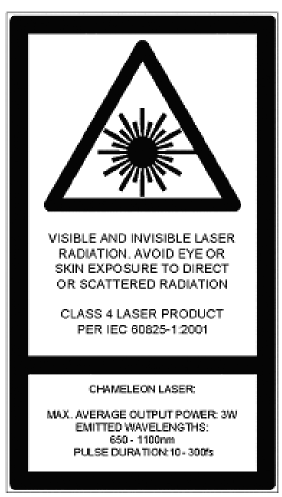

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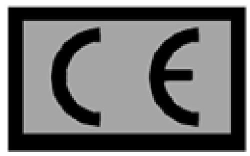
Figure 1.1-1. Safety Features and Labels (Sheet 2 of 4)

5.



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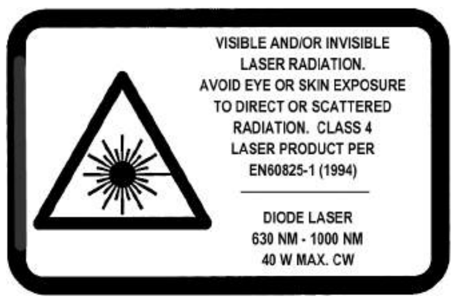

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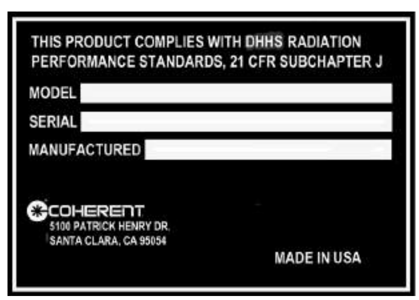

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Figure 1.1-1. Safety Features and Labels (Sheet 3 of 4)

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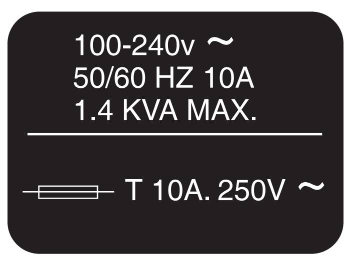

11.

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

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)

Test Equipment

1. Spectrum Analyzer w/ BNC cables
   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

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

Shipment Inspection

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. Interconnecting 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.

Environmental Requirements

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).

Electrical Requirements

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

Unpacking the Power Supply and Laser Head

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.

Unpacking and Set Up of the Water Chiller

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 standard IEC connector and will accept 100-240 VAC 50/60 Hz. <u>Do not connect the power cable at this time.</u>

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 Corrosion 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.

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 Baseplate.
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.

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 available 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 desiccant 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 contaminated 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.

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 contamination 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 illuminate 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

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.

System and Test Equipment Set UP

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 recommends 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 inspection.

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

Figure 1.2-3. Rear View of Chameleon Laser Head

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.

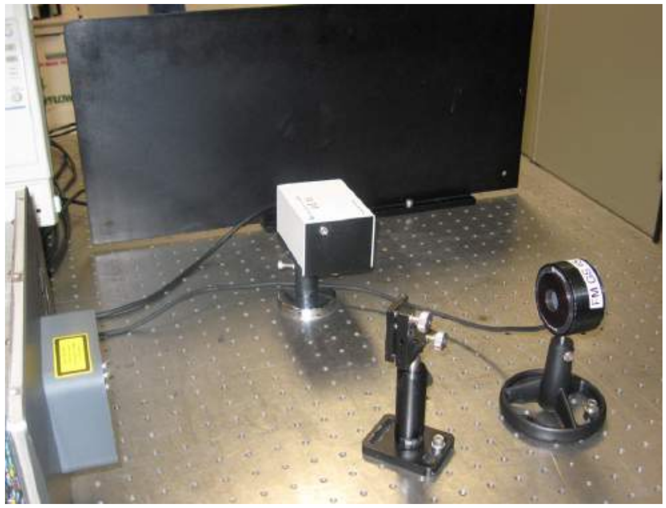

Figure 1.2-5. Test Set Up with Beam Split, IST/Rees Spectrometer, and Power Supply

9. Complete the electrical connection of the IST/Rees spectrometer 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 temperatures 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.

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.

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14. Close the shutter.

System Acceptance Test

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 Chameleon 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 alignment 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.

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2. Open the shutter.

3. Tune the system to 800 nm.
4. Using the Datalogger program:
    a. Record Data is not required.
    b. For Wavelength Sweep:
    - 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 Wavelength.
    - The external wavelength is within 5 nm of the Set Wavelength.
    - The output of the external spectrometer and note any instability, not modelocking, Q-Switching, or CW Breakthrough.

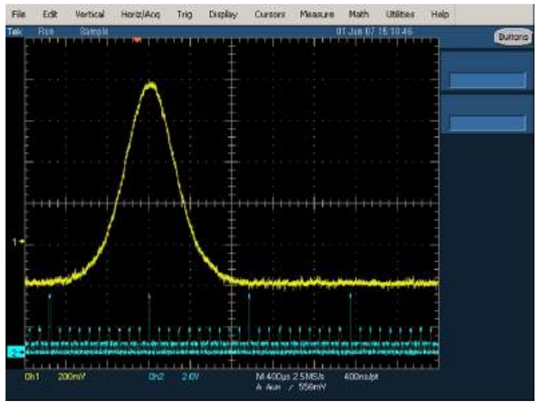

Figure 1.2-6. Example of Acceptable Modelocked Laser Output

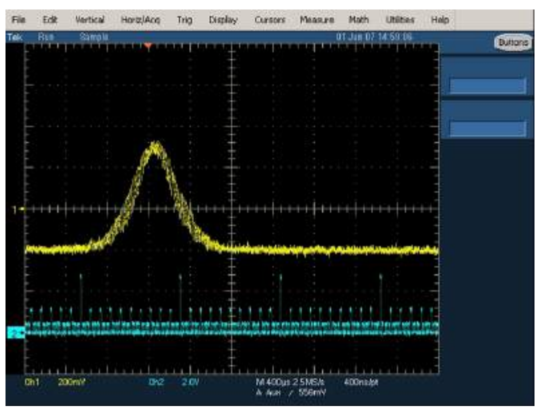

Figure 1.2-7. Example of Unacceptable Laser Output (Q-Switching)

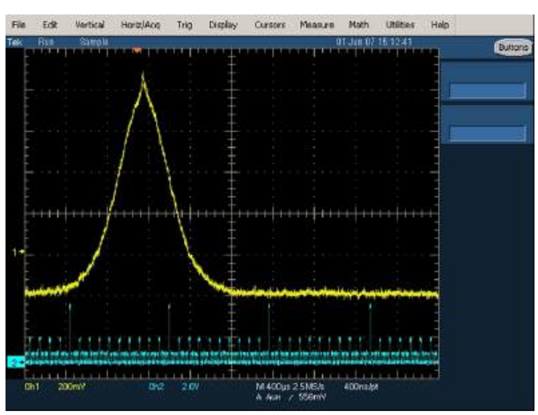

Figure 1.2-8. Example of Laser Output with CW Breakthrough

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

9. Close the Datalogger program.
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 Breakthrough 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.

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 operation, 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)

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 microscope 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.

Installation of the Chameleon GUI Program

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.

5. Windows should recognize that the new hardware (USB spectrometer). 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 spectrometer.

Closing the Installation

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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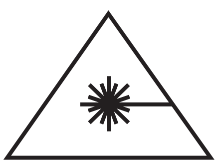
Chameleon Ti:Sapphire Oscillator

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 wavelength range can cover 400 nm (680 nm – 1080 nm). Typical bandwidth 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. Circularity 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 oscillators 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.

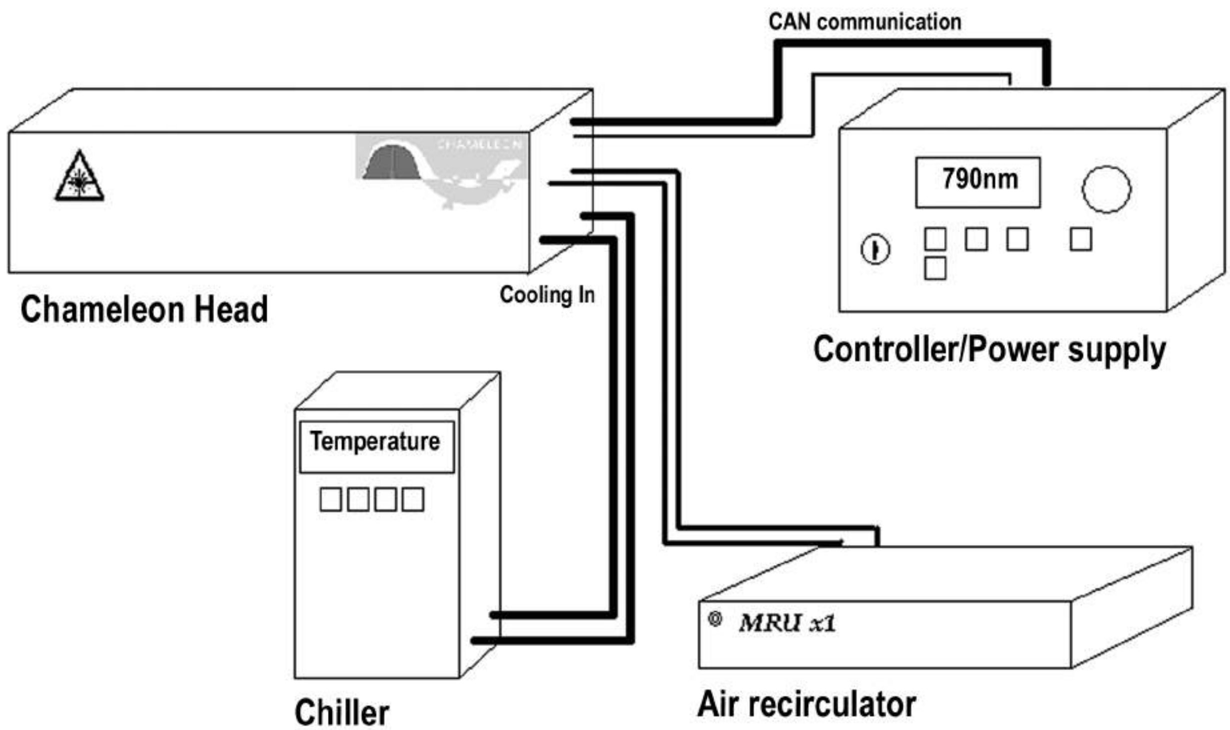


Figure 1.3-1. Chameleon System

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.

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.

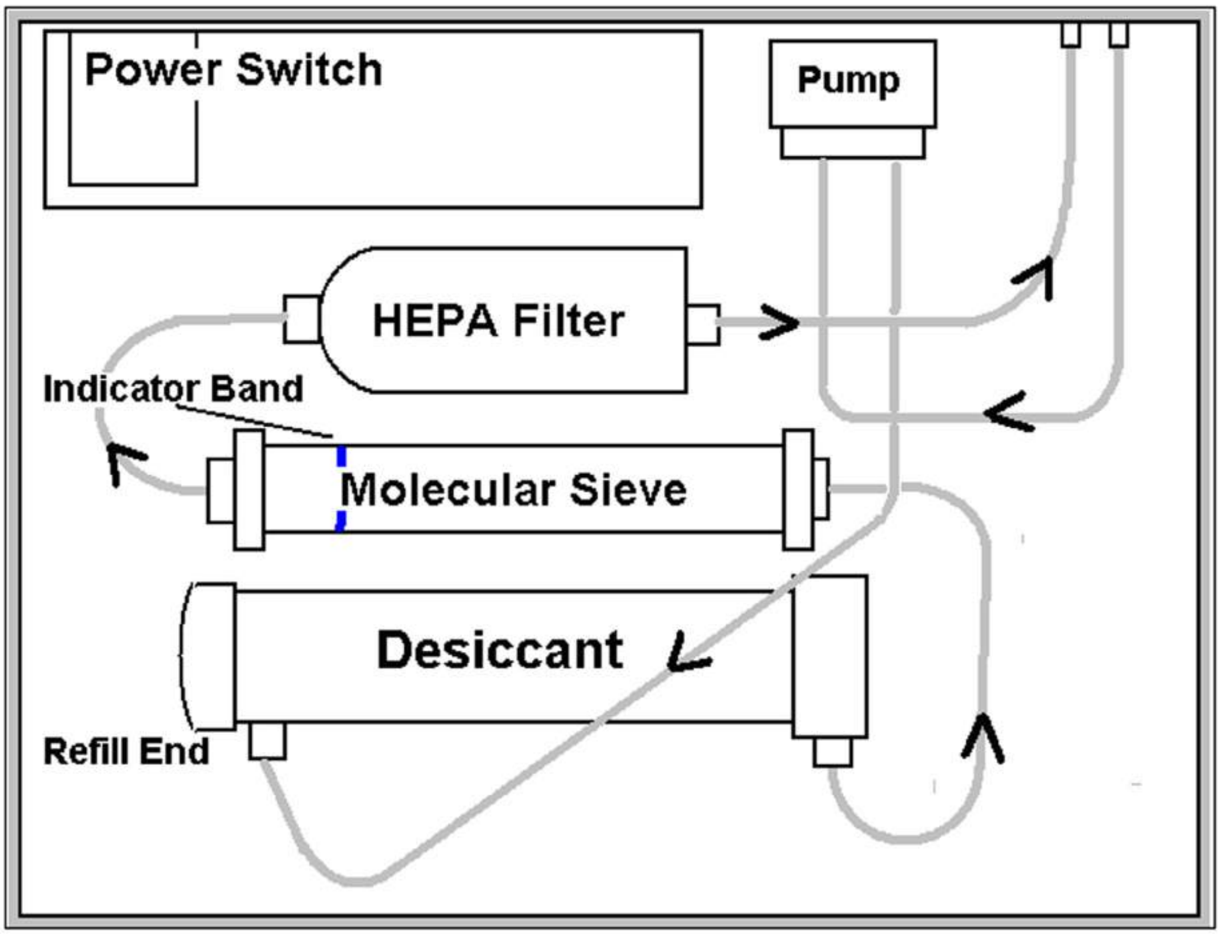


Figure 1.3-2. MRU X1

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.

- 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 recommended 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 Thermotek, 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.

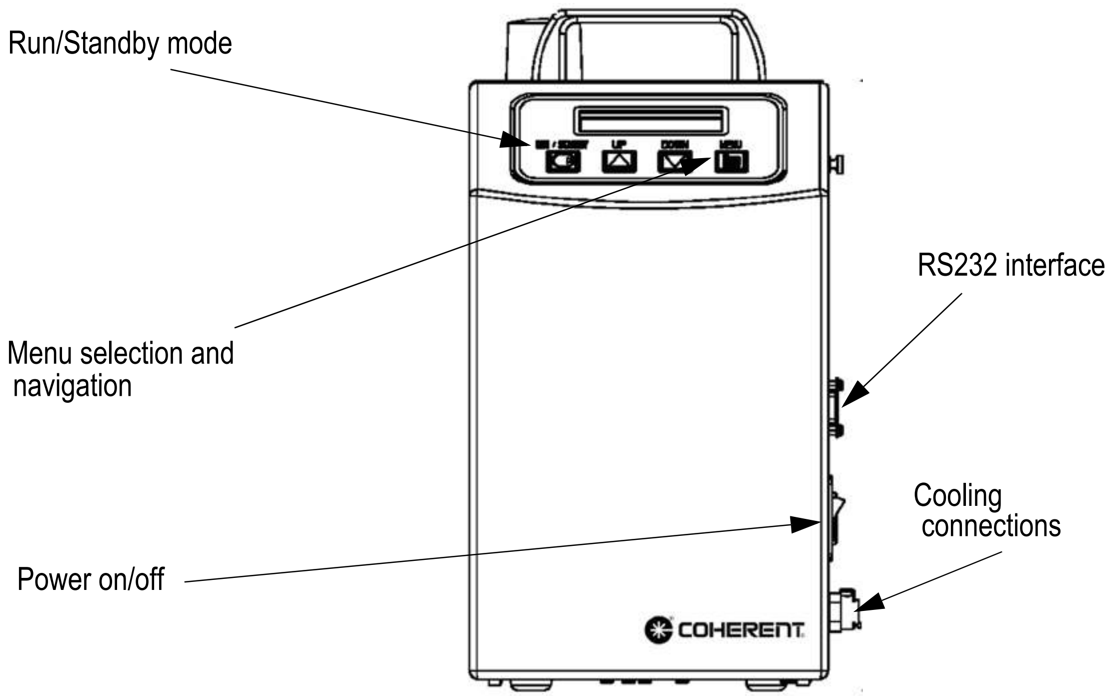


Figure 1.3-3. Thermotek Model T255P

The Thermotek chiller is designed to run with distilled water, but certain approved chemicals can be added. Coherent strongly recommends 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) respectively. These Verdis are custom tested and manufactured for integration 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

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 hardware. 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.

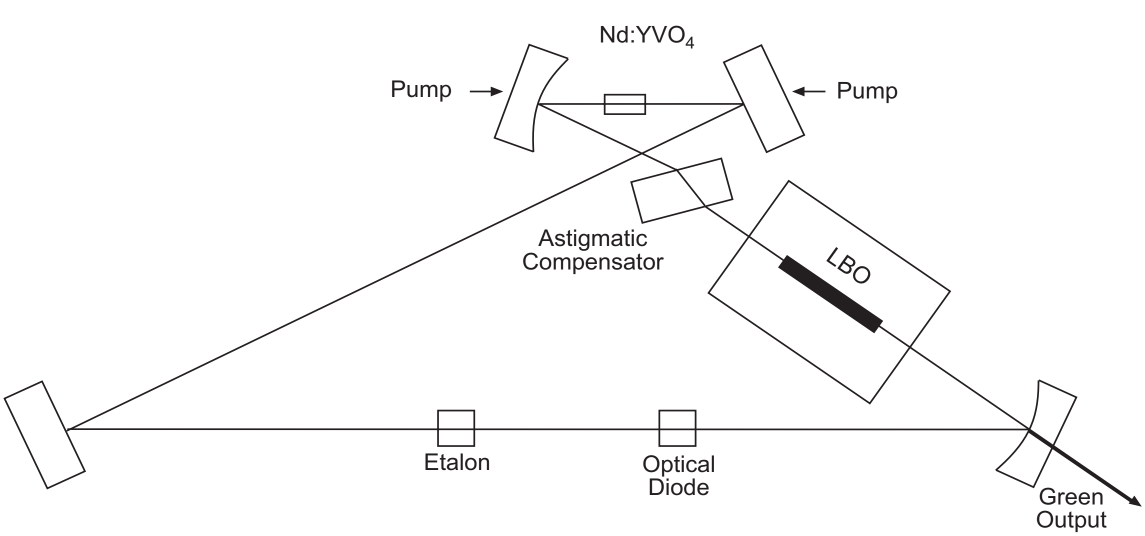


Figure 1.3-4. Pump Head Optical Schematic

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.

Power Supply/ Controller

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 Chameleon 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 handshaking between two separate microprocessors. Both the Verdi CPU board and the Chameleon Head board have their own microprocessor.

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

Analog board in addition to the Verdi Head board. The newest Chameleons use the Verdi software in its present state. Minimal software 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 controlling 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 photodiode 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.

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 temperature 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 conservatively 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. Accumulated heat in the laser head is dissipated by the water-cooled baseplate. Baseplate temperature is monitored by the CPU in the power supply and by the Chameleon software on later 80 MHz Chameleons. More detailed information can be obtained from the operator'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 maintaining 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 bandwidth 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 perturbation to allow the longitudinal modes to easily find phase relationship to both the cavity length, and temporally with each other. Generally modelocking is maintained as the system changes wavelengths, 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.

Table 1.4-1. 90 MHz Cavity (Chameleon 210 / XR) Software Version History

Chameleon Software Version	CPU Board EEPROM Part Number	ECO Release	FSB	Changes
7.0T	1064420	E016271, 09-Mar-2004	na	• Release for XR
7.1T	1072618	E021800, 20-Nov-2004	na	
7.4T	1086453	E027327, 28-Apr-2005	na	• Improve LBO servo
7.5T	1100705	E032049, 29-Sep-2005	na	• Changed back to previous LBO parameter values

Table 1.4-2. 80 MHz Cavity (Chameleon XR/ Ultra / Ultra II) Software Version History

Chameleon Software Version	CPU Board EEPROM Verdi Software	ECO Release	FSB	Changes
7.84	8.83, 1080102	E030636, 31-Aug-2005	na	• Misc. changes / additions
7.84A	8.83, 1080102	E032935, 24-Oct-2005	na	• Added slit home retry
7.84B	8.83, 1080102	E0033071, 28-Oct-2005	na	• Improved modelocking capability
7.86	8.83, 1080102	E032572, 21-Nov-2005	na	• Numerous changes based on field results and extensive in-house testing.

Table 1.4-2. 80 MHz Cavity (Chameleon XR/ Ultra / Ultra II) Software Version History (Continued)

Chameleon Software Version	CPU Board EEPROM Verdi Software	ECO Release	FSB	Changes
7.87	8.83, 1080102	E037101, 09-Feb-2006	na	• Corrected CAN issue causing Head Comm Fault (54). • Saves Verdi Head EEPROM data in Interface Board EEPROM incase of corrupted data. • Updated Head EEPROM default data.
7.90	8.83, 1080102	E043661, 17-Aug-2006	493, 06-Nov-2006	• Pump raster slowed down to improve finding lasing. • Threshold ranges extended to between 1% to 100%. • Now displays average laser diode current.
7.91	8.83, 1080102	E044779, 29-Sep-2006	493, 06-Nov-2006	• Improved handling of slow and fast photodiodes. • Reinstated verbose commands and queries. • Corrected queries with CRLF.
7.92	8.83, 1080102	E047743, 16-Nov-2007	498, 03-Jan-2007	• Corrects reading of Chameleon Head Board revision. • Allows proper operation with RoHS power supply LCDs • Corrects incorrect Verdi power during start up.
7.93	9.53, 1136058	E053350, 07-May-2007	506, 09-May-2007	• Corrects Ramping by using ?LRS instead of ?P to determine if Verdi is at Set Power. • Corrects modelock fault during start by not checking for mode-lock until system ready • Can now set head hours for replacement PCBA.
7.94	9.53, 1136058	E055451, 27-Jun-2007	511, 19-Jul-2007	• Corrects incompatibility of ‘redesigned’ EEPROM used on Chameleon Head Board.

Table 1.4-2. 80 MHz Cavity (Chameleon XR/ Ultra / Ultra II) Software Version History (Continued)

CHAMELEON SOFTWARE VERSION	CPU BOARD EEPROM VERDI SOFTWARE	ECO RELEASE	FSB	CHANGES
8.025	9.57	---	---	• Released version
8.11	9.57	E073370	587, 09-Oct-2009	• Corrects wavelength re-calibration procedure • Corrects various calibration dispersion issues

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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 additional 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.

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 TEM_{00}.
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.

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 individually 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 wavelength. 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.

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 individually 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 wavelength. 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.

Wavelength Accuracy is OFF by >3 nm

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 calibration as required.

Chameleon Mode is Not TEM_{00}

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.

Power Supply Faults

No 48 V PS AC 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.

No 48 V PS DC Voltage

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.

High 48 V PS Temperature (Lambda only)

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.

Verdi Faults

Verdi Laser Head Interlock Fault, Fault #1

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.

External Interlock Fault, Fault #2

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.

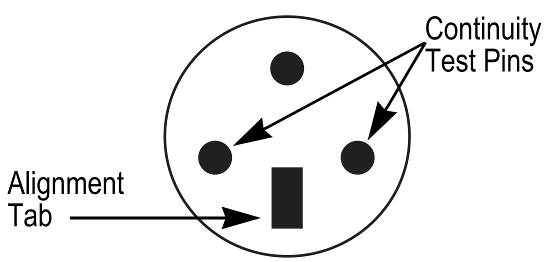

Figure 2.1-1. External Interlock Plug

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

Power Supply Interlock Fault, Fault #3

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.

LBO Temperature Fault, Fault #4

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 resistance 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 Interconnect BD and the Display PCB.
5. Verify drive signal connections between the Display PCB and the Mother BD.
6. Verify LBO heater drive.

LBO Not Locked at Temperature Fault, Fault #5

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, approximately 60 minutes from cold start.

Vanadate Temperature Fault, Fault #6

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 Interconnect BD and the Display PCB.
5. Verify drive signal connections between the Display PCB and the Mother BD.
6. Verify Vanadate TEC drive.

Etalon Temperature Fault, Fault #7

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 resistance 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).

Diode 1 or 2 Temperature Fault, Fault # 8/9

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.

Baseplate Temperature Fault, Fault #10

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 resistance on the Head board should be 10 kΩ
4. Verify connectors on Head board and +5 V reference voltage.

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

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 resistance 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.

Diode 1 or 2 Over Current Fault #16/17

Definition: The read current is greater than 32 A in Light Regulation.

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.

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.

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

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.

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

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 Distribution 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.

Diode 1 or 2 EEPROM Fault, Fault #25/26

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.

Verdi Head EEPROM Fault, Fault #27

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.

P/S EEPROM Fault, Fault #28

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.

Verdi Head/PS Mismatch Fault, Fault #29

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.

LBO Battery Fault, Fault #30

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.

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 terminals 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.

CPU EEPROM Checksum Fault, Fault #32

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.**

Verdi Head EEPROM Checksum Fault, Fault #33

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.**

Diode 1or 2 EEPROM Checksum Fault, Fault #34/35

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.

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

CPU EEPROM Range Fault, Fault #36

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.**

Verdi Head EEPROM Range Fault, Fault #37

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.**

Diode 1 or 2 EEPROM Range Fault, Fault #38/39

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 temperature set points and diode hours) and clear the Diode EEPROM in the EEPROM Diagnostics menu. **The Diode set temperature and hours will have to be re-entered following this procedure.**

Head-Diode Mismatch Fault, Fault #40

Definition: The diode initialization does not match the head initialization.

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.

90 MHz Chameleon Faults

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 Chameleon 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 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. Use PZT Recovery function.
2. Place the laser system in Standby, verify that the Automodelocking function is enabled, and attempt to restart the system.
3. Place the laser system in Standby, enable the PowerTrack function 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.

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 Chameleon light loop mode

If it is detected that the system is not Power Tracking for a continuous 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 manufacturing 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 PowerTrack circuit description (SVC-CHAM-3.2).

Below QSwitch Power Fault, Fault #46

Definition: This fault is currently inactive.

If this fault occurs a warning message is displayed 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: None

Ti-Sapph Temp., Fault #47

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.

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

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 continuous 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.

80 MHz Chameleon Faults

Cavity Humidity Fault, Fault #50

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%

RH, there could be a leak in the system or the MRU is unable to remove moisture from any inherent leakage in high ambient humidity.

Action: If this fault appears:

1. Verify that the MRU is running.
2. Open the MRU cover and verify that the Drierite filter is still blue and not showing signs of turning pink. If pink, change the Drierite filter or material, and let MRU run for 2 hours before attempting to run the Chameleon laser.
3. Check air hose fittings and o-rings for signs of damage or wear. Replace if needed.

Tuning Stepper Motor Homing Fault, Fault #51

Definition: The stepper motor used for the Tuning slit was not able to find the home position.

The stepper motor locates home position when the laser is starting and when performing a requested power map. If the motor cannot detect the home position, such as the motor is not moving due to electrical or mechanical reasons, this fault is generated.

Action: If this fault appears:

1. Attempt to home the Tuning stepper motor using the HM=1 RS-232 command or from the Home Stepper menu.
2. Check Chameleon Head board connections and seating.
3. Cycle the power supply power.
4. Check the appropriate signals on the Chameleon Head board to see if the motor is moving. This can help determine if the issue is electrical (Head board, interconnections) or possibly mechanical.

Output Power is Low, Fault #52

Definition: This fault indicates that the system is unable to start lasing or has low power.

After the Verdi power ramps up and it's determined that the Verdi has reach requested power, the system can check it's Chameleon power level against the lasing threshold. If the system does not reach the lasing threshold then this fault is generated.

Action: If this fault appears:

1. Verify Verdi pump power.
2. Verify Pump and Cavity PZT status and positions.
3. Verify that the chiller set temperature is at 20ºC and the Baseplate Temperature is about 30 to 35ºC.
4. Run the Initialise.
5. Manually optimize the PZT positions and run Power Map.

Laser Failed to Modelock, Fault #53

Definition: This fault indicates that the Chameleon was unable to modelock.

After the system has started lasing, the starter fires and checks for modelock status. If the system is not modelocked this fault is generated.

Action: If this fault appears:

1. Verify that Modelock Search in the Settings menu is set to On.
2. Verify that Starter in the Settings menu is set to Auto.
3. Verify Verdi pump power and that Verdi status is no longer Ramping.
4. Verify Pump and Cavity PZT status and positions.
5. Verify that the chiller set temperature is at 20ºC and the Baseplate Temperature is about 30 to 35ºC.
6. Verify cavity relative humidity.
7. Run Initialise.
8. Manually optimize the PZT positions and run Power Map.

Head Board Communication Fault, Fault #54

Definition: The Verdi Interface board was unable to communicate with the Chameleon Head board.

Action: If this fault appears:

1. Check the connections at the Chameleon Head board, Verdi Interface board, and any associated interconnections; particularly the CAN interface.
2. Cycle the power supply power.
3. Upload Chameleon Head board software. Upgrade Chameleon Head board and Verdi Interface board to current version if possible. If possible, save contents of Chameleon Head board.
4. Replace Chameleon Head board and /or Verdi Interface board

System Lasing Fault, Fault #55

Definition: This fault indicates that the Chameleon has stopped lasing. For Vision systems, start below.

Action: If this fault appears:

1. Turn the key to STANDBY for a few seconds and back to ON.
2. Verify Verdi pump power.
3. Verify Pump and Cavity PZT status and positions.
4. Verify that the chiller set temperature is at 20ºC and the Baseplate Temperature is about 30 to 35ºC.
5. Run the Initialise.
6. With an IR viewer or external power meter, verify system is lasing.
7. Check Lasing Threshold in the Calibration Set Up menu. Also check the slow photodiode voltage.

If this fault appears on a Vision:

- Tune to 720 nm (a visible wavelength).
- Remove the fast photodiode, and using an IR viewer or card, look for light out. If there is light visible, the issue is within the Precompensation section. If there is no light, the problem lies within the Chameleon cavity.

  Light visible: see procedure for Fault #59.
  No light: see procedure steps 1-7 for Fault #55 (above).

PS-Head EEPROM Mismatch Fault, Fault #56

Definition: The system recognizes that the software versions of the Chameleon Head board and Verdi Interface board are different; these are expected to be the same version number.

Action: If this fault appears:

1. On the System Information menu, verify that the PSU Software (Verdi Interface board) and Head Software (Chameleon Head board) versions are the same.
2. Upload current version software to both the Chameleon Head board and the Verdi Interface board, or replace both boards with ones with current version software.

Modelock Slit Stepper Motor Homing Fault, Fault #57

Definition: The stepper motor used for the Modelock slit was not able to find the home position.

The stepper motor locates home position when the laser is starting and when performing a requested power map. If the motor cannot detect the home position, such as the motor is not moving due to electrical or mechanical reasons, this fault is generated.

Action: If this fault appears:

1. Attempt to home the Modelock Slit stepper motor using the HMSLIT=1 RS-232 command or from the Home Stepper menu.
2. Cycle the power supply power.
3. Check Chameleon Head board connections and seating.
4. Check that Slit Stepper Piggy board is seated correctly.
5. Check the appropriate signals on the Chameleon Head board to see if the motor is moving. This can help determine if the issue is electrical (Head board, interconnections) or possibly mechanical.

Verdi EEPROM Fault, Fault #58

Definition:

Prior to Verdi software version 9.53, it was possible for a few Verdi Head EEPROM locations to become corrupted. Chameleon software versions 7.87 thru 7.92 kept an image of the Verdi Head EEPROM data and if it determined that the Verdi data had become corrupted would restore the original Verdi EEPROM data. This functionality was no longer needed so it was removed from Chameleon software version 7.93.

Action: If this fault appears:

1. Cycling the power supply power should resolve this.
2. Recommended to upgrade Chameleon Head board and Verdi Interface board software to version 7.93 or later. Requires change to Verdi software, minimum version 9.53.

Vision Precomp Stepper Fault, Fault #59

Definition:

The precomp stepper failed to home

Action: If this fault appears:

1. Check precomp stepper home position by sending RS232 command: ?COMPPOS
2. Check the stepper home location by sending: ?HMCOMP
3. Try homing the stepper by sending RS232 command: HMCOMP=1 or from the home precompensator menu.
4. Cycle the AC mains power (turn OFF, wait 15 seconds, then turn ON).
5. Check the Chameleon Headboard seating and connections - particularly the stepper daughter board.
6. Check the appropriate signals on the Headboard & precomp stepper daughter board.
7. Check the wiring connection to the D-type on the underside of the precompensation section from the Headboard. Wiring follows the same routing as the shutter actuator.

Chameleon Curve EEPROM Fault, Fault #60

Definition:

The EEPROM holding curve data is faulty. The precomp EEPROM data is stored in a separate EEPROM from the standard Chameleon data.

Action: If this fault appears:

1. Cycle AC mains power (turn OFF, wait 15 seconds, then turn ON).
2. Check Headboard connections.
3. Reload software.

Introduction

The following outlines how the Chameleon determines when stable CW lasing has been achieved. All referenced components and test points can be found in the Figure 3.1-1 Slow Photodiode Detector block diagram.

Signals

SLOW_PD_IN: Slow Photodiode signal. This signal (TP49) is a voltage representation of the average output power of the laser system.

LASING_THRESH: Factory set lasing threshold voltage. This voltage is used to determine, by comparison to the slow photodiode signal, when stable CW lasing has been achieved. The set voltage is typically 0.5 volts (TP48), and is varied via VR8.

Start-Up

After keying the system to the “Laser On” position, the current to the FAP-I’s increases and the Piezo controlled pump beam alignment mirror enters into a “raster” scanning mode (see the Power Track circuit description for additional information on this function). As the PZT mirror scans through its range the SLOW_PD signal is amplified (U21A), divided, and then compared (U35B) to the LASING_THRESH voltage. When the slow photodiode signal exceeds the threshold reference voltage, the output of U35B goes low. This low signal is inverted by U31F causing the green Lasing LED (LED3) to illuminate. This high signal is also sent to the Chameleon Control BD and is used by the CPU to determine when stable CW lasing has been achieved.

NOTE:

1. The amplified photodiode signal, before passing through the 50% voltage divider, is used as an input for the Power Track (Section 3.2) and the Chameleon Light Loop circuits.
2. The low output from U35B is also used as input for the Power Track circuit. In the Power Track circuit, this input switches the Piezo driven mirror from “raster” to “dither” mode.

Troubleshooting

The following should be verified when the laser system can not achieve stable CW lasing, or if no output is being generated by the laser system.

If the power supply front panel display does not read properly, or acts erratic in any manner, it could be an indication that there is a problem with the low voltage supplies or the display itself.

To determine if the problem is due to a low voltage being out of range, or a faulty front panel display, the troubleshooting procedure should be entered at step 6.

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1. Through the front panel of the power supply, verify that the system is setup for automated operation.
   a. Chameleon PZT control setting is ON.
   b. The Power Track Function is enabled.
   c. The auto modelock function is enabled.
   d. The Peak Hold function is enabled on either the pump or cavity, most likely the pump. This is done automatically by the PZT control mode setting.
2. Set wavelength to 800 nm.
3. Verify that the chiller is on and is set to 25°C.
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 Chameleon 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.
5. Visually verify that the raster/dither circuit is operating as expected.
   a. Close the Chameleon shutter and place an IR card in the output beam path.

b. Depress the Shutter Open button. As the 532 nm pump energy increases a flashing spot should be observed on the card. Once the setpoint for dither scan is reached the spot on the IR card should stop flashing, remain on, and increase in brightness.

6. Verify that the +5 V is available on the CPU board and in acceptable range (± 5%).

As one of the first steps in troubleshooting, it is always good practice to verify all of the system's low voltages. A complete list of all low voltage test points can be found in the Introduction of Section 2.3, Troubleshooting Fault Messages.

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7. Verify that the ±12 VF, the +5 VREF, and the +2.5 VREF are available on the Chameleon Analogue BD and in acceptable range. Note that these voltages are generated or filtered on the pump BD.

   +12 VF: TP31 (+), TP7 (AGND)

   –12 VF: TP11 (+), TP7 (AGND)

   +5 VREF: TP35 (+), TP7 (AGND)
   [generated from +12 VF]

   +5 VF: TP8 (+), TP7 (AGND)

   +2.5 VREF: TP36 (+), TP7 (AGND)

If any of these voltages are found to be out of range (± 10%) the Analogue BD should be inspected for damaged components or connectors and replaced.

8. Verify that the green lasing LED (LED3) illuminates. (Note that on some early boards the "lasing" and "modelocked" labels were reversed. The LED numbers, however, are correct.) If it does not, and the slow photodiode voltage at TP49 is in the 8 V±0.4 when tuned to 800 nm volt range (voltage before the 50% voltage divider and U35B), the problem is on the Head BD.

   If the green lasing LED is illuminating, verify that the lasing signal is reaching U5A on the Control BD (TP34). If the signal can be read on this test point, the Control BD should be replaced.

9. Verify that the lasing threshold setpoint is in the 1.3 - 1.5 volt range (TP48). If the voltage is out of range use VR8 to adjust the voltage to 1.4 V.

10. Verify that the slow photodiode signal, TP49, increases as the output power increases. If the input signal from the photodiode does not track with the output power there may be a problem with the detector.

    If slow photodiode signal, TP49, does not increase as output power increases than the Analogue board should be replaced.

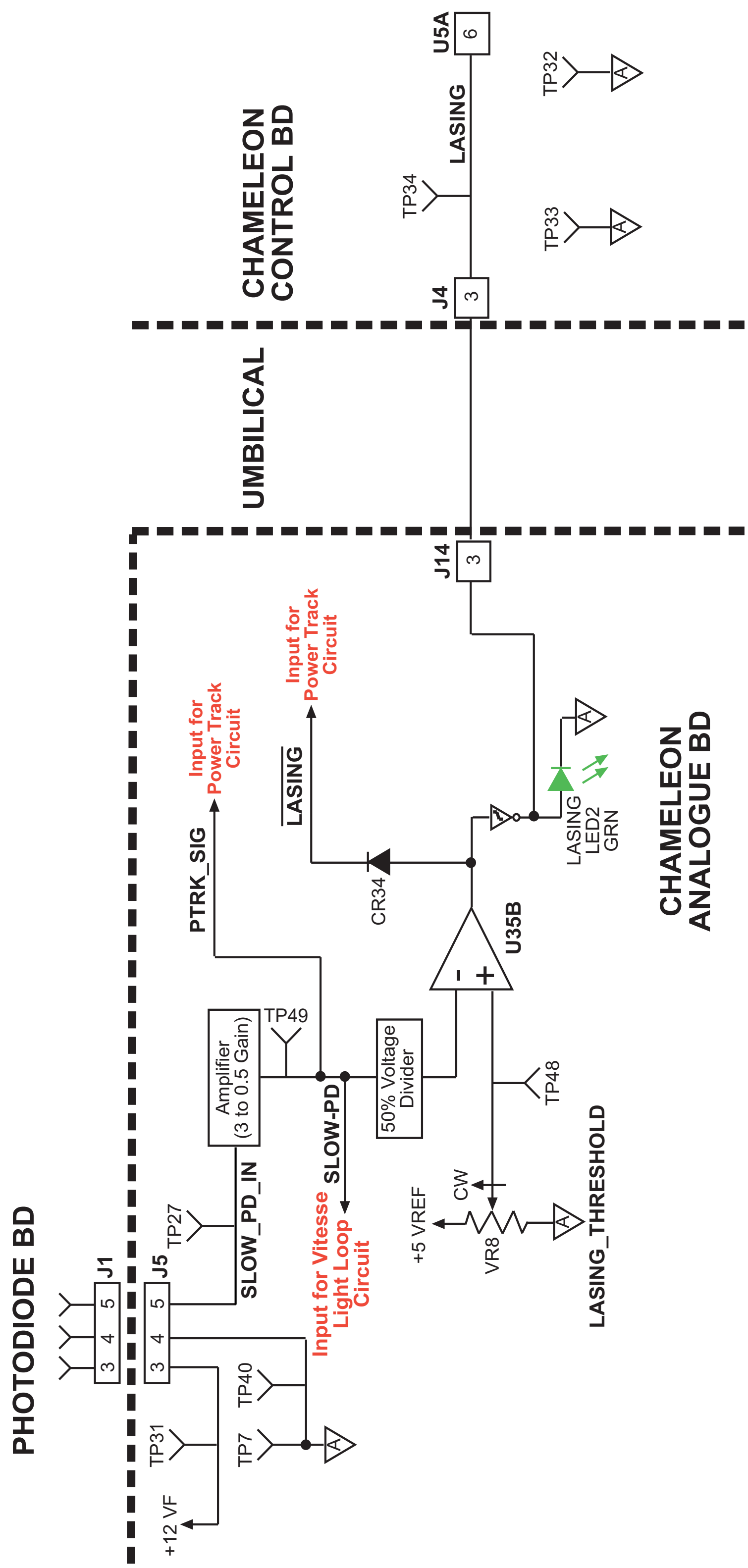

Figure 3.1-1. Lasing Detection Circuit Block Diagram

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Introduction

The following outlines how the Chameleon Power Track function (dither mode) is implemented, as well as the initial rastering of the pump beam alignment mirror when the system is first enabled. All referenced components and test points can be found in the Power Track block diagram shown in Figure 3.2-2.

Definitions

Raster Scan: The rapid movement of the pump beam alignment mirror through the full dynamic range of the Piezo Mirror X and Y PZTs (PZT voltage range is 0 to 120 volts). Allows for a fast, but rough, alignment of the pump beam with the Chameleon optical cavity. The X and Y PZT voltages are varied simultaneously. This function is implemented when the system is first keyed to the “Laser On” position or if the Power Track function is enabled. **Only the pump mirror raster scans**.

Dither Scan: Small amplitude 15 Hz dither of the PZT X and Y voltages. Changes in the PZT voltages are checked against the output of the Slow Photodiode. Allows for the fine alignment of the pump beam to the Chameleon optical cavity. The X and Y PZT voltages are varied independently. Both the pump mirror and the cavity mirror dither scan, but not at the same time.

Signals

PTRK_SIG: Amplified Slow Photodiode signal, see the Lasing Detection circuit (Test points located on Chameleon Analogue BD) for additional information.

LASING: Digital signal indicating that stable CW lasing has been achieved (TP26, active LOW), see the Lasing Detection circuit description for additional information.

PTRK_ON: Digital signal (TP45, active LOW) indicating that the Power Track function has been activated in the Chameleon software. The signal is TTL low (0 volts) when Power Track is on and TTL high (5 volts) when Power Track is off.

If Power Track is enabled, and LASING is high, the Piezo driven mirror will stay in raster mode indefinitely.

PKHOLD: Signal (TP60) indicating that the PeakHold function has been activated in the Chameleon software. PeakHold inhibits the Power Track function, thus stopping the dithering of the cavity beam alignment mirror. When this function is enabled the PZTs are held at their last set voltage. The signal is TTL low (0 volts) when PeakHold is off and TTL high (5 volts) when PeakHold is on.

PZT Signals: Hardware signals that peak the mirrors based on integrating improvements in the slow photocell voltage caused by the dither.

PZTX_PT_CAV: PZT X signal from the from the Power Track electronics. Signal ranges from 0 to 5 volts.

PZTY_PT_CAV: PZT Y signal from the from the Power Track electronics. Signal ranges from 0 to 5 volts.

PZT_MAN_CAV: Signal indicating that manual control of the Piezo driven cavity beam alignment mirror has been requested via the P/S front panel. The signal is TTL low (0 volts) when manual control is disabled and TTL high (5 volts) when manual control is enable.

PZT1_SIG_CAV: PZT X signal entered from the front panel when manual control of the PZTs is selected. Signal ranges from 0 to 5 volts.

PZT2_SIG_CAVPT: PZT Y signal entered from the front panel when manual control of the PZTs is selected. Signal ranges from 0 to 5 volts.

Raster Mode

The raster mode of operation does not apply to the Cavity mirror.

U42

The values, TTL low or high, of the “A” and “B” inputs of switch U24 determine the mode of operation for the Power Track circuit. The “A” input is from the 0.4 HZ counter (clock) U22. The TTL value of the “B” input is determined by two input signals. The Power Track On/Off signal (PTRKON) and the lasing signal from the SPD circuit.

Dither Mode

The Power Track dither signal works on the combined inputs of the slow photodiode (PTRK_SIG) and the 15 Hz Triangle wave (the same signal used by the raster scan to move the Y PZT). If a change in PZT voltage results in an increase in the SPD signal, the base PZT voltage is set to the new voltage. The goal is to reach the peak of the Chameleon output and then dither around this maximum. Any deviation from the output maximum will result in a lower SPD input which will result in a shift back to the previous PZT voltage.

Power Track LED

Once lasing has been achieved (LASING, TP26 = 0 V) and the dither mode is activated, the Power Track error voltage (signal) is monitored until it is within 33 mV of ground. When this condition is met the output of U31D will go high (TP42) causing the Power Track LED (LED4) to illuminate. This high signal (PTRKING) is also feed back to the CPU.

The Power Track error signal is the AC component (resulting from the dither scan) of the amplified SPD signal. This AC component is coupled from the SPD signal by C148 and is then fed into an amplifier and integrator circuit. The amplifier/integrator compares the SPD AC component to the original dither signal to determine the error voltage. The phase relationship between the AC component of the SPD signal and the original dither signal is used to determine if the current PZT voltages place the dither signal on the rising or falling side of the output maximum, see Figure 3.2-1.

The resulting Power Track error signal (correction) is added to the dither scan signal, inputs X0 and Y1 of U42. As the system approaches optimum alignment between the Chameleon and the pump, the error signal will go to zero. This will cause the Power Track circuit to dither around the PZT voltages which correspond to the maximum output of the system.

Op-Amps U38A and U38B

Attached to the X and Y outputs of U24 is a single IC which consists of two Op-Amps, U25A & B. The purpose of these amplifiers is the inversion of the PZT drive outputs of U42, and to hold the PZT drive voltages at their last determined value when “Peak Hold” (TP60) has been enabled in the Chameleon software. After Peak hold has been enabled, and the operation of U42 has been inhibited, the PZTs will be reliably held at their last voltage for a very long time. The integrators drop only a few millivolts per hour. After some time has

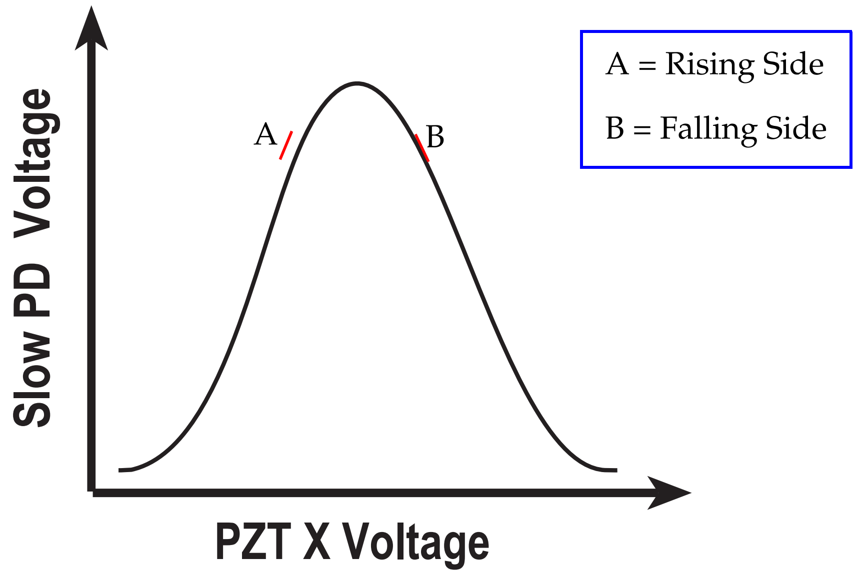

Figure 3.2-1. Chameleon Output Power Curve
Locations A & B Correspond to 180° Out of Phase Power Track Error Signals

passed the Peak Hold function should be disabled so that the Power Track function can reoptimize the Piezo mirror position. The outputs of U38 A and B can be measured on TP16 and TP21, respectively.

In the Chameleon software, the CPU board allows the pump mirror to optimize first. Then it allows the cavity mirrors to align. Then it returns to the pump mirror and leaves it in Power Track mode. If the laser wavelength is changed, then the pump mirror is peak held and the cavity mirror is power tracked until the tuning stops. Periodically the software will switch from pump to cavity to pump again to keep the whole laser system optimized.

PZT Signal Selection & Amplification

The PZT drive signal can originate from one of two sources; the Power Track circuit or from the front panel of the P/S. The source is selected by the two switches, U13A and U13B, and depends on the TTL level of the “PZT Manual” input line. When PZT_MAN_CAV is TTL high (5 V, logical true), the switches select the X1 (U13A, PZT1_SIG_CAV, TP20) and Y1 (U13B, PZT2_SIG_CAV, TP12) input lines for the PZT drive signals. When the PZT_MAN_CAV signal is TTL low (0 V), the Power Track circuit determines the PZT drive voltage as discussed above.

Before being sent to the Piezo controlled mirror, the X and Y drive signals (0 to 5 V) are amplified 26-times to match the dynamic range of the PZTs which are 0 to 120 V. To supply the voltage required for this amplification a +48 V to +120 V voltage converter circuit is employed.

Troubleshooting

The following should be verified when:

- optimum output power can not be achieved
- the Chameleon software does not indicate that the Power Track function is operational

If the power supply front panel display does not read properly, or acts erratic in any manner, it could be an indication that there is a problem with the low voltage supplies or the display itself.

To determine if the problem is due to a low voltage being out of range, or a faulty front panel display, the troubleshooting procedure should be entered at step 6. This is a very rare occurrence.

1. Through the front panel of the power supply, verify that the system is setup for automated operation.
   a. Chameleon PZT control setting is ON.
   b. The Power Track Function is enabled.
   c. The auto modelock function is enabled.
   d. The manual control of the PZTs is not enabled
   e. the Peak Hold function is enabled on either the pump or cavity, most likely the pump. This is done automatically by the PZT control mode setting.
2. Verify that the chiller is on and that the Chameleon baseplate is at operational temperature, typically 25°C. The exact manufacturing set temperature can be found on the Customer Data sheet.
3. 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.

4. Verify that the +5 V is available on the CPU board and in acceptable range (± 5%).

As one of the first steps in troubleshooting, it is always good practice to verify all of the system's low voltages. A complete list of all low voltage test points can be found in the Introduction of Section 2.3, Troubleshooting Fault Messages.

---

5. Verify that the ±12 VF, the +5 VREF, and the +2.5 VREF are available on the Chameleon Analogue BD and in acceptable range. Note that these voltages are generated or filtered on the Head BD.

   +12 VF: TP31 (+), TP7 (AGND)

   -12 VF: TP11 (+), TP7

   +5 VREF: TP35 (+), TP7 [generated from +12 VF]

   +5 VF: TP8 (+), TP7 (AGND)

   +2.5 VREF: TP36 (+), TP7 (AGND)

If any of these voltages are found to be out of range (± 10%) the Analogue BD should be inspected for damaged components or connectors and replaced.

6. Verify the operation of the Lambda power supply (LEDs on front face on some models), and that the +120 V is available on the Chameleon Head BD (TP5).

   a. If the +120 V is missing, and the Lambda LEDs are indicating that the supply is operating normally, the fuse F1 or F2(0.250 A, 125 V) on the Chameleon Analogue BD may be damaged.

   b. If the +120 V is out of range, and there is no visible damage to operational amplifiers U4 and U5, there is most likely a problem with the 48 - 120 V conversion circuit.

In both of the above cases, unless component damage is clearly visible, the presence +48 V on the Power Distribution BD should be verified before the Chameleon Head BD is replaced.

7. Verify if the PTRKING LED (LED4) is illuminating.

   a. If LED4 is illuminating the Power Track electronics on the Chameleon Head board are most likely OK, and the problem is a connection between the Head BD and the Control BD. Using the attached block diagram, trace the PTRKING TTL signal to the Control BD. This signal should be a logical high (5 V) when Power Track is operational.

   b. If LED4 is not illuminating verify that the PTRKON (from the Control BD, TP45 on the Analogue BD) and the LASING TTL signals are both a logical low (0 V).

      If the state of either signal is incorrect, the signal should be traced back to its source to determine the cause.

8. If LED4 is not illuminating, and all TTL signals are OK, place the Piezo controlled mirror in manual control and verify that the drive voltage for each stack is within range, and that the voltage follows the DAC count displayed on the front panel.

   PZT1, TP1 (+) TP7(–), 0 - 120 V

   PZT2, TP3 (+) TP7(–), 0 - 120 V

   If either voltage is found to be out of range, the Analogue BD should be replaced.

   If the voltage ranges are OK, and there does not appear to be a problem with the connections to the mirror, the laser head will need to be replaced.

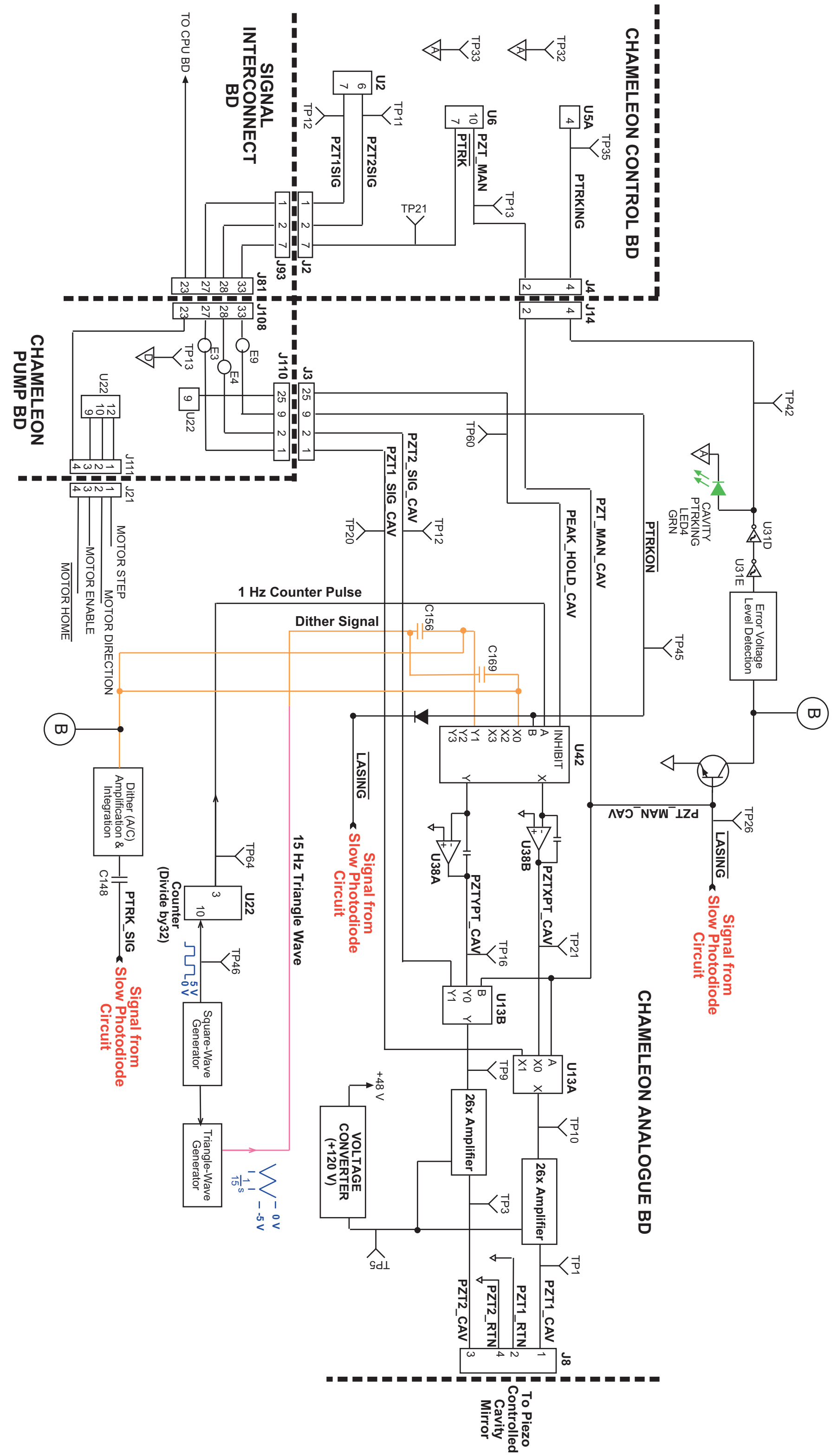

Figure 3.2-2. Power Track - Cavity Circuit Block Diagram

Introduction

The following outlines how the Chameleon Power Track function (dither mode) is implemented, as well as the initial rastering of the pump beam alignment mirror when the system is first enabled. All referenced components and test points can be found in the Power Track – Pump block diagram shown in Figure 3.3-3. Please note that there are two mirrors with PZT's in the Chameleon system, the Pump Mirror which steers the pump beam into the Ultrafast cavity and the Cavity mirror, which acts to stabilize the cavity.

Definitions

Raster Scan: The rapid movement of the pump beam alignment mirror through the full dynamic range of the Piezo Mirror X and Y PZTs (PZT voltage range is 0 to 120 volts). Allows for a fast, but rough, alignment of the pump beam with the Chameleon optical cavity. The X and Y PZT voltages are varied simultaneously. This function is implemented when the system is first keyed to the "Laser On" position or if the Power Track function is enabled. Only the pump mirror raster scans.

Dither Scan: Small amplitude 15 Hz dither of the PZT X and Y voltages. Changes in the PZT voltages are checked against the output of the Slow Photodiode. Allows for the fine alignment of the pump beam to the Chameleon optical cavity. The X and Y PZT voltages are varied independently. Both the pump mirror and the cavity mirror dither scan, but not at the same time.

Signals

PTRK_SIG: Amplified Slow Photodiode signal, see the Lasing Detection circuit (Section 3.1) for additional information.

LASING: Digital signal indicating that stable CW lasing has been achieved (TP26, active LOW), see the Lasing Detection circuit description for additional information.

PTRK_ON: Digital signal (TP45, active LOW) indicating that the Power Track function has been activated in the Chameleon software. The signal is TTL low (0 volts) when Power Track is on and TTL high (5 volts) when Power Track is off.

If Power Track is enabled, and LASING is high, the Piezo driven mirror will stay in raster mode indefinitely.

PEAK_HOLD_PUMP: Signal (TP62) indicating that the PeakHold function for the pump mirror has been activated in the Chameleon software. PeakHold inhibits the Power Track function, thus stopping the dithering of the pump beam alignment mirror. When this function is enabled the PZTs are held at their last set voltage. The signal is TTL low (0 volts) when PeakHold is off and TTL high (5 volts) when PeakHold is on.

PZT Signals: Hardware signals that peak the mirrors based on integrating improvements in the slow photocell voltage caused by the dither.

PZTX_PT_PUMP: PZT X signal from the from the Power Track electronics. Signal ranges from 0 to 5 volts.

PZTY_PT_PUMP: PZT Y signal from the from the Power Track electronics. Signal ranges from 0 to 5 volts.

PZT_MAN_PUMP: Signal indicating that manual control of the Piezo driven pump beam alignment mirror has been requested via the P/S front panel. The signal is TTL low (0 volts) when manual control is disabled and TTL high (5 volts) when manual control is enable.

PZT3PT_SIG_PUMP: PZT X signal entered from the front panel when manual control of the PZTs is selected. Signal ranges from 0 to 5 volts.

PZT4PT_SIG_PUMP: PZT Y signal entered from the front panel when manual control of the PZTs is selected. Signal ranges from 0 to 5 volts.

Raster Mode

The raster mode of operation allows for the rapid alignment of the pump laser to the Chameleon optical cavity (Ti:Sapphire crystal). The pump mirror raster scan will engage when there is no lasing and power track is off. Remember only the pump mirror raster scans. After keying the system to the “Laser On” position, the current to the FAP-Is increases and the Piezo driven pump beam alignment mirror automatically enters into a “raster” scanning mode of operation, see Figure 3.3-1. In this mode the voltage to the pump mirror X and Y PZTs are simultaneously varied over their full dynamic range (0 to

120 V) while the output voltage from the Chameleon Slow Photodiode (SPD) is monitored. When the SPD voltage reaches a predetermined level, the LASING signal (TP26) changes from high (5 V) to low (0 V) and the Power Track circuit is switched from raster scan to dither scan.

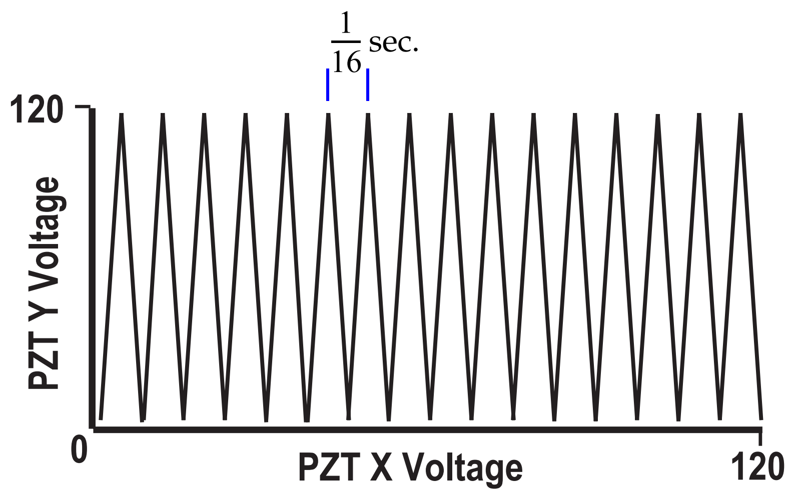

Figure 3.3-1. Raster Scan X & Y PZT Drive Signal

U43

The values, TTL low or high, of the “A” and “B” inputs of switch U43 determine the mode of operation for the Power Track circuit. The “A” input is from the 0.4 HZ counter (clock) U23. The TTL value of the “B” input is determined by two input signals. The Power Track On/Off signal (PTRKON) and the lasing signal from the SPD circuit. Figure 3.3-1 presents the actions of the circuit for each of the possible combinations of states for these two inputs.

Table 3.3-1. U43 Logic Table for “A” and “B” Inputs

A	B	MODE
0	0	Dither X pump
1	0	Dither Y pump
0	1	Raster X & Y pump
1	1	Raster X & Y pump

When the circuit is in raster mode, the Y PZT signal is obtained from the Y2 and Y3 inputs of switch U43. This signal is a 15 Hz triangle wave. The X PZT signal is obtained on input X2 and X3 and is a voltage ramp (TP37). Both of these signals range from 0 to –5 volts.

Dither Mode

The Power Track dither signal works on the combined inputs of the slow photodiode (PTRK_SIG) and the 15 Hz Triangle wave (the same signal used by the raster scan to move the Y PZT). The dither scan consists of sequential 1 mV changes in the X PZT voltage, and 5 mV changes in the Y PZT voltage. If a change in PZT voltage results in an increase in the SPD signal, the base PZT voltage is set to the new voltage. The goal is to reach the peak of the Chameleon output and then dither around this maximum. Any deviation from the output maximum will result in a lower SPD input which will result in a shift back to the previous PZT voltage.

Power Track LED

Once lasing has been achieved (LASING, TP26 = 0 V) and the dither mode is activated, the Power Track error voltage (signal) is monitored until it is within 33 mV of ground. When this condition is met the output of U36B will go high (TP42) causing the Power Track LED (LED5) to illuminate. This high signal (PTRKING) is not feed back to the CPU.

The Power Track error signal is the AC component (resulting from the dither scan) of the amplified SPD signal. This AC component is coupled from the SPD signal by C155 and is then fed into an amplifier and integrator circuit. The amplifier/integrator compares the SPD AC component to the original dither signal to determine the error voltage. The phase relationship between the AC component of the SPD signal and the original dither signal is used to determine if the current PZT voltages place the dither signal on the rising or falling side of the output maximum, see Figure 3.3-2.

The resulting Power Track error signal (correction) is added to the dither scan signal, inputs X0 and Y1 of U43. As the system approaches optimum alignment between the Chameleon and the pump, the error signal will go to zero. This will cause the Power Track circuit to dither around the PZT voltages which correspond to the maximum output of the system.

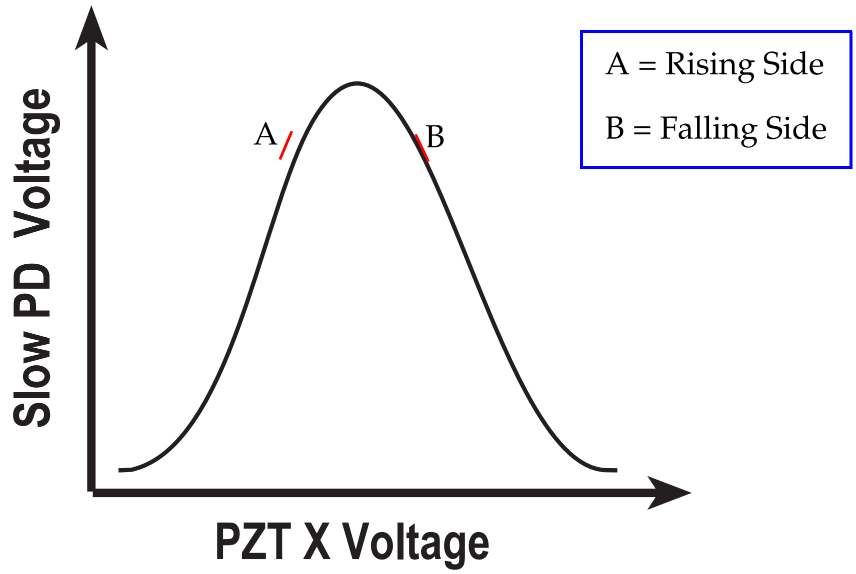

Figure 3.3-2. Chameleon Output Power Curve
Locations A & B Correspond to 180° Out of Phase Power Track Error Signals

Op-Amps U25A and U25B

Attached to the X and Y outputs of U43 is a single IC which consists of two Op-Amps, U39A & B. The purpose of these amplifiers is the inversion of the PZT drive outputs of U43, and to hold the PZT drive voltages at their last determined value when "Peak Hold" (TP62) has been enabled in the Chameleon software. After Peak hold has been enabled, and the operation of U43 has been inhibited, the PZTs will be reliably held at their last voltage for a very long time. The integrators drop only a few millivolts per hour. After some time has passed the Peak Hold function should be disabled so that the Power Track function can reoptimize the Piezo mirror position. The outputs of U39 A and B can be measured on TP19 and TP25, respectively.

In the Chameleon software the CPU board allows the pump mirror to optimize first, followed by the cavity mirror. It then returns to the pump mirror and leaves them in power track mode. If the laser wavelength is changed then the pump mirror is peak held and the cavity mirror is power tracked until the tuning stops. Periodically the software will switch from pump to cavity to pump again to keep the whole laser system optimized.

PZT Signal Selection & Amplification

The PZT drive signal can originate from one of two sources; the Power Track circuit or from the front panel of the P/S. The source is selected by the two switches, U17A and B, and depends on the TTL level of the "PZT Manual" input lines. When PZT_MAN_PUMP is TTL high (5 V, logical true), the switches select the X1 (U17A, PZT3_SIG_PUMP, TP24) and Y1 (U17B, PZT4SIG, TP18) input lines for the PZT drive signals. When the PZT_MAN_PUMP signal is TTL low (0 V), the Power Track circuit determines the PZT drive voltage as discussed above.

Before being sent to the Piezo controlled mirror, the X and Y drive signals (0 to 5 V) are amplified 26-times to match the dynamic range of the PZTs which are 0 to 120 V. To supply the voltage required for this amplification a +48 V to +120 V voltage converter circuit is employed.

Troubleshooting

The following should be verified when:

- the system will not switch from raster to dither scan
- optimum output power can not be achieved
- the Chameleon software does not indicate that the Power Track function is operational

If the power supply front panel display does not read properly, or acts erratic in any manner, it could be an indication that there is a problem with the low voltage supplies or the display itself.

To determine if the problem is due to a low voltage being out of range, or a faulty front panel display, the troubleshooting procedure should be entered at step 6. This is a very rare occurrence.

1. Through the front panel of the power supply, verify that the system is setup for automated operation.
   a. Chameleon PZT control setting is ON.
   b. The Power Track Function is enabled.
   c. The auto modelock function is enabled.
   d. The manual control of the PZTs is not enabled.

e. the Peak Hold function is enabled on either the pump or cavity, most likely the pump. This is done automatically by the PZT control mode setting.

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

3. 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 Chameleon 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.

4. Verify that the +5 V is available on the CPU board and in acceptable range (±5%).

As one of the first steps in troubleshooting, it is always good practice to verify all of the system's low voltages. A complete list of all low voltage test points can be found in the Introduction of Section 2.3, Troubleshooting Fault Messages.

---

5. Verify that the ±12 VF, the +5 VREF, and the +2.5 VREF are available on the Chameleon Analogue BD and in acceptable range. Note that these voltages are generated or filtered on the Head BD.

   +12 VF: TP31 (+), TP7 (AGND)

   –12 VF: TP11 (+), TP7 (AGND)

   +5 VREF: TP35 (+), TP7 (AGND)
   [generated from +12 VF]

   +5 VF: TP8 (+), TP7 (AGND)

   +2.5 VREF: TP36 (+), TP7 (AGND)

If any of these voltages are found to be out of range (±10%) the Analogue BD should be inspected for damaged components or connectors and replaced.

6. Verify the operation of the Lambda power supply (LEDs on front face on some models), and that the +120 V is available on the Chameleon Analogue BD (TP6).

   a. If the +120 V is missing, and the Lambda LEDs are indicating that the supply is operating normally, the fuse F1 or F2 (0.250 A, 125 V) on the Chameleon Analogue BD may be damaged.

   b. If the +120 V is out of range, and there is no visible damage to power amplifiers U6 and U7, there is most likely a problem with the 48 – 120 V conversion circuit.

   In both of the above cases, unless component damage is clearly visible, the presence +48 V on the Power Distribution BD should be verified before the Chameleon Analogue BD is replaced. This can be accomplished by measuring the voltage on J83 of the Signal Interconnect board, pins 1 and 2.

7. Verify if the PTRKING LED (LED5) is illuminating.

   a. If LED5 is illuminating the Power Track electronics on the Chameleon Analogue board are most likely OK, and the problem is a connection between the Analogue BD and the Control BD. Using the attached block diagram, trace the PTRKING TTL signal to the Control BD. This signal should be a logical high (5 V) when Power Track is operational.

   b. If LED5 is not illuminating verify that the PTRKON (from the Control BD, TP45 on the Analogue BD) and the LASING TTL signals are both a logical low (0 V).

      If the state of either signal is incorrect, the signal should be traced back to its source to determine the cause.

8. If LED5 is not illuminating, and all TTL signals are OK, place the Piezo controlled mirror in manual control and verify that the drive voltage for each stack is within range, and that the voltage follows the DAC count displayed on the front panel.

   PZT3, TP2 (+) TP7 (AGND), 0 - 120 V

   PZT4, TP4 (+) TP7 (AGND), 0 - 120 V

   If either voltage is found to be out of range, the Head BD should be replaced.

If the voltage ranges are OK, and there does not appear to be a problem with the connections to the mirror, the laser head will need to be replaced.

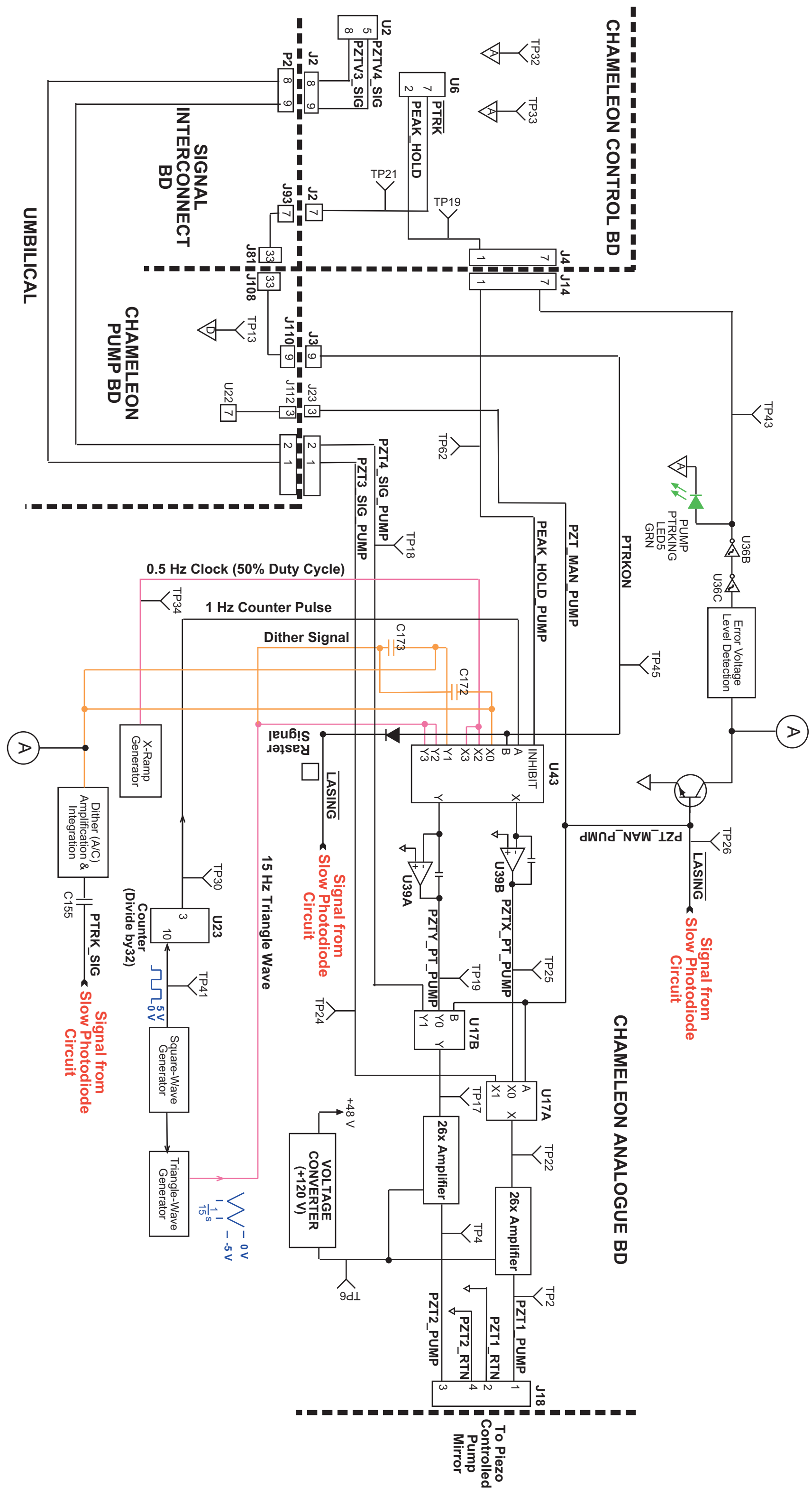

Figure 3.3-3. Power Track - Pump Circuit Block Diagram

Introduction

The following outlines how the Chameleon laser system determines when the modelocking starter should be both engaged and disengaged. All referenced components and test points can be found in the Starter Circuit block diagram.

Signals

SLOW-PD: This is the Slow Photodiode signal and represents the average output power of the system.When the system achieves set power, this voltage should be 1V to 4V. See the “Lasing Detection” block diagram (**SLOW_PD_IN**) for additional information on this signal.

STRTR_THRESH: This voltage, Starter Threshold, is compared to the amplified Slow Photodiode voltage to determine when to enable the starter circuit. The voltage is set via VR1 and can be measured at TP29.

RF_PRESENT: TTL signal (high = true, low = false) used to determine when modelocking has been achieved.The state of this signal (as measured at TP32) is determined by comparing the Fast Photodiode signal to a predetermined voltage level. See the “Modelock Detection” block diagram for additional information.

STRTR: TTL signal from the CPU required for the starter circuit to activate. A TTL high = true, and a TTL low = false.

Start-Up

Keying the laser system to the “Laser On” position, with AutoModelock and PowerTrack activated, causes the current to the FAP-I(s) to increase and the Piezo controlled pump beam alignment mirror to enter into raster scan until the CW output reaches a preset level. The system then switches to dither mode (see the Lasing Detection and PowerTrack block diagrams). As the CW power of the system continues to increase, the amplified output from the slow photodiode is compared to a preset voltage level by U21B. This comparison voltage, STRTR_THRESH, can be measured on TP29. When the input from the slow photodiode (SLOW-PD) exceeds the starter threshold voltage the output of U21B goes low. This low signal turns on the power amplifier U24 which applies an AC voltage to the starter solenoid. The change in state of the output of U21B can be measured indirectly at TP33 and TP34. The voltage measured on these test points depends on the setting of VR4. VR4 is the starter level adjustment trimpot. Typically the level is set somewhere between 2 and 3 VAC RMS.

The starter solenoid is activated when pin 1 (SHUTDOWN) of U24 goes low. When this occurs the Zener diode, CR27, is forward biased at a voltage just above threshold. At such a low voltage the Zener acts like a broad band frequency (white noise) generator.The output of the Zener is directed into a fixed 80x amplifier circuit and then into a variable amplification circuit (VR4, STRTRLVL). The starter solenoid is configured in the circuit as a “Bridge Tied Load” where the total gain across the load (solenoid) is 2x.

TTL Circuit Logic

It is important to note that the STRTR and RF_PRESENT TTL signals can only “disable” the starter circuit. For the starter circuit to be activated the output of U21B must be a logical low.

Once Modelocking is detected RF_PRESENT will change state from TTL low to TTL high causing the starter circuit to shut down.

Troubleshooting

The following should be verified when the system can not achieve Modelocked operation.

1. Through the front panel of the power supply verify that the PowerTrack function is enabled set the Automodelocking function to disabled.
    a. Using an external power meter, verify that the system is able to achieve output power, as detailed in performance data sheet.
    b. Verify that the internal power reading matches that of the external meter, recalibrate if required.
    c. Through the front panel of the power supply enable the AutoModelocking function. If the system does not modelock proceed with step 2.

    Note that if the system can not achieve specified power, the problem may be in the Lasing Detection or PowerTrack circuits.

2. Verify that the +5 V is available on the CPU board and in acceptable range, ±5%.

As a troubleshooting first step it is always good practice to verify all of the system low voltages. A complete list of all low voltage test points on the CPU BD and the Power Distribution BD can be found in the Introduction of Section 2.1, Troubleshooting Fault Messages.

---

3. Verify that the TTL logic is correct for the system to be trying to modelock.

    a. Verify that the starter signal from the CPU BD is a TTL high on the Chameleon Pump BD at terminal connector E8 and on the Chameleon Analogue BD at connector J3 pin 8.

    b. Verify that the signal from the slow photodiode is reasonably close to +5 V at TP46 (the system should be in PowerTrack mode and running a specified power).

    c. Verify that the RF_PRESENT TTL is a logical low at TP32.

    If any of these voltages are found to be incorrect, the TTL signal should be traced (using the appropriate block diagram and troubleshooting procedure) to determine the cause of the problem.

4. Hook a sampling DVM across TPs 33 and 34. Verify that an amplified drive signal is being provided to the starter assembly.

    The AC level ranges from 2 VAC to 3 VAC.

If all signals are found to be in acceptable range, including the solenoid AC drive level, the Chameleon head may need to be replaced. Contact Technical Support at 1-800-367-7890.

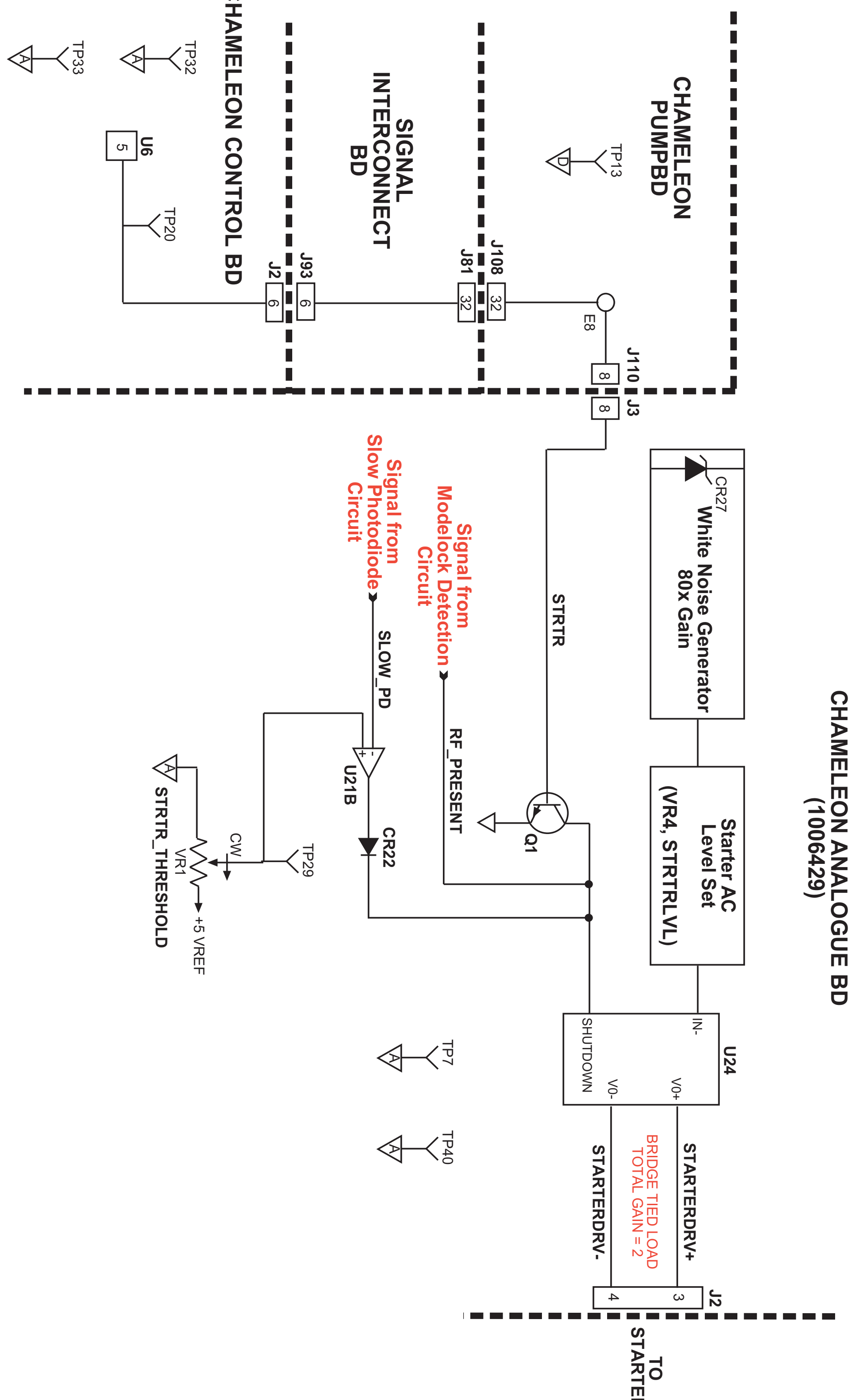

Figure 3.4-1. Modelocking Starter Circuit Block Diagram

Introduction

The following outlines how the Chameleon laser system determines when modelocking has been achieved. All referenced components and test points can be found in the Modelock Detection block diagram.

Signals

FAST_PD: This signal is from the fast silicon detector. This detector is capable of detecting the 90 MHz modelocked pulse train from the laser system.

RF THRESH SET: This DC voltage, RF Threshold Setpoint, is compared to the RF amplified, filtered, and then rectified Fast Photodiode voltage to determine when the system is modelocked. The voltage is set via VR6 (measured at TP13) and is typically between 2.0 and 2.5 V.

RF_PRESENT: TTL signal (high = true, low = false) used to determine when modelocking has been achieved.The state of this signal (as measured at TP32) is determined by comparing the Fast Photodiode signal to a predetermined voltage level. See the “Modelock Detection” block diagram for additional information.

MODELOCKED: TTL signal to the CPU indicating that modelocking has been achieved. A TTL high = true, and a TTL low = false.

Start-Up

After keying on, and once stable CW operation has been achieved, the Starter Circuit is engaged to modelock the system. To determine if the system is in a modelocked state of operation the Fast Photodiode signal is compared to a factory preset level (RF THRESH SET).

Before this can occur, the 900 MHz pulse train signal from the Fast Photodiode is amplified and then sent through a 270 MHz bandpass filter. The filter only passes the third harmonic of the detector signal (i.e., 270 MHz) and the output of the filter is in the form of a sine wave. The 270 MHz signal is then converted to a DC voltage which depends only on the peak voltage of the wave. This voltage can be sampled at TP15 and is 4.8 V when the system is modelocked, and is 0 V when the system is not modelocked.

The comparison of the modelocked preset voltage to the fast photodiode is performed by U14A. When the detector signal is greater that the preset voltage the output of U14A goes low. This low output is filtered and inverted by U31 before being sent to the CPU and the Starter Circuit. The output from U31 is also used to forward bias the green MDLCK LED (LED2).

Troubleshooting

The following should be verified when the system can not determine if modelocked operation has been achieved.

1. Through the front panel of the power supply verify that the PowerTrack function is enabled, set the Automodelocking function to disabled.
   a. Using an external power meter, verify that the system is able to achieve output power, as detailed in performance data sheet.
   b. Verify that the internal power reading matches that of the external meter, recalibrate if required.
   c. Through the front panel of the power supply enable the AutoModelocking function. If the system does not modelock proceed with step 2.

   Note that if the system can not achieve specified power, the problem may be in the Lasing Detection or PowerTrack circuits.
2. Verify that the +5 V is available on the CPU board and in acceptable range, ±5%.

As a troubleshooting first step it is always good practice to verify all of the system low voltages. A complete list of all low voltage test points on the CPU BD and the Power Distribution BD can be found in the Introduction of Section 2.3, Troubleshooting Fault Messages.

---

3. Verify that the RF THRESH SET voltage is in the 2.0 to 2.5 V range.

4. Measure the FAST_PD signal at TP15.

   If the signal is 5 V (± 10%) the problem is a connection to the P/S for the MODELOCKED signal.

   If the signal is low, and does not change when mode-locking is enabled, the Starter Circuit electronics should be verified. If the Starter electronics are OK, the problem is in the Chameleon head.

If the system electronics indicate that Modelocked operation has been achieved, but the front panel indicates that the system is not Modelocked, the modelocked operation of the system should be verified experimentally.

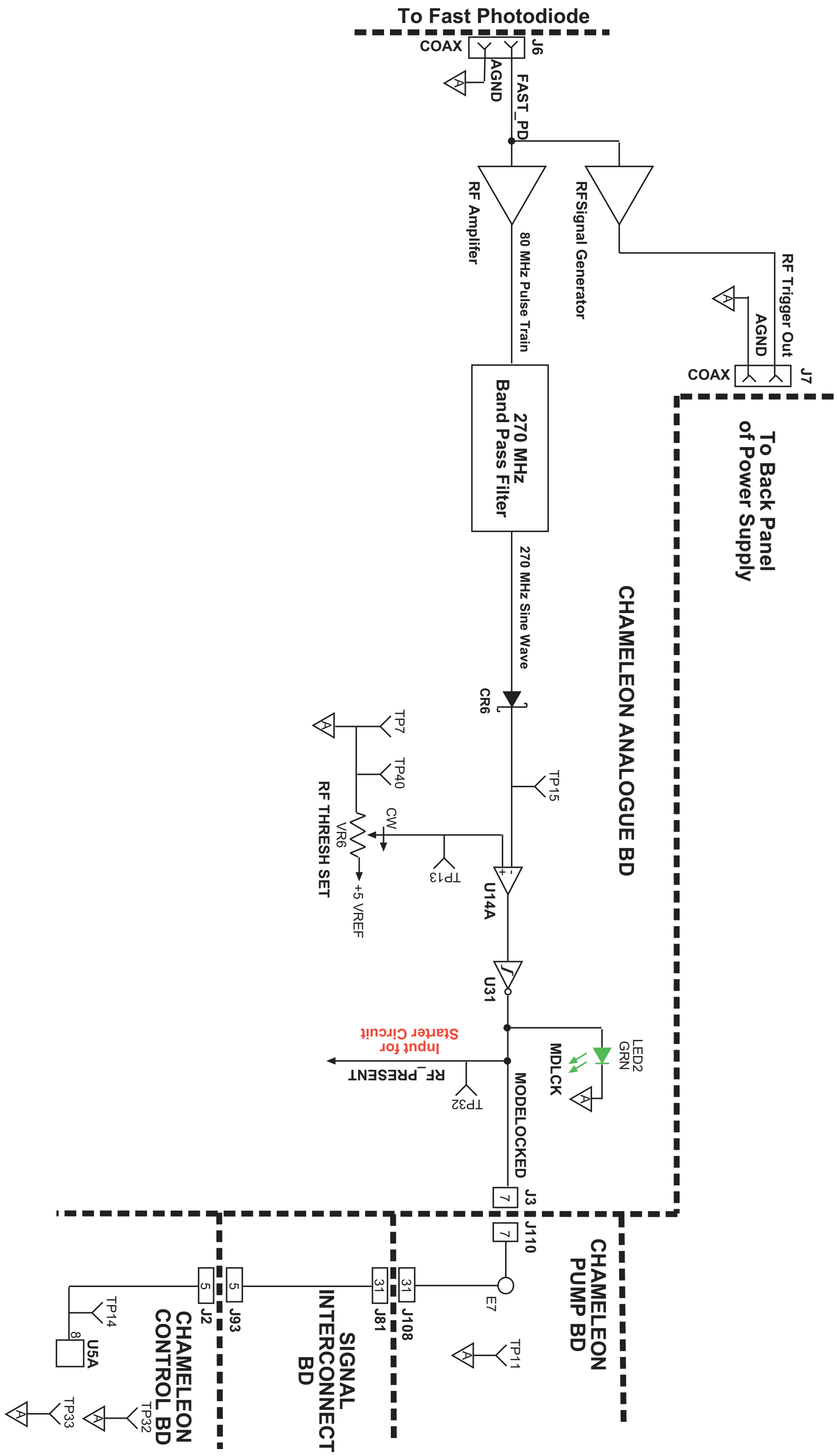

Figure 3.5-1. Modelocking Detection Circuit Block Diagram

80 MHz Chameleon System

The Chameleon is a tunable UltraFast Verdi pumped laser system. Depending upon the model, the tuning range can be from 680 to 1080 nm (Ultra II) with a modelocked 140 fs pulse at 80 MHz and output power up to 3.6 Watts.

For the 80 MHz cavity systems, the Chameleon cavity is pumped with an integrated Verdi V-18 OEM system.

Unlike the 90 MHz cavity systems (210/XR) where the system was controlled by software piggy-backed within the Verdi CPU software, the 80 MHz cavity systems have separate Verdi and Chameleon software, where the Verdi system is a slave to the Chameleon.

The Chameleon Head contains an Ocean Optics Spectrometer. Depending upon the Chameleon build date, this could be a model USB2000 or USB4000. The spectrometer only has a connection through a USB cable to an external computer. Unfortunately, these two spectrometers are not software compatible requiring separate Chameleon Service software and the latest Chameleon GUI.

The electronics for the Chameleon is comprised of a microprocessor controlled Verdi Interface board and a microprocessor controlled Chameleon Head board. The electronic block diagram (Figure 3.6-1) shows these boards plus the interconnections through the Verdi Signal Interconnect board and the Verdi Pump board.

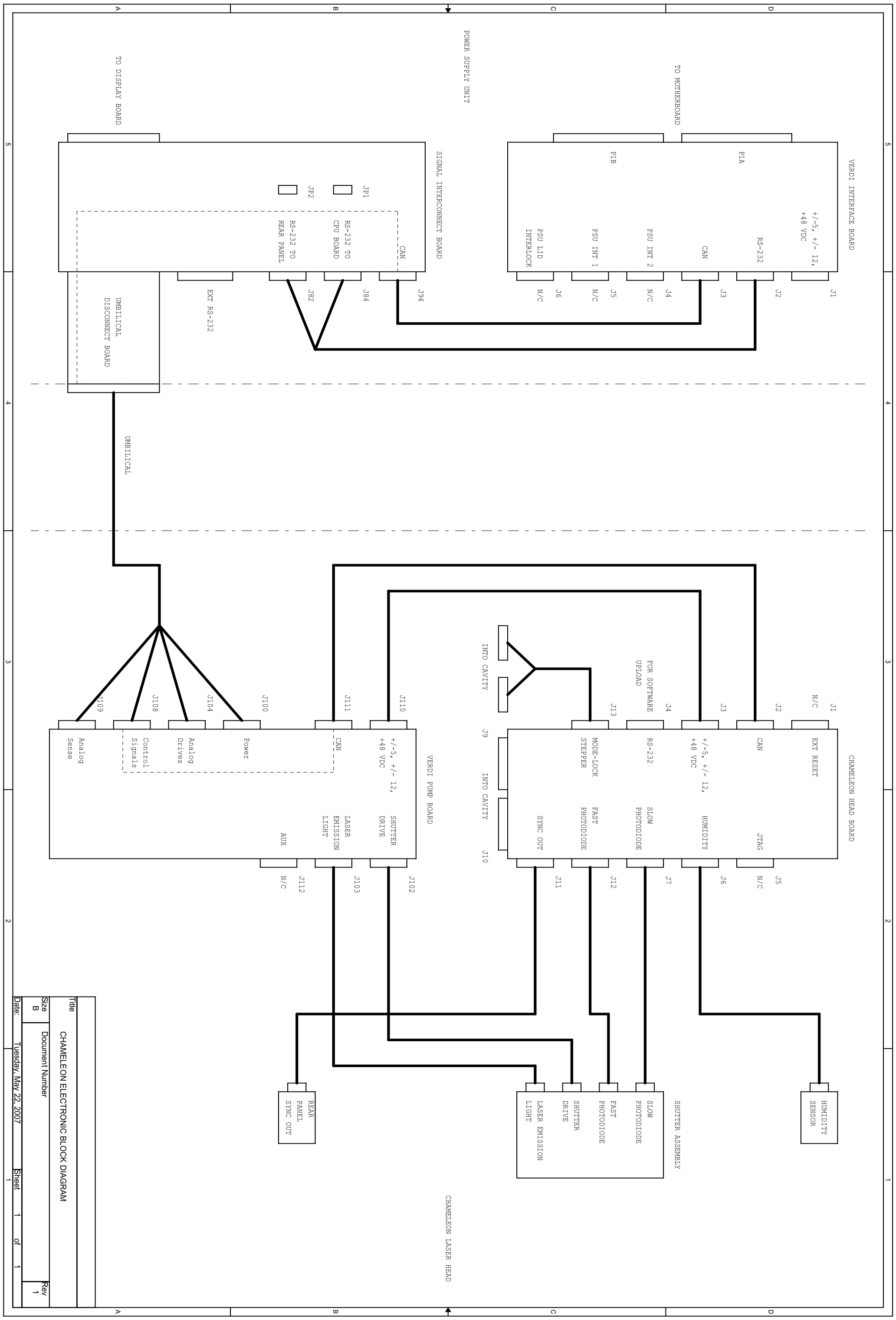

Figure 3.6-1. Chameleon Electronic Block Diagram

Communication between the Verdi Interface board and the Chameleon Head board uses a Controller Area Network (CAN) protocol. The signals are routed from the Verdi Interface board through a cable to the Verdi Signal Interconnect board, then through the umbilical to the Verdi Pump board and then cabled to the Chameleon Head board. CAN is a serial, asynchronous, multi-master communication protocol.

Communication between the Verdi Interface board and the Verdi CPU board uses RS-232. RS-232 signals from the connector at the rear of the power supply would typically (for a Verdi) travel through the Verdi Signal Interconnect board to the Display board and routed onward to the CPU board. For the Chameleon, the RS-232 signals from the rear connector on the Signal Interconnect board are intercepted and cabled to the Verdi Interface board, then back to the Signal Interconnect board and onward to the CPU board. This same connection between the Verdi Interface board and Signal Interconnect board to the CPU board is used for communication between the Chameleon and the Verdi. JP1 and JP2 on the Signal Interconnect board must be removed for the Chameleon to intercept the external RS-232 signals.

The schematics for the Verdi Interface board and Chameleon Head board are drawn in a hierarchal format, which for the top level(s) contain little electronic circuitry but shown more as a block diagram.

Verdi Interface Board

Software on the Verdi Interface board (Figure 3.6-2) controls the overall Chameleon operation including the interfacing to the Verdi system and intercepting the external RS-232 Commands and Queries.

The electronics, other than some system bus buffering, RS-232 and CAN interfacing, and watchdog circuit, are within the microprocessor. There is also on-board interlock circuitry that is currently not used. An unused EEPROM is located on the Verdi Interface Board.

Software upgrade for the Verdi Interface board is through the power supply's rear RS-232 connector. The Verdi Interface board also supports a connector for the JTAG interface; this is currently not used for software upload.

Communication with the Chameleon can be bypassed for direct control with the Verdi by removing the cable at J82 and J84 on the Verdi Signal Interconnect board, installing shunts at JP1 and JP2, and removing the Verdi Interface board from the power supply.

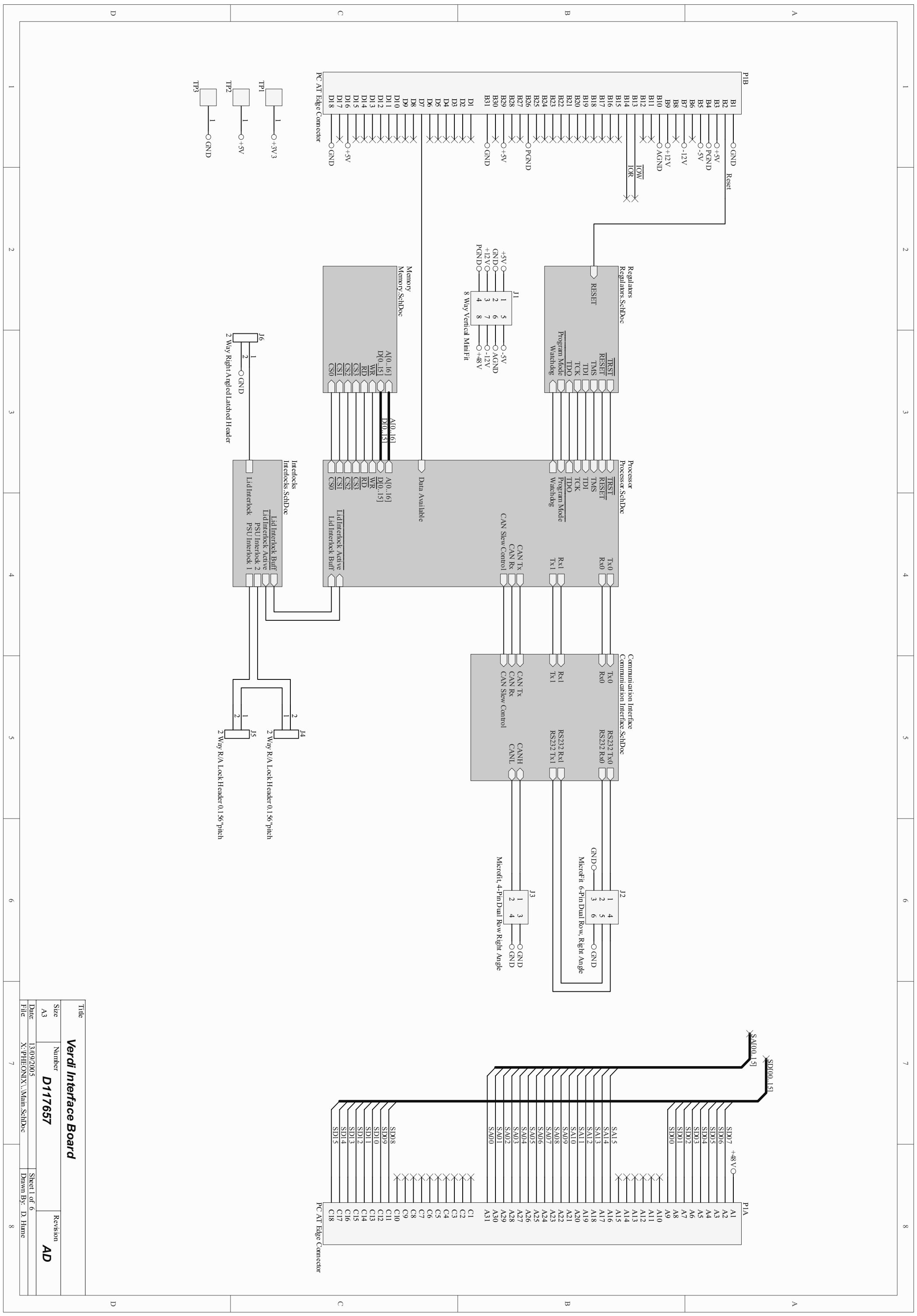

Figure 3.6-2. Verdi Interface Board

Table 3.6-1. Verdi Interface Board LEDs

NAME	LEDS	COMMENTS
Tx0	D2	Orange LED
Rx0	D4	Orange LED
Tx1	D3	Orange LED
Rx1	D5	Orange LED
CAN Rx	D6	Orange LED
CAN Tx	D7	Orange LED
Reset	D1	Red LED
Watchdog	D12	Red LED
	D11	Green LED
Interlock	D9	Green LED
Interlock	D10	Red LED

Table 3.6-2. Verdi Interface Board Test Points

NAME	TEST POINTS		COMMENTS
GND	TP3		
+3.3 VDC	TP1		
+5 VDC	TP2		

Table 3.6-3. Verdi Interface Board Connections

NAME	CONNECTOR	CONNECTION	COMMENTS
+/-5, +/- 12, +48 VDC	J1		Not Used
RS-232	J2	SIB J82 SIB J84	Intercepts External RS-232 & Comm path to Verdi CPU
CAN	J3	SIB J94	Comm path to Cham Head Bd.
PSU Interlock 2	J4		Not Used
PSU Interlock 1	J5		Not Used
PSU Lid Interlock	J6		Not Used

Chameleon Head Board

Software on the Chameleon Head board monitors and drives the head functions.

The electronics include signal conditioning for the slow and fast photodiodes, home sense and drives for the tuning and modelock stepper motors, drive circuit for the starter, and high voltage (~ 108VDC) drivers for the PZTs.

For software upgrade, the Chameleon Head board supports an RS-232 connector, and a JTAG interface (currently not used).

There are no potentiometers to adjust; thresholds are set as percentages within the Calibration Set Up menu (Ref: Section 4.4). There are LEDs and Test Points to provide access to the operation of the head board.

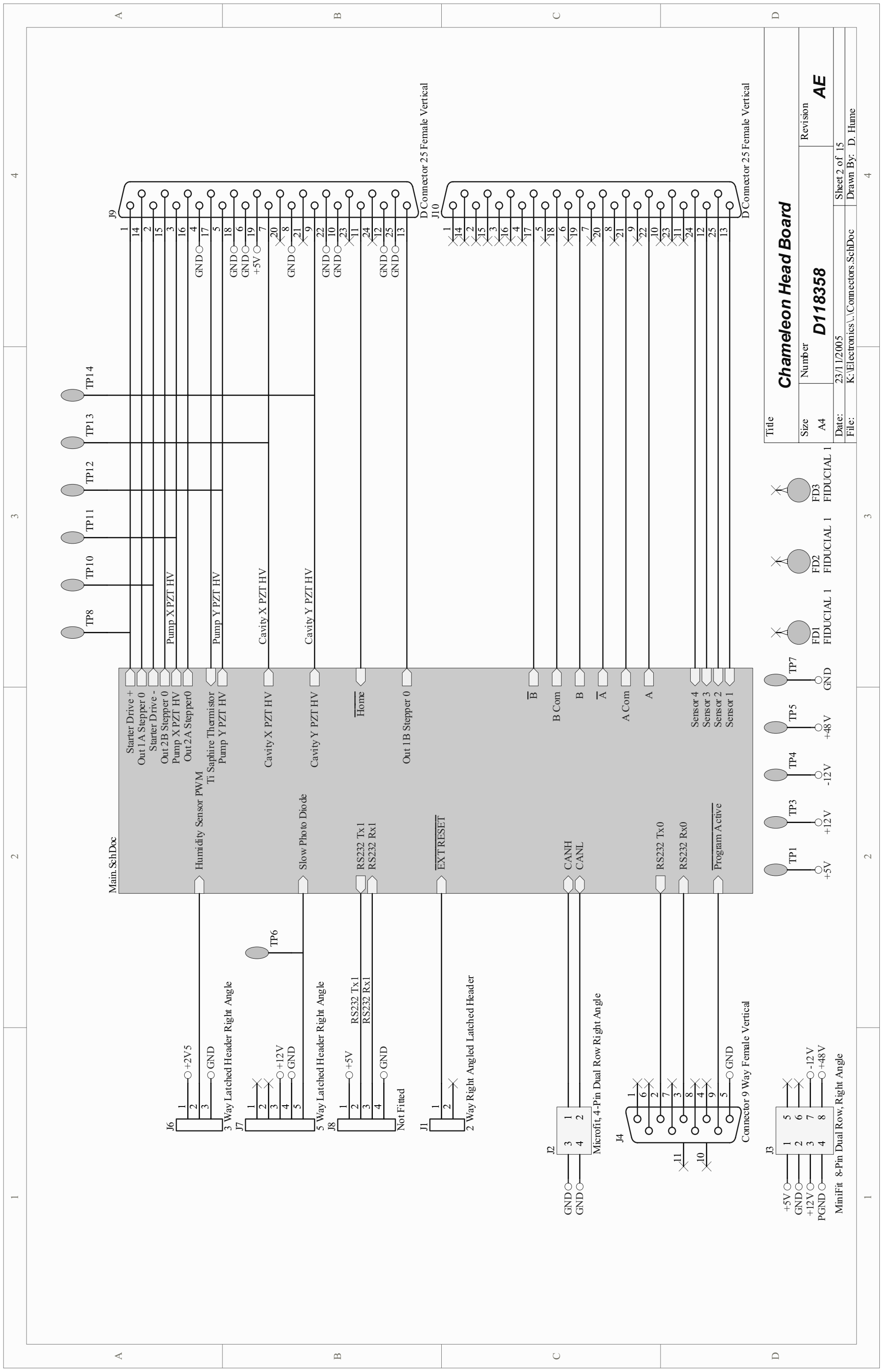

Figure 3.6-3. Chameleon Head Block 1

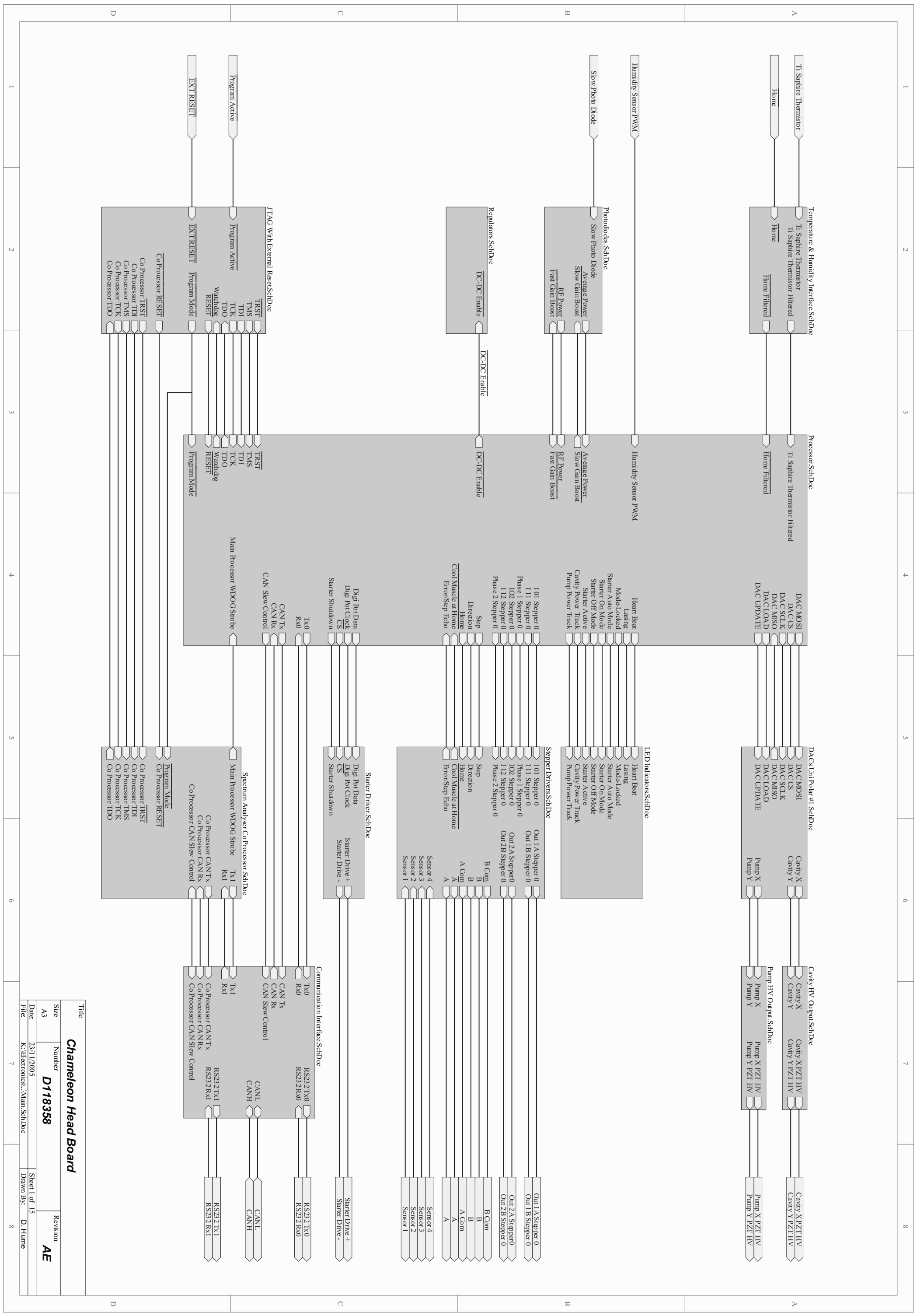

Figure 3.6-4. Chameleon Head Block 2

Table 3.6-4. Chameleon Head Board LEDs

NAME	LEDS		COMMENTS
Lasing	D17	D38	Green LED
Starter Active	D13	D35	Orange LED
Mode-Locked	D18	D39	Green LED
Pump Power Track	D15	D41	Green LED
Cavity Power Track	D14	D36	Green LED
Starter Mode: Auto	D19	D40	Green LED
Starter Mode: On	D11	D33	Orange LED
Starter Mode: Off	D12	D34	Orange LED
Heart Beat	D16	D37	Green LED
CAN Rx	D5		Orange LED
CAN Tx	D6		Orange LED
Tx0 (Not Used)	D1		Orange LED
Rx0 (Not Used)	D3		Orange LED

Table 3.6-5. Chameleon Head Board Test Points

NAME	TEST POINTS		COMMENTS
GND	TP7		
+5 VDC	TP1		
+12 VDC	TP3		
-12 VDC	TP4		
+14 VDC	TP5		
+3.3 VDC			uP and LEDs
HV+			PZT Drives
Slow Photodiode	TP6		
Average Power	TP18		
Starter Drive +/-	TP8	TP10	
RF Power	TP17		
Pump X PZT HV	TP11		~ 108 VDC
Pump Y PZT HV	TP12		~ 108 VDC
Cavity X PZT HV	TP13		~ 108 VDC
Cavity Y PZT HV	TP14		~ 108 VDC

Table 3.6-6. Chameleon Head Board Connections

NAME	CONNECTOR	CONNECTION	COMMENTS
External Reset	J1		Not Used
CAN	J2	VPB J11	Comm path from Verdi CPU
+5, +/- 12, +48 VDC	J3	VPB J110	Supply voltages
RS-232	J4		Used Only for Software Upload
JTAG	J5		Not Used
Humidity Sensor Assy	J6		
Slow Photodiode	J7		From Shutter Assy
Cavity connections	J9 & J10		
Sync Out	J11		To Rear Panel Sync Output
Fast Photodiode	J12		From Shutter Assy
Modelock Stepper	J13		

Table 3.6-7. Other Chameleon Head Connections

NAME	CONNECTOR	CONNECTION	COMMENTS
Shutter	VPB J102		To/From Shutter Assy
Laser Emission	VPB J103		To Shutter Assy-
Supply Voltages	VPB J100		From Umbilical
Analog Drive	VPB J104		From Umbilical
Control Signals	VPB J108		From Umbilical
Analog Sense	VPB J109		From Umbilical
Aux	VPB J112		Not Used

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PZT Operation

The normal status of operation for the PZTs will be either 'Auto' or 'Auto*'. 'Auto' indicates that the PZT control is in "auto" mode but is currently holding its position, 'Auto*' indicates that the system is scanning the PZT axis for maximum power as indicated by the slow photodiode.

The PZT scan-rate is controlled by a DAC using two factors, a gain and an amplitude. Each axis has separate amplitude factors, but the individual axis on each mirror share a common gain, providing a total of six factors. The amplitude determines the amount of change or drive the PZT will undergo, so obviously the amplitude factors for the Cx and Px will be smaller since the x-axis is more sensitive (a result of the limited aperture introduced by the slits). The gain factor controls the sensitivity or reactance that the PZTs will have to the slow photodiode. The cavity PZT will typically have a smaller gain factor. All of these values are stored in the Chameleon Head EPROM, and should <u>not</u> be changed from their original factory settings.

When the system is not modelocked, things can change more than they normally would if an RF signal is present (indicating mode-lock). The pump laser will be moving towards the calibrated power level as the starter will be active, causing the signal on the slow photodiode to be rather unstable. The PZTs will be making frequent changes, although not as fast as when below the lasing threshold. Below lasing threshold the PZTs will move the cavity to the last known good value positions, while the pump PZTs are in raster mode, in an effort to find a signal above lasing threshold. The system will then go through a process designed to move the pump PZTs slowly, while rapidly scanning the cavity PZTs. This is something entirely different than the PZT operation used when lasing is achieved.

PZT Verification

The PZTs used in the Chameleon Ultra use a solid state dielectric ceramic material with very high mechanical precision and repeatability. Because of this, the likelihood of change, as a result of the physical characteristics of the PZT, is minimal. The required drive voltage is 0-100 VDC, and this drive voltage is controlled by the DAC on the Chameleon Head board. Each of the four PZTs receives its specific positional information as a 0-2 VDC signal converted from a 0-255 digital count from the micro processor. This voltage signal from the DAC is then converted to a 0-10 VDC range by the LM324(U6) op-amp. Individual ICs are used to then convert this to a 0-100 V signal to drive the PZTs. Any problems covering these conversions can directly effect the PZTs behavior, therefore it is extremely important to verify that the PZTs are tracking correctly.

To verify the PZT function, the PZT control status must be in manual, because the adjustment range covers from –100% to +100%, zero volts from the PZT drive will relate to –100% and the 100 V rail will relate to +100%.

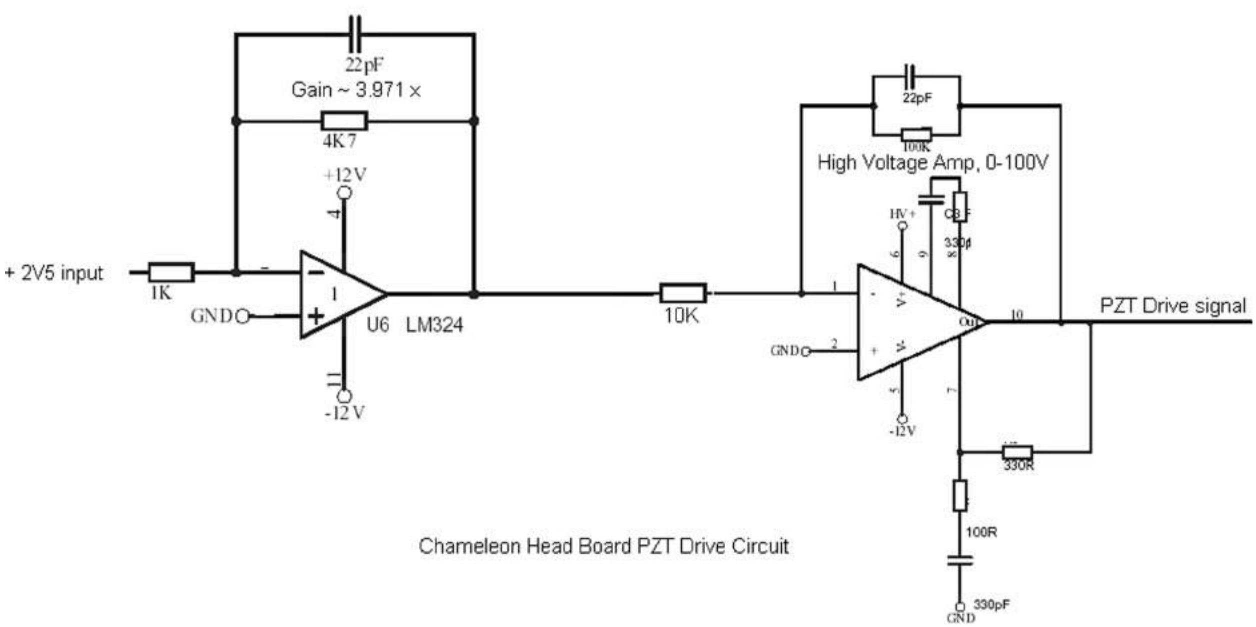

Figure 3.7-1. Chameleon Head Board PZT Drive Circuit

Before starting this procedure, it is important to review Svc-Cham-1.1 "Laser Safety" in this manual. There are significant voltage levels present in these circuits! These voltages can be harmful to equipment and/or technicians if proper precautions are NOT adhered to!

1. Using the Service menu, select Manual Control and set the Cavity and Pump PZT controls to Manual with the POWER LEVEL 2 button.
2. Select the correct range (or auto) and function on the DMM. Also insure the leads are configured correctly.
3. Bring all the PZT values to –100%.
4. Connect the ground lead from the DMM to TP7 on the Chameleon Head board.
5. Connect the positive lead from the DMM to TP19, which is the +HV supply for the PZT drivers. The voltage should read ~108 VDC +/-5 V.
6. Starting with TP11, which is the PZT drive for Px, verify the voltage increases as the Px adjustment is changed from –100% to 0% to +100%. –100% should measure 0.0 VDC +/- 2.0 V, 0% should measure 50 VDC +/-5 V, and +100% should measure 102 VDC +/- 5 V.
7. Repeat step 6 for TP12(Py), TP13(Cx) and TP14(Cy).
8. Refer to the Chameleon Head board Schematic for further details.

It is important to note that the fluorescence pattern should show change when viewed on a white card while changing any of the PZT controls. With the shutter open, an IR viewer will enhance the image. What should be observed are two distinct fluorescent spots with one spot moving as the specific PZT control is adjusted. In this particular test, overlap will most likely not be achieved since the PZT controls are being scanned from one limit to the other. The purpose of this test is to verify that the DAC and HV-amplification is occurring and working properly along with demonstrating the ability to change the fluorescence pattern exiting from the Chameleon. Careful observation can allow the individual performing the test to determine if overlap is a possible by noting the range of adjustment to each of the fluorescent spots and the intensity, as the internal reflections from the PZT controlled mirrors, changes.

Introduction

The following presents the information required to connect via RS-232 to the laser system power supply and then calibrate the system. The example connection procedure utilizes the Windows program “Hyper Terminal”. It is assumed that the engineer has read, and is comfortable with, the RS-232/Software section of the Chameleon Operator’s Manual.

If there is no modem connected, or installed, in the computer system Windows “may” inquire if you want to install a modem the first time you launch the Hyper Terminal program. If this occurs, dismiss the query window by clicking on the Cancel button.

Establishing Connection

The Hyper Terminal program can be launched using the following procedure.

1. Single click on the Windows “Start” button and scroll up to “Programs” to activate its pop-up menu.
2. From the “Programs” menu scroll up to “Accessories” to activate its pop-up menu.
3. Single click on the “Hyper Terminal” folder.
4. From the resulting folder window select the Hyper Terminal program, “Hypertrm.exe”, by double clicking on the program icon.

If the program has launched properly the window shown in Figure 4.1-1 should be displayed. If this is the first time a connection is to be made continue with the section “First Time Connection Configuration”. If a connection has been made previously, procedure with the section “Loading a Connection File”.

Loading a Connection File

1. Dismiss the “Connection Description” dialog box by clicking on the “Cancel” button.

Figure 4.1-1. Initial Hyper Terminal Window

2. From the "File" menu select "Open". From the Open dialog box select the Verdi communications file by double clicking on it.

3. Press the "Return" key on the keyboard to establish connection. At this point the Verdi prompt, see Figure 4.1-6, should be displayed in the main window of Hyper Terminal program.

First Time Connection Configuration

1. In the "Connection Description" dialog box type the file name "Verdi" and click on the OK button. We use the "Verdi" name because the protocol is the same. Different parameters are not needed for a Chameleon connection.

2. The next step will depend on whether a modem is connected to the computer system being used.

   a. If a modem is installed in (or connected to) the computer, the dialog box illustrated in Figure 4.1-2 will be displayed. Dismiss this window by Clicking on Cancel button.

From the “File” menu of Hyper Terminal select “Properties” to display the dialog box given in Figure 4.1-3.

b. If the computer is not connected to a modem the “Properties” dialog box should be displayed, Figure 4.1-3.

Figure 4.1-2. Hyper Terminal Phone Number Dialog Box

3. Configure the Properties dialog box as illustrated in Figure 4.1-3, and then click on the “Configure...” button.
4. Setup the communication port as illustrated in Figure 4.1-4 and click on the OK button.
5. Click on the “Properties” window “Settings” tab and then click on the “ASCII Setup” button. Configure the “ASCII Setup” window as illustrated in Figure 4.1-5 and click on the OK button.
6. Close the “Properties” window by clicking on the OK button.
7. Press the “Return” key on the keyboard to establish connection. At this point the Verdi prompt displayed, see Figure 4.1-6, should be seen in the main window of Hyper Terminal.

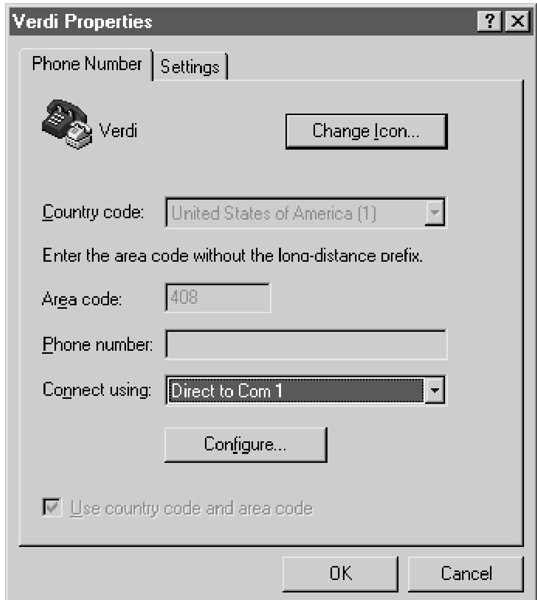

Figure 4.1-3. Hyper Terminal Properties Dialog Box

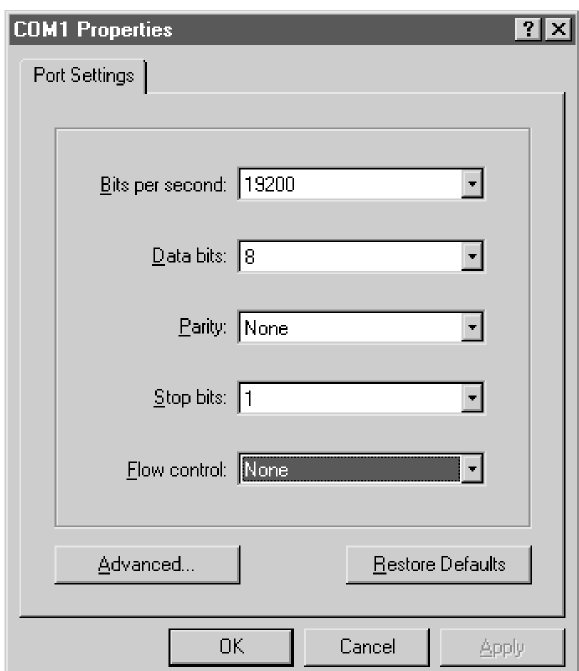

Figure 4.1-4. Hyper Terminal Communications Port Dialog Box

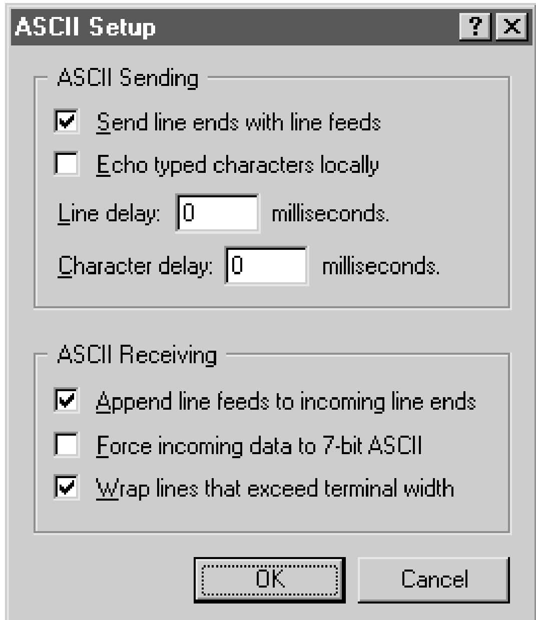

Figure 4.1-5. Hyper Terminal ASCII Setup Dialog Box

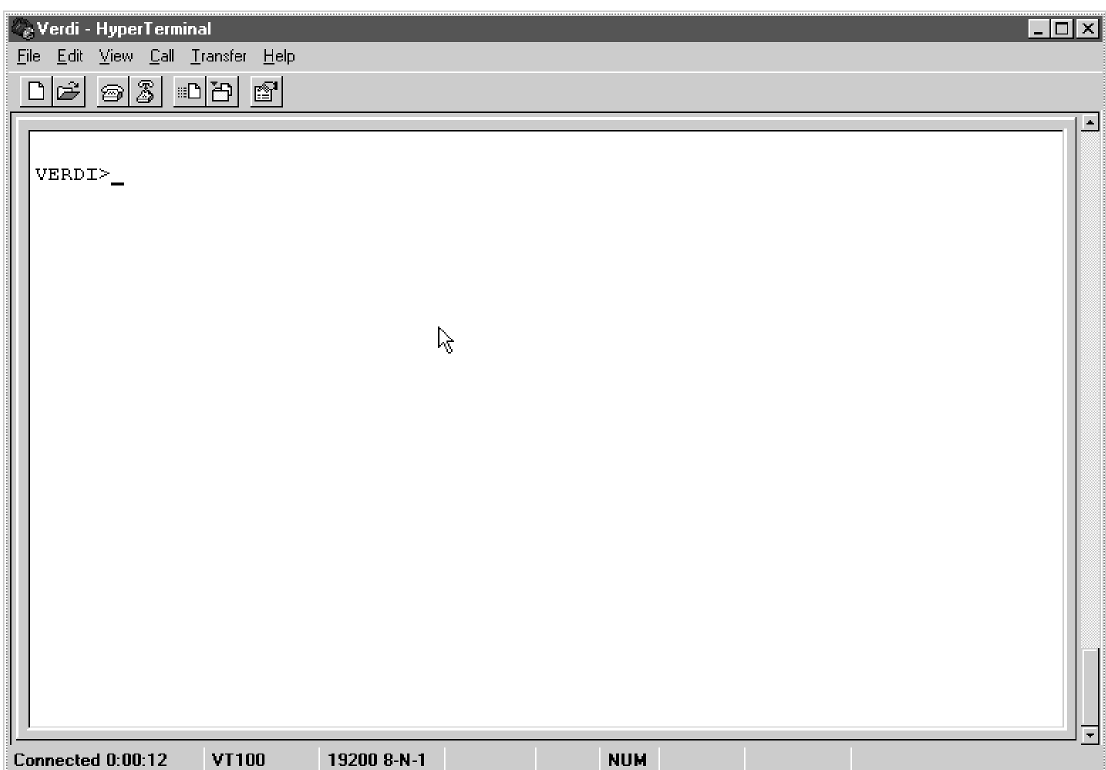

Figure 4.1-6. Hyper Terminal Main Window Illustrating Verdi Prompt

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Introduction

The following presents the Chameleon service RS-232 commands and queries. It is assumed that the engineer has read, and is comfortable with, the RS-232 Software section of the Chameleon Operator's Manual.

It is important to note that the tables below contains the commands and queries for the base Verdi system as well as those which are unique to the Chameleon laser system.

The Chameleon laser system uses a DCE, straight through, serial cable for RS-232 communications.

To place the system into service mode, enter the command: ACCESS=CLG5182

Table 4.2-1. Chameleon RS-232 Service Commands

COMMAND	ACTION	90 MHz	80 MHz
ALIGNP=n ALIGNW=n	set alignment power set alignment wavelength		X
AUTOMODELOCK=n AMDLK=n	If n = 0: turn off automodelock (starter). If n = 1: turn on automodelock (starter).	X	X
CAVITY PEAK HOLD=n PHLDC=n	If n = 0: turn off Cavity PZT peak hold. If n = 1: turn on Cavity PZT peak hold.	X	X
CAVITY PZT MODE=n PZTMC=n	If n = 0: put Cavity PZTs in auto mode. If n = 1: put Cavity PZTs in manual mode.	X	X
CAVITY PZT X=n.nn PZTXC=n.nn	Set Cavity PZT X Voltage to specified volts	X	X
CAVITY PZT Y=n.nn PZTYC=n.nn	Set Cavity PZT Y Voltage to specified volts	X	X
POWER TRACK=n PTRK=n	If n = 0: turn off Power Tracking. If n = 1: turn on Power Tracking	X	
PUMP PZT MODE=n PZTMP=n	If n = 0: put Pump PZTs in auto mode. If n = 1: put Pump PZTs in manual mode.	X	X
PUMP PZT X=n.nn PZTXP=n.nn	Set Pump PZT X Voltage to specified volts	X	X
PUMP PZT Y=n.nn PZTYP=n.nn	Set Pump PZT Y Voltage to specified volts	X	X
PUMP SETTING=n.nn PP=n.nn	Set pump power level to fraction of QS to CW pump band. For example, PP=0.80 sets pump level to 80% of the QS-CW power band.	X	X
RECOVERY PZT X=n.nn REQX=1	Cavity PZT X voltage setting for recovery.	X	
RECOVERY PZT Y=n.nn REQY=1	Cavity PZT Y voltage setting for recovery.	X	
RECOVERY WAVELENGTH=nnn REQW=nnn	Wavelength the system will tune to for recovery sequence.	X	X
RHH=n	Set Chameleon head hours. Note: Prior to software version 7.93 n=1 set the Chameleon head hours to zero.		X

Table 4.2-1. Chameleon RS-232 Service Commands (Continued)

COMMAND	ACTION	90 MHz	80 MHz
STEPPER POSITION=nnn STPRPOS=nnn	Move the tuning motor to the specified absolute position count.	X	X
TUNING LIMIT MAX=nnn TMAX=nnn	User settable maximum tuning limit (within the calibrated tuning range). This should only be changed on the advice of the factory.	X	X
TUNING LIMIT MIN=nnn TMIN=nnn	User settable maximum tuning limit (within the calibrated tuning range). This should only be changed on the advice of the factory.	X	X
VERDI=n	n=0; Chameleon mode n=1; Verdi mode		X

Table 4.2-2. Chameleon Operator RS-232 Commands

COMMAND	ACTION	90 MHz	80 MHz
BAUDRATE=nnnn B=nnnn	Sets the RS-232 Serial port to the specified value. nnnn = 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200.	X	X
ECHO=n E=n	A change in the echo mode takes effect with the first command sent after the echo command. n=0 Turns echo off. Characters transmitted to the laser are not echoed to the host. n=1 Turns echo on. Characters transmitted to the laser are echoed to the host.	X	X
FLASH=1 FL=1	Flash Verdi laser output below lasing threshold to allow single-frequency mode to re-center.	X	X
HEARTBEAT=n HB=n	When enabled, shuts the laser down if no RS-232 activity occurs within a time specified by the heartbeat rate (HBR). n=0 Disables heartbeat n=1 Enables heartbeat	X	X
HEARTBEATRATE=n HBR=n	Specifies the time-out period (between 1 to 100 seconds) for laser shut down in the absence of RS-232 activity.	X	X
HOME STEPPER=1 HM=1	Homes the tuning motor. This action can take 3-30 seconds.	X	X
HOME SLIT=1 HMSLIT=1	Homes the modelocking slit.		X
LASER=n L=n	Changes mode. n=0 Puts laser into STANDBY Note: Turning the keys witch to STANDBY, and then to the ON position overrides this command. n=1 Resets faults and turns the laser on. Clears fault screen on power supply and fault history (?FAULT HISTORY), so lasing resumes if there are no active faults. Note: Keys witch must be in the ON position.	X	X
LBO HEATER=n LBOH=n	Turns LBO heater on/off. n=0 Off (cool down) n=1 On (heating)	X	X
LBO OPTIMIZE=n LBOOPT=n	Begins LBO temperature optimization routine. n=0 Stops or aborts LBO optimization n=1 Begins LBO optimization.	X	X

Table 4.2-2. Chameleon Operator RS-232 Commands (Continued)

COMMAND	ACTION	90 MHz	80 MHz
LOCK FRONT PANEL=n LFP=n	Enables/disables user input from the front panel. n=0 Enables n=1 Disables		X
PROMPT=n >=n	Turns "VERDI>" prompt on/off. n=0 Off n=1 On	X	X
PUMP PEAK HOLD=n PHLDP=n	If n = 0: turn off Pump PZT peak hold. If n = 1: turn on Pump PZT peak hold.	X	X
RECOVERY=1 REQ=1	Initiates Recovery sequence. This action can take up to 2 minutes to complete.	X	
SHUTTER=n S=n	Opens/closes external shutter. n=0 Closes n=1 Opens	X	X
SEARCH MODELOCK=n SM=n	Enables/disables search for modelocking. n=0 Enables n=1 Disables	X	X
WAVELENGTH=nnn VW=nnn	Sets the Chameleon wavelength to the specified value in nanometers. If the specified wavelength is beyond the lower or upper limit, the wavelength is set to the lower or upper limit.	X	X
WAVELENGTH STEP=nnn VWS=nnn	Changes the Chameleon wavelength by the specified amount in nanometers.	X	X
XR=n	Displays prompts. 0 = 80 MHz 1 = 90 MHz		X

Table 4.2-3. Chameleon RS-232 Operator /Service Queries

COMMAND	ACTION	90 MHz	80 MHz
PRINT AUTOMODELOCK ?AMDLK	Returns: “0” if automodelock (starter) is off “1” if automodelock (starter) is on	X	X
PRINT CAVITY PEAK HOLD ?PHLDC	Returns: If 0: Cavity PZT peak hold is off. If 1: Cavity PZT peak hold is on.	X	X
PRINT CAVITY PZT MODE ?PZTMC	Returns: If 0: Cavity PZTs are in auto mode. If 1: Cavity PZTs are in manual mode.	X	X
PRINT CAVITY PZT X ?PZTXC	Returns: Cavity PZT X (Rd) Voltage in volts	X	X
PRINT CAVITY PZT Y ?PZTYC	Returns: Cavity PZT Y (Rd) Voltage in volts	X	X
PRINT HOMED ?HM	Returns: If 0: The tuning motor has not been homed. If 1: The tuning motor has been homed.	X	X
PRINT MODELOCKED ?MDLK	Returns: If 0: Chameleon is off (standby) If 1: Chameleon is modelocked If 2: Chameleon is CW	X	X
PRINT POWER TRACK ?PTRK	Returns: If 0: Power Track is off. If 1: Power Track is on.	X	
PRINT PUMP PEAK HOLD ?PHLDP	Returns: If 0: Pump PZT peak hold is off. If 1: Pump PZT peak hold is on.	X	X
PRINT PUMP PZT MODE ?PZTMP	Returns: If 0: Pump PZTs are in auto mode. If 1: Pump PZTs are in manual mode.	X	X
PRINT PUMP PZT X ?PZTXP	Returns: Pump PZT X (Rd.) Voltage in volts	X	X

Table 4.2-3. Chameleon RS-232 Operator /Service Queries (Continued)

COMMAND	ACTION	90 MHz	80 MHz
PRINT PUMP PZT Y ?PZTYP	Returns: Pump PZT Y (Rd.) Voltage in volts	X	X
PRINT PZT CONTROL STATE ?PZTS	Returns: an integer followed by a short text of the PZT control state as displayed on the PZT Control Screen.	X	X
PRINT RECOVERY PZT X ?REQX	Returns: Cavity PZT X voltage setting for recovery.	X	
PRINT RECOVERY PZT Y ?REQY	Returns: Cavity PZT Y voltage setting for recovery.	X	
PRINT RECOVERY WAVELENGTH ?REQW	Returns: Wavelength the system will tune to for recovery sequence.	X	
PRINT STEPPER POSITION ?STPRPOS	Returns: Position (counts) that the motor was last moved to for a desired tuning.	X	X
PRINT TISAPH TEMP ?TT	Returns the Ti:Sapph temperature in degrees Celsius.	X	
PRINT TUNING LIMIT MAX ?TMAX	Returns value of (user settable) maximum tuning limit as wavelength in nm.	X	X
PRINT TUNING LIMIT MIN ?TMIN	Returns value of (user settable) minimum tuning limit as wavelength in nm.	X	X
PRINT UF POWER ?UF	Returns actual Chameleon power, in nnn.n milliwatts	X	X
PRINT WAVELENGTH ?VW	Returns last commanded Chameleon wave-length, in nnn nanometers.	X	X

Table 4.2-3. Chameleon RS-232 Operator /Service Queries (Continued)

COMMAND	ACTION	90 MHz	80 MHz
PRINT FAULTS ?F	Returns a list of number codes of all active faults, separated by an "**&**" or Returns "System OK" if there are no active faults 0 = no faults 1 = Verdi Head Interlock Fault 2 = External Interlock Fault 3 = PS Cover Interlock Fault 4 = LBO Temperature Fault 5 = LBO Not Locked at Set Temp 6 = Vanadate Temp. Fault 7 = Etalon Temp. Fault 8 = Diode 1 Temp. Fault 9 = Diode 2 Temp. Fault 10 = Baseplate Temp. Fault 11 = Heatsink 1 Temp. Fault 12 = Heatsink 2 Temp. Fault 16 = Diode 1 Over Current Fault 17 = Diode 2 Over Current Fault 18 = Over Current Fault 19 = Diode 1 Under Voltage Fault 20 = Diode 2 Under Voltage Fault 21 = Diode 1 Over Voltage Fault 22 = Diode 2 Over Voltage Fault 25 = Diode 1 EEPROM Fault 26 = Diode 2 EEPROM Fault 27 = Verdi Head EEPROM Fault 28 = PS EEPROM Fault 29 = Verdi PS-Head Mismatch Fault 30 = LBO Battery Fault 31 = Shutter State Mismatch 32 = CPU EEPROM Checksum Fault 33 = Verdi Head EEPROM Checksum Fault 34 = Diode 1 EEPROM Checksum Fault 35 = Diode 2 EEPROM Checksum Fault 36 = CPU EEPROM Range Fault 37 = Verdi Head EEPROM Range Fault	X	X

Table 4.2-3. Chameleon RS-232 Operator /Service Queries (Continued)

COMMAND	ACTION	90 MHz	80 MHz
	38 = Diode 1 EEPROM Range Fault 39 = Diode 2 EEPROM Range Fault 40 = Head - Diode Mismatch	X	X
	43 = Lost Modelock Fault 44 = Lost Power Track Fault 46 = Below Q-Switch Power Fault 47 = Ti-Sapph Temp. Fault 49 = Pump PZTX Fault 50 = Pump PZTY Fault	X	
	50 = Cavity Humidity Fault 51 = Tuning Stepper Motor Homing Fault 52 = Output power is low 53 = Laser Failed to Begin Modelocking 54 = Head Board Communication Fault 55 = System is Not Lasing 56 = PS-Head Software Mismatch Fault 57 = Modelock Slit Stepper Motor Homing Fault 58 = Verdi Head EEPROM Fault		X
	59 = Vision Precomp Stepper Fault 60 = Chameleon Curve EEPROM Fault	Vision Only	
PRINT HEAD HOURS ?HH	Returns the number of operating hours on the system head.	X	X
PRINT KEYSWITCH ?K	Returns status of the keys witch: 0 = Off (standby) 1 = On	X	X
PRINT LASER ?L	Returns status of the laser: 0 = Off (standby) 1 = On 2 = Off due to Fault (check faults or fault history)	X	X

Table 4.2-3. Chameleon RS-232 Operator /Service Queries (Continued)

COMMAND	ACTION	90 MHz	80 MHz
PRINT SEARCH MODELOCK ?SM	Returns the status of search for modelocking: 0 = Disabled 1 = Enabled	X	X
PRINT SHUTTER ?S	Returns the state of the external shutter: 0 = Closed 1 = Open	X	X
PRINT SOFTWARE VERSION ?SV	Returns the Chameleon Interface and Head board software version number.	X	X
PRINT TUNING STATUS ?TS	Returns the tuning status: 0 = Ready (i.e. no tuning operation being performed) 1 = Tuning in progress 2 = Search for Modelock in progress 3 = Recovery / Initialize operation in progress	X	X

Table 4.2-4. Verdi Service RS-232 Commands

COMMAND	ACTION
CAL DIODE1 CURRENT POINT1=nn.nn CD1CP1=nn.nn	Calibrate the 12 amp current point for laser diode #1 to nn.nn amps.
CAL DIODE1 CURRENT POINT2=nn.nn CD1CP2=nn.nn	Calibrate the 19 amp current point for laser diode #1 to nn.nn amps.
CAL DIODE2 CURRENT POINT1=nn.nn CD2CP1=nn.nn	Calibrate the 12 amp current point for laser diode #2 to nn.nn amps.
CAL DIODE2 CURRENT POINT2=nn.nn CD2CP2=nn.nn	Calibrate the 19 amp current point for laser diode #2 to nn.nn amps.
CALIBRATE DIODE1 VOLTAGE=n.nn CD1V=n.nn	Calibrate the voltage (at 20 amps) for laser diode #1 to n.nn volts.
CALIBRATE DIODE2 VOLTAGE=n.nn CD2V=n.nn	Calibrate the voltage (at 20 amps) for laser diode #2 to n.nn volts.
CALIBRATE PHOTOCELL=nn.nn CP=nn.nn	Calibrate the photocell to specific value, obtained from external meter.
CURRENT=nn.nn C=nn.nn	Set to current regulation at the specified average diode current.
CURRENT DELTA=n.n CD=n.n	Set the diode current delta to specified value to n.n.
DIODE1 ACTUAL WAVELENGTH=nnn.nn D1AW=nnnn	Set the actual wavelength of diode #1 to nnn.nn nanometers. The diode operating temperature is calculated from this value.
DIODE1 DRIVE=nnnn D1D=nnnn	Open diode #1 temperature servo and set the drive setting to nnnn.
DIODE1 RATED CURRENT=nn.nn D1RC=nn.nn	Set diode #1 rated current to nn.nn amps.
DIODE1 RATED CURRENT FACTOR=nn.nn D1RCF=nn.nn	Set diode #1 rated current factor (aging factor) to nn.nn.
DIODE1 TEMP=nn.nn D1T=nn.nn	Set diode #1 temperature to specified value, nn.nn.
DIODE2 ACTUAL WAVELENGTH=nnn.nn D2AW=nnn.nn	Set the actual wavelength of diode #2 to nnn.nn nanometers. The diode operating temperature is calculated from this value.
DIODE2 DRIVE=nnnn D2D=nnnn	Open diode #2 temperature servo and set the drive setting to nnnn.

Table 4.2-4. Verdi Service RS-232 Commands (Continued)

COMMAND	ACTION
DIODE2 RATED CURRENT=nn.nn D2RC=nn.nn	Set diode #2 rated current to nn.nn amps.
DIODE2 RATED CURRENT FACTOR=nn.nn D2RCF=nn.nn	Set diode #2 rated current factor (aging factor) to nn.nn.
DIODE2 TEMP=nn.nn D2T=nn.nn	Set diode #2 temperature to specified value, nn.nn.
EEPROM:mm=nn EE:mm=nn	Write byte nn to eeprom at address mm. **This command should be used with extreme care.**
ETALON DRIVE=nnnn ED=nnnn	Open the etalon temperature servo and set the drive setting to nnnn.
ETALON TEMP=nn.nn ET=nn.nn	Set the Etalon temperature to a specified value, nn.nn.
LBO DRIVE=nnnn LBOD=nnnn	Open the LBO temperature servo and set the drive setting to nnnn.
LBO FAULT=n	If n = 0: disable LBO not at temp fault. If n = 1: enable LBO not at temp fault. Should default to enabled upon CPU reset!!!
LBO TEMP=nn.nn LBOT=nn.nn	Set LBO temperature to specified value, nn.nn.
LR GAIN=n LRG=n	Set the light regulation gain (G = 2(n-1))
LR SWITCH=n LRS=n	Set the light regulation loop switch. 0 = open; 1 = closed
LR DAC=n.nn LRD=n.nn	Set the light regulation DAC voltage to n.nn.
NOMINAL WAVELENGTH=nnn.nn NW=nnnn	Set the nominal wavelength for the Verdi to nnn.nn nanometers.
VANADATE DRIVE=nnn VD=nnn	Open the Vanadate temperature servo and set the drive setting to nnn.
VANADATE TEMP=nn.nn VT=nn.nn	Set the vanadate temperature to the specified value, nn.nn.

Table 4.2-5. Verdi Service RS-232 Queries

QUERY	ACTION
?BAT VOLTS ?BV	Display the voltage of the Backup Battery, nn.nn volts.
?DIODE1 ACTUAL WAVELENGTH ?D1AW	Display the actual wavelength of diode #1, nnn.nn nanometers.
?DIODE1 CURRENT DRIVE ?D1CD	Display the current drive to diode #1.
?DIODE1 RATED CURRENT ?D1RC	Display diode #1 rated current, nn.nn amps.
?DIODE1 RATED CURRENT FACTOR ?D1RCF	Display diode #1 rated current factor, n.n.
?DIODE1 RATED CURRENT MAXIMUM ?D1RCM	Display diode #1 rated current maximum, nn.nn.
?DIODE1 VOLTAGE ?D1V	Display the voltage drop across diode #1, n.nn volts.
?DIODE2 ACTUAL WAVELENGTH ?D2AW	Display the actual wavelength of diode #2, nnn.nn nanometers.
?DIODE2 CURRENT DRIVE ?D2CD	Display the current drive to diode #2.
?DIODE2 RATED CURRENT ?D2RC	Display diode #2 rated current, nn.nn amps.
?DIODE2 RATED CURRENT FACTOR ?D2RCF	Display diode #2 rated current factor, n.n.
?DIODE2 RATED CURRENT MAXIMUM ?D2RCM	Display diode #2 rated current maximum, nn.nn.
?DIODE2 VOLTAGE ?D2V	Display the voltage drop across diode #2, n.nn volts.
?CURRENT DELTA ?CD	Display the diode current delta.
?EEPROMmm ?EEmm	Display the byte value stored in eeprom address mm.
?HEAD ID ?HI	Displays the laser head initialization state. V5G = 5 Watt Head V2G = 2 Watt Head

Table 4.2-5. Verdi Service RS-232 Queries (Continued)

QUERY	ACTION
?LAMBDA CURRENT ?LC	Returns the current from the Lambda power supply. **This query is only available for v 5.03, or higher, of the Verdi software.**
?LBO IN CONTROL ?LBOC	Returns the microprocessor in control of the LBO temperature servo. 1 = CPU micro in control 0 = LBO micro in control
?LBO OPTIMIZER POWER DATA ?LOPD	Returns the string of output powers obtained in the LBO Optimization routine. Powers correspond to temperatures given by the LBO Optimizer Temperature Data command.
?LBO OPTIMIZER TEMP DATA ?LOTD	Returns the string of temperatures used in the LBO Optimization routine. Temperatures correspond to output powers given by the LBO Optimizer Power Data command.
?LIGHT LOOP CAL ?LLC	Returns the Light Loop Calibration value. SDAC = Desired Output Power x LLC
?LIGHT REG DAC SETPOINT ?LRDS	Display the Light Regulation DAC set-point.
?LIGHT REG GAIN ?LRG	Display the Light Regulation Gain value.
?LOOP_SNOOP ?LS	Returns the value of the Loop Snoop Voltage Signal.
?NOMINAL WAVELENGTH ?NW	Display the nominal wavelength of the system, nn.nn nanometers. Value should be 808 nm.
?PHOTOCELL CAL ?PCC	Returns the photocell calibration value. Actual Output Power = A/D x PCELL CAL
?POWER SUPPLY ID ?PI	Displays laser head initialization state. 2BC = 2 Bar Coherent; 2BSDL = 2 Bar SDL 1BC = 1 Bar Coherent; 1BSDL = 1 Bar SDL

Table 4.2-5. Verdi Service RS-232 Queries (Continued)

QUERY	ACTION
?SERVICE SWITCH ?SS	Display the state of the Base Menus. 0 = Service menus; 1 = Customer menus
?SET CURRENT ?SC	Display the set current in Current Mode.
?SYSTEM ID ?SI	Displays system identification. V5G = 5 Watt System V2G = 2 Watt System
?THERMISTOR REF ?TR	Displays the thermistor reference voltage for the diodes and heatsinks. Should nominally be 2.5 V.
?THERMISTOR REF HEAD ?TRH	Displays the thermistor reference voltage for the Vanadate, etalon and LBO. Should nominally be 5.0 V.

Table 4.2-6. Precompensator Commands (Chameleon Vision only)

COMMAND	ACTION
COMP:x=	A command to indicate that a PreComp is fitted
COMPGCALH:yyyy=zzzzz	A command to set the high calibration point
COMPGCALW:yyyy=zzzzz	A command to set the precomp calibration
COMPPOS=	A command to move the precompensator stepper
COMPSCALH:x=yyyy	A command to set the high calibration point
COMPSCALW:yyyy=zzzzz	A command to set the precomp calibration
COMPWCAL:y=zzzzz	A command to set the precomp wavelength calibration
DELCURVE=	A command to delete curve number
DELCURVEPT=x	A command to delete the last point in a curve
GDD=	A command to manually set the GDD curve
GDDCURVE=	A command to set the Precomp calibration curve
GDDCURVEN=	A command to select the curve by name
HMCOMP=	A command to home the precompensator stepper
SETCURVEN:x=	A command to change the curve name
SETCURVEPT=	A command to change the curve point

Table 4.2-7. Precompensator Queries (Chameleon Vision only)

QUERY	ACTION
?COMP	A query for a PreComp being fitted
?COMPGCALH	A query for the high calibration point
?COMPGCALW	A query for the wavelength at precomp calibration point
?COMPPOS	A query for the precompensator stepper position
?COMPSCALH	A query for the high calibration point
?COMPSCALW	A query for the wavelength at precomp calibration point
?COMPWCAL:y	A query for the wavelength at precomp calibration point
?CURVE:ww=x	A query for the calibration curve points
?CURVEN	A query to return name of curve
?CURVEPT	A query for the curve point
?CURVEPTGDD:x	A query for the calibration curve GDD at point x
?CURVEPTW:x	A query for the calibration curve wavelength at point x
?GDD	A query for the GDD setting
?GDD:	A query for the GDD setting at a different wavelength
?GDDCURVE	A query to check the Precomp calibration curve
?GDDCURVEN	A query for the curve by name
?GDDMAX	A query to find the max GDD value at the current wavelength
?GDDMAX:xxxx	A query to find the max GDD value at wavelength xxxx
?GDDMIN	A query to find the min GDD value at the current wavelength
?GDDMIN:xxxx	A query to find the min GDD value at wavelength xxxx
?HMCOMP	A query for the precompensator stepper home position

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Introduction

The following are the Chameleon control software Service submenus. Definitions for the corresponding Verdi menus can be found in the Verdi Service manual. Figure 4.3-1 and Figure 4.3-2 provide a comparison of the Customer to Service selectable menus.

Note that the "Status" submenus and many of the "Settings" submenus for the Verdi and Chameleon are the same in both Service and Customer mode. Information for these submenus can be found in the Operator's manual.

Customer Base Menu

Wavelength Tuning
ChameleonStatus
Pump Laser Menu → Power Adjustment
Verdi Servo Status
Verdi Laser Status
Diode Parameters
FAULT Status
Temperature Set Points
LBO Settings
LBO Optimization
Speaker Volume
RS-232

Figure 4.3-1. Customer Base Menus

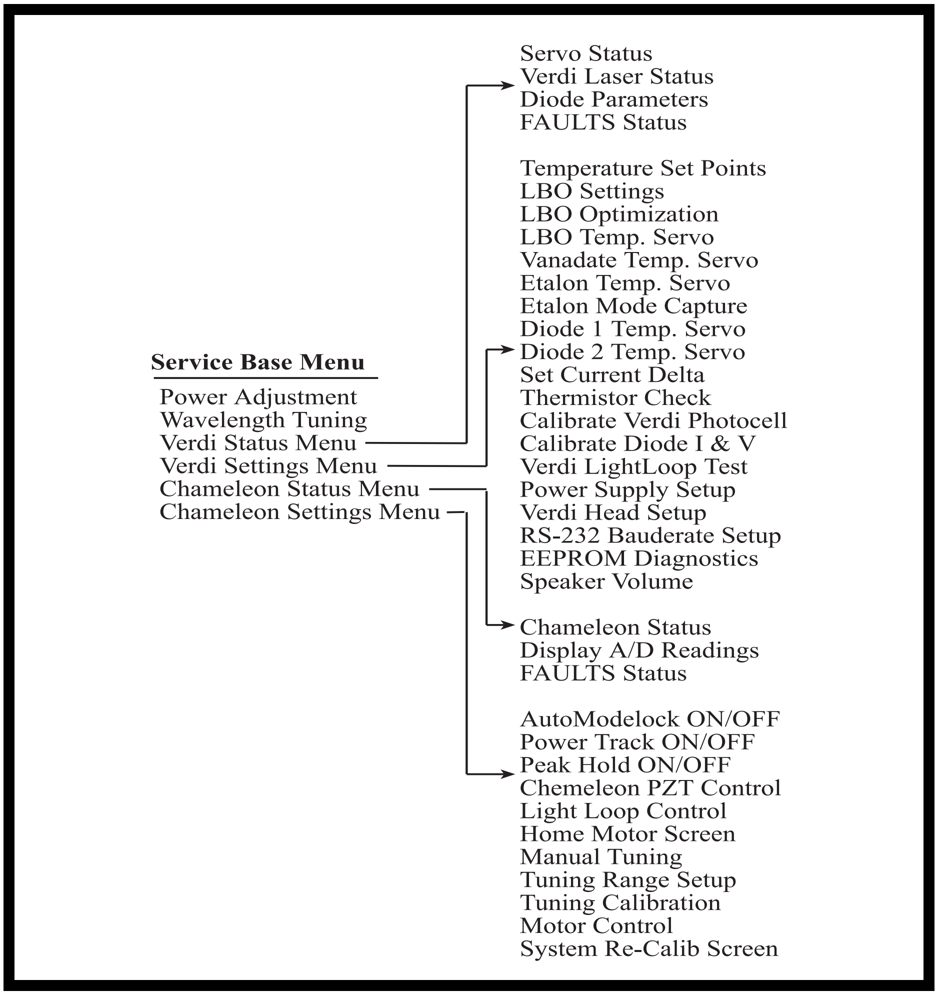


Figure 4.3-2. Service Base Menus

The following (Figure 4.3-3) is the Chameleon software Light Loop Control menu. You can choose between Verdi Light Loop and Current Control. Current control can be useful for diagnosing Verdi power problems.

```
LIGHT LOOP CONTROL
In Verdi Light Loop Mode

Press SELECT to change mode
➔ Verdi Light Loop Mode
****
Current Control Mode
Press EXIT for Menus
```

Figure 4.3-3. Chameleon Light Loop/Current Control Menu

CHAMELEON STATUS MENU

Ver	:	5.91T	Pwr	:	925.9 mW
Mdlk	:	YES	VW	:	800 nm
PTrk	:	ON	Cw	:	8.50 W
Strt	:	ON	SetP	:	8.13 W
PHld	:	OFF	QSw	:	7.28 W
LL	:	On	LS	:	2.80 V
Pzt	:	AUTO	Pos	:	-1328
Stat	:	0	Verd	:	8.08 W

Displays the current status of the Chameleon system.
Ver: Displays the installed Software version.
Mdlk: Displays the current modelocking status, yes or no.
PTrk: Displays current Power Track status, on or off.
Strt: Displays the current Starter status, on or off.
PHld: Displays the current Peak Hold status, on or off.
LL: Displays the Light Loop Status, off means Verdi current control.
PZT: Displays current PZT status, auto or manual.
Stat: Displays.
Pwr: Displays the current Chameleon power.
VW: Displays the current Chameleon wavelength.
Cw: Displays the Cw power limit for the current wavelength.
SetP: Displays the current Verdi set power.
QSw: Displays the Q-Switching power limit for the current wavelength.
LS: Displays the current Loop Snoop voltage.
POS: Displays the current tuning motor position.
Verdi: Displays the current Verdi power as read by the Verdi photocell.

DISPLAY A/D READINGS	
slow photodiode :	3.32 V
Cavity PZT X Rd :	1.87 V
Cavity PZT Y Rd :	1.86 V
Pump PZT X Rd :	2.36 V
Pump PZT Y Rd :	2.58 V
Green Photocell :	2.02 V
Press EXIT to return to Menus	

Displays the current voltages read from various parts of the system.

CHAMELEON SETTING MENU

```
AUTOMODELOCK ON/OFF

Automodelock Setting:  ON

Press  SELECT to toggle Setting

Press  EXIT to  return  to Menus
```

Allows the Auto-modelocking feature to be turned on or off for troubleshooting.

```
POWER TRACK ON/OFF

Power Track Setting:  ON
Power Track status : ON

Press SELECT to toggle Setting

Press  EXIT to return  to Menus
```

Allows Power Track to be turned on or off for trouble-shooting.

```
PEAK HOLD ON/OFF

Pump Peak Hold :  OFF
Cavity Peak Hold  :  ON

Press SELECT to toggle Pump

Press  EXIT to return  to Menus
```

Allows the Peak Hold function to be turned on or off for troubleshooting.

```
CHAMELEON PZT CONTROL
cX:  A P  R: 2.02  O:-0.02   S: 2.04
cY:  A P  R: 2.15  O:-0.02   S: 2.17
pX:  A    R: 2.29  O:+2.29   S: 0.00
pX:  A    R: 2.47  O:+2.47   S: 0.00
925.7mW  1.0% MDLK  Pump Dthr
>Cavity Peak Hold
 ...Cavity PZT mode
```

...Cavity PZT X Voltage
...Cavity PZT Y Voltage
...Pump Peak Hold
...Pump PZT mode
...Pump PZT X Voltage
...Pump PZT Y Voltage
...PZT control
...Power change Percent
...Recovery

Displays the current status of the Cavity and Pump PZTs, as well as allowing the adjustment of their settings and voltage levels. In the menu shown, “c” and “p” indicate cavity or pump, “X” and “Y” indicate the x and y tuning plane, “A” indicates automatic mode (as opposed to manual mode), the “P” indicates which mirror is being peak held (as both mirrors are never tuned at the same time), “R” indicated Read Voltage, “O” indicates offset (used in manufacture only), and “S” indicates Set Voltage.
By scrolling down to the various lines at the bottom of the menu screen, one can change these various settings.

```
HOME MOTOR SCREEN

** Motor is HOMED **

Press SELECT to Home Motor

Press  EXIT to return  to Menus
```

Allows the Tuning Motor to be sent to its home position. Useful for verifying operation of the motor in cases of wavelength inaccuracies.

```
        MANUAL TUNING
Chameln:916.9mW Verdi: 8.08W
        MODELOCKED

     Set POSITION = -1328

      Turn KNOB to change
Press  EXIT to return  to Menus
```

Allows manual adjustment of the tuning Motor. Can be used to verify operation of the tuning motor.

```
  TUNING RANGE SETUP

     Turn KNOB to change

 Min. Wavelength =       720nm
 Max. Wavelength =       940nm

 [SELECT]             [EXIT]
```

Allows the Chameleon tuning range to be calibrated. This is NOT to be changed in the field. Doing so can result in a loss of the tuning calibration information.

```
     TUNING CALIBRATION
  Verdi: 8.29 W  MODELOCKED
   Wavelength       :   840 nm
   Position         :    -1750
   QS Verdi Power   :   7.66 W
   CW               :   8.45 W
   ChameleonPower   : 1340.0mW
   Start Possible   :     Yes
```

Allows the Chameleon Tuning Calibration to be set. See Chapter FIVE, Maintenance and Calibration for the complete procedure. This should only be done on the advice and with the approval of Product Support. Product Support will then forward the information to the factory in Scotland.

```
      MOTOR CONTROL
-1328 MDLK    925.3mW  HM:0
          STEPS = 0
     Turn KNOB to change
     Press SELECT to move
>Move Steps
 Go Absolute Position
 ...Enable Motor
```

```
 ...Disable Motor
 ...Direction Forward (HI)
 ...Direction Reverse (LO)
 ...Step Pulse
 ...Percentage Setting
 ...Search for Modelock
 ...Home
 ...Backlash comp.
 ...Tuning Pause
 ...Reset calib. Table
```

Allows manual control of the tuning motor, as well as other unrelated functions. The menus which may be useful in the field are listed below. The other choices are either functions which are duplicated in other menus or are settings which should not be adjusted.

Percentage Setting: Allows the pump percentage to be changed, in effect lowering or raising the Verdi pump power. The percentage refers to the

```
SYSTEM RE-CALIB SCREEN
  Verdi         Chameleon
  8.20W  Old     1150.3 mW



   To start       To Exit
    [SELECT]       [EXIT]
```

Currently not used in the Chameleon system.

Home Screen

Power: 1900 mW

800nm

Status: OK

The user must access this menu to adjust the Chameleon output wavelength. Select the desired wavelength using the front panel POWER ADJUST knob and press MENU SELECT.

The screen displays the actual modelocked power available from the Chameleon laser head, and the current operating status of the laser as follows:

OK: Normal operation, modelocked laser output available at displayed power and wavelength.

Standby:Keys witch OFF.

Power ramping (0.9%): Diodes ramping to operating power, progress displayed as average current until Verdi threshold current and then as a percentage of Verdi set power.

Starting:System at operating power and starting modelock.

Tuning: Tuning operation in progress.

Cooling down (xx%): System cooling down during total shutdown, progress displayed as a percentage.

Warming up (xx%): System warming up during cold start, progress displayed as a percentage, not to be confused with “power ramping”.

Main Menu

MAIN MENU

► Dispersion Settings
System Diagnostics
System Shutdown
Alignment Mode
Initialise
Service

Five Customer submenus and one Service submenu selection.

The Service submenu is displayed using the ACCESS=CLG5182 command. ACCESS=0 removes the Service submenu.

Customer Submenus

DISPERSION SETTINGS

SEE OWNERS MANUAL

NO CHANGES IN SVC MODE

SYSTEM DIAGNOSTICS

SYSTEM DIAGNOSTICS

► RS-232 Baud Rate
System Information
Fault Screen

Provides serial communication protocol, software information, and diagnostic parameters.

RS 232 BAUD RATE

RS-232 SETTING

New settings: 19200, 8,N,1

Turn knob for new baud rate

Press SELECT to confirm
Press Exit to cancel

Allows adjustment of the baud rate only on the RS-232 communications “New settings:” option. This is done by using the POWER ADJUST knob. Press SELECT to accept the new baud rate value before exiting this screen. Bauds available are 2400, 4800, 9600, 19200 and 38400.

System Information

Cx:	-20%	Px*:	25%
Cy:	-32%	Py*:	-45%
Wavelen:	800 nm	Step:	1955
ChamPwr:	3930 mW	Pump:	14.4 W
Run Hours:	1500	S/N:	1234
► PSU Software:		7.93	
Head Software:		7.93	
Verdi Software:		9.53	
Interface PCB:		AA	
Interface PCBA:		AA	
Head PCB:		AF	
Head PCBA:		AG	
Baseplate Temperature:		35.1	
Verdi Current:		50.4	

Note: You must scroll down to view these fields

SYSTEM INFORMATION

Displays key laser operating parameters:

Mirror positions as percentage values in the range –100% to +100%. 0.0% is the center position corresponding to a PZT value of ~2.25. –100.0% would be a PZT value of 0.00, and +100.0% would correspond to a PZT value of 5.00. Note: PZT values can be extracted via RS-232 commands as a voltage.

Cx: Cavity x mirror position

Cy: Cavity y mirror position

Px: Pump x mirror position

Py: Pump y mirror position

* denotes the mirror currently under PowerTrack servo control. During normal operation. This would mean that the PZTs without the '*' are under PZT-Hold status.

Wavelen: Laser output wavelength in nm

Step: Stepper position

ChamPwr: Available laser output power in milliwatts

Pump: Pump laser power

Run hours: Total Chameleon laser head running hours

S/n: Chameleon laser head serial number

PSU Software: Denotes the software version of the power supply/controller

Head Software: Denotes the software version of the Chameleon head.

Verdi Software: Denotes the software version of the Verdi. Head board and power supply PCB versions are also included as a submenu along with baseplate temperature.

Interface PCB: Revision of Verdi interface PCB
Interface PCBA: Revision of Verdi interface PCBA
Head PCB: Revision of Chameleon head PCB
Head PCBA: Revision of Chameleon head PCBA
Baseplate Temperature: Chameleon baseplate temperature
Verdi Current: Verdi laser diode current

Fault Display

No Active Faults

FAULT SCREEN

Displays faults related to both the Chameleon and Verdi pump laser. If faults are active, fault codes and descriptions will be displayed. Refer to Svc-Cham-2.1 "Fault Messages" for a complete list of faults and associated corrective actions.

SYSTEM SHUTDOWN

Initiates system cool down prior to total system shut down. This would cool the LBO down the same as the "LBO cooling" in the Verdi menu. Cool down will be displayed as a % of LBO set temperature and referenced to the baseplate temperature.

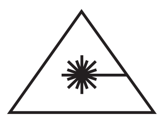
System Shutdown

Press SELECT to continue

Press EXIT to abort

ALIGNMENT MODE

Reduces laser output to a nominal low power and tunes laser to a visible wavelength in order to facilitate alignment in applications where the normal operating power is likely to cause damage to sensitive components. The alignment wavelength can be set using the alignw RS232 command. The factory default value is 730 nm. The alignment power can be set using the alignp command. The factory default value is 300 mW.



The laser still poses a significant laser hazard when operating in this mode and the user should follow the laser safety precautions outlined in Section Two: Laser Safety.

Alignment Mode

Press SELECT to continue

Press EXIT to abort

Alignment Mode

Use the Shutter button

Press EXIT when finished

INITIALISE

Initialise

Press SELECT to continue

Press EXIT to abort

Pressing Select will begin the Initialization procedure.

Initialise

Please wait...

The INITIALISE routine is used when the system is not operating at a particular wavelength. The routine automatically homes the stepper, tunes the laser to a preset wavelength at the peak of the gain and then scans the cavity and pump mirrors to determine the optimum alignment. Once the routine is completed the laser automatically tunes the laser to the original wavelength.

Chameleon Service Menus

Service Submenus

SERVICE MENU

► Calibration set up
Calibration
Home Stepper
Manual Control
Humidity
Settings
Accessory

Accessible only when in Chameleon Service Mode. Provides access to calibration factors and system operational parameters.

Note: Some of these values are system model specific. Values shown are for the Chameleon Ultra II.

CALIBRATION SET UP

CALIBRATION SET UP	
► Min Wavelength	670 nm
Max Wavelength	1090 nm
Wavelength Points	43
Pump Level	80%
Lasing Threshold	10%
Starter Threshold	50%
RF Threshold	24%
Slow PD Offset	100 mV
Low Gain Switch Off	690
Upper Gain Switch Off	1000

Note: You must scroll down to view these fields

Adjusting the wavelength values or number of calibration points in this menu will result in the calibration table becoming scrambled. Do not change these values unless the Chameleon EEPROM is backed up or there is a spare copy.

Min Wavelength: is adjusted by the POWER ADJUST knob, and can be set as low as 650 nm, however the system can only tune down to 680 nm (the default value). The actual tuning range cannot be set via this menu, this menu only sets the range for the wavelength calibration points.

Max Wavelength: Is adjusted by the POWER ADJUST knob, and can be set as high as 1150 nm, however the system can only tune up to 1080 nm. Again, tuning range is established outside of the service menu.

Wavelength Points: The number of points the system will evenly space through the tuning range established. Maximum number of points is 84 default.

Pump Level: The Verdi power level as a percentage being 10% to 95% of the range established by “QS Verdi Power” and “CW Verdi Power” (See Calibration Menu below). Default Pump Level is 80%.

Lasing Threshold: The percentage of the slow photodiode reading where lasing is comfortably achieved. It is a range dependant value, that is applicable to any wavelength, as this is now characterized for each individual Chameleon laser head. The available threshold range is 1% to 100%, and the default value is 10%.

Starter Threshold: The percent of the slow photodiode reading where CW output is fairly optimized and there is enough gain to possibly allow modelocking. It is a range dependant value, that is applicable to any wavelength, as this is now characterized for each individual Chameleon laser head. The available threshold range is 1% to 100%, and the default value is 50%. Starter can be monitored via the LED, or across TPs 8 and 10 on the Chameleon Head board. Pressing POWER LEVEL 1 button will fire the starter.

RF Threshold: When the modelocking detection circuit produces a signal above this value, the laser is assumed to be modelocked. The available threshold range is 1% to 100%, and the default value is 25%. TP17 on the Chameleon Head board is where the RF can be monitored.

Slow PD Offset: A factory determined offset value for the slow photodiode.

Low Gain Switch OFF 690: One of the two gain boost switches to allow signal amplification for the slow photodiode above 690 nm. Set to OFF for current shutter assemblies with a germanium slow photodiode.

Upper Gain Switch OFF 1000: One of the two gain boost switches to allow signal amplification for the slow photodiode above 1000 nm. Set to OFF for current shutter assemblies with a germanium slow photodiode.

CALIBRATION

CALIBRATION MENU	
► Verdi	14.7 W
Wavelength	670 nm
Position	1026
Slit position	3500
QS Verdi power	13.80
CW Verdi power	14.83
Chameleon power	3996 mW
Start possible	yes/no

Verdi: Displays Verdi power from the Verdi photodiode.

Wavelength: Displays the wavelength starting with 670 nm or the min. wavelength established in the Calibration Set-up menu. Wavelength can be changed by using the POWER ADJUST knob, and will step through the selected number of steps established in the Calibration Set-up menu.

Position: Displays the tuning stepper motor position in digital counts relevant to the wavelength displayed above. The POWER ADJUST knob can be used to adjust this value to mach the wavelength measured with an external spectrum analyzer to the displayed wavelength. Favor the internal spectrum analyzer when performing this calibration as this is what the customer will be making comparisons against. Press SELECT to accept value.

Slit Position: Displays the modelock slit rotational position in digital counts relevant to the width of the slit opening. The slit rotation causes a narrowing of the beam path's aperture similar to two mechanical sides translating in the x-axis. The POWER ADJUST knob can be used to adjust this value. Higher values relate to a smaller slit width, and the opposite for lower digital values. This should be left at factory preset.

QS Verdi Power:Displays the Verdi power where Q-Switching begins to occur. This is the lower limit where the range for the Pump Level is determined for the Calibration Set-up menu. It can be adjusted by using the POWER ADJUST knob. Press SELECT to accept value.

CW Verdi Power: Displays the Verdi power where CW-Breakthrough begins to occur. This is the upper limit where the range for the Pump Level is determined for the Calibration Set-up menu. It can be adjusted by using the POWER ADJUST knob. Press SELECT to accept value.

Chameleon Power: Displays the output power from the Chameleon. This point is characterized against an external calibrated power meter. It can be adjusted by using the POWER ADJUST knob. Press SELECT to accept value. Slow and fast photodiode readings are stored when SELECT is pressed. Ensure that the laser is modelocked when calibrating.

Start Possible: Press SELECT to test the setting above. Displays the status of the possible start of modelock at the wavelength displayed. This is established by the system after a test is complete and cannot be adjusted. The menu will display a “Yes” or “No” indicating if modelock can or cannot be started at this wavelength.

HOME STEPPER

Two stepper motors present in the 80 MHz system, wavelength tuning stepper and the modelock slit stepper.

HOME STEPPER

► Home Tuning Stepper
Home Slit Stepper
Slit Offset: 0

Press SELECT to continue
Press EXIT to cancel

Home Tuning Stepper:

Will run the tuning stepper to the mechanical stop, and return to the count position established before the home command was sent. This might be mechanically different than before.

STEPPER

Stepper Homing

Please Wait

STEPPER

Slit Homing

Please Wait

Home Slit Stepper:

Will run the slit stepper to the mechanical stop, and return to the count position established before the home command was sent.

HOME STEPPER

Home Tuning Stepper
Home Slit Stepper
► Slit Offset: 0

Press SELECT to continue
Press EXIT to cancel

Slit Offset:

Displays the offset in digital counts for the modelock slit and has a range of 0 to 5250 (the default is 0). Slit offset should remain at factory preset.

MANUAL CONTROL

► PZT	: actual	: status		: Pmap	
cx	: -60%	: Auto*		: -55%	
cy	: -26%	: Auto*		: -30%	
px	: -80%	: Auto		: -75%	
py	: -75%	: Auto		: -65%	
Step 300		cham pwr		: 3900 mW	
pwr map		pump pwr		: 14.7 W	
Slit		calib slit pos		: 3378	

PZT:

Actual: Is the actual PZT location between the –100% and +100% range.

Status: Auto: This status indicates a "hold" condition.

Auto*: PowerTrack is dithering this mirror. Note that after tuning, the cavity PZTs will dither for 5 seconds before going into hold, and switching to pump dither. Press POWER LEVEL 2 button to toggle between Auto* (servo ON) and Auto (servo OFF, peak hold ON).

Man: PZT mode is manual, and the POWER ADJUST knob can adjust the PZT position highlighted in the menu. Press SELECT button to toggle between Auto and Manual.

Pmap: Is the optimal PZT location between the –100% and +100% range as determined by the most recent power map data.

Cx: Cavity x mirror position as a percentage(+/-100%).

Cy: Cavity y mirror position as a percentage(+/-100%).

Px: Pump x mirror position as a percentage(+/-100%).

Py: Pump y mirror position as a percentage(+/-100%).

Step: The tuning stepper motor position in digital counts. This can be changed when troubleshooting the PZTs, but will return to the preset position when tuning the system in the Home Screen.

Cham pwr: The Chameleon power at the output of the Chameleon.

POWER MAP
Put the PZTs in auto first

Pwr map: All PZTs must be set to Auto, or the system will alert the operator. When the powermap is running, the message "- Running" will appear next to the power map menu item. Running the power map automatically determines the optimum pump and cavity PZT positions.

Pump pwr: The current power out of the Verdi.

Slit: **Calb:** Indicates that the slit is in the calibrated position as stored for the wavelength currently running.

Man: Indicates that the slit can be manually changed via the POWER ADJUST knob. Toggle from Calib to Man. Note: Any changes are permanently stored from the manual setting once SELECT has been pressed. The calibrated slit position is just that, and cannot be changed in this state. If manual is selected, the slit can be changed for troubleshooting purpose. To restore the calibrated slit position, select calibrated again, go to the home screen, change the wavelength (say by 1nm) and return to the original wavelength and then return to this menu.

Slit Pos: Displays the current slit position in digital counts.

HUMIDITY		
► Current RH	:	1%
Low RH point	:	0%
High RH point	:	32%

► **Modelock search**	:	**off/on**
Starter	:	**auto/off/on**
Tweak cavity mirror	:	**off/on**
Tuning speed	:	**200**
pump x amplitude	:	**50**
pump y amplitude	:	**85**
pump lock gain	:	**64**
cavity x amplitude	:	**350**
cavity y amplitude	:	**700**
cavity lock gain	:	**32**
default settings		

HUMIDITY MENU

Current RH: Displays the current relative humidity as indicated by the sensor in line with the MRU circulation. This is only a readout and will not be highlighted as a menu option.

Low RH Point: The set point selected when the sensor is at ideally near 0% humidity. The baseline for the sensor calibrated range will be stored into the eeprom from this data point.

High RH Point: The set point selected when a higher humidity is exposed to the sensor, typically the room environment with a calibrated hygrometer will suffice.

SETTINGS

Modelock Search:

Enables/disables the auto-modelock feature. When “On” is selected, the system will increase power, and optimize the alignment to insure modelock. “Off” will disable this feature. Modelock search will go to a known good wavelength (one where “Yes” shows in the “Start possible” field in the wavelength calibration table) and try to modelock at that wavelength if problems are noticed at the set wavelength, once modelocked, the system will “drag” itself back to this wavelength in the modelocked condition. In the event of the system losing modelock for over 30 seconds, modelock search will tune the laser to a central wavelength and stepwise tune the system every 20 seconds until modelocking is achieved. The system will then tune to the original wavelength.

Starter: Auto: The starter will activate when the cavity power reaches the “Starter threshold” for the current wavelength, and automatically turn off once the “RF Threshold” value is achieved.

On: The starter will always be on, the system will automatically override this setting when leaving theService menu, as this is a troubleshooting feature.

Off: This turns the starter off. Used for optimizing CW power.

The front panel POWER LEVEL 1 button allows manually firing the starter and will override any of these set conditions.

Tweak Cavity Mirror: Leave this feature on.

Tuning Speed: Set the speed of the tuning step motor in Hz. Range is from 0 to 2000, the default value is 200 Hz. This is factory set at a speed where > 25 nm/sec can be achieved.

Pump X amplitude: Dither amplitude for the Px PZT. [see note below]

Pump Y amplitude: Dither amplitude for the Py PZT. [see note below]

Pump Lock Gain: [see note below]

Cavity X amplitude: Dither amplitude for the Cx PZT. [see note below]

Cavity Y amplitude: Dither amplitude for the Cy PZT. [see note below]

Cavity Lock Gain: [see note below]

Note: These parameters are factory set to optimize the cavity and pump PZT power tracking routines. Do not adjust these parameters in the field unless specifically requested to do so.

ACCESSORY

ACCESSORY

► Precompensator
Attenuator

Two sub-menus are available from the Accessory menu: Precompensator and Attenuator.

PRECOMPENSATOR

PRECOMPENSATOR

► Precompensator Set-up
Dispersion Calibration
Restore Curve Data

Three sub-menus are available from the Precompensator sub-menu: Precompensator Set-up, Dispersion Calibration and Restore Curve Data.

PRECOMPENSATOR SET-UP

PRECOMPENSATOR SETUP

► Precompensator Fitted
Autotune Enabled
Precomp Position
Home Precompensator

Precompensator Fitted: Default for a Vision should be **YES**. Select **NO** to turn system into a standard UltraII. The software for Vision and UltraII is the same so the Vision menus will be visible in the Ultra menu structure but disabled.

Autotune Enabled: This is the calibration look-up table for the Precomp Stepper. Default for a Vision system would be **Enabled**.

Precomp Position: Precomp Stepper position / manual control

Home Precompensator: Home the stepper

DISPERSION CALIBRATION

DISPERSION CALIBRATION

► Calibrate Pt
Wavelength
GDD Low
Stepper Low
GDD High
Stepper High

Dispersion Calibration: This entire menu correlates to the Precomp Stepper Calibration points and serves as the look-up table for the stepper (see Autotune Enabled).

Calibrate Pt:

Wavelength:

GDD Low:

Stepper Low:

GDD High:

Stepper High:

RESTORE CURVE DATA

RESTORE CURVE DATA

► For Factory Use Only!

Precompensation factory defaults.

Warning: Do not select unless instructed to do so by the factory, because calibration data is reset to a base menu only used as a starting point for calibration. This menu is for factory use.

ATTENUATOR

ATTENUATOR

► Attenuator Fitted
Calibrate Attenuator
Attenuator Position
Home Attenuator

These menus affect and control the IR power attenuator which is currently not active.

CALIBRATE ATTENUATOR

Currently not active.

CALIBRATE ATTENUATOR

► 100% transmission
0% transmission

Verdi Service Menus

The Verdi Main Screen and Base Menu are displayed using the Verdi=1 command. Verdi=0 returns the display to Chameleon Service mode. To enter Verdi Service mode, the shunt on JP9 on the power supply CPU board must be installed first (refer to Svc-Cham-5.14 “Verdi Optimization 80 MHz System”).

These commands are only valid in service mode after entering the ACCESS command. Refer to the appropriate Verdi Service manual and/or latest FSB/FSU for using this menu.

Chameleon Service Software

There are a number of Chameleon Service programs that are used to support the Chameleon systems. Some functionality of the programs are similar, however each program has a specific use.

Use of these programs requires the RS-232 connection between the Chameleon (power supply or laser head) and the computer, and/or the USB cable for the internal spectrometer to the laser head.

Software Version Compatibility

Revisions to the Chameleon Service programs were driven by changes in the internal spectrometer or the Chameleon software version.

For the Service Engineer it is recommended to install all of the following versions in order to support each of the Chameleon models and configurations. Some of the programs are typical MS-Windows programs that have a "Setup" file to execute that controls the install; others are older LabView programs where the "program folder" simply needs to be copied to the Service Engineer's computer.

When installing these programs it is important to select the correct USB driver for the internal spectrometer. Some of the programs require connection to a Chameleon system to run; program installation should be done when a system is available to ensure that the system and program can communicate.

Table 4.5-1. Chameleon Service Software Version Cross-Reference

	INTERNAL SPECTROMETER	CHAMELEON DATALOGGER	CHAMELEON DATA RUN	SOFTWARE VERSION	CHAMELEON PC	BOOTLOADER PC
90 MHz Cavity 210/XR	Ocean Optics SAS1024	2.4	1.9	6.X - 7.5T	1.06	na
80 MHz Cavity XR/Ultra/Ultra II	Ocean Optics USB2000	2.5	2.0	na	na	2.1
80 MHz Cavity XR/Ultra/Ultra II	na	na	na	7.81 - 7.88	1.10	2.1
80 MHz Cavity XR/Ultra/Ultra II	Ocean Optics USB4000	2.6.1	2.1.1	7.90 - >	1.14	2.1

Table 4.5-2. Chameleon Service Software Version Install Reference

PROGRAM	VER.	ACTION TO INSTALL	VER.	ACTION TO INSTALL	VER.	ACTION TO INSTALL
Bootloader PC	2.1	Windows Install				
Chameleon PC	1.06	Copy Folder	1.10	Copy Folder	1.14	Copy Folder
Datalogger	2.4	Copy Folder	2.5	Windows Install	2.6.1	Windows Install
Data Run	1.9	Windows Install	2.0	Windows Install	2.1.1	Windows Install

Bootloader PC

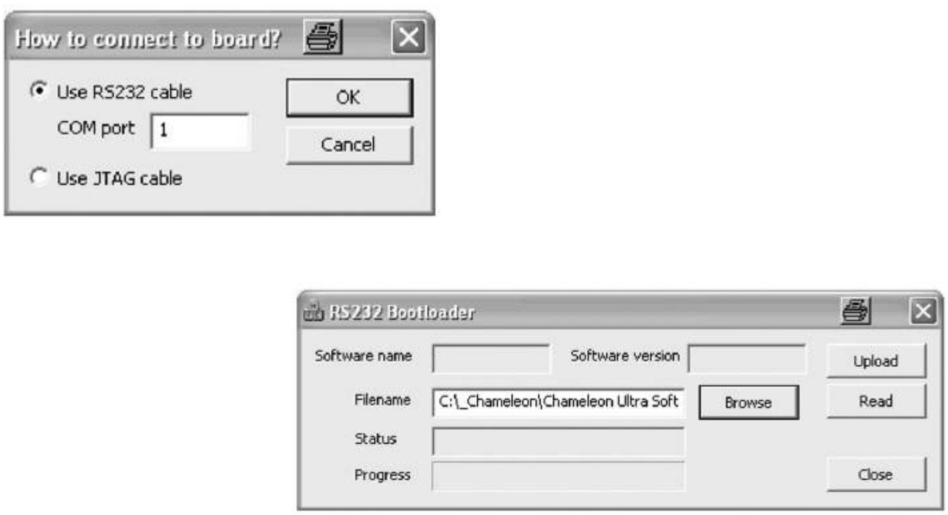


Figure 4.5-1. Bootloader PC

The Bootloader PC program is written to upload S-Record software files when used with a Chameleon system that would be for the Verdi Interface Board and the Chameleon Head Board. An option is available for uploading using RS-232 or the JTAG interface. As such, it is only used with the 80 MHz Cavity Chameleon systems. Use of the Bootloader PC is further described in the Software Upload procedure, SVC-CHAM-5.3, in this manual.

Chameleon PC

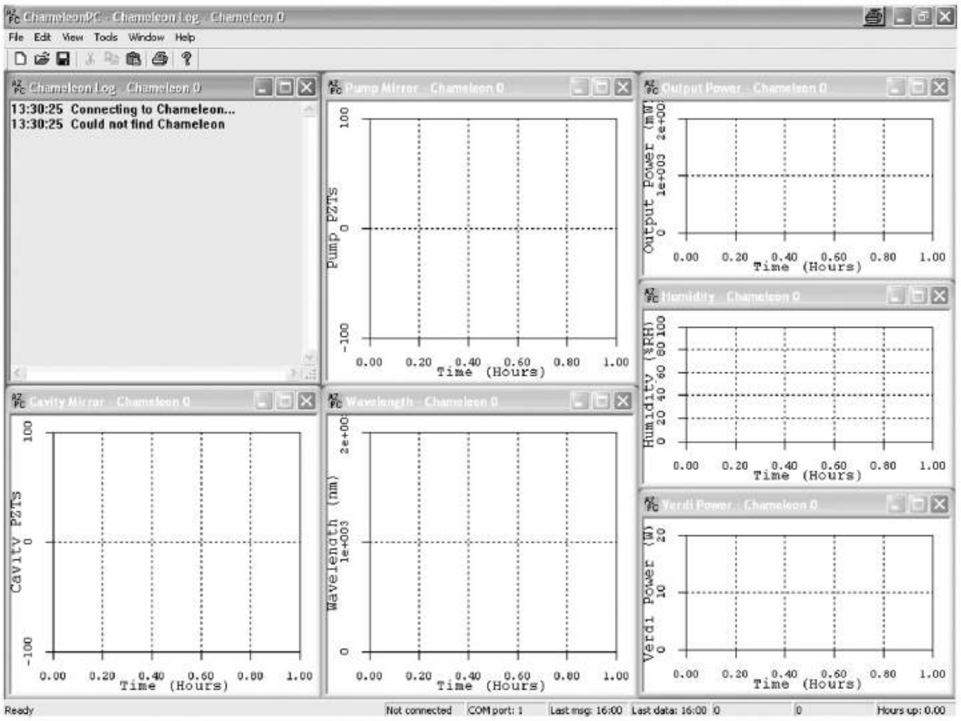


Figure 4.5-2. Chameleon PC

The Chameleon PC program is used to monitor the Verdi pump power, Pump and Cavity Mirror PZTs, Humidity, Wavelength, and Chameleon output power. More importantly, drop down menus provide the Verdi and Chameleon Head EEPROM Editors and a general purpose Terminal Window.

Chameleon Data Run

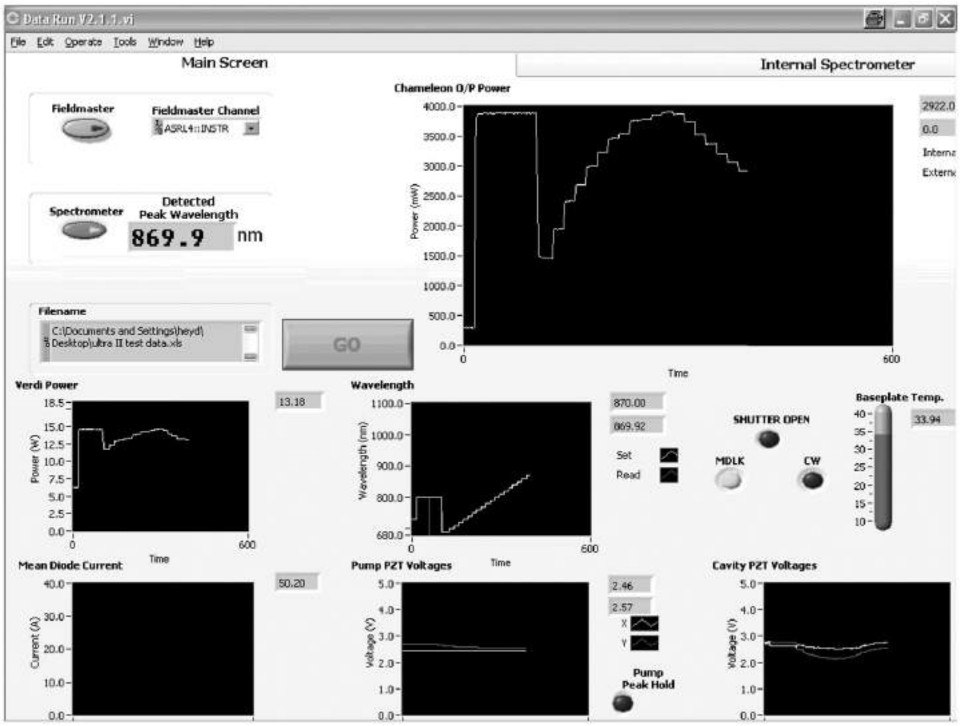


Figure 4.5-3. Chameleon Data Run

The Chameleon Data Run program can be used to monitor Verdi pump power, Pump and Cavity Mirror PZTs, Wavelength, and Chameleon output power. It has a monitor for baseplate temperature but does not include humidity. There is also a larger display for the internal spectrometer. A major use of this program is to perform a wavelength scan (start, end, increment), checking modelocking, etc., and allow saving the data that includes wavelength, power, and cavity positions, as well as, Verdi servo set temperatures. This is useful for inspecting power levels and PZT positions across the tuning range.

Chameleon Datalogger

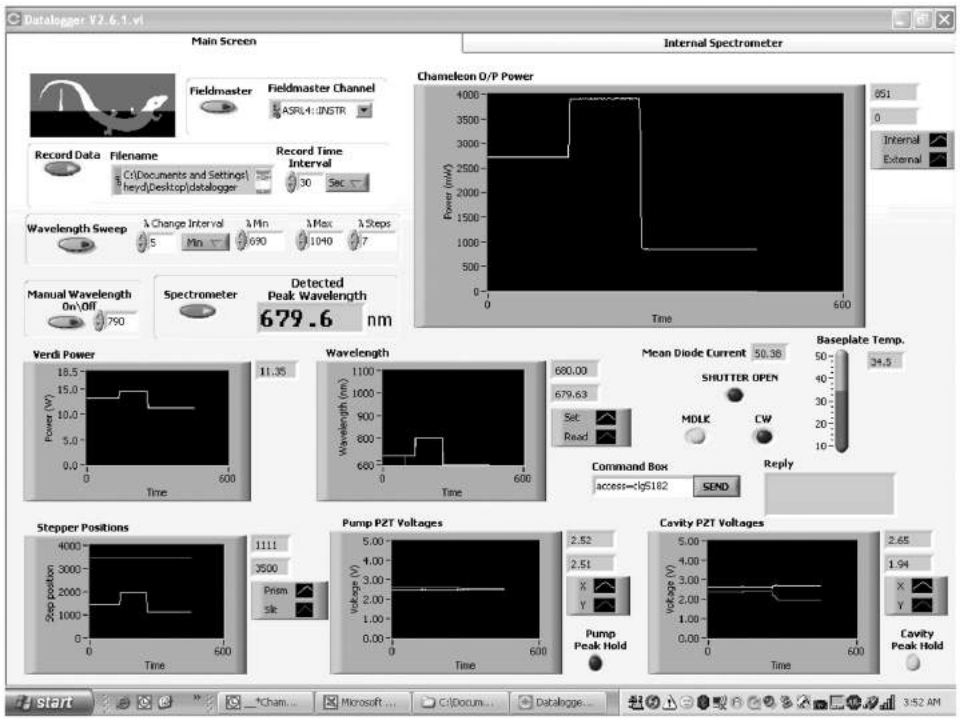


Figure 4.5-4. Chameleon Datalogger

The Chameleon Datalogger program is similar in layout to the Chameleon Data Run program in that can be used to monitor operation and scan across the tuning range. It collects similar data as to wavelength, power, and PZT positions, but also adds slit positions, baseplate temperature and FAP current. For wavelength scanning, it can also specify start, end, and increment, but also specify when to change to the next wavelength and how often to record data. The main screen also includes a command box for sending a RS-232 command/query directly to the Chameleon.

Chameleon GUI

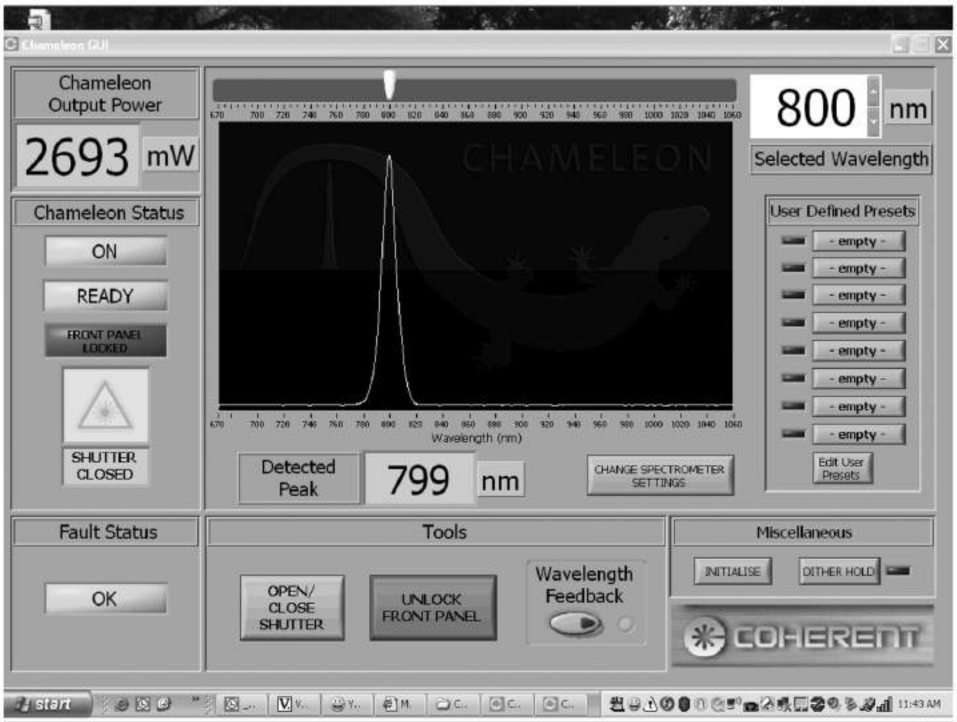


Figure 4.5-5. Chameleon GUI (v2.06)

The Chameleon GUI is not a Service program but the program provided to the customer for remote control of the Chameleon system. Typically, the power supply is “locked” and the customer change and monitor wavelengths, Initialise, as well as place the Pump PZT in Peak Hold (i.e. Dither Hold) in v2.06, etc.

Coherent GUI

Shown below is a generic Coherent GUI, which includes the Chameleon Vision functionality, was released in November 2009. Please note that the laser head board and Verdi interface board must run software revision 8.11 or higher to support the Coherent GUI.

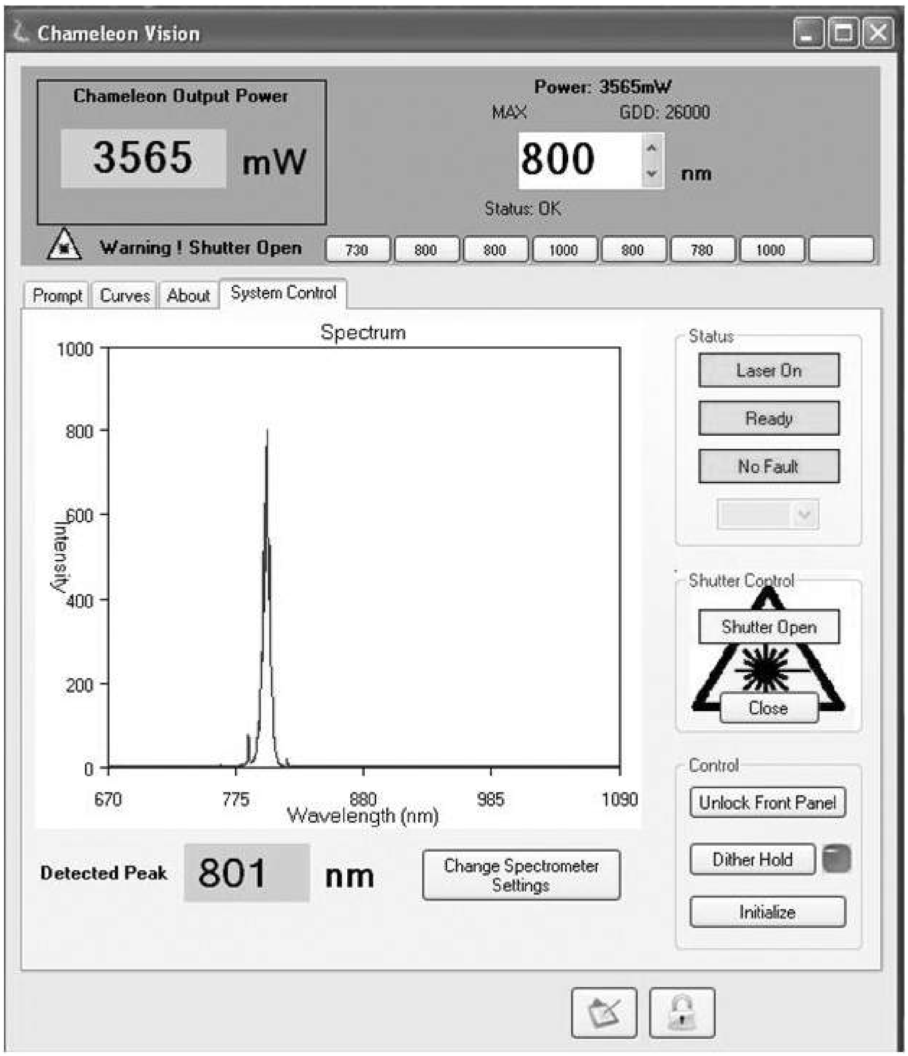


Figure 4.5-6. Coherent GUI

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Preliminary Steps and Data Backup

Contact Coherent Technical Support at 1-800-367-7890 if diagnostic assistance is required to determine the need for FAP-I replacement.

The following equipment will be required to replace a FAP-I:

Laptop or Desktop computer
Copy of Coherent ChameleonPC program
Serial cable
Replacement FAP-I kit (Includes thermal compound)
Phillips screwdriver
Allen keys
ESD Wrist strap

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1. Ensure the main power to the Chameleon laser is on. Key the laser to STANDBY.
2. Remove the power supply cover. This will trigger the “Power Supply Interlock” fault.
3. Establish an RS-232 connection between the power supply and a computer. See SVC-CHAM-4.1 for more information.
4. Save copies of the Chameleon and Verdi head EEPROMs using the Chameleon PC program.

FAP-I Replacement

1. Perform the “Turn-off (Complete Shut Down)” procedure located in Section Four of the Chameleon Operator’s Manual. The associated cool-down cycle will take approximately 30 minutes. The front panel display will indicate when the cool-down cycle is complete.

Do not turn off the power switch or disconnect the AC power input until the cool down cycle is complete.

---

2. When the LBO cool down cycle is complete, turn off the main power switch on the power supply rear panel.

   <u>Do not disconnect the power cord from facility power.</u> The power supply chassis must be grounded either by the power cord or a separate ground to avoid ESD.

The FAP-I can be damaged by electro-static discharge (ESD). To avoid ESD, a personal grounding strap should be used at all times.

FAP-I Handling Precautions

1. The FAP-I can be damaged (electro-static discharge, ESD) by improper handling. To avoid ESD, a personal grounding strap should be used at all times. The ESD strap must be connected to a conductive part of the chassis.

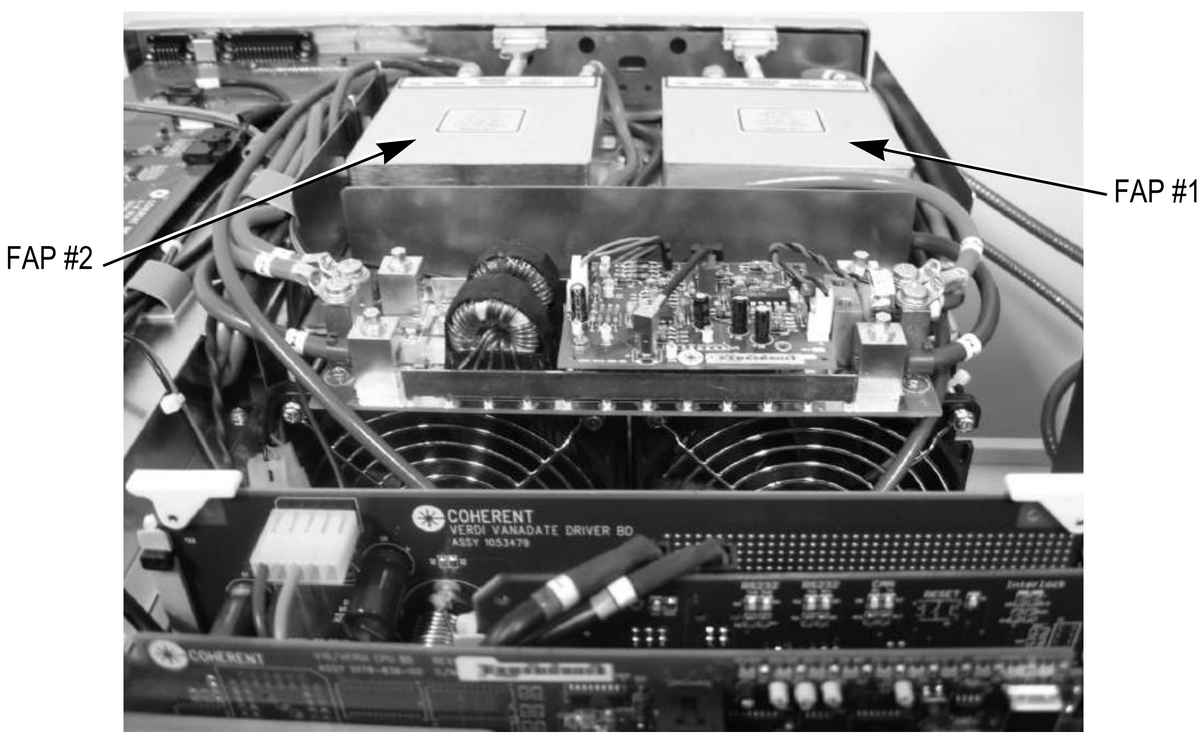


Figure 5.1-1. Location of FAP-I Assemblies

2. A shorting clip (Figure 5.1-2) must be installed between the anode and cathode terminals to avoid inadvertent ESD before the leads are disconnected from the terminals.

3. When disconnecting the fiber optic cable from the FAP-I assembly, a cap (Figure 5.1-2) should be installed over both the FAP-I optical emission port and the end of the fiber optic cable to protect them from damage or contamination.

Figure 5.1-2. Fiber Optic Covers and FAP-I Anode/Cathode Shorting Clip

The end of the fiber optic cable constitutes an optical surface. Do not allow the end of the fiber optic cable to make contact with any surface including the fingers.

A contaminated optical surface can cause system damage. To minimize exposure to the environment, the blue protective plastic cap should be installed whenever the fiber is disconnected.

When removing or installing the fiber optic cable, do not allow the fiber optic cable to rotate while loosening the ferrule connector.

Fiber Cable Handling Precautions

1. When removing or installing a fiber optic cable, do not allow the fiber optic cable to rotate while loosening the ferrule connector (Figure 5.1-4).
2. The end of the fiber optic cable constitutes an optical surface. Do not allow the end of the fiber optic cable to contact any surface including the fingers. To minimize exposure to the environment, the protective plastic cap should be left in place until a connection is made and immediately installed over the fiber end when a connection is disassembled.
3. Do not allow the end of the fiber optic cable to contact the diode (FAP-I) assembly or any other surface including the fingers. Failure to do so can damage the optical surface.

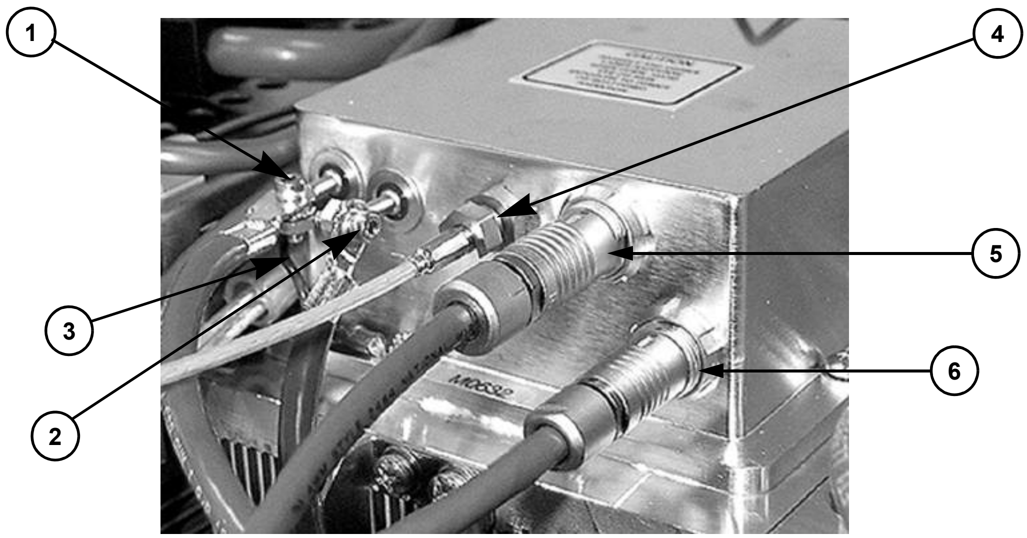
Inspect the fiber optical surface to verify there is a need to clean prior to performing the cleaning procedure. Do not clean the fiber optical surface unless it is contaminated.

4. Do not install a contaminated or damaged fiber optic cable to the FAP-I. Doing so will cause a failure of the laser system. Contamination or damage can be difficult to detect. A magnifier will be helpful during examination.

Do not use acetone as a cleaning solvent on the fiber optical surfaces. It will dissolve the matrix which supports the fiber and permanently destroy the optical transport fiber.

5. Do not clean the end of the fiber optic cable unless it is contaminated. If necessary, the end of the fiber optic cable should be inspected and cleaned using the section titled, “Fiber Optic Cleaning”. Do not use any other procedure or method. If scratches or other damage is noted, the FAP-I replacement should be terminated and the plastic cap reinstalled. Contact Coherent technical service.

6. Excessively tight fiber umbilical bends (less than a 5 inch radius) can cause permanent damage.



1. Anode Connector
2. Cathode Connector
3. Case/Anode Ground Jumper
4. Fiber Optic Connector
5. Personality Module, Thermistors, Hours Connector
6. TEC Coolers Inputs/Outputs Connector

Figure 5.1-3. FAP-I Assembly Interface

FAP-I Removal

1. Install shorting clip (Figure 5.1-2) between anode and cathode of FAP-I assembly to be removed. Disconnect the anode and cathode connectors, see Figure 5.1-3.
2. Disconnect the Case/Anode ground jumper from the FAP-I assembly.

Wear finger cots or powder-free latex examination gloves while handling the fiber optic cable.

---

3. Disconnect the fiber optic cable as follows:
   a. While firmly holding the fiber optic cable, loosen the ferrule connector securing the fiber optic cable to the FAP-I. It may be necessary to use a small wrench (3/8”) to loosen the connector.
   b. Note that the ferrule is cutout, see Figure 5.1-4. Carefully extract the fiber optic cable from the FAP-I and remove the ferrule. Immediately install the two plastic protective caps, one over the end of the fiber cable and the second over the FAP-I optical output port (Figure 5.1-2).
4. Disconnect the Personality module and TEC connectors from the FAP-I assemblies by pulling back on the outer sleeve and then unplugging the connector.
5. Remove eight screws securing the FAP-I to the heat sink (two on each side).

Due to the thermal compound on the bottom of the FAP-I assembly, it may be necessary to work the old assembly loose by rotating (wiggling) it back and forth around its center.

---

6. Remove the FAP-I and clean the thermal grease from the FAP-I and the mounting surface (alcohol works well for this).

FAP-I Installation

1. Remove the new FAP-I from the shipping container. Leave the shorting clip and protective plastic cap in place to avoid possible ESD and contamination damage, respectively.

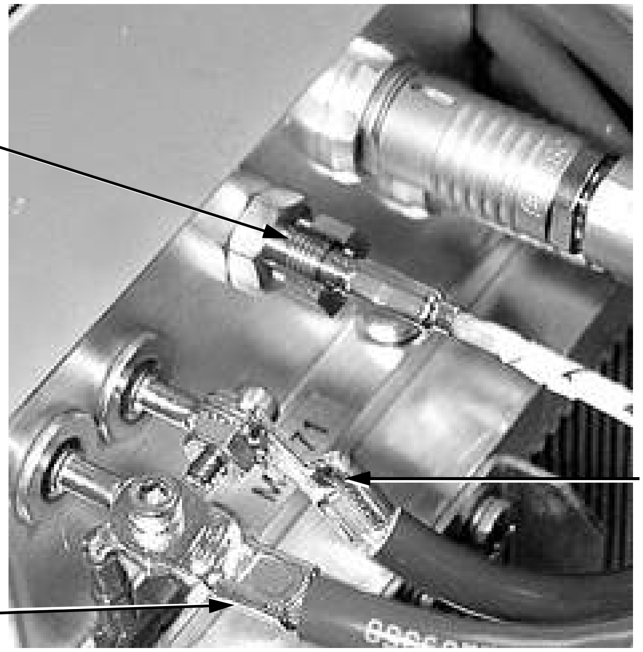


Figure 5.1-4. FAP-I Fiber Optic Connector

2. The new FAP-I should come with a precut plastic mask for applying thermal compound. If this mask is not included, place masking tape over the edges of the FAP-I baseplate as illustrated in Figure 5.1-5.
3. Using a clean metal, plastic, or wooden applicator, apply an even coating of thermal grease to the bottom of the FAP-I. The thickness of the grease film should be less than the thickness of the masking tape. Remove the masking tape.
4. Position the FAP-I assembly on the heat sink and reattach the Case/Anode ground jumper to the FAP-I baseplate.
5. Secure the FAP-I to the heat sink using the remaining seven mounting screws. Remove any excess thermal grease from around the assembly.

After connection, the red anode lead should be horizontally oriented and the black cathode lead should be vertically oriented. This is illustrated in Figure 5.1-4 and is done to minimize the potential of generating/picking-up EM noise.

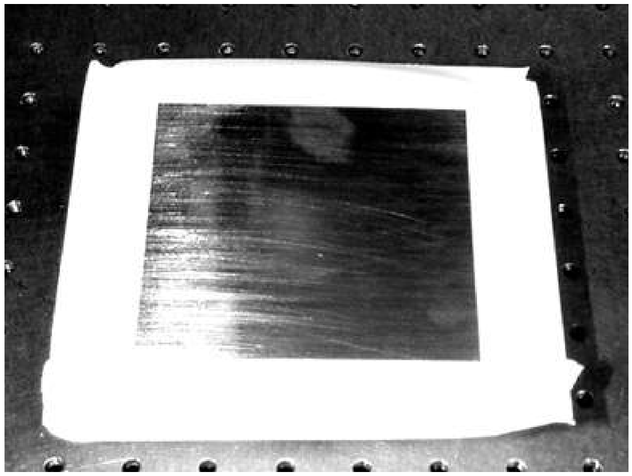


Figure 5.1-5. Preparation of the Replacement FAP-I Assembly

6. Re-connect the anode and cathode leads. Be sure to reconnect the case/anode ground jumper when connecting the anode lead. Remove the anode/cathode shorting clip.
7. Re-connect the Personality module and TEC connectors, and reconnect the fiber optic cable.
8. If disconnected, connect the power supply power cord to facility power. If a ground wire was used, remove it.
9. Replace the power supply cover and perform the cold start turn-on procedures, detailed in Section Four of the Chameleon Operator's manual.

Fiber Optic Cleaning

Before performing the cleaning procedure, inspect the fiber optic surface with a fiberscope to determine the extent to which the fiber might be damaged or contaminated.

Only perform the cleaning procedure if the fiber optic surface shows imperfections, otherwise the procedure may introduce dust, dirt, or potentially induce damage to the fiber optic.

Necessary Equipment

The following materials are required to perform this procedure:

- Cleanroom-quality swabs made by ITW Texwipe part number TX743B
- Fresh spectroscopic-grade Methanol
- Fiber microscope (fiberscope), 100X total magnification [1]
- Non-powdered, non-coated Latex (or equivalent) gloves

Important: Do not use Acetone on any part of the laser fiber!

Fiberscope

A recommended cost-effective fiberscope is the Westover FM-C Series Field Microscope and SMA adapter manufactured by Coherent part # 1110925. See Figure 5.1-6.[2] The adapter has no

Figure 5.1-6. Fiberscope with 20X Eyepiece

threads. If it is necessary to attach the fiber firmly to the microscope during inspection, use the adapter part number 1134846.

1. Customers who have purchased 200x microscopes may use those instead.
2. For Noyes microscopes, a part number 1111484 adapter must be used.

Inspect the Fiber

Always wear latex gloves (or the equivalent) while performing any of the following procedures. Dust, condensation, and oils from the hand can be transferred to the optical surface, which can lead to damage. If contaminants are visible on the outer wall of the nose, clean this surface first. See “Fiber Cleaning” on page 11.

1. Tilt the fiber as shown in Figure 5.1-7 and gently slide it into the adapter.

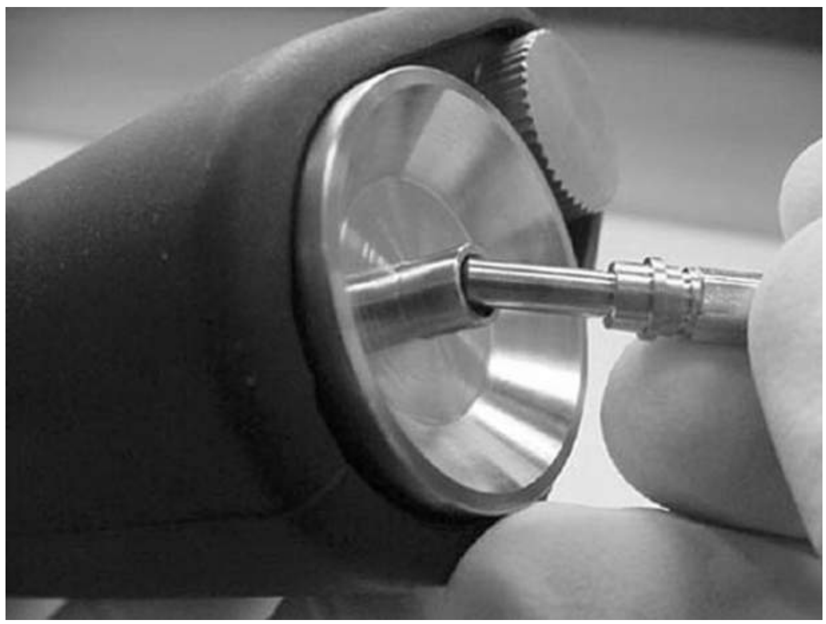


Figure 5.1-7. SMA Adapter

2. Inspect the fiber for defects: spots on coating, scratches, burns, contamination. Reference the size of the defect to the size of the fiber's cladding. Defects are counted and estimated per fiber quadrant. Divide the fiber into quadrants in such a way so that the maximal number of defects will fall within the same quadrant.

If the fiber surface complies with the acceptable guidelines as illustrated in “Fiber Evaluation Criteria” on page 13 section, immediately install the fiber optic into the FAP

Fiber Cleaning

If you have noticed contaminates on the outer wall of the fiber nose, perform the following to cleaning process:

1. Use methanol and a swab and clean with movements starting from the tip of the fiber and ending at the shoulder.
2. Halfway through the perimeter turn the swab around to use it's other flat side.
3. Repeat if necessary.
4. For fibers which have a built-in nut move the swab around the perimeter of the fiber tip.

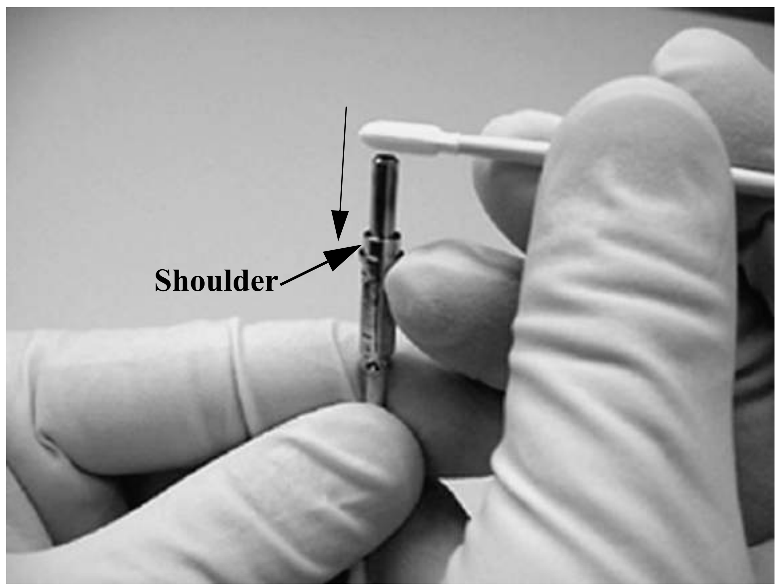


Figure 5.1-8. Cleaning the Fiber Nose

If you have noticed contamination on the fiber surface, perform the following to clean:

1. Place two to three drops of Methanol on the swab.
2. Vigorously shake off excess Methanol from the swab.

Excess Methanol on the fibers can cause potentially catastrophic damage to the fiber optic and the FAP.

Only the synthetic cloth should make contact with the fiber optic surface. Do not allow the plastic applicator to touch the fiber surface.

3. Holding the fiber surface vertically drag the swab once across the fiber optic surface in a direction away from yourself, See Figure 5.1-9. **Do not** move the swab back and forth. **Do not** re-use the swab. Use a new, clean swab each time for the swipe.

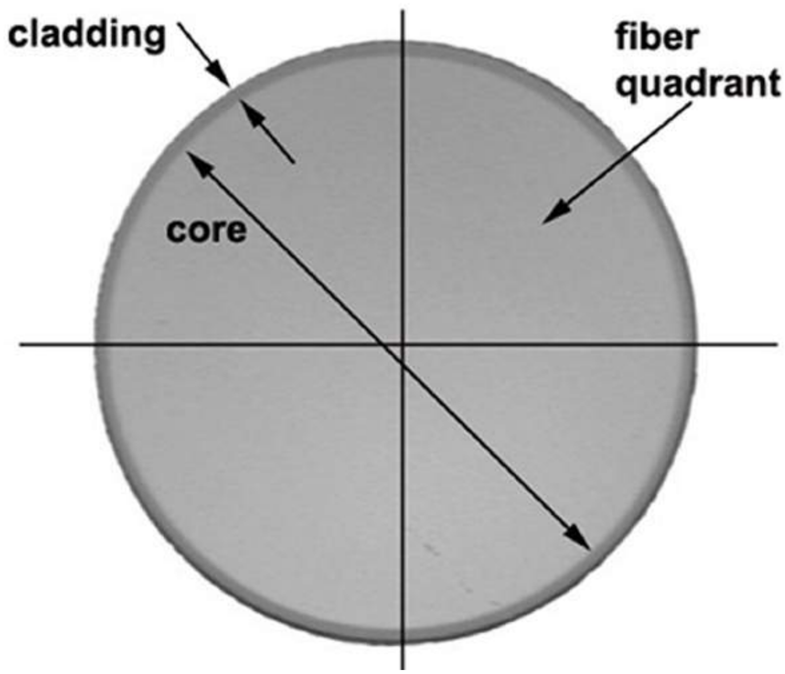
Figure 5.1-9. Placement of the Swab on the Fiber Optic Surface

4. Re-check the fiber using the fiberscope.
   - If the fiber surface complies with the acceptable guidelines as illustrated in "Fiber Evaluation Criteria" on page 13 section, immediately re-install the fiber optic into the FAP.
   - If imperfections remain, repeat the procedure using a new swab.
   - If imperfections still remain, compare the image in the fiberscope with Table 5.1-1 to determine whether the fiber optic must be replaced.

Fiber Evaluation Criteria

Figure 5.1-10 shows an image of a fiber optic surface as viewed through a fiberscope. It shows the convention of quadrants used for evaluation, and an example of how to estimate the size of a defect when compared to the size of the cladding.

Figure 5.1-11 shows images as viewed through a fiberscope of different types of damage. Note that the views shown are the optical surface.



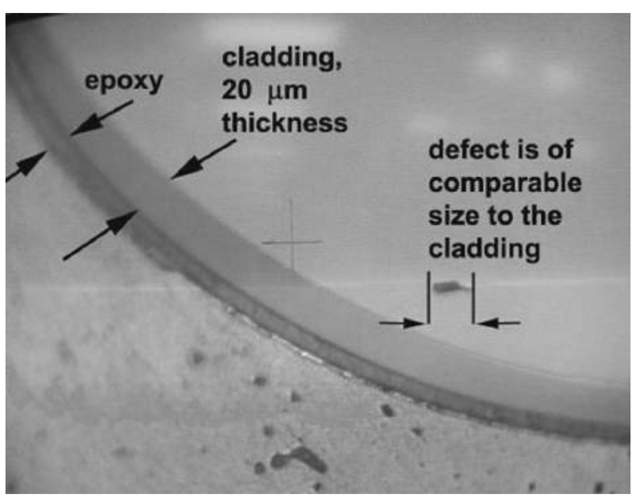


Figure 5.1-10. Fiber Description

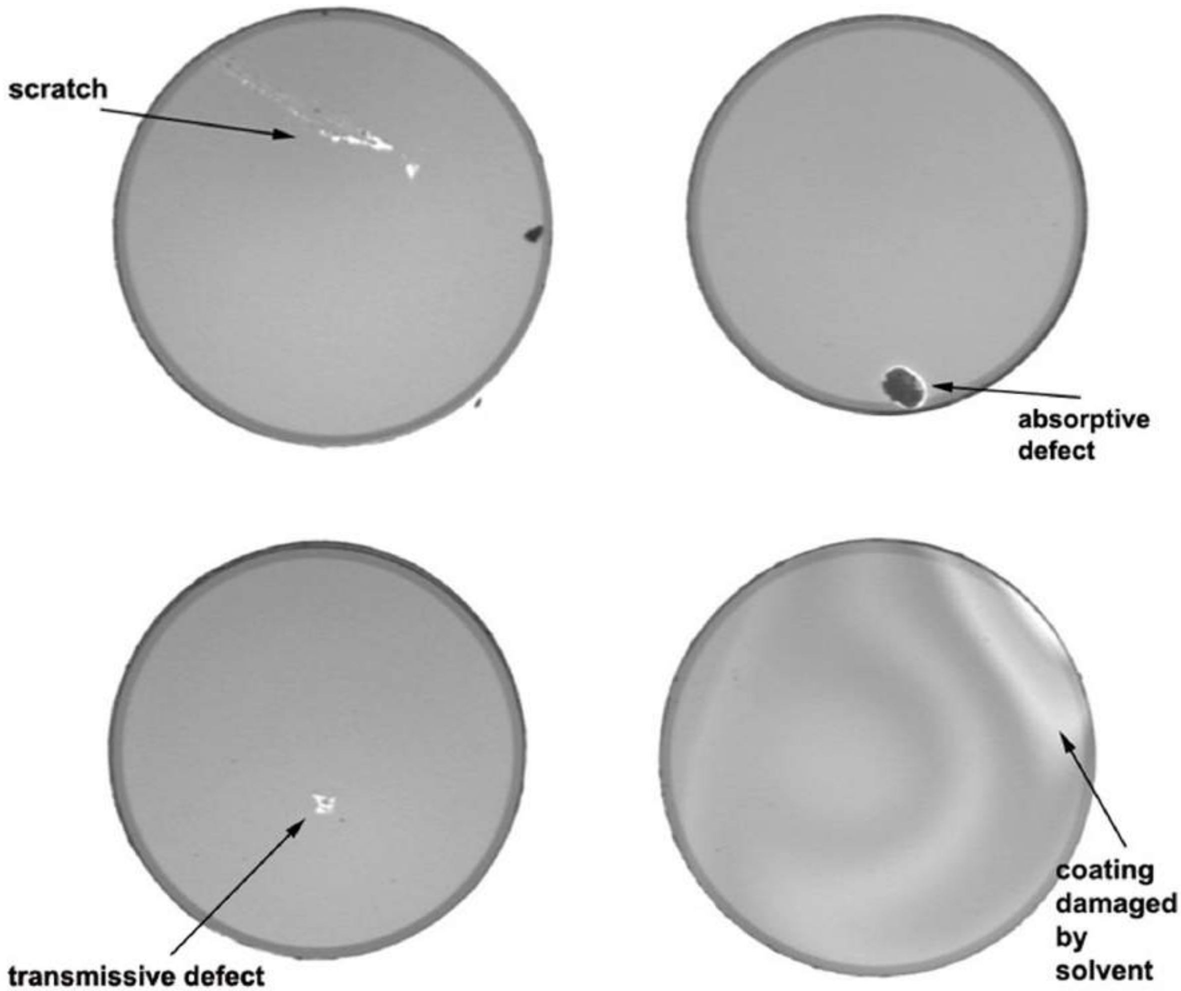


Figure 5.1-11. Examples of Fiber Damage

Table 5.1-1. Evaluation Criteria

CORE:	
Cracks or coating delamination	none allowed
Absorptive defects (dark in appearance)	< 5 microns
Transmissive defects	< 20 microns
Maximum number of defects 10 - 20 microns per quadrant	1
Maximum number of defects smaller than 10 microns per quadrant	4
Maximal number of defects allowed for the core	16
CLADDING:	
Cracks/chips or coating delamination	Allowed in outer 50%
Absorptive defects	< 10 microns
Transmissive defects	< 20 microns
Maximum number of defects per quadrant	4
Maximal number of defects allowed for the cladding	6
NOSE END (METAL PART)	
Machine burrs on SMA ID	40 microns
Coating delamination	< 20 microns

These criteria are applicable for new fibers and are listed here to provide general evaluation guidelines. Fibers which have been in use for some time can have defects in excess of these criteria. If unsure how to proceed, contact Coherent Service 1-800-367-7890 (408-764-4557 outside the U.S.) if further guidance is needed.

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Introduction

The backup battery in the laser system power supply must be replaced as soon as possible after the fault message “battery low” is displayed on the power supply front panel. Failure to do so could result in damage to the system when coupled with a loss in AC power.

Do not turn off the power switch or disconnect the AC power input until the LBO cool down cycle is complete.

Preliminary Steps & Data

1. Turn the front panel key to STANDBY.
2. Perform the “Turn-off (Complete Shut Down)” procedure located in Section Three of the Operator’s Manual. The associated cool-down cycle will take approximately 45 minutes. The front panel display will indicate when the cool-down cycle is complete.
3. After the LBO cool down cycle is complete, turn off the power switch on the power supply rear panel and disconnect the power cord from facility power.

Battery Removal and Installation

1. The Chameleon backup battery is located towards the front (with respect to the P/S front display) right hand corner of the Chameleon power supply.
2. Remove the two Phillips-head screws which secure the battery retaining bracket in place, see Figure 5.2-1, and remove the bracket.
3. Unplug the battery from the Mother board.
4. Remove the depleted battery and install the replacement.
5. Reinstall the battery retaining bracket and reconnect the laser system to the facility power.

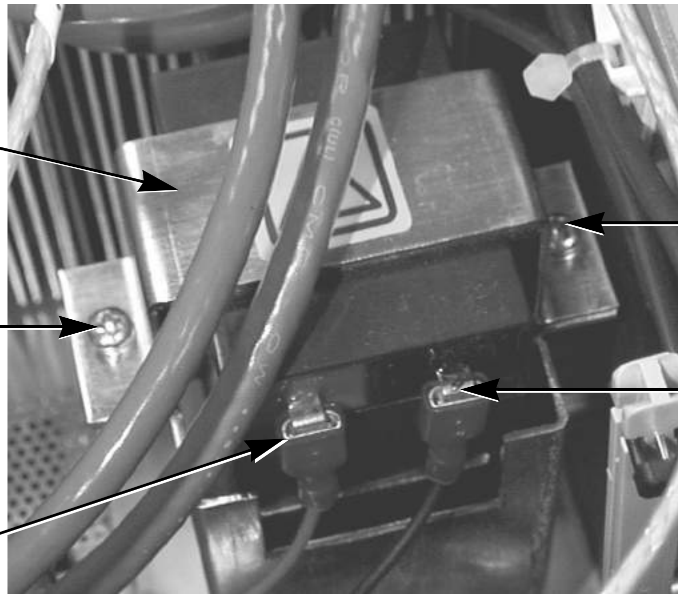

Figure 5.2-1. Power Supply Backup Battery

Battery Charge Circuit Verification

1. Attach a DVM across R8 on a 90 MHz system (or R9 on a 80 MHz system) on the Mother board, see Figure 5.2-2. Note that the polarity of the hookup is not important.
2. Power on the unit using the switch on the back panel of the power supply. The meter should start reading at 245 mV and begin counting down. The voltage (and speed) to which the meter counts down will depend on the initial charge state of the battery, see Table 5.2-1.

Table 5.2-1. 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

3. After the power to the laser system is enabled, and the charge voltage across R8 (or R9) has stabilized, the voltage across the battery terminals should read between 13 V and 14.6 V

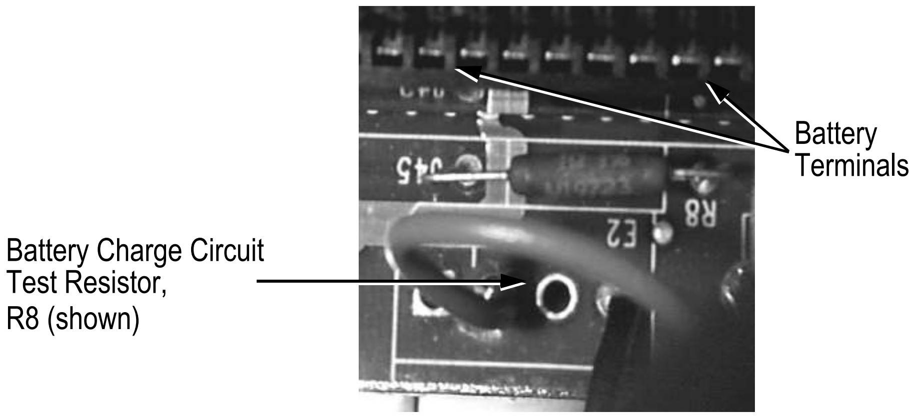

Figure 5.2-2. Location of Battery Charge Circuit Resistor

Verification of Successful Installation

1. Perform the "Turn-on (Cold Start)" procedure located in Section Three of the Operator's Manual. The "battery low" message should no longer be displayed on the power supply front panel.
2. Reinstall the power supply top cover. Verify that the laser system is free of system faults.

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Preliminary Steps and Data Backup

This procedure can be used to upgrade Chameleon software from any version 5.91 or higher, to the current revision. The procedure involves the use of a Coherent-supplied program, TBD, which will download the memory eeprom data from the laser to a file, and then upload this information once the software change is complete, if necessary.

The following equipment will be required to change (upgrade) the Chameleon software version:

Laptop or Desktop computer
Copy of Coherent TBD data backup program
Serial cable, straight-through
Replacement software eprom
Eprom removal tool
Allen keys
ESD wrist strap

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1. Ensure the main power to the Chameleon laser is ON. Key the laser to “Standby”.
2. Remove the power supply cover. This will trigger the “Power Supply Interlock” fault. Over-ride the interlock by re-inserting the screws in the power supply chassis where the interlock switched are located.
3. Move Jumper JP 9 to the shorted position. This jumper is located approximately halfway down the right edge of the CPU board. Refer to Figure 5.3-1 and Figure 5.3-4 to locate the CPU board and JP 9. This will give access to the Service Level menus in Chameleon Software after the power has been cycled.
4. Cycle the power using the main AC switch on the back of the power supply.
5. Establish an RS-232 connection between the power supply and a computer. See SVC-CHAM-4.1 for instructions.

6. Run Data back-up program to make a copy of current system settings. **Program instructions to be a separate document, Reference document here.**

Laser Shutdown

1. Perform the “Turn-off (Complete Shut Down)” procedure located in Section Four of the Chameleon Operator’s Manual. The associated cool-down cycle will take approximately 30 minutes.

Do not turn off the power switch or disconnect the AC power input until the cool down cycle is complete.

---

2. When the LBO cool down cycle is complete (the LBO temp is below 30ºC), turn off the main power switch on the power supply rear panel.

   Do not disconnect the power cord from facility power. The power supply chassis must be grounded either by the power cord or a separate ground to avoid ESD.

Software Change

1. To access the software EPROM, the CPU board will first need to be disconnected and removed from the power supply. Refer to Figure 5.3-1 to locate the CPU board.

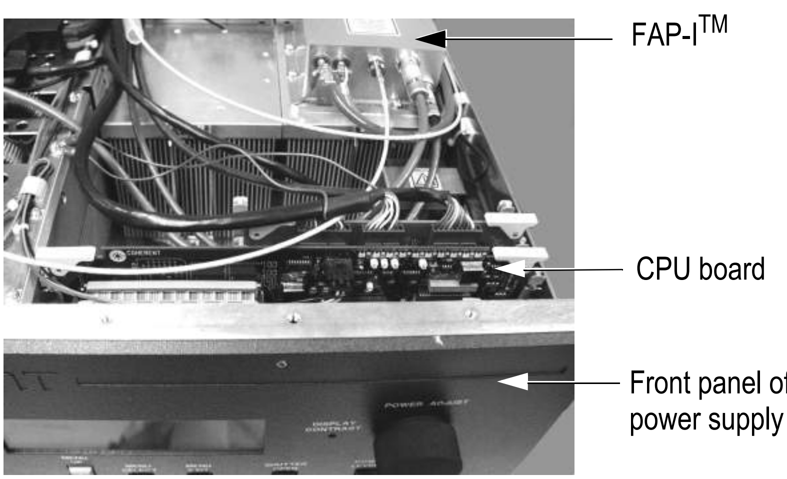

Figure 5.3-1. Location of CPU Board

2. Carefully unplug the ribbon cable connecting the CPU board to the Display board by pulling back (towards the front of the power supply) and then pushing down on the two black retaining hooks located on either end of the CPU board ribbon cable connector (see Figure 5.3-2).

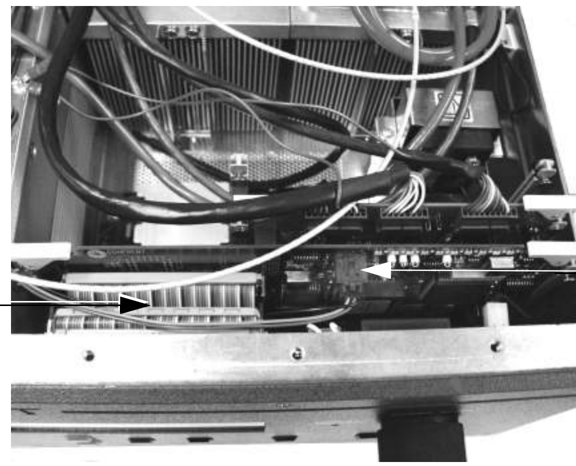

Figure 5.3-2. Ribbon and Diode Drive Cables

3. Unplug the diode drive cable (see Figure 5.3-2).

4. Unlock the CPU board from the Mother board guide rails by pressing in (towards the back of the power supply) the two silver lock pins (see Figure 5.3-3). The CPU board is unplugged from the Mother board by lifting up on the two white tabs located on the corners of the board.

5. The software EPROM is located in the lower right hand corner of the CPU board as indicated in Figure 5.3-4. Note the orientation of the EPROM. The slots in the EPROM socket, at the lower right and upper left hand corners, are used to extract the EPROM chip.

6. Insert the “hooked” end of the EPROM removal tool, illustrated in Figure 5.3-5, into one of the socket slots. While alternating between the corners of the EPROM socket, carefully extract the old EPROM by applying upward pressure.

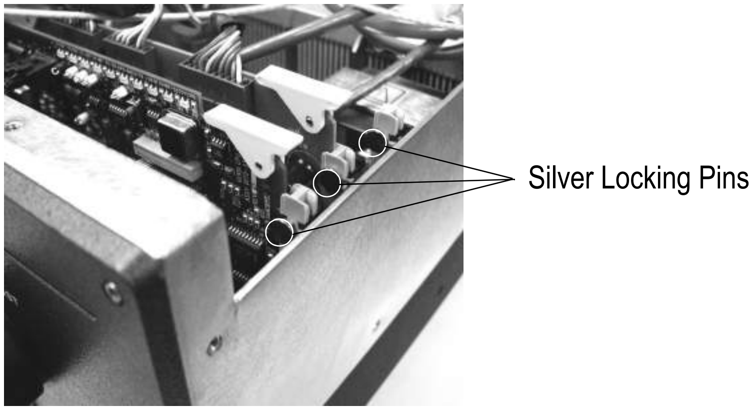

Figure 5.3-3. CPU Board Locking Pins

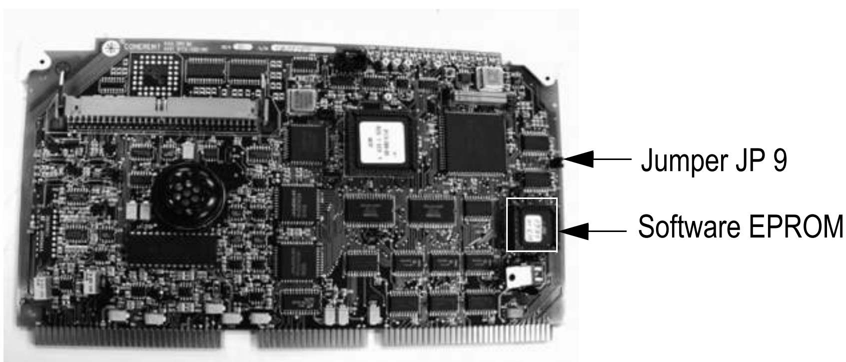

Figure 5.3-4. Location of Software EPROM and Jumper JP9 on CPU Board

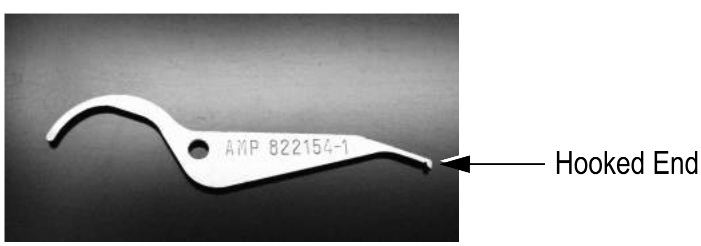

Figure 5.3-5. EPROM Removal Tool

7. Insert the replacement EPROM. Note that one edge is beveled. This beveled edge should be installed so that it is closest to the outside edge of the CPU board. Press down firmly on the software EPROM to make sure it is completely seated in the socket.

8. Reinstall the CPU board in the power supply, making sure to re-lock the board to the two guide rails extending from the Mother board.

9. If disconnected, connect the power supply power cord to facility power. If a ground wire was used, remove it.

10. Perform the cold start turn-on procedures, detailed in Section Four of the Chameleon Operator's manual. When the main AC power is restored, the "System Initializing" screen will show the new software version. If this screen is not shown and the display shows only a flashing line, the new software EPROM is either installed incorrectly or is corrupt.

11. Once the LBO has reached the set temperature, which will take 30 minutes, verify that the Chameleon is functioning properly.

12. Remove jumper JP9. This jumper is located approximately halfway down the right edge of the CPU board. Refer to Figure 5.3-4.

13. Cycle the power using the main AC switch on the back of the power supply.

14. Replace the power supply cover.

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Verdi Software

Because the later 80 MHz digital Chameleon platforms essentially separated the Chameleon software from the Verdi software, the only consideration would be that the serial command library used by the Verdi software is compatible with the Chameleon software being uploaded. A detailed table referencing compatible versions of Verdi and Chameleon software can be found in the “Software History” sub-section in the “General” section of this manual.

Ensure that the software upgrades are of the same version for both the Verdi Interface PCB and the Chameleon Head PCB. In order to complete the upgrade, both the Verdi Interface and the Chameleon head must have the new software uploaded. Also, should a problem develop during the upgrade, it is important to have a pre-programmed Head board and Verdi Interface board readily available.

Make a copy of both the Chameleon and Verdi EEPROM data before uploading the new software.

Verifying the Chameleon Software Version

1. Before starting the software upgrade, verify the current Chameleon software version on the System Information screen (see Figure 5.4-1).
2. To query the software version use the serial command "?SV".
3. Leave the serial cable connected to the controller until the Interface board has been successfully upgraded then continue with the "Chameleon Head Board Software Upgrade" portion of this procedure.
4. Record the number of "Run Hours." This is the Chameleon head hours.

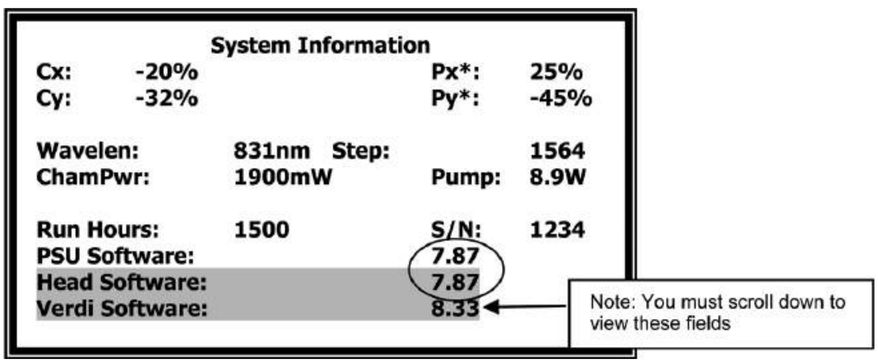

Figure 5.4-1. System Information Screen

Interface Board Software Upgrade

1. Before upgrading, save backup copies of the Chameleon and Verdi EEPROM data using ChameleonPC version 1.14 or later.
2. Place the Chameleon in service mode by sending the RS-232 command ACCESS=CLG5182.
3. With the serial cable connected to the controller run the BootloaderPC program. (Note: This is different from the ChameleonPC program used to read and write EEPROM data).
4. The software will then prompt for the connection type, RS-232 or J-TAG. Select RS-232.
5. Once the connection type is selected, press OK and the window to browse for the software filename will be displayed (see Figure 5.4-2).

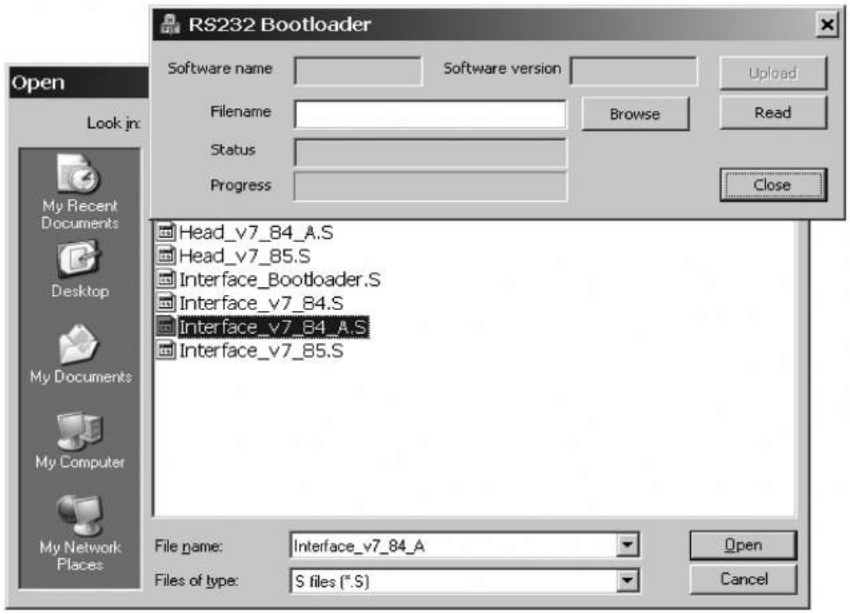

Figure 5.4-2. Interface Binary File Selection

6. Select the path to the new interface software and press OPEN.
7. The UPLOAD button will now be highlighted along with all the remaining fields being populated with the file information in the bootloader window (see Figure 5.4-2). Verify that the software version is the correct version to be uploaded, then press UPLOAD.
8. The upload progress will be displayed along with the status relating to each binary block. The entire process should take no more than half-a-minute. See Figure 5.4-3.

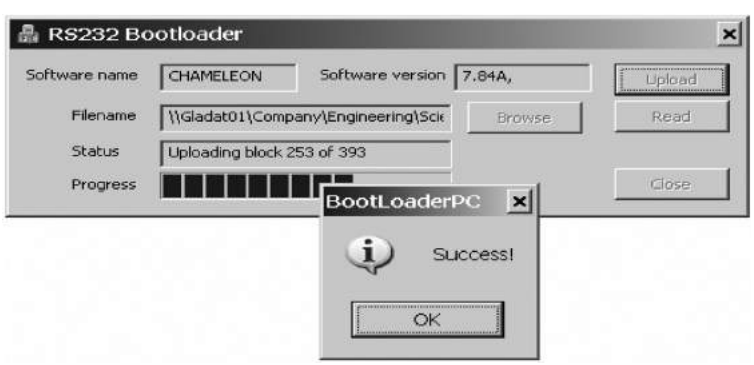

Figure 5.4-3. Upload File Progress

9. If there was a problem with the handshaking between the Interface board and the PC, a “Failed to Upload file Error” (see Figure 5.4-4) may be seen. BootloaderPC may display this error message at the end of the upload process; this does not always necessarily mean that the upload has failed. Check the system information menu to see if the new software is now running. If the front panel display shows the desired software version then the upload has been completed. If not, cycle the power supply and attempt to repeat the upload. If the error occurs persistently then it may be necessary to use the pre-programmed Verdi Interface board.

Figure 5.4-4. Failed to Upload File

10. Check the Chameleon “System Information” display menu to insure that the new software was loaded correctly. See Figure 5.4-1.
11. Disconnect the serial cable from the rear of the power supply. The Interface software has been updated.

Chameleon Head Board Software Upgrade

1. Before upgrading, ensure that backup copies of the Chameleon and Verdi EEPROM data have been saved using ChameleonPC version 1.14 or later.
2. Connect the serial cable to the Chameleon Head board. See Figure 5.4-5.
3. For systems prior to Vision software v8.1, connect the programming “Dongle” (p/n 1150286) at the Headboard end. The “Dongle” is used to pull a watchdog reset line to 0 volts which some laptops do not do, which would cause a crash during programming.

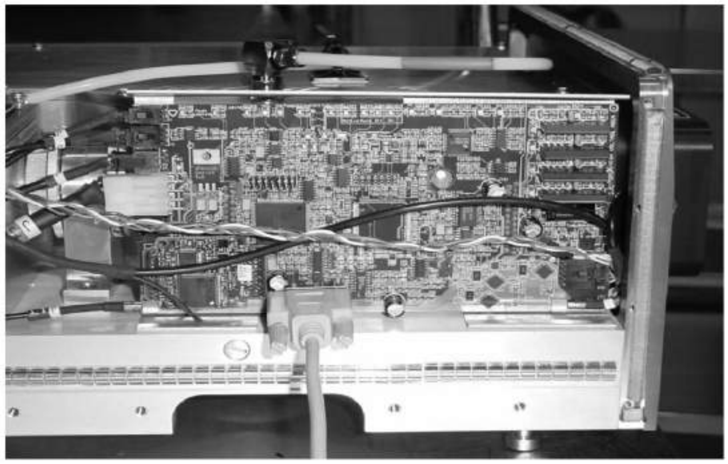

Figure 5.4-5. RS-232 Connection to Chameleon Head Board

4. Again, run the <u>Software</u> Bootloader program just as done for the Interface board.
5. The software will then prompt for the connection type, RS-232 or J-TAG. Once again, select RS-232.
6. Once the connection type is selected, press OK and the window to browse for the software filename will be displayed (see Figure 5.4-2). Only this time make sure the filename refers to the Head software instead of the Interface board.
7. Select the path to the new Chameleon Head software and press OPEN.
8. The UPLOAD button will now be highlighted along with all the remaining fields being populated with the file information in the bootloader window (see Figure 5.4-2). Verify that the software version is the correct version to be uploaded, and then press UPLOAD.
9. The upload progress will be displayed along with the status relating to each binary block. The entire process should take no more than half-a-minute (see Figure 5.4-3).
10. If there was a problem with the handshaking between the Chameleon Head board and the PC, a "Failed to Upload file Error" (see Figure 5.4-4) may be seen. BootloaderPC may display this error message at the end of the upload process; this does not always necessarily mean that the upload has failed. Check the system information menu to see if the new software is now running. If the front panel display shows the desired

software version then the upload has been completed. If not, cycle the power supply and attempt to repeat the upload. If the error occurs persistently then it may be necessary to use the pre-programmed Verdi Interface board.

11. Check the Chameleon “System Information” display menu to insure that the new software was loaded correctly.

12. Disconnect the serial cable from the Chameleon Head board. [The Chameleon Head board software has been updated, proceed to "EEPROM Verification"]

If the software upgrade is unsuccessful, the Verdi Interface board or the Chameleon Head board must be upgraded using the pre-programmed PCBAs.

EEPROM Verification

1. Once the software upgrade is complete, verify that all of the EEPROM factors for both the Chameleon and Verdi are unaffected by comparing them to the original values.

2. If the EEPROM data checks out, run a functional test of the Chameleon system with a diagnostics program such as “Datalogger”. [The Software upgrade is complete]

3. Use the RHH RS-232 Command to restore Chameleon head hours recorded from Page 2. Note that prior to software version 7.93, RHH=1 set the head hours to zero.

Introduction

The MRU is a rack mountable Miniature Recirculator Unit that filters and recirculates air within the laser cavity. This helps to assure a dry and contamination-free laser cavity. The unit consists of a pump to move the air, a cartridge of DrieRite to help remove moisture from the air, a HEPA filter to remove fine particulates, and a Molecular Sieve cartridge to remove fine particulates, moisture, and hydrocarbons.

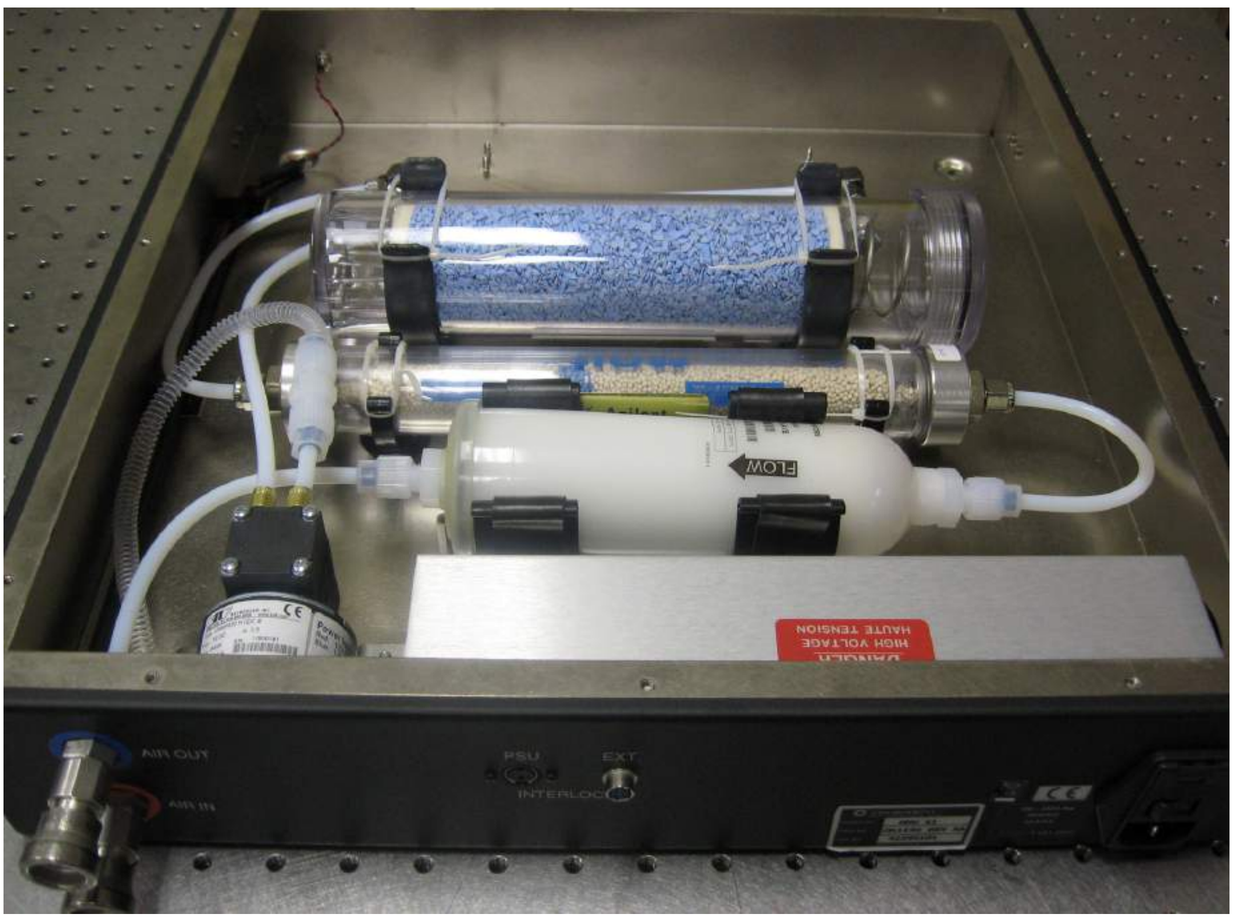

Figure 5.5-1. MRU-X1

Early 90 MHz Cavity Chameleons were shipped with the model MRU-1000. Once the internal cartridges showed signs of saturation, the MRU was to be replaced to minimize risk of contamination of the laser cavity. Expected lifetime of the unit was at least 5000 hours assuming good connections and a good seal on the laser head.

The MRU-1000 was replaced by the MRU-X1. The two are interchangeable assuming the correct fittings are used. The MRU-X1 has replaceable cartridges that can be easily replaced instead of replacing the entire MRU. It is also possible to replace the material in the DrieRite and Molecular Sieve cartridges.

Some Chameleon systems may have been shipped with an MRU-X2. If a MRU-X1 was not available at the time of shipment, a MRU-X2 may have been substituted for the MRU-X1. The MRU-X2 is functionally the same but contains a second DrieRite filter with a view port on the front of the MRU chassis.

Symptoms of Saturation

1. The laser is experiencing instability modelocking at certain wavelengths (water absorption lines 920 - 980 nm).
2. The Relative Humidity indicator is reading greater than 5%; typical reading is 0-1%).

Verification

1. Turn off the power to the MRU and unplug from the facility power.
2. Remove the screws on the lid of the MRU, and remove the lid.
3. Replace the DrieRite filter/desiccant when the desiccant, which is normally light blue, has turned pink.
4. Replace the Molecular Sieve filter/material every 5,000 hours or when the blue band of beads (located about half way along the filter length) has changed to a buff color.
5. Routinely replace the HEPA filter after 3 years or 25,000 hours of operation.
6. If the DrieRite cartridge is blue but the system has experienced the symptoms as described above, disconnect the hoses and connect it to a "clean" flow meter in line with the Recirculator. The airflow should be about one L/min; if less than 0.3 L/min, the MRU needs to be replaced.
7. Replace the lid.

Hose Routing

On MRU X1 units with serial numbers less than 150, the corrugated tube was routed under a non-corrugated hose. See Figure 5.5-2. On some of these units, it was noticed that over time, pump vibrations caused the internal corrugated hose to rub against a connector eventually wearing through-holes in the tubing.

On all later units the manufacturer has routed the corrugated tube over the non-corrugated hose as shown in Figure 5.5-3.

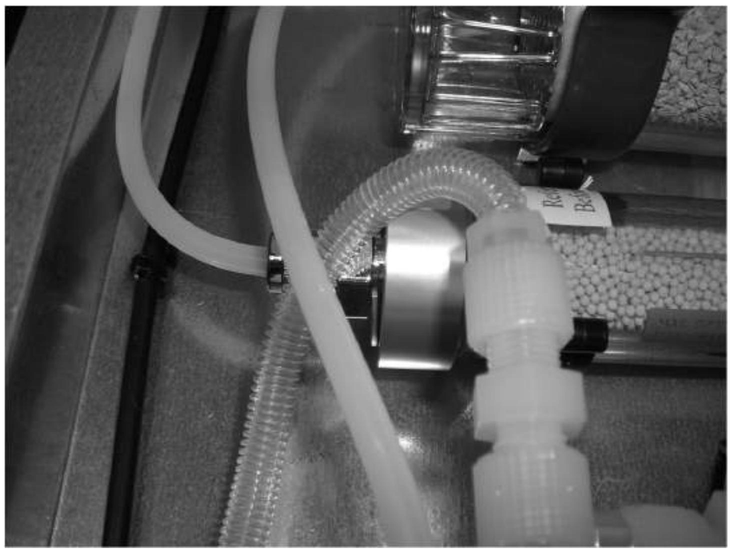

Figure 5.5-2. Old Hose Routing (Corrugated Tube Under)

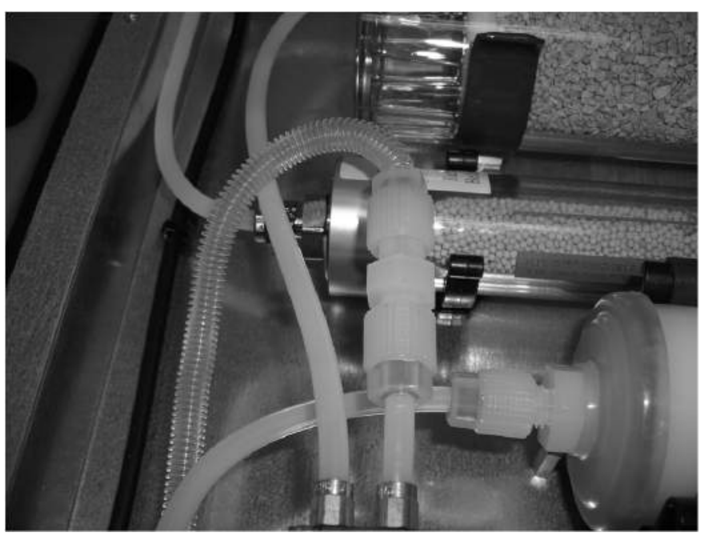

Figure 5.5-3. New Hose Routing (Corrugated Tube Over)

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Introduction

During the manufacture process, the system is calibrated at 21 equally spaced wavelength points across the Chameleon tuning range. At each of the 21 calibration points the system records a unique data set as illustrated in Figure 5.6-1.

TUNING CALIBRATION		
Verdi: 8.29 W MODELOCKED		
Wavelength	:	840 nm
Position	:	-1750
QS Verdi Power	:	7.66 W
CW	:	8.45 W
ChameleonPower	:	1340.0mW
Start Possible	:	Yes

Figure 5.6-1. Tuning Calibration Screen

Adjustments to the tuning calibration should not be necessary for a system operating normally in the field. The system is calibrated accurately during manufacturing and the data should remain valid for the lifetime of the unit. A re-calibration in the field should only be carried out following an appropriate investigation of other potential fault areas. A re-calibration can be targeted at specific wavelength problem areas or can be performed across the whole tuning range.

A Rees spectrum analyzer should be used to diagnose CW breakthrough and Q-Switching breakthrough points. In practice, the QS limit can be seen on the Rees as the point at which the signal just starts to go noisy. It is recommended, however, that a more accurate diagnosis of the Q-Switching limit is performed using the signal from the fast photodiode (synch output) displayed on a fast oscilloscope (>200 MHz). The CW limit can be seen on the Rees as the point at which a narrow spike just starts to appear.

Procedure

The procedure takes place in the Tuning Calibration submenu, which can be found in the Chameleon Settings menu list.

1. When the Tuning Calibration screen is first entered, the data set for the start of the tuning range is displayed (short wavelength limit). The remaining data from all of the other calibration points can be displayed in sequence by rotating the POWER ADJUST knob on the front panel of the power supply. It is important that you do not press the select button until you are ready to begin the calibration.
2. Scroll to the wavelength point requiring re-calibration.
3. Press select to activate the calibration point for editing. Note that the exact system wavelength is fixed by the system The cursor should already have advanced to the stepper position value.
4. Rotate the POWER ADJUST knob to change the stepper value. The wavelength will change in real time as viewed on the Rees. Rotate the knob until the actual Chameleon wavelength agrees with the system wavelength displayed on the menu, then press select.
5. The cursor should already have advanced to the QS Verdi Power value. The current Verdi power is displayed at the top left of the screen. Turn the POWER ADJUST knob one click to update actual Verdi power to that displayed at the QS Verdi power.
6. Adjust the power control knob to investigate the stable mode-locking power band and verify the position of Q-switching. Perform a careful adjustment of the pump power to locate accurately the QS breakthrough level. Press select to enter the QS Verdi power into system memory.
7. The cursor should have already advanced to the CW Verdi Power value. Turn the know one click to update actual Verdi power to that displayed at the CW Verdi power.
8. Adjust the power control knob to investigate the stable mode-locking power band and verify the position of the CW breakthrough edge. Perform a careful adjustment of the pump power to locate accurately the CW breakthrough level. Press select to enter the CW Verdi power into system memory.
9. The cursor should already have advanced to the Chameleon Power value. Now rotate the POWER ADJUST knob to enter the correct Chameleon output power as measured on an

external calibrated power meter. Press select to enter the value into memory.

10. As soon as the previous power calibration point was entered into memory, by pressing the select button, the system performs an automated self-test of the start of modelocking. The self-test procedure takes about a minute and once complete the system records a YES or NO on the line for start possible. During the test cycle, the Verdi power is decreased to drop the Chameleon below lasing threshold and thus stop modelocking. The power is then increased back to the original power level and the started motor initiated.

11. After waiting for the modelock starting self-test to complete the cursor is automatically returned to the top of the screen. The remaining tuning points can be re-calibrated by scrolling the POWER ADJUST knob to the desired region and the repeating the above steps.

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Introduction

This procedure documents the correct procedure for replacing the Chameleon shutter assembly.

Replacement Procedure

1. Put the laser in Standby. Remove the power supply cover and jumper J9 on the CPU board to enable Service mode for later portions of the procedure.
2. Cool down the LBO crystal. Once the LBO has reached room temperature, turn off the AC power.
3. Remove the outer cosmetic cover from the laser head.
4. Be sure to wear an ESD wrist strap whenever handling electronic components.
5. Disconnect the fiber at the spectrometer. Be sure to protect the fiber tip from damage.
6. Disconnect the shutter cable from J102 on the Chameleon Pump board. Also, the Emission LED, J103 on the same board.
7. Disconnect the Fast Photodiode (J6) and the Slow Photodiode (J5) from the Chameleon Analogue board.
8. Remove the front bezel from the laser head by removing the three screws along the bottom. Carefully slide the bezel over the shutter block.
9. Remove the shutter block (4 screws and 2 locating dowel pins). Be careful to support the shutter block so that it does not drop.
10. Remove the fiber connector from old shutter block and clean with methanol only.
11. Install old fiber in new shutter block.
12. Install new shutter block complete with gasket. Fully tighten the 4 fixing screws.
13. Replace front bezel. Be careful not to pinch any of the cables or fiber when feeding them through the cutouts in the bezel.
14. Reconnect all cables as previously removed, and reconnect the fiber to the spectrometer.

15. Turn AC power back on, and allow LBO to reach set temp.
16. Turn on laser and wait for lasing.
17. Initiate PZT Recovery.
18. Tune laser to 800 nm. Verify typical output power as measured on an external power meter.
19. Verify that the shutter block operates properly. It is recommended to use an IR card to verify that no IR light is leaking from the shutter block.
20. Verify that the emission LED operates as normal.
21. Verify that the spectrometer operates as normal.
22. Measure the voltage on TP27 on the Analogue board and record voltage. This value should be between 7.5 V and 9.5 V.
23. Measure the voltage on TP49 on the Analogue board. Adjust VR2 to get a value of 9.0 V.
24. Measure the voltage on TP15 on the Analogue board and record. This value should be between 3.8 V and 4.6 V.
25. Any problems with the voltages mentioned above indicate that the system should be returned to the factory for re-alignment.
26. Due to differences in the photodiodes, it is necessary to now calibrate the output power of the system, as described below.

Power Calibration

1. Go to the “Tuning Calibration” screen. Only the Chameleon Power data point will be entered, be sure not to change any other parameters in the menu.
2. The menu will begin with the shortest wavelength point. Press select to enter the menu, then scroll to the Chameleon Power line using the arrow keys.
3. Turn the knob until the power displayed in the menu matches the calibrated external power meter.
4. Use the arrow keys to scroll to the top line and change the wavelength to the next point.
5. Repeat the above procedure for all 21 calibration points.
6. Set gain switches in calibration menu to **off**.

Verification

To finish the procedure, exit the tuning calibration screen and verify reliable operation of the Chameleon by performing repeated tuning across the full operating range. Make sure the PZT signals stay within their normal operating range.

Remove the jumper from J9 on the CPU board, and cycle power to disable the Service Menus. Replace all external covers.

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Procedure

1. Put the laser in Standby.
2. Cool down the LBO crystal. Once the LBO has reached room temperature, turn off the AC power.
3. Remove the outer cosmetic cover from the laser head.
4. Be sure to wear an ESD wrist strap whenever handling electronic components.
5. Disconnect all Analogue board connections:
   J2, 10-way red molex
   J3, interconnect, 25-way bump-polarized ribbon
   J4, 10-way molex
   J5, show photodiode input, 4-way red molex
   J6, fast photodiode input, SMB
   J7, synch output, SMB
   J8, PZT Cavity, HV, 4-way clear molex
   J9, currently not used on Chameleon
   J14, 8-way red molex
   J18, PZT Cavity, HV, 4-way clear molex
   J19, 6-way red molex
   J21, 4-way red molex
6. Remove the four fixing screws to hinged bracket, and the single clamping screw on the front edge of the board.
7. Remove insulating sheet from the underside of the old Analogue board and re-fix it to the underside of the new board.
8. Install new Analogue board complete with insulating sheet and tighten four fixing screws.
9. Replace and tighten the single clamping screw on the front of the board.
10. Connect all cables as listed above. Be sure not to confuse J8 and J18 or J6 and J7.
11. Check all connections.
12. Turn on the AC power. While the LBO is heating, some preliminary values can be adjusted.
13. Adjust the lasing threshold. Measure the voltage on TP48 and adjust VR8 so that the voltage is 0.5 V (±0.05 V).

14. Adjust the Starter Threshold. Measure the voltage on TP29 and adjust VR1 so that the voltage is 1.0 V (±0.05 V).
15. Adjust the RF threshold. Measure the voltage on TP13 and adjust VR6 so that the voltage is 1.0 V (±0.05 V).
16. Once the LBO has reached set temperature, turn the key on. Once the system is lasing, set the Chameleon wavelength to 800 nm.
17. Initiate a PZT recovery and wait a few minutes for the system to finish.
18. Verify that the laser is operating with the typical ML output power at 800 nm (1.3–1.7 W)
19. Adjust the slow photodiode signal (only if typical lasing performance has been confirmed). Measure the voltage on TP49 and adjust VR2 so that the voltage reads 9.0 V (±0.05 V).
20. Verify reliable operation of the Chameleon by performing repeated tuning across the entire tuning range. Make sure the PZT signals stay within their normal operating range.

Pump Board Replacement

1. Put the laser in Standby. Remove the power supply cover and jumper J9 on the CPU board to enable Service mode for later portions of the procedure.
2. Cool down the LBO crystal. Once the LBO has reached room temperature, turn off the AC power.
3. Remove the outer cosmetic cover from the laser head.
4. Be sure to wear an ESD wrist strap whenever handling electronic components.
5. Disconnect all board connections:
   J100, 6 way clear molex
   J102, 6 way, clear molex
   J103, 4 way, black molex
   J104, 12 way clear molex
   J105, 11 way red molex
   J106, 6 way, red molex
   J107, 10 way, red molex
   J108, 37 pin d-connector
   J109, 9 pin d-connector
   J110, 25 way bump polarized, ribbon
   J111, 4 way, red molex
   J112, 4 way red molex
6. Remove the ten screws which hold the Pump board in place.
7. Remove old Pump board, replace with new one, and reattach the ten mounting screws.
8. Remove the Verdi beam bellows.
9. Install the Verdi Diagnostic mirror (PN 1058622). This overrides the Verdi beam bellows interlock automatically.
10. Set up power meter at the side of the laser head to safely capture the Verdi output from the diagnostic mirror.
11. Check all connections and turn on AC power. Allow time for the LBO to reach temperature.

12. Perform all procedures as specified for Head board replacement, as listed in the Verdi Service Manual, including:
    - Diode calibration
    - LBO Optimization procedure
    - Verdi Photocell calibration
13. Once calibration is complete, return the laser to standby. Refit the Verdi bellows and reinstall interlock.
14. Remove the jumper from J9 on the CPU board and cycle the power to disable the service menus.
15. Verify that the Chameleon laser can be operated as normal.

Controller Board Replacement

1. Put the laser in Standby.
2. Cool down the LBO crystal. Once the LBO has reached room temperature, turn off the AC power.
3. Remove the outer cover from the power supply.
4. Be sure to wear an ESD wrist strap whenever handling electronic components.
5. Disconnect the following:
   J2, 10-way red molex
   J3, 10-way red molex
   J4, 8-way red molex
6. Push out both board locking clips.
7. Remove Controller board from Mother board by using white lever arms.
8. Insert replacement board by carefully lining it up and pushing it down firmly. Press the locking pins to lock the board in place.
9. Reconnect all connectors listed above, being careful not to confuse J2 and J3.
10. Check all connections and turn on AC power.
11. Once the LBO has reached operating temperature, verify normal Chameleon operation.

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Chameleon 210, XR

For the older Chameleon 210 and XR systems, the manual Power-map procedure will need to be followed. If the system being serviced is a 210 or XR system, proceed to the section titled “Manual Power Map”.

The system needs to be allowed to come to equilibrium with the room environment before a valid power-map can be taken. Allow ample time for the system to stabilize before starting the power-map routine.

Automatic Power Map

1. Place the Chameleon in Service mode by sending the RS-232 command ACCESS=CLG5182
2. Select the Service Menu option under the Main Menu selections and then select Manual Control.
3. The manual control menu will show the cavity and pump PZT values as a percentage of the DAC range and the status of the PZTs along with the Chameleon and pump power and tuning and slit stepper motor positions.
4. The Power-Map command will also be displayed on this screen (see Figure 5.11-1).

PZT	Actual	Status	Pmap
Cx	: -24%	: AUTO	: -12%
Cy	: +33%	: AUTO	: +34%
Px	: -41%	: AUTO *	: + 6%
Py	: +28%	: AUTO *	: +51%
Step : 167		Cham Pwr	: 945mW
Pwr map		Pump Power : 8.33 W	
Slit : 2200		Calb slit pos	: 2500

Figure 5.11-1. Manual Control

5. Use the MENU UP and MENU DOWN buttons to highlight a specific menu option. Toggle between “Manual” “Auto” and “Auto*” by using the SELECT button under the PZT fields.
6. To make a change to a specific PZT value by using the POWER ADJUST knob the status must be in “Manual” mode.
7. If the initialize command failed to obtain a signal above the lasing threshold, then a new power map can be taken by highlighting the “Pwr map” option, and pressing select, the status must be “Auto” for this option to work.
8. If the factory default power-map fails to provide significant fluorescence return the PZT status to manual for all four (4) PZTs.
9. Start by leaving the Cx and Px values at their default values and center the pump (Py) PZT at 0%.
10. Scan the Cy from +100% to –100% and either view or measure the fluorescence to determine the maximum point Once determined, leave it there.
11. Do the same for the Py PZT and then return all PZTs to “Auto” again and try the power map one more time.

Obtaining Lasing

1. For systems that fail to provide sufficient fluorescence or show some promise to go above lasing threshold, the PZTs may need to manually be scanned.
2. Verify the chiller temperature is set to 20°C and the baseplate temperature is <35°C.
3. Verify the Verdi output power is above 6 W.
4. Place all PZT controls into ‘manual’ mode and verify that the fluorescence pattern changes as the PZTs are changed (try each control to verify the PZT is actually functioning for its specific axis).
5. Center the Px and Py at the factory default first, or if the factory default PZT values are not known, or they have already been tried then set the PZT values to 0%.
6. Set the Cy value to –100% and the Cx to –100%.
7. Place a white card in front of the output aperture and open the shutter.

8. An IR viewer will help improve visual sensitivity and provide safety as well.
9. There should be some fluorescence present on the card, ideally two spots.
10. Place the Px and Py into “Auto” mode and scan the Cx slowly from –100% to +100% while viewing the fluorescence pattern on the card. It should be possible to see the fluorescence spots moving as the pump mirror rasters.
11. Change the Cy value by 20% and scan the Cx again repeating steps 10 and 11 until the two spots overlap, lasing occurs or the the Cy value has gone through the entire range from –100% to +100%.
12. If the pump PZTs have not been tried at 0% yet, repeat steps 5 through 11 again with Px and Py at 0%.
13. If the system still fails to provide a signal above lasing threshold, proceed to the Svc-Cham-2.1 “Troubleshooting” section of this manual.

Manual Power-map

Refer to FSB#436 for additional information regarding ‘Manual Power-Map’

1. Tune the laser to 790 nm ensure that the laser is modelocked and that the output power has stabilized. Do not adjust the pump power for any of the following steps.
2. Now set the PZTs as indicated by table 1 using the Chameleon PZT Control menu under the Chameleon Alignment menu (Chameleon Settings menu for 210 and XR series).
3. With the Px and Py PZTs set to ‘Auto’, set Cy to 0% (2.25V) and decrease Cx slowly until the voltage is set to the value in the first row of table 1 (power map for x-plane) – do this slowly enough so that the pump PZTs can compensate for the misalignment and maintain modelocking. Monitor the spectrum with a Rees spectrometer and check that the system remains modelocked.
4. Wait at least 30 seconds for the pump alignment to optimize. Now record both the externally measured power and the internal photodiode signal TP6 (TP27 for Analog Head board) on table 1 – Power map for x-plane.

5. Set Cx to the next value in the table and wait at least 20 seconds for the pump alignment to optimize. Make sure that mode-locking is maintained. Record the data in the next line of the table.
6. Repeat the previous step until the table for the x-power map is complete.
7. Now inspect the data to determine the optimum setting for Cx according to the internal slow photodiode. Set Cx to this optimum setting allowing sufficient time for the pump to optimize accordingly. Monitor the spectrum with a Rees spectrometer and check that the system remains modelocked.
8. Now slowly decrease Cy until the voltage is set to the value in the first row of the table (power map for y-plane) – again do this slowly enough so that the pump track can compensate for the misalignment and maintain modelocking.
9. Wait at least 30 seconds for the pump alignment to optimize. Now record both the externally measured power and the internal photodiode signal TP6 (TP27 for Analog Head board) on table 2 – Power map for y-plane.
10. Set Cy to the next value in the table and wait at least 20 seconds for the pump alignment to optimize. Make sure that mode-locking is maintained. Record the data in the next line of the table.
11. Repeat the previous step until the table for the y-power map is complete.
12. Inspect the data to determine the optimum setting for Cy according to the internal slow photodiode. Set Cy to this optimum setting allowing sufficient time for the pump to optimize accordingly. Monitor the spectrum with a Rees spectrometer and check that the system remains modelocked.
13. With cavity PZTs now set to their optimum values Cx and Cy, record the corresponding values Px and Py which been adopted by the pump PZTs.
14. The power map is now complete, this data can now be stored as the initialize (recover) values for the Chameleon.
15. Place all PZT control back to the ‘Auto’ status and return to the main menu.

16. From the main menu select 'Initialize' and verify the system will use the new PZT values stored in the EPROM.

For 210 and XR systems 0% will be ~2.25V

Table 5.11-1. Cavity X Axis Power Map

Cx	External Power Meter	TP6 (TP27)
-60%		
-40%		
-30%		
-25%		
-20%		
-15%		
-10%		
-5%		
0%		
+5%		
+10%		
+15%		
+20%		
+25%		
+30%		
+40%		
+60%		

Table 5.11-2. Cavity Y Axis Power Map

CY	EXTERNAL POWER METER	TP6 (TP27)
-80%		
-60%		
-40%		
-20%		
-10%		
0%		
+10%		
+20%		
+40%		
+60%		
+80%		

Introduction

This chapter is divided into two sections, one for the older Internal Beam Steerer (IBS) with the exposed knurled rings and a separate section for the covered IBS version. Both sections include the specific procedures for removing and replacing the IBS in a way that minimizes risk of misalignment.

The settings on the Internal Beam Steerer (IBS) unit should never be adjusted outside of the factory. Incorrect adjustment of the IBS will likely result in a misaligned cavity and could cause irreparable damage to the Ti:Sapphire crystal assembly. Adjustment of the IBS outside of the factory will void the manufacturer's product warranty.

Equipment list

- Brass Shims (P/N 1125843, two required)
- 3 mm Hex wrench
- Hemostats
- Methanol
- Lens tissue
- 532 nm 45º Pick-off Mirror (P/N 1058622)

Old Style IBS with Exposed Knurled Rings

Removal Procedure

1. Close the shutter, place the Chameleon keys witch into the Standby position, and remove the Chameleon head cover. Note that the IBS is close to the Verdi Head board. IF there is a concern with removing the IBS while voltage is applied to the Verdi Head board, turn off the laser following the proper shutdown procedure.
2. The IBS sits securely between the Verdi pump laser and the VPUF cavity. The two outermost knurled rings provide a sealed enclosure for the beam path on either side of the IBS. The inner two rings are the IBS adjustment rings, it is important not to move these.
3. Before touching the hardware securing the IBS, loosen the knurled outer ring sitting against the VPUF cavity clockwise when facing the VPUF (see Figure 5.12-1).
4. Loosen the knurled outer ring sitting against the Verdi pump clockwise when facing the front of the Verdi head (see Figure 5.12-1), the rotation of the rings should oppose.
5. Loosen and remove the two M4 screws holding the IBS base.
6. Carefully slide the IBS assembly straight up making sure not to bump the inner IBS adjustment rings (see Figure 5.12-2).
7. Once the IBS has been removed, place it in a safe area so as to maintain the factory alignment.
8. At this point there will be access to the Verdi pump beam and the Verdi and VPUF windows. The mounting holes are identical between the 80 MHz and 90 MHz systems, so the Verdi pick-off can be used. Ensure that the beam does not hit the wiring harnesses from the head PCBA.

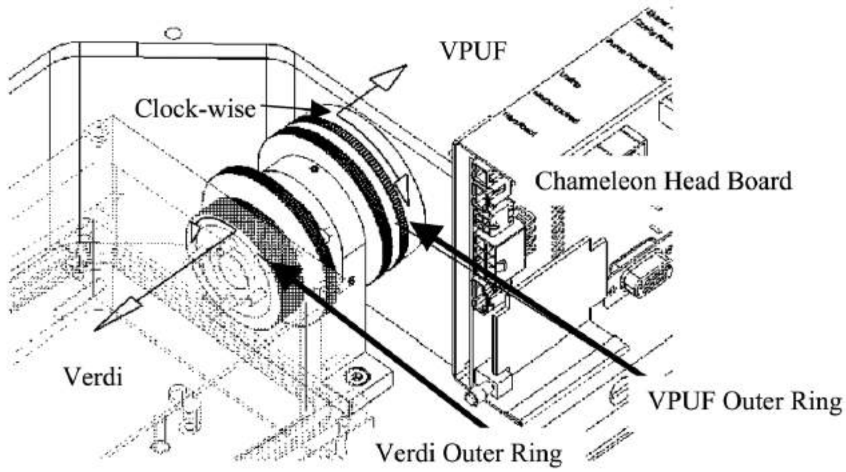

Figure 5.12-1. Loosening the IBS "Outer" Rings

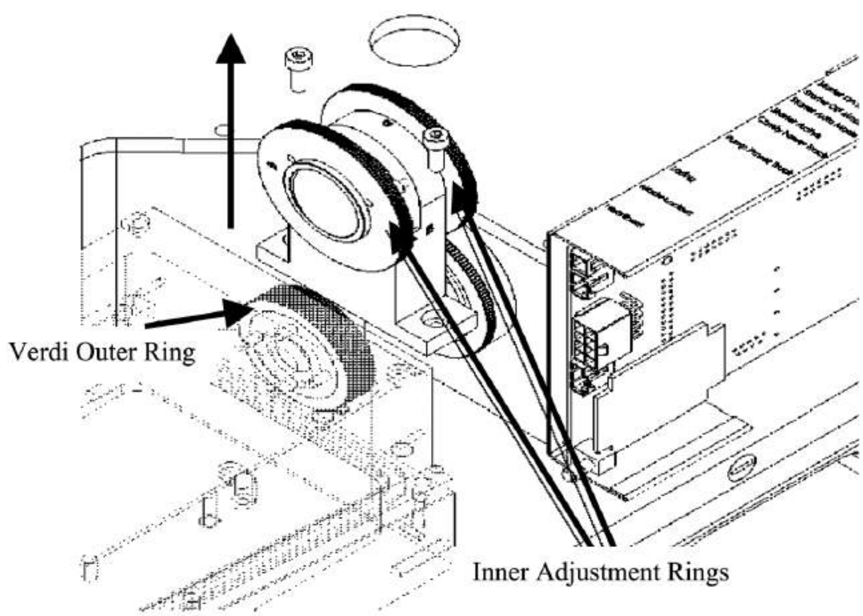

Figure 5.12-2. IBS Removal

Re-installing the IBS

1. Inspect the Verdi output window and the VPUF window. If necessary, using a hemostat and a clean piece of lens tissue, clean the Verdi output window and/or the VPUF window with a small amount of methanol. Make sure to use separate pieces of lens tissue for each of these windows.
2. Carefully slide the IBS between the two outer knurled rings back into its position. Make sure that the inner adjustment rings do not get bumped as the assembly is slid down (see Figure 5.12-2). The bearing ring side of the mount should face the Verdi pump.
3. Secure the base of the IBS assembly with the two M4 screws.
4. Tighten the knurled outer ring sitting against the Verdi pump counter-clockwise when facing the front of the Verdi head (see Figure 5.12-1), stop once the ring is snug.
5. Tighten the knurled outer ring sitting against the VPUF cavity counter-clockwise when facing the VPUF (see Figure 5.12-1), again stop once the ring is snug.
6. If necessary, turn the system back on and wait for the temperatures to stabilize; turn the keys witch from Standby to On.
7. Allow the system to ramp up normally and reach the set Verdi power.

Covered IBS Version

Removal Procedure

1. Close the shutter, place the Chameleon keys witch into the Standby position, and remove the Chameleon head cover. Please note that the IBS is close to the Verdi Head board. IF there is a concern with removing the IBS while voltage is applied to the Verdi Head board, turn off the laser following the proper shutdown procedure.

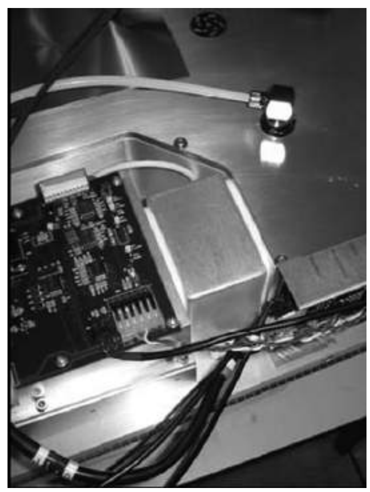

Figure 5.12-3. IBS Cover

2. Remove the two M4 hexagonal socket screws holding the IBS cover in place and slide the cover off to reveal the IBS.

Figure 5.12-4. Removing IBS Cover

3. The two knurled rings have been locked in place at the factory. Great care must be taken to not move them.

Figure 5.12-5. IBS Assembly

4. Remove the two M4 screws that secure the IBS assembly in place and remove the IBS. Once the IBS has been removed, place it in a safe area so as to maintain the factory alignment.

Figure 5.12-6. Pick-off Mirror Installed

5. At this point there is access to the Verdi pump beam and the Verdi and VPUF windows. The mounting holes are identical between the 80 MHz and 90 MHz systems, so the Verdi pick-off can be used. Ensure that the beam does not hit the wiring harnesses from the head PCBA.

Re-installing the IBS and Cover

1. Inspect the Verdi output window and VPUF window. If necessary, using a hemostat and a clean piece of lens tissue, clean the Verdi output window and the VPUF window with a small amount of methanol. Make sure to use separate pieces of lens tissue for each of these windows.
2. Carefully replace the IBS into position and secure with the two M4 screws.

Figure 5.12-7. Replacing IBS

3. Insert the two sheets of shim material (P/N 1125843) on either side of the IBS assembly taking care not to touch the Verdi output or VPUF windows, or the IBS surfaces.

Figure 5.12-8. Inserting Shim Material

4. Gently slide in the IBS cover between the shims; this will be quite tight.

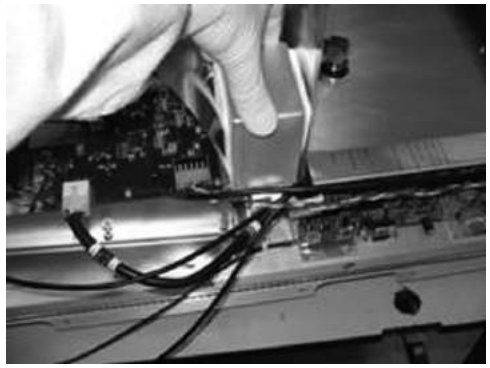

Figure 5.12-9. Sliding Cover in Place

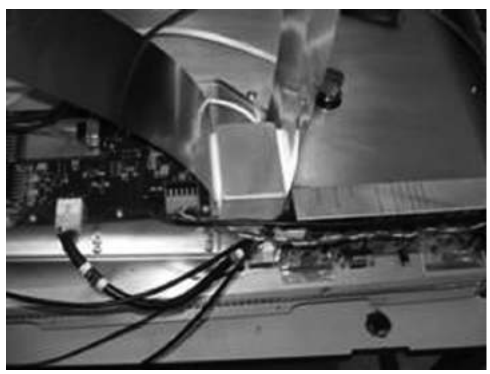

Figure 5.12-10. Cover in Place

5. Slowly remove the shims while holding the cover in place and replace the IBS cover screws.

Figure 5.12-11. Installing Cover Screws

6. If necessary, turn the system back on and wait for the temperatures to stabilize; turn the keys witch from Standby to On.
7. Allow the system to ramp up normally and reach the set Verdi power.

Introduction

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

Depending upon the tuning range there are a predefined number of calibration points; the calibration end points may be beyond the tuning end points. These are preset at the factory and are not to be changed.

For the calibration, an external IST/Rees optical spectrum analyzer with an oscilloscope will be needed. This is used to verify the wavelength, or adjust the stepper position to correct the wavelength, and to determine the Q-Switch and CW Breakthrough points. The Q-Switch limit can be seen on the oscilloscope as the point at which the signal just starts to go noisy (lower power limit). The CW limit can be seen on the oscilloscope as the point at which a narrow spike just starts to appear (high power limit). The actual Verdi power is 80% of the difference of these two points. This is the Pump Level in the Calibration Set-up and should not be adjusted from the factory preset value.

Prior to any wavelength calibration it is important to understand why the calibration is required. If the reason is low Verdi power, should the Verdi servo temperatures, etc., be optimized first? If it's low Chameleon output power, is it related to the PZT positions or another Chameleon specific issue?

Equipment List

(Extracted from Svc-Cham-1.2 “Installation and On-Site Customer Training”)

Personal Equipment

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

Chameleon Standard	720 to 950 nm
Chameleon XR	705 to 980 nm
Chameleon Ultra	690 to 1040 nm
Chameleon Ultra II	680 to 1080 nm
Note: 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 equivalent (optional).
3. Installed software with revision appropriate for the Chameleon model and internal spectrometer:
   - Chameleon PC
   - Chameleon Data Run
   - Chameleon Datalogger

Test Equipment

1. Spectrum Analyzer w/ BNC cables
   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)

Tools, Etc.

1. 45º Uncoated Fused Silica Beam Split
   (1 to 5% reflectivity per surface)
2. Misc. Tools: Allen wrenches/drivers, screw drivers, pliers, etc.

Adaptors, Cables, Parts, Etc.

1. RS-232 Serial Cable, 2 m (P/N 1115727)
2. USB Cable, Type A-A, 3 m (P/N 1116322)

Save EEPROM Data

1. Connect a RS-232 cable between the Chameleon power supply and the Service Engineers' computer. Connect a USB cable between the Chameleon laser head and the computer. Note that this computer must already have all required software installed.
2. If not already, turn the power switch at the rear of the Chameleon power supply to the ON (1) position. Verify that the power supply turns on with no faults displayed on the power supply front panel LCD.
3. Verify that the shutter is closed. Some systems will have this marked as Full Power/Alignment Mode; verify that the LED is off.
4. Run the latest version of the Chameleon PC program. Verify that the program can communicate through the RS-232 to the power supply. Note that this program does not display measured wavelength, so it cannot verify communication through the USB port.
5. Click on the “Tools” drop-down menu. Click “Chameleon Eprom Editor”. The Head EEPROM data should load automatically (Figure 5.13-1).

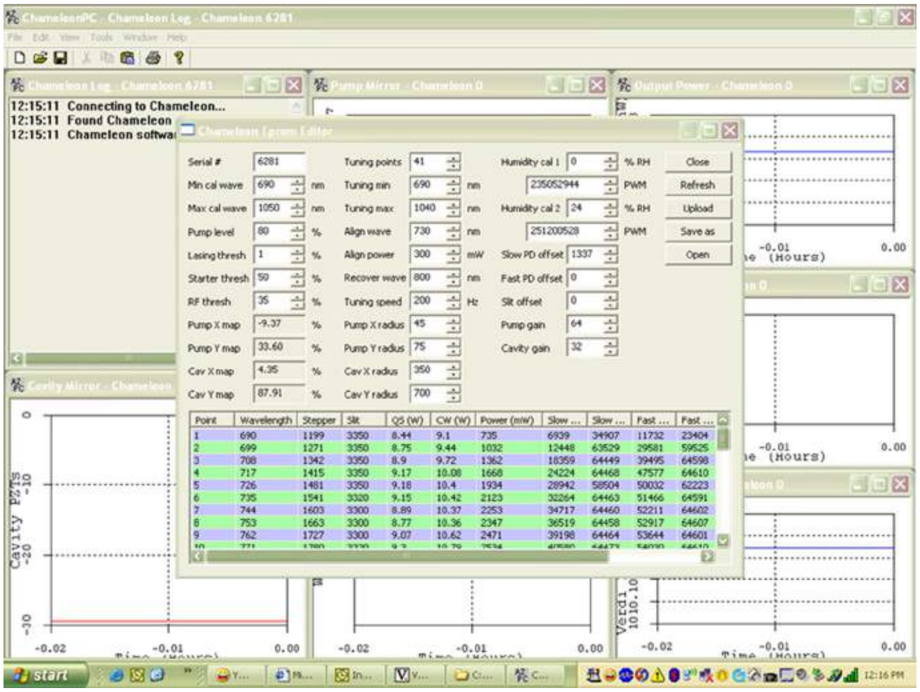

Figure 5.13-1. Chameleon EEPROM Editor

6. Click “Save As”. Pick an appropriate location and filename; the filename must include, at a minimum, the four digit system serial number, that this is a Chameleon Head EEPROM, and present date; if expecting to make system changes and save additional copies, include the time (in 24 hour format). Example: 6281_Cham Hd_061207_0930.

   Any changes to the Chameleon calibration will be changed in the Chameleon Head EEPROM. The saved file can be considered a restore point if needed. Note that the last production EEPROM data is available on the Santa Clara N: drive in the Chameleon serialized folders.

7. Click “Close”.

8. Click “Tools” again. This time click on “Verdi Eprom Editor”. It will be necessary to click on “Get from Verdi” to load the displayed table (Figure 5.13-2).

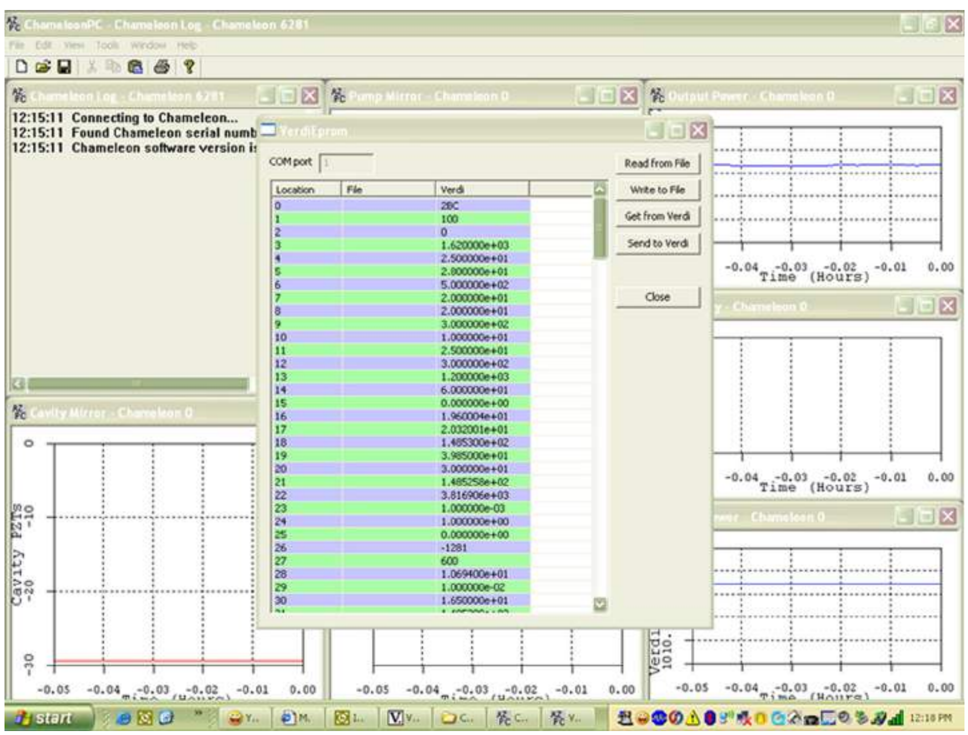

Figure 5.13-2. Verdi EEPROM Editor

9. Click "Write to File". This time, the filename should include the four digit system serial number, that this is a Verdi Head EEPROM, and the present date; time is optional.
   Example: 6281_Verdi Hd_061207_0935.

   The Verdi system has other EEPROMs; one for each laser diode and one for the power supply. These are not accessible, nor saved, by this program.

10. Click "Close".

11. Close the Chameleon PC program.

Equipment Set Up

1. 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 spectrum analyzer. Refer to Figure 5.13-3.

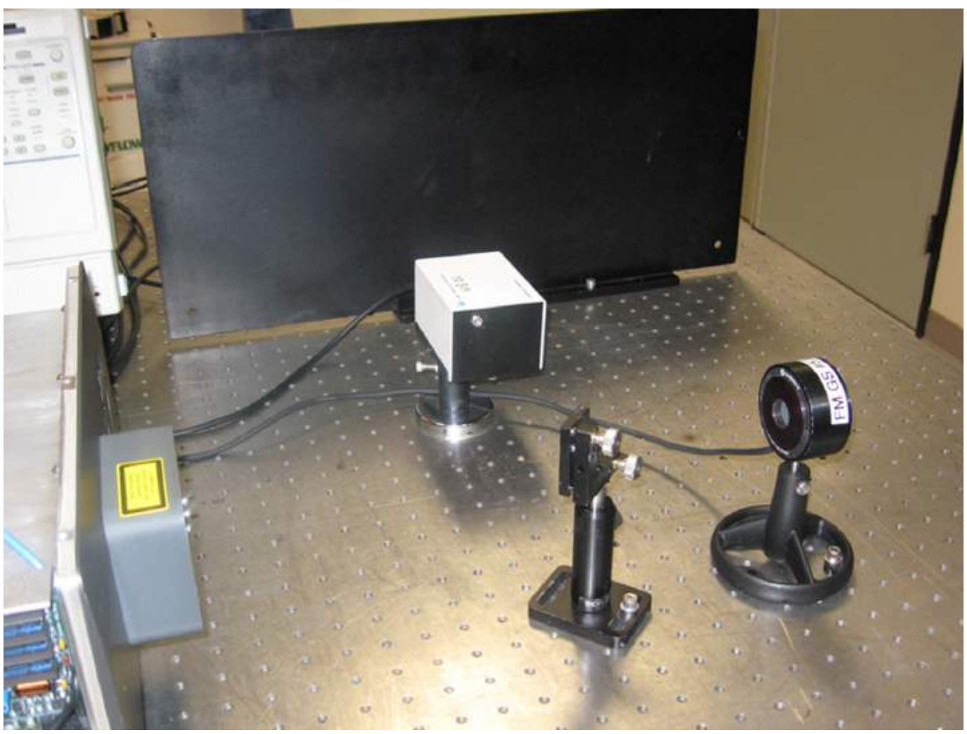

Figure 5.13-3. Test Set Up with Beam Split, Rees Spectrometer, and Power Meter

2. Complete the electrical connection of the IST/Rees spectrum analyzer to the oscilloscope, etc. Common set up is:
    a. Rees Signal to 'scope Ch 1
    (DC, 200 mV/div; adjust as required)
    b. Rees Trigger to 'scope Ext Trig
    (DC, 1 mS/div; adjust as required)
    c. Rees Markers to 'scope Ch 2
    (DC, 2 V/div; adjust as required)
3. Verify that the system status is in Standby. If the servo temperatures are not up to temperature this will be displayed as “Warming (xx.x%)”.
4. Turn the keys witch to ON. 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”.
5. Tune the laser to 720 nm.
6. 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 power of the Chameleon saturates the IST/Rees detector use a ND filter to attenuate the beam. The spectrometers are very alignment sensitive and if misaligned can cause the displayed pulse to appear distorted and/or unstable.

7. Close the shutter.

Pre-calibration Check

Prior to calibration, the laser should always be put on 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 alignment is found, it is stored in the Chameleon Head EEPROM so that the laser will return to this optimum alignment when the laser is turned on in the future.

It is good practice to make sure that the mirrors are in the optimum position prior to calibration. This is particularly important after the laser has been subjected to harsh shocks or temperature variations as often experienced during shipping. These can change the alignment slightly making the last known good PZT positions, stored prior to shipment, irrelevant.

System acceptance does not use the Sync Out signal from the laser head. The Sync Out 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.

The Chameleon system should be lasing for at least one hour to allow for thermal equilibrium before continuing.

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2. Open the shutter.
3. Tune to 800 nm.
4. Set up the Datalogger:
    a. Record Data is not required.
    b. For Wavelength Sweep:
    - 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. 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 (i.e. the positions at 800 nm are approximately equal to the positions the last few times it was at 800 nm).

5. Click on “Wavelength Sweep” to turn it off.
6. Manually tune the laser across the entire tuning range in 10 nm steps.

Chameleon Standard	720 to 950 nm
Chameleon XR	705 to 980 nm
Chameleon Ultra	690 to 1040 nm
Chameleon Ultra II	680 to 1080 nm

At each wavelength, verify:

- Internal wavelength is within ± 5 nm of the Set Wavelength.
- External wavelength is within ± 5 nm of the Set Wavelength.
- Output of the external spectrometer and note any instability, not modelocking, Q-Switching, or CW Breakthrough.

Any indication during the sweep of losing modelock, exhibiting signs of Q-Switching or CW Breakthrough, will require re-calibration of the wavelength calibration points around the issue area. Refer to Figure 5.13-4, Figure 5.13-5 and Figure 5.13-6.

Wavelength Calibration

1. From the Main menu, scroll to the Calibration menu and press SELECT. When the Calibration screen is first entered, the lowest calibration point is displayed (Figure 5.13-7).

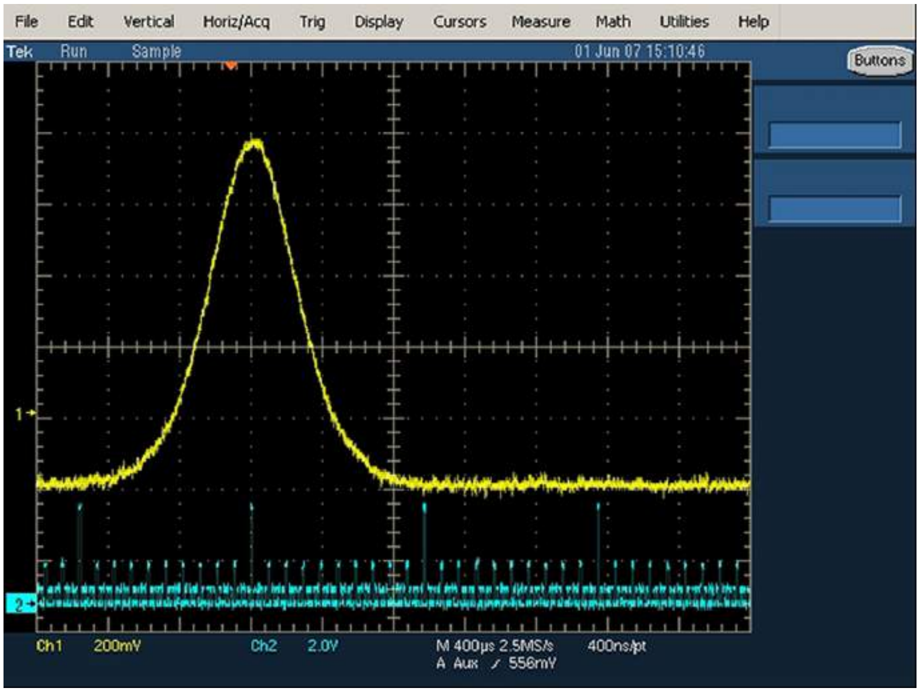

Figure 5.13-4. Example of Acceptable Modelocked Laser Output

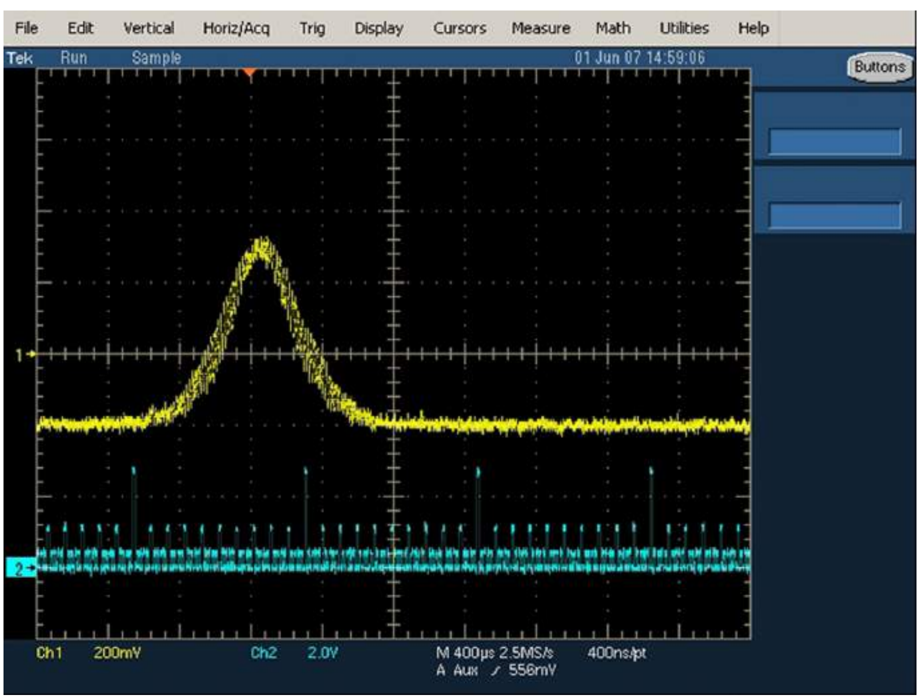

Figure 5.13-5. Example of Unacceptable Laser Output (Q-Switching)

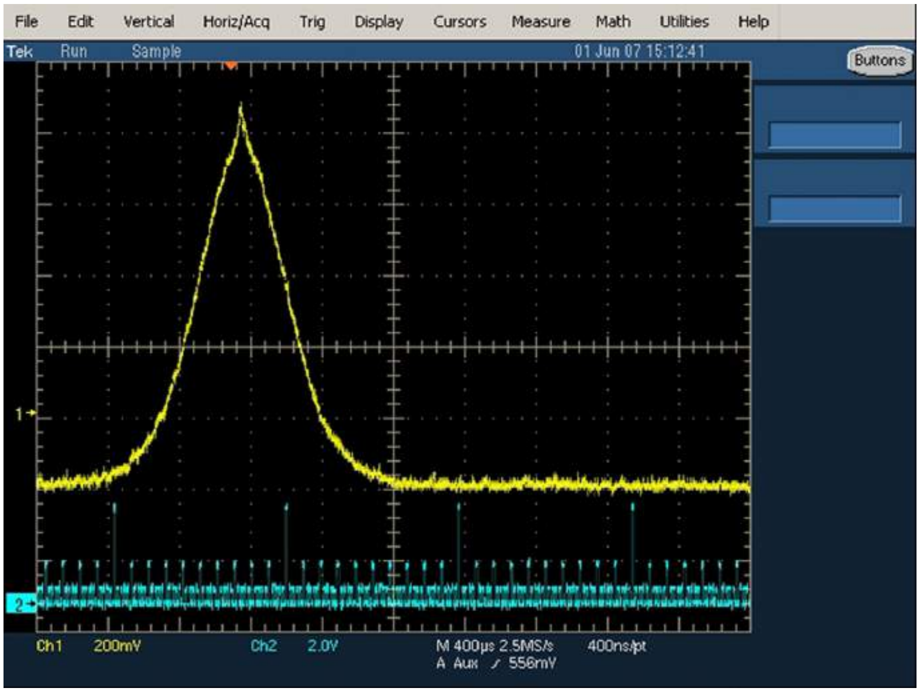

Figure 5.13-6. Example of Unacceptable Laser Output (CW Breakthrough)

Figure 5.13-7. Calibration Screen

Since SELECT has not been pressed, the Chameleon is still at the previous wavelength and the displayed "Chameleon Power" in Fig 5.13-7 is for that wavelength. Once SELECT is pressed, the wavelength will change and the displayed "Chameleon Power" will change to that wavelength's output power.

2. Rotate the POWER ADJUST knob to check each of the calibration points in sequence or rotate to find a specific calibration point.

   Press SELECT to activate that calibration point. The laser will tune to this wavelength as specified by the Tuning stepper motor position. The cursor will move to the next line, "Position".

Note the Chameleon Datalogger screen Pump and Cavity (PZT) Peak Hold indicators. After any wavelength change, wait for the indicators to settle with the Pump Peak Hold to be On before proceeding.

---

3. Rotating the POWER ADJUST knob will change the output wavelength (i.e. the stepper motor position).

   The wavelength will change in real time as viewed on the oscilloscope with the spectrum analyzer. Adjust, if necessary, the stepper position so that the oscilloscope displays within ± 5 nm of the wavelength for this calibration point. Check the wavelength as displayed by the Datalogger program, and if necessary adjust the stepper motor position, so that the internal spectrometer also displays within ± 5 nm for this wavelength.

   Press SELECT to save this and move to the next line or press the DOWN ARROW to move to the next line without saving this data.

If the wavelength is not stable due to Q-Switching or CW Breakthrough, the position can be corrected prior to leaving this calibration point.

---

4. Rotating the POWER ADJUST knob will change the (modelock) Slit Position. This does not typically need to be done and should remain at the factory setting. Press the DOWN ARROW to keep the current value and move to the next line.

   The lower the slit position number, the wider the slit. If too wide, the output pulse will be unstable; if the slit is too narrow, the delta between the CW Breakthrough power and the Q-Switch power will be too small.

The minimum delta between the CW Breakthrough power and the Q-Switch power is ½ Watt.

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5. Rotating the POWER ADJUST knob will change the Verdi power for the Q-Switch data point (i.e. QS Verdi Power,).

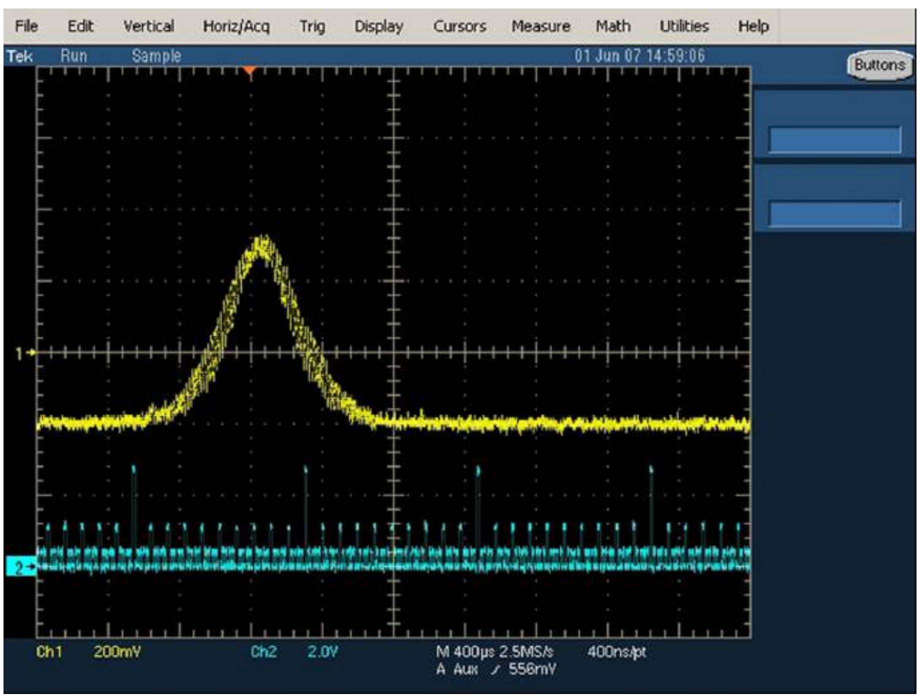


Figure 5.13-8. Example of Q-Switched Laser Output

Lower the Verdi power to display obvious Q-Switching on the oscilloscope. Slowly increase the Verdi power until the Q-Switching is no longer noticed, and then slowly decrease the

Verdi power until the signal just starts to go noisy. It is important to perform a careful adjustment of the pump power to accurately locate the Q-Switch level.

Press SELECT to save this and advance to the next line.

6. Rotating the POWER ADJUST knob will change the Verdi power for the CW Breakthrough (i.e. CW Verdi Power).

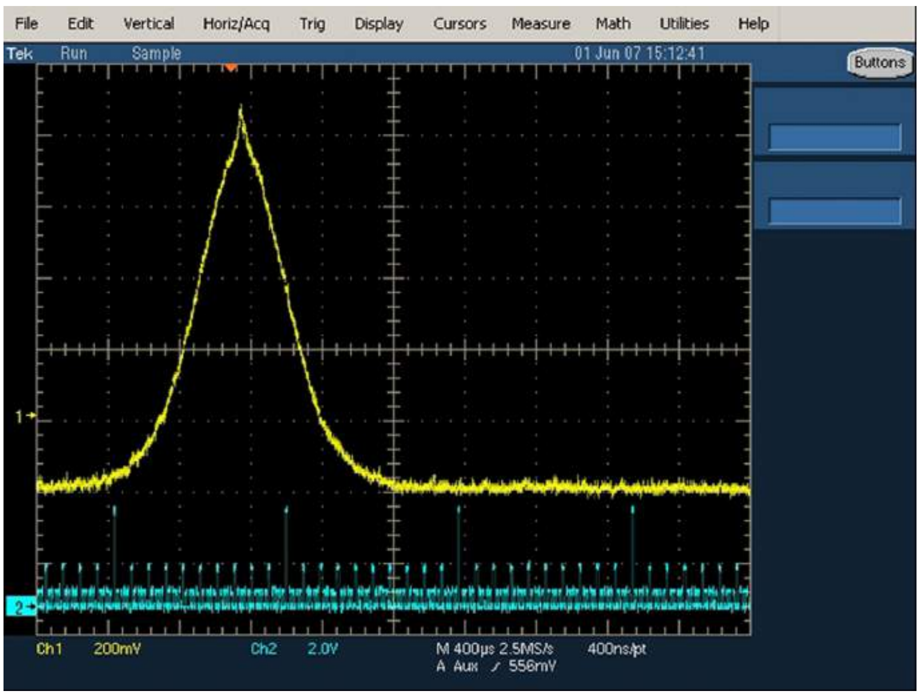


Figure 5.13-9. Example of Laser Output with CW Breakthrough

Increase the Verdi power to display obvious CW Breakthrough on the oscilloscope. Slowly decrease the Verdi Power until the CW Breakthrough is no longer noticed, and then slowly increase the Verdi power until the narrow pike just starts to appear. It is important to perform a careful adjustment of the pump power to accurately locate the CW Breakthrough level.

Press SELECT to save this and advance to the next line.

Verify that the delta between the CW Verdi Power and QS Verdi Power is greater than ½ W.

Also verify that, if any, the dispersion spike to the left of the selected wavelength is less than 25% of the pulse amplitude as measured on the IST/Rees Spectrometer. This spike will have no effect on imaging and contains very little power. Any required correction will need to be performed at the factory.

7. Rotating the POWER ADJUST knob will change the displayed Chameleon power.

   Measure the Chameleon power using the external power meter. Increase the measured value accordingly to compensate for power loss through both surfaces of the 45º beam split. (i.e. two surfaces of a fused silica beam split could require adding up to 10% to the measured power).

   Adjust the knob so that the displayed "Chameleon Power" will display actual output power. Press SELECT to save this and advance to the next line.

8. Pressing SELECT will run a self-test of the start for modelocking. Once complete, YES or NO is recorded on the line for "Start Possible".

   During the test cycle, the Verdi power is decreased to lower the Chameleon laser below threshold and thus stop modelocking. The Verdi power is then increased to the required pump power level and the starter initiated. If the system is able to modelock, a "Yes" will be recorded.

9. Re-calibrate any remaining wavelength points by rotating the POWER ADJUST knob to the desired wavelength calibration point and repeating the above steps.

10. Exit the Calibration menu.

System Acceptance Test

1. 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 exhibiting signs of Q-Switching or CW Breakthrough.

MODEL	TUNING RANGE	SPEC'D OUTPUT POWER	
Chameleon Standard	720 to 950 nm	> 1.0 W	Peak
Chameleon XR	705 to 980 nm	> 1.5 W	Peak
Chameleon Ultra	690 to 1040 nm	> 600 mW > 800 mW > 2.0 W > 1.1 W > 400 mW > 300 mW	690 nm 700 nm 800 nm 920 nm 1020 nm 1040 nm
Chameleon 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

2. Tune the system to 800 nm.
3. Using the Datalogger program:
   a. Click on "Record Data."
   - Select folder and enter filename. Filename should include the four digit system serial number, that this is a Datalog file, present date, maybe time, and AfterCal. Example: 6281_DL_061207_1330_AfterCal
   - "Record Time Interval". This time interval will determine along with the "λ Change Interval", how many measurements are recorded for each wavelength. Set to 30 Seconds.

b. For "Wavelength Sweep":

- λ Change Interval. Set to 30 Seconds.
- λ Min. & λ Max. Set to the minimum and maximum wavelengths for the sweep. This will typically be the tuning limits for the specific Chameleon laser model.

Chameleon Standard	720 to 950 nm
Chameleon XR	705 to 980 nm
Chameleon Ultra	690 to 1040 nm
Chameleon Ultra II	680 to 1080 nm

- λ Steps. Set to 10.

c. Click on "Wavelength Sweep".

- Let the sweep run at least one cycle forward and back. It will run until manually stopped.

4. During the sweep:
   - Verify that the Pump and Cavity PZTs do not drift to either rail (0 or 5 V).
   - Monitor that the internal wavelength is within ± 5 nm of the Set Wavelength.
   - Monitor that the External wavelength is within ± 5 nm of the Set Wavelength.
   - Monitor the output of the external spectrometer and note any instability, not modelocking, Q-Switching, or CW Breakthrough.
5. Close the Datalogger program.
6. 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 is available from Service mode.
   d. Click OK. Click GO.

e. Select folder and enter filename. The filename should include the four digit system serial number, that this is a Data Run, present date, maybe time, and AfterCal. Example: 6281_DR_061207_1400_AfterCal.

f. Click OK.

7. Verify that the system stays modelocked with no CW Breakthrough or Q-Switching during the run.

8. 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.

9. 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.

10. 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.

Verdi Low Power

Low power from the Verdi pump laser can cause loss of modelock or instability in the Sync Out signal. Before re-calibrating each of the Chameleon wavelengths check the Chameleon Pump and Cavity PZT positions, and the Verdi temperature optimizations and calibrations.

Due to issues with the Verdi photocell calibration and other concerns with the Verdi and Chameleon, it is recommended to upgrade the Verdi and Chameleon software to their current revisions before proceeding.

The Verdi temperature optimization routines for LBO or laser diodes (FAP-I) are not available from the power supply front panel in Chameleon Customer mode or Chameleon Service mode. For front panel access it is necessary to enter Verdi mode; this is the equivalent of the Verdi Customer mode. Similarly, for additional Verdi access, such as Verdi photocell calibration or manual temperature optimization, it is necessary to enter Verdi Service mode. The LBO Temperature Optimization can be initiated, while in Chameleon Customer mode, using the LBOOPT RS-232 Command.

The Verdi LBO and laser diode temperature optimizations, as well as accessing Verdi Service mode, can be accessed while completely integrated within the Chameleon. If need be, the Verdi can be isolated from the Chameleon; the Verdi Head Assembly will not be removed from the Chameleon Head.

After removing the Internal Beam Steerer (IBS) and inserting the 532 nm 45° Pick-off mirror, be sure to keep the Chameleon Head Board and shutter wiring harnesses away from the beam path. Also be aware of the amount of scatter of light from the Verdi reflecting off the power meter and then reflecting off the polishes aluminum surfaces of the Chameleon and Verdi heads.

Verdi Customer Mode

With the Verdi integrated into the Chameleon, it is necessary to first access Chameleon Service mode, then access the Verdi menus.

Using Chameleon PC Terminal Window (or Windows HyperTerminal) type the RS-232 commands:

1. ACCESS=CLG5182 <Enter>
   (Places Chameleon in Service mode.)
2. VERDI=1 <Enter>
   (Places Chameleon in Verdi mode.)

The temperature optimization routines for the LBO and laser diodes are now available. Refer to the appropriate current Verdi Operator / Service Manual for details specific to these optimizations. These operations can be performed without removal of the Internal Beam Steerer (IBS).

To Disable Service Mode:

1. VERDI=0 <Enter>
   (Disables Verdi mode.)
2. ACCESS=0 <Enter>
   (Disables Chameleon Service mode.)

Verdi Service Mode

With the Verdi integrated into the Chameleon, it is necessary to first access Chameleon Service mode, then access the Verdi Service menus.

1. Insert the shunt at JP9 on the Verdi CPU Board to enable Verdi Service mode.
2. Cycle the Chameleon system power.

Using Chameleon PC Terminal Window (or Windows HyperTerminal) type the RS-232 commands:

3. ACCESS=CLG5182 <Enter>
   (Places Chameleon in Service mode.)
4. VERDI=1 <Enter>
   (Places Chameleon in Verdi mode).

The complete Verdi Service mode is now available. Refer to the appropriate current Verdi Service Manual for details.

Follow procedure SVC-CHAM-5.12 in this manual for removing the Internal Beam Steerer (IBS) and installing the 532 nm 45° Pick-off mirror, and re-installing the IBS. On older systems, it may be necessary to gently remove one of the IBS alignment dowels in order to install the mirror. It may also be necessary to remove the harness tie wrap to ensure that the wiring is not in the beam path.

Be aware of the amount of scatter of light from the Verdi reflecting off the power meter and then reflecting off the polishes aluminum surfaces of the Chameleon and Verdi heads.

After the keys witch is turned to the ON position, the Verdi will output a very low power beam that can be used to align the power meter. Opening the shutter will provide the available Verdi output power.

To Disable Service Mode:

1. VERDI=0 <Enter>
   (Disables Verdi mode.)
2. ACCESS=0 <Enter>
   (Disables Chameleon Service mode.)
3. Remove the shunt from JP9 on the Verdi CPU Board
4. Cycle the Chameleon system power.

Completely Isolating Verdi from Chameleon

In normal operation, all external RS-232 communication to the Verdi system passes through the Chameleon. Control of the Verdi system by the Chameleon (Verdi Interface Board) is through the RS-232 and the Motherboard.

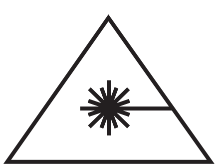
Only if required to completely isolate a Verdi from the Chameleon, is it necessary to physically change the communication path with the Verdi. This does not include removing the Verdi Head Assembly from the Chameleon Head.

Removing and handling of the Verdi Interface Board requires the use of an ESD wrist strap and an appropriate ESD bag.

1. Turn the Chameleon system power to Off (0).
2. Disconnect the RS-232 cable at J82 and J84 on the Signal Interconnect Board.
3. Disconnect the CAN cable at J94 on the Signal Interconnect Board.
4. Remove the Verdi Interface Board from the power supply. Place into ESD bag.
5. Insert shunts into JP1 and JP2 on the Signal Interconnect Board.
6. Insert the shunt at JP9 on the Verdi CPU Board to enable Verdi Service mode.
7. Disconnect the low voltage power cable at J110 on the Verdi Pump Board.
8. Turn the Chameleon system power back On (1).

The complete Verdi Service mode is now available. Refer to the appropriate current Verdi Service Manual for details.

Follow procedure SVC-CHAM-5.12 in this manual for removing the Internal Beam Steerer (IBS) and installing the 532 nm 45° Pick-off mirror, and re-installing the IBS. On older systems, it may be necessary to gently remove one of the IBS alignment dowels in order to install the mirror. It may also be necessary to remove the harness tie wrap to ensure that the wiring is not in the beam path.



Be aware of the amount of scatter of light from the Verdi reflecting off the power meter and then reflecting off the polishes aluminum surfaces of the Chameleon and Verdi heads.

After the keys witch is turned to the ON position, the Verdi will output a very low power beam that can be used to align the power meter. Opening the shutter will provide the available Verdi output power.

To Disable Service Mode:

Handling of the Verdi Interface Board requires the use of an ESD wrist strap.

1. Turn the Chameleon system power is Off (0).
2. Reconnect the low voltage power cable to J110 on the Verdi Pump Board.
3. Remove the shunt at JP9 on the Verdi CPU Board.
4. Remove the shunts at JP1 and JP2 on the Signal Interconnect Board.
5. Re-install the Verdi Interface Board.
6. Reconnect the CAN cable to J94 on the Signal Interconnect Board.
7. Reconnect the RS-232 cable to J82 and J84 on the Signal Interconnect Board.
8. Turn the Chameleon system power back On (1).

Verdi Photocell Calibration

Following the steps above for access to the Verdi Service menus, or if needed, to isolate the Verdi from the Chameleon system.

The following Verdi photocell calibration procedure is extracted from FSB 505 (7-May-2007) for the release of Verdi software version 9.53. Check the latest Verdi information to use a more recent procedure if available. When following the photocell calibration procedure, it is important to follow all steps, and in particular, wait at the appropriate times for the temperature and light loop servos to stabilize by waiting for the letters (LV(V2)ED1D2) to appear.

1. Make sure the system is in current control. Wait until all servos lock (except “Laser”, and “Vanadate(s)”).
2. Turn the keys witch to the ON position. Increase the current until the power meter registers output as close to rated power as possible. It is ok for the output power to be set a few watts above rated power. V18 have a very high slope; rollover can be between 20 and 28 watts.
3. Go to the “Light Loop Test” menu. Verify that the “PC Gain” is set to “8”, and set the “Serial DAC Voltage” to “2.50 V”

4. Go to “Calibrate Photocell” menu.
5. With cursor at “PC cal PT#1” and arrow pointing at “Iset = A”. Adjust the current until the power meter reading is as close as possible to the rated output.

   If the output power is not stable, slightly increase power so that it is stable.
6. Adjust R55 on the head board. The A/D count must be within the 2000 - 2500 range (2000 is optimal).

   V18 have very high slope; rollover can be between 20 W and 28 W. Following current ramp-up, after the output stabilizes on the high side of the slope, adjust the A/D count to be between 2500 and 2800, depending on the power. This is over-compensating - in light loop, at 18 W, the A/D count will decrease and must be within the 2000 to 2500 range.
7. Wait until all letters (LV(V2)ED1D2) appear on screen; i.e.: the light loop and temperature servos have stabilized.

   Push in the front panel power adjust knob to move the arrow to “Pset”. Adjust Pset to match the power meter reading. Press SELECT to calibrate.
8. At the prompt, “Push menu down to adjust PT#2”, move the cursor to “PC cal PT #2”. Decrease the current until the power meter reads approximately 0.50 W. Wait until all letters (LV(V2)ED1D2) appear on the screen.

   Push in the front panel power adjust knob to move the arrow to “Pset”. Adjust Pset to match the power meter reading. Press SELECT to calibrate.
9. After calibrating PT#2 in current control, you will see a prompt: “Menu down to enter light mode.” Move the cursor down. Press SELECT to enter light mode.
10. Press the front panel power adjust knob to move the arrow to “SDAC”.

    Slowly increase the Serial DAC voltage to approximately 2.5 V until the power meter reading shows output close to spec power (18 W).
11. Press the front panel power adjust knob to move the arrow to “Pset”. Wait for the current reading to stop changing and for all

letters (LV(V2)ED1D2) to appear on the screen.

Adjust Pset to match the power meter reading. Press SELECT to calibrate PT#1.

12. Move the cursor down to calibrate PT#2. Press the front panel power adjust knob to move the arrow to “SDAC”.

    Slowly decrease the Serial DAC voltage until the power meter reading shows output of approximately 0.50 W.

13. Press the front panel power adjust knob to move the arrow to “Pset”. Wait for the current reading to stop changing and for all letters (LV(V2)ED1D2) to appear on the screen.

    Adjust Pset to match the power meter reading. Press SELECT to calibrate PT#2.

14. Exit to main menu.

    Check the calibration accuracy for several power levels, including spec and maximum power.

15. If an adjustment of power is necessary, go to the “Photocell calibration” menu, and repeat the light loop calibration for PT#1 and PT#2.

16. Go to “Light loop test.” Verify that the SDAC is 3.0 V ± 1.0 V at max power.

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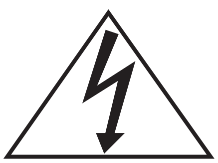
Fast Photodiode

This document details the recommended procedure for replacing the fast photodiode in the Chameleon Vision.

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

All electronic components are sensitive to static. Please take appropriate precautions.



Before starting this procedure, ensure that the laser is powered off and disconnected from mains.

Parts Required

FRU, Fast Photodiode Assy Part Number: 1170714

High Bandwidth Oscilloscope (100MHz minimum)

BNC-to-BNC cable

Procedure

1. Power down the Chameleon Vision system and disconnect the main power cord.
2. Remove the outer cover on the laser head.
3. Connect ESD wrist-strap before touching any circuit boards, cables or electronic assemblies.
4. Refer to Figure 5.15-1 below. Remove the 2 cables from the circuit board.
5. Using a 2 mm hex wrench, unscrew the 2 hex screws that mount the board to the head wall and remove the board.
6. Using the same mounting screws, install the new board and connect the cables.

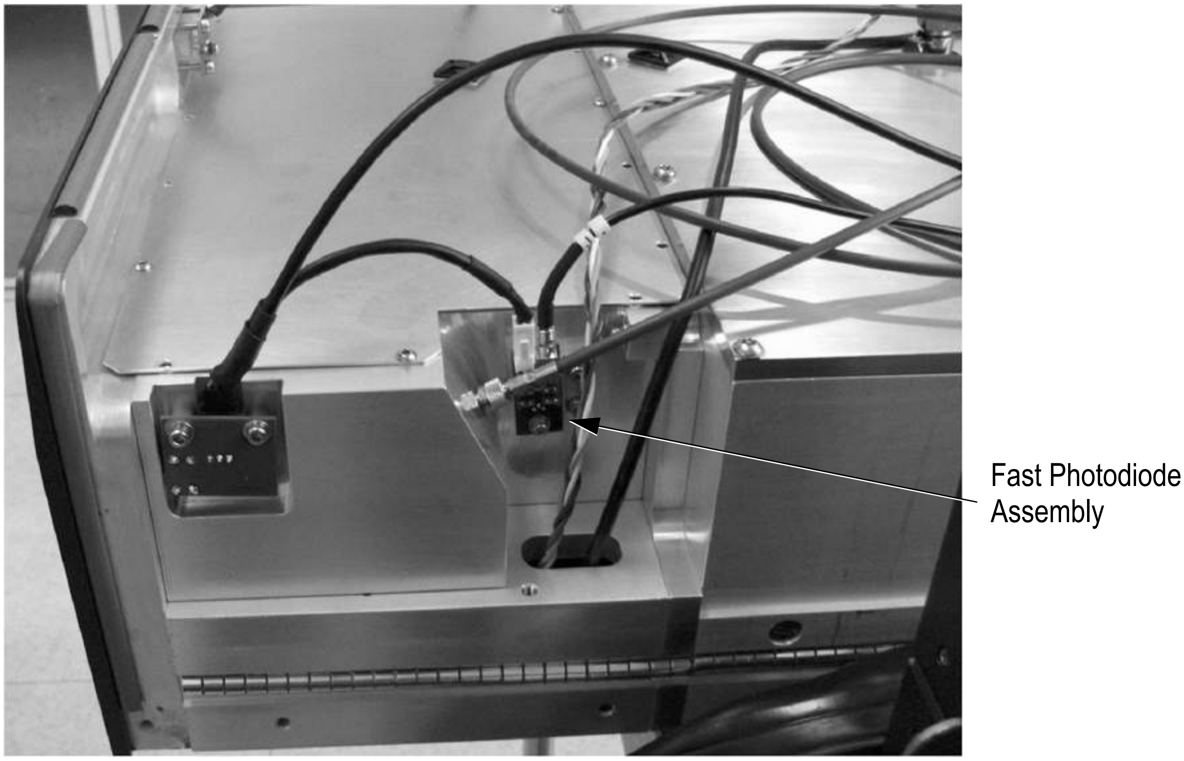


Figure 5.15-1. Fast Photodiode Assembly

Set-up and Test

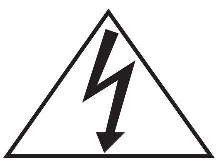
1. With the cover still removed, connect the Chameleon Vision system to main power and turn on.
2. After the warm up period, key-on at 800 nm. Verify the laser is running and is modelocked.
3. Connect the BNC cable to SYNC OUT (on laser head) and the oscilloscope.
4. With the board mounting screws loosened enough to allow the board to move, adjust the board position (up/down & left/right) to achieve the best modelocked signal (maximize the peak-to-peak signal) on the oscilloscope.
5. Tighten the board mounting screws and re-install the laser head cover.

Slow Photodiode

This document details the recommended procedure for replacing the slow photodiode in the Chameleon Vision laser head.

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

All electronic components are sensitive to static. Please take appropriate precautions.



Before starting this procedure, ensure that the laser is powered off and disconnected from mains.

Parts Required

FRU, Slow Photodiode Assy   Part Number: 1170715

Procedure

1. Power down the Chameleon Vision system and disconnect the main power cord.
2. Remove the outer cover on the laser head.
3. Connect ESD wrist-strap before touching any circuit boards, cables or electronic assemblies.
4. Refer to Figure 5.16-1 below. Remove the cable from the Slow Photodiode circuit board.
5. Remove the cable assembly from the board.
6. Using a 2.5 mm hex wrench, unscrew the 2 hex screws that mount the board to the head wall and remove the board.

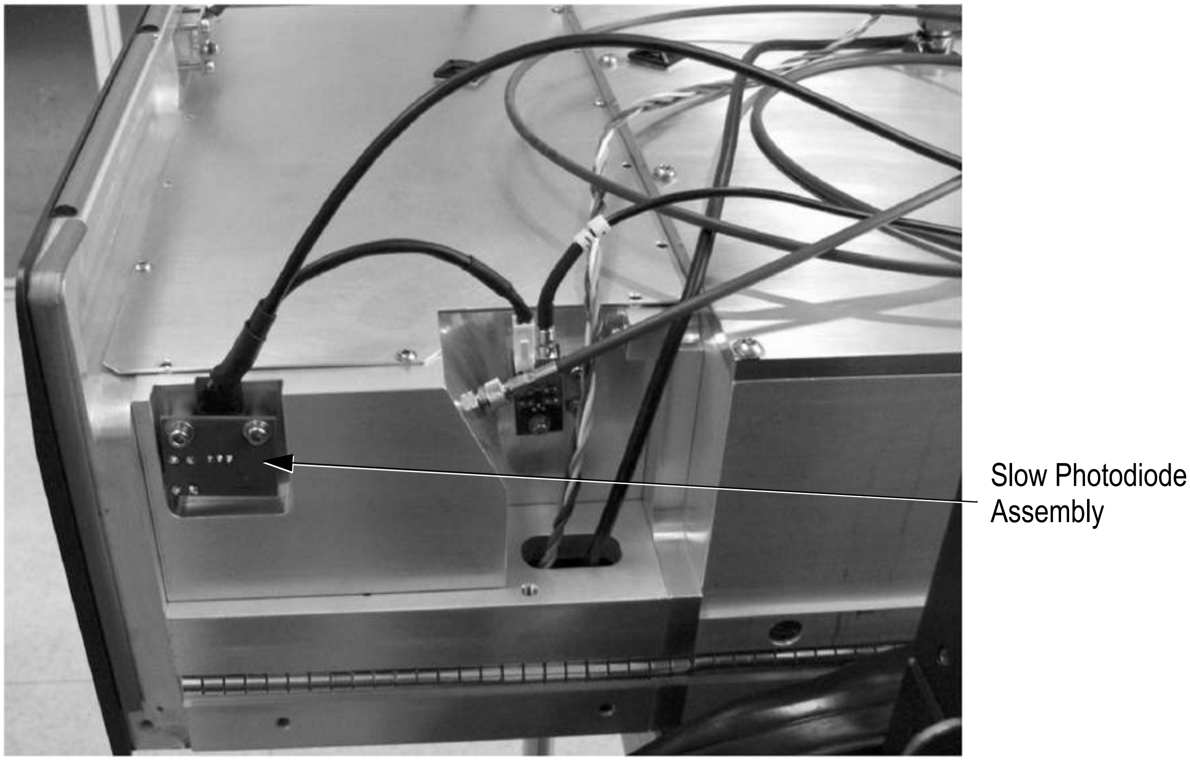


Figure 5.16-1. Slow Photodiode Assembly

7. Using the same mounting screws, install the new board and tighten the mounting screws.
8. Re-connect the cable assembly to the board.
9. Install the laser head cover.

Set-up and Test

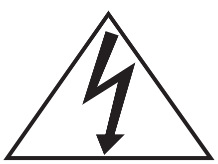
1. Connect the Chameleon Vision system to main power and turn on.
2. After the warm up period, key-on at 800 nm. Verify the laser is running and is modelocked.
3. Power calibration may be required after slow PD replacement.

Shutter Actuator

This document details the recommended procedure for replacing the shutter actuator (rotary solenoid) in the Chameleon Vision laser head.

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

All electronic components are sensitive to static. Please take appropriate precautions.



Before starting this procedure, ensure that the laser is powered off and disconnected from mains.

Parts Required

FRU, Shutter Actuator Assy   Part Number: 1170716

Procedure

1. Power down the Chameleon Vision system and disconnect the main power cord.
2. Remove the outer cover on the laser head.
3. Connect ESD wrist-strap before touching any circuit boards, cables or electronic assemblies.
4. Refer to Figure 5.17-1 below. Position the laser head at the edge of a table such that the Precompensation section bottom cover is exposed.
5. Remove the 7 precompensation section access panel screws using a 2 mm hex wrench. Catch the access panel as it drops down.

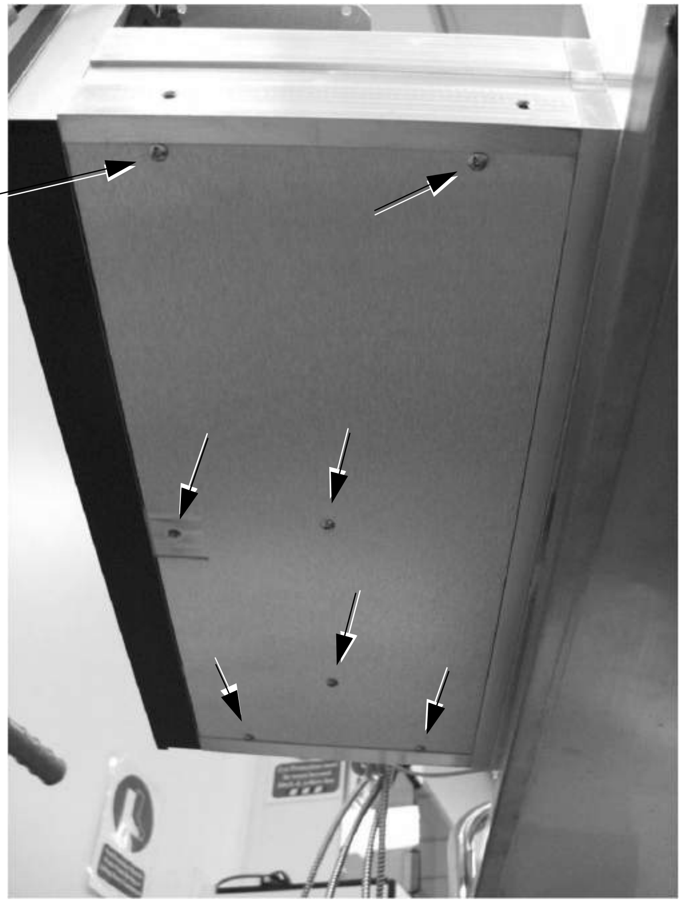
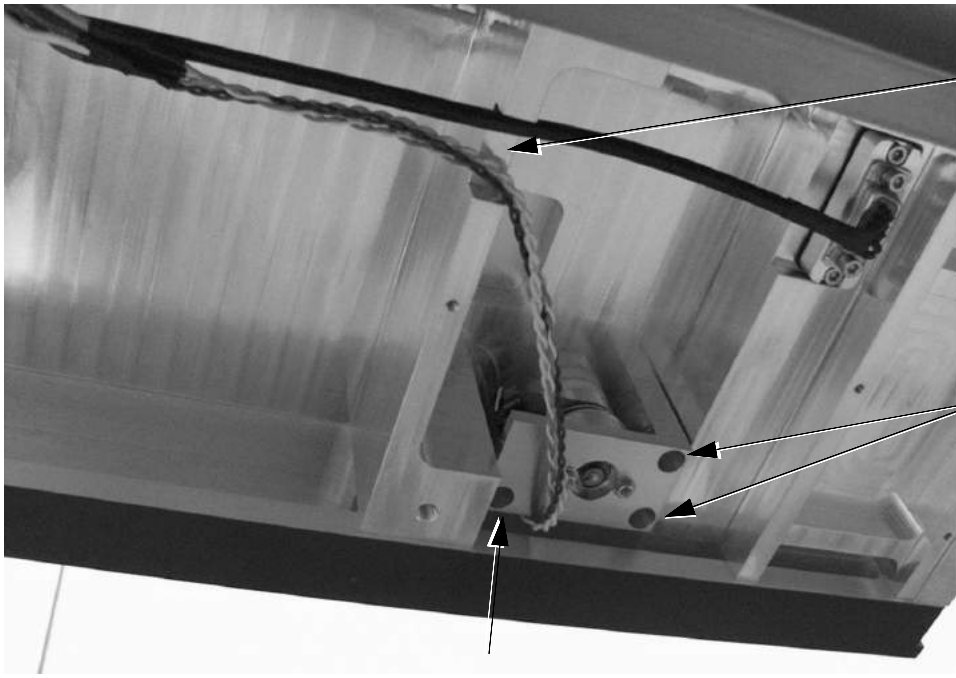


Figure 5.17-1. Precompensator Bottom Access Panel & Screw Locations

6. Locate the shutter actuator (solenoid) as shown in Figure 5.17-2. Using a 3 mm hex wrench, remove the 3 socket head mounting screws that mount the actuator mount to the bottom of the precompensator deck.
7. Disconnect the cable end from the pump board as shown in fig below.Figure 5.17-3.
8. Install the new shutter actuator in the reverse order. Ensure the cable is routed inside the cable cut-out as shown in Figure 5.17-2.

Set-up and Test

1. With the cover still removed, connect the Chameleon Vision system to main power and turn on.



Route Cable through Cut-out

Remove 3 mount screws

Looking up from floor at bottom of Precompensation section.

Figure 5.17-2. Shutter Actuator Mount Screws & Cable Routing

Top view looking down

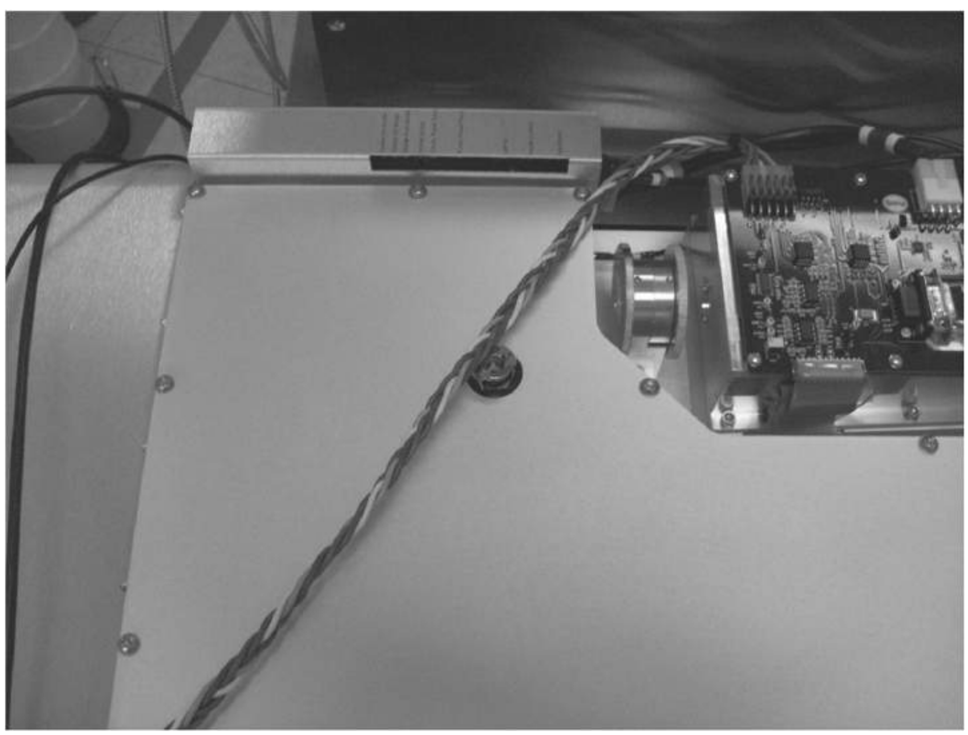


Figure 5.17-3. Pump Board Cable Connection

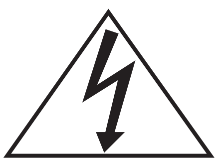
2. After the warm up period, key-on at 800 nm. Verify the laser is running and is modelocked.
3. Command the shutter to open and close. Verify no shutter faults occur.
4. Re-install the laser head cover.

Emission LED PCB Assembly

This document details the recommended procedure for replacing the Emission LED PCB Assembly in the Chameleon Vision laser head.

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

All electronic components are sensitive to static. Please take appropriate precautions.



Before starting this procedure, ensure that the laser is powered off and disconnected from mains.

Parts Required

FRU, Emission LED Assembly   Part Number: 1173106

Procedure

1. Power down the Chameleon Vision system and disconnect the main power cord.
2. Remove the outer cover on the laser head.
3. Connect ESD wrist-strap before touching any circuit boards, cables or electronic assemblies.
4. Refer to Figure 5.18-1 below. Using a 2.5 mm hex wrench, unscrew the 4 allen head screws holding the PCB assembly to the wall.
5. Disconnect the cable end from the J103 on the pump board as shown in Figure 5.18-2 below.

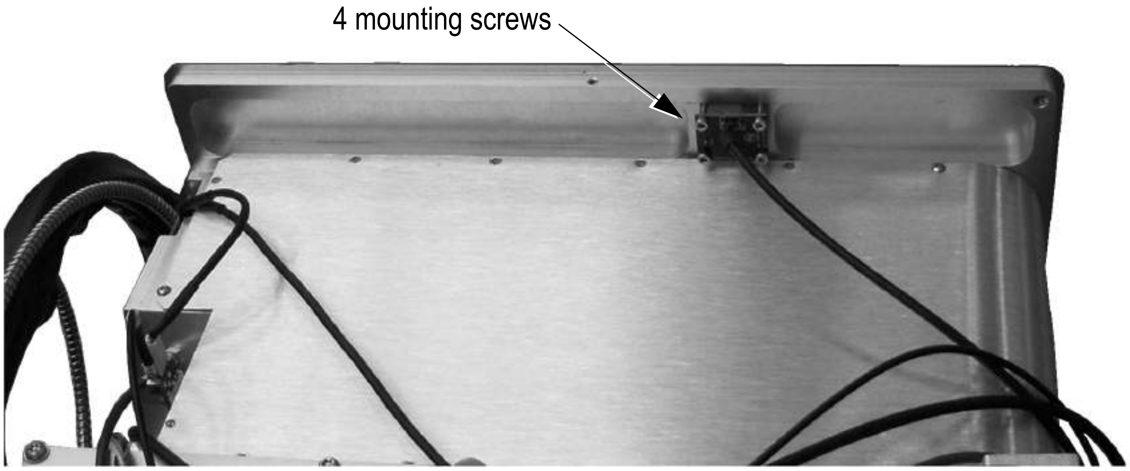


Figure 5.18-1. Emission LED Assembly Location and Mounting Screws

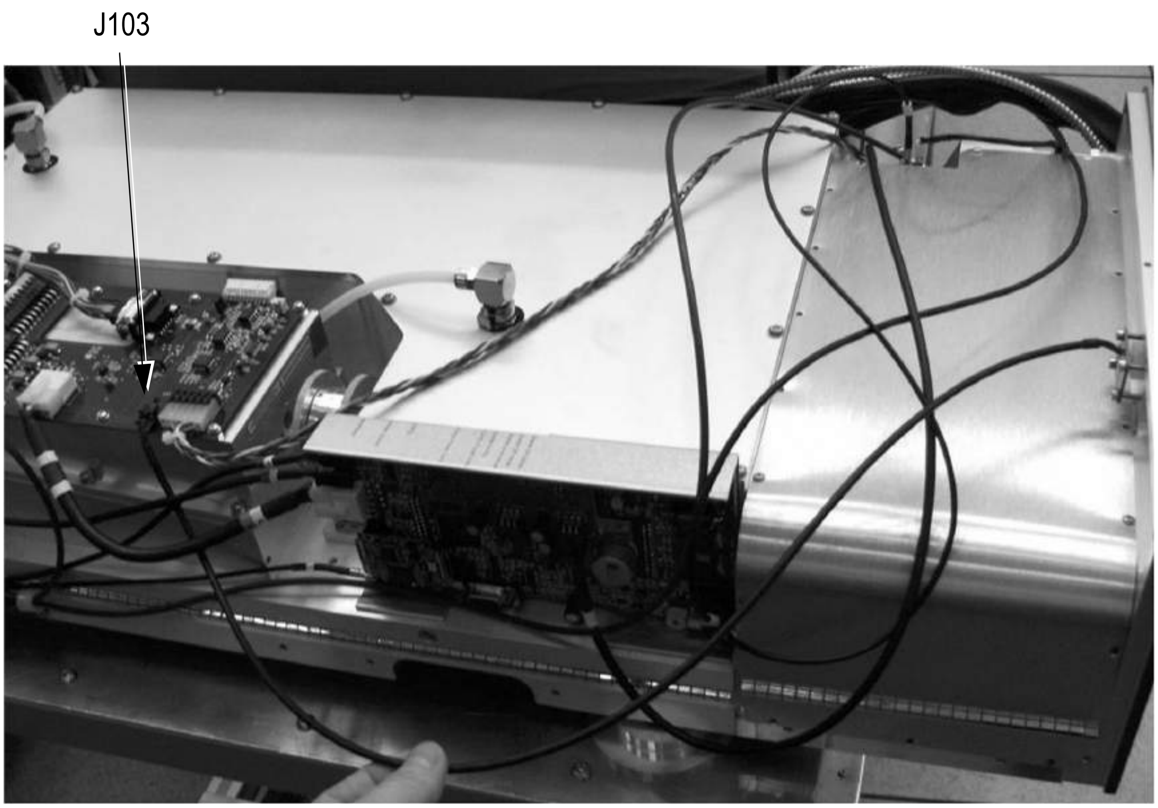


Figure 5.18-2. Pump Board Cable Connection

6. Install the new emission LED PCB assembly in the reverse order. Route and tie the cable as required.

Set-up and Test

1. With the cover still removed, connect the Chameleon Vision system to main power and turn on.
2. Verify the emission LED is illuminated. See Figure 5.18-3 below.

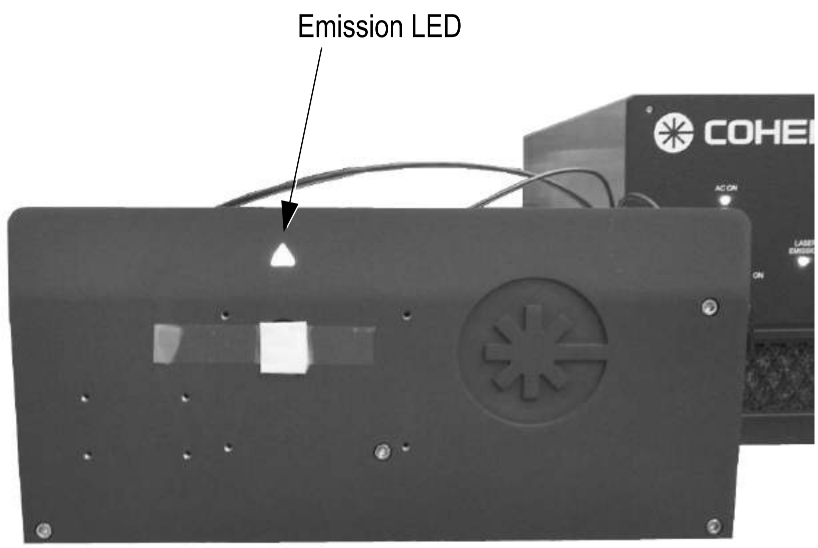


Figure 5.18-3. Emission LED ON

3. Re-install the laser head cover.

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FSBs

NO.	DATE	TITLE
430	12/05/2003	Optishield Chiller Additive
436	09/09/2004	When to Replace a Chameleon
463	08/04/2005	Corrective Action for Verdi CPU Boards
468	10/12/2005	Differences between the Chameleon 210/XR Series Lasers, and the Chameleon Ultra
483	04/25/2006	Preparing a Chameleon for Shipment or Long-term Storage
487	08/28/2006	Release of Version 9.5 Software for all Viper/ Verdi/ Chameleon Ultra Models
490	10/02/2006	Verdi V-18 Over Temperature Faults
491	10/06/2006	ThermoTek T255P Chiller "EEPROM Write Error" Firmware Upgrade to Rev D.05
493	11/06/2006	Release of Chameleon Software Version 7.91
495	01/03/2007	Update on Field Upgrade of Chameleon Ultra Software
498	01/03/2007	Release of Chameleon Software Version 7.92
505	05/07/2007	Release of Version 9.53 Software for all Viper/Verdi/80 MHz Chameleon Models
506	05/07/2007	Release of Chameleon Software Version 7.93
511	07/19/2007	Release of Chameleon Software Version 7.94
538	6/30/2008	Chameleon Umbilical Tether Change
575	5/7/2009	Chameleon Vision Calibration Procedure
585	8/27/2009	Chameleon Vision Sealed Cavity

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Spare Parts List

Use of Green Replacement Part Numbers

It is acceptable to use the existing (brown) replacement parts for systems originally shipped as brown. If no longer available, use the RoHS Compliant "green" replacement part number. If a green number is not identified in the list below, there is no equivalent green part number at the time the list was last revised.

Systems originally shipped as a RoHS Compliant system require that all replacement parts are green.

Refer to Document D125498 for the complete FRU list.

DESCRIPTION	PART NUMBER	REFURB PART NUMBER	PART NUMBER (GREEN)	REFURB PART NUMBER (GREEN)
90 MHZ CHAMELEON 210, XR TESTED PCBAS, PCBA ASSEMBLIES				
CPU Board	0174-924-50	na	1125327	na
Mother Board	0171-954-50	na	1120632	na
Signal Interconnect Board	0175-201-50	na	1124244	na
Power Piggy Board	1042723	na	1120427	na
Chameleon Control Board	1066404	na	na	na
Chameleon Analogue Board	1040959	na	na	na
Chameleon Pump Board	None	na	na	na
Chameleon XR Pump Board	None	na	na	na

DESCRIPTION	PART NUMBER	REFURB PART NUMBER	PART NUMBER (GREEN)	REFURB PART NUMBER (GREEN)
Humidity Sensor Assembly	1124986	na	na	na
Noise Reduction Assembly	0172-905-50	R172-905-50	1126919	na
Power Distribution Assembly	0170-368-50	na	1120598	na
Power Distribution Assembly (Obsolete)	0175-030-50	R0175-030-50	na	na
80 MHz CHAMELEON, XR, ULTRA, ULTRA II TESTED PCBAs, PCBA ASSEMBLIES				
CPU Board	1046338	na	1125327	na
Mother Board	1066659	na	1120632	na
Signal Interconnect Board	1093967	na		na
Power Piggy Board	1042723	na	1120427	
Vanadate 2 Driver Board	1066654	na	1124223	na
OEM Umbi Disconnect Board	1086053	na		na
Verdi Interface Board	1117712	na	1117724	
Chameleon Head Board	1107704	na	1117719	
Chameleon Pump Bd, V-18 OEM	1086054	na	1122977	na
Noise Reduction Assembly	1051110	na	1126919	na
Power Distribution Assembly	1066656	na	1120598	na

DESCRIPTION	PART NUMBER	REFURB PART NUMBER	PART NUMBER (GREEN)	REFURB PART NUMBER (GREEN)
COMMON TESTED PARTS AND ASSEMBLIES				
Power Entry Module Assembly	1050672	na	1120413	na
48 VDC Power Supply	1103725	na	1120426	na
Battery, 12 VDC	4002-0031	na	1094989	na
Diode Fan Assembly	1050674	na		na
90 MHz CHAMELEON 210 TESTED PARTS AND ASSEMBLIES				
Programmed EPROM	1040960	na	na	na
FAP-I Kit, 20 W, 810 nm, (V-10)	0175-723-00	na	1117208	na
Front Panel Display Assembly	1064183	na	1126908	na
Power Supply, Cover	0172-557-00	na	0172-557-00	na
Tested Power Supply, V-10	0178-281-50	R178-281-50	1104728	1119254
Shutter Assembly, Chameleon	1060045	na	na	na
Spectrometer, SAS 1064	1042967	na	na	na
Spectrometer Fibre	1042968	na	na	na
Output Window	1042969	na	1042969	na

DESCRIPTION	PART NUMBER	REFURB PART NUMBER	PART NUMBER (GREEN)	REFURB PART NUMBER (GREEN)
Shutter Assembly, Chameleon (Obsolete)	1040096	na	na	na
Front Panel Display Assembly (Obsolete)	0175-055-50	R0175-055-50	na	na
90 MHz CHAMELEON XR TESTED PARTS AND ASSEMBLIES				
Programmed EPROM	1040960	na	na	na
FAP-I Kit, 22 W, 810 nm, (V-12)	1068676	na	1117209	na
Front Panel Display Assembly	1064183	na	1126908	na
Power Supply, Cover	0172-557-00	na	0172-557-00	na
Tested Power Supply, V-12	1068678	1068679	1104728	1119254
Shutter Assembly, Chameleon	1060045	na	na	na
Spectrometer, SAS 1064	1042967	na	na	na
Spectrometer Fibre	1042968	na	na	na
Output Window	1042969	na	1042969	na

DESCRIPTION	PART NUMBER	REFURB PART NUMBER	PART NUMBER (GREEN)	REFURB PART NUMBER (GREEN)
80 MHZ CHAMELEON, XR, ULTRA, ULTRA II TESTED PARTS AND ASSEMBLIES				
FAP-I Kit, 40 W, 810 nm, (V-18)	1063072	na	1117196	na
Front Panel Display Assembly	1080921	na	1126908	na
Fan Speed Controller, 48 VDC	na	na	1078651	na
Fan #3 Assy, Verdi OEM	0175-005-00	na	1104253	na
Power Supply, Verdi OEM Cover	1052113	na	1052113	na
Power Supply, Verdi OEM Hatch	1052114	na	1052114	na
Shutter Assy, Chameleon Ultra	1093715	na	1118825	na
Shutter Assy, Chameleon Ultra II	na	na	1118825	na
Shutter Assy, Adjustable	na	na	1127782	na
Spectrometer, USB4000	na	na	1129364	na
Spectrometer, USB2000 (Discontinued)	1095735	na	na	na

DESCRIPTION	PART NUMBER	REFURB PART NUMBER	PART NUMBER (GREEN)	REFURB PART NUMBER (GREEN)
80 MHZ CHAMELEON VISION TESTED PARTS AND ASSEMBLIES				
Fast Photodiode Assembly			1170714	
Slow Photodiode Assembly			1170715	
Shutter Actuator Assembly			1170716	
Emission LED Assembly			1173106	
OTHER FRUS, TESTED ASSEMBLIES, AND MISC. SPARES				
Chameleon GUI Software	na	na	1129725	na
Chiller, Chameleon (all versions)	na	na	1112788	na
Tested Chiller, Chameleon (all versions), incl. hoses & Optishield	na	na	1115165	
Water Hoses, Chameleon	1039965	na	na	na
Water Hoses, Chameleon Ultra	na	na	1094710	na
Cooling Hardware, Chameleon	1109798	na	na	na
Air Recirculator, MRU X1	1119308	na	1133533	na
Air Recirculator Hose Assy	1040787	na	1040787	na
Filter, DrieRite Cylinder	1051489	na	1115384	na
Filter, HEPA Polypro Capsule	1049763	na	1049763	na
Filter, Molecular Sieve 4 A	1049762	na	1115734	na
Replacement Drierite, 5 lb. Jar	1049761	na	1049761	na

DESCRIPTION	PART NUMBER	REFURB PART NUMBER	PART NUMBER (GREEN)	REFURB PART NUMBER (GREEN)
Accessory Kit, Chameleon	1042970	na	na	na
Accessory Kit, Chameleon Ultra	1108037	na	1117744	na
Corrosion Inhibitor, Optishield Plus, 1 pint	1050571	na	1050571	na
Cable, RS-232, 2 m	na	na	1115718	na
Cable, RS-232, 5 m Extender	na	na	1115719	na
Cable, USB 2.0, Type A-A, 3 m	na	na	1116322	na
Fuse, Chameleon, 10 A	5110-0072	na	1087377	na
Fuse, Chameleon Ultra, 15 A	5110-0002	na	1087369	na
Power Cord, 15 A, 10 ft.	6005-0145	na	1110736	na
Power Cord, 15 A, 10 ft., No Plug	6005-0146	na	1106348	na
Power Supply Air Filter	0172-568-00	na	0172-568-00	na
Power Supply Ext Interlock Plug	0171-642-00	na	1102059	na
Power Supply Spare Key	5107-0143	na	1116159	na
Power Supply Rack Mount Kit	0172-720-00	na	0172-720-00	na
Chiller Storage Accessories and Box	na	na	1111827	na
MRU Storage Accessories and Box	na	na	1111831	na
Chameleon Head / Power Supply Storage Accessories (No Crate)	na	na	1111832	na
Shipping Crate, Chameleon	1047197	na	na	na
Shipping Crate, Chameleon Ultra	1117088	na	na	na

DESCRIPTION	PART NUMBER	REFURB PART NUMBER	PART NUMBER (GREEN)	REFURB PART NUMBER (GREEN)
Air Recirculator, MRU 1000 (Obsolete)	1040089	na	na	na

Special Tooling List

DESCRIPTION	PART NO.	REFURB P/N	PART NO. (GREEN)	REFURB P/N (GREEN)
Chameleon 45º Pick-off Mirror	1058622	na	na	na
Chameleon Ultra IBS Shim (Need 2 ea.)	1125843	na	na	na

Schematics

DRAWING TITLE	DRAWING NUMBER	REVISION	DRAWING NUMBER (GREEN)	REVISION
COMMON CIRCUIT BOARDS				
Power Piggy Board	0178-523-00	CD	1084971	AC
Display Board	1054607	AF	1085026	AF
Keyboard	1042244	AC	1085023	AB
Noise Filter Board	0171-398-00	AB	1084949	AB
Noise Reduction Board	0172-904-00	AA	1084953	AD
Display Board (Obsolete)	0172-463-00	F	na	-
Keyboard (Obsolete)	0170-378-00	OB	na	-
90 MHZ CHAMELEON 210, XR				
Power Distribution Board	0169-430-01	DF	1108932	AC
CPU Board	0174-924-00	AD	1084981	AD
Mother Board	0171-954-00	AC	1085037	AD
Signal Interconnect Board	0175-201-00	AA	1085311	AB
Chameleon Control Board	1006101	AB	na	-
Chameleon Analogue Board	1006429	AB	na	-
Chameleon Pump Board	1006834	BA	na	-
Chameleon XR Pump Board	1062605	AA	na	-

DRAWING TITLE	DRAWING NUMBER	REVISION	DRAWING NUMBER (GREEN)	REVISION
80MHZ CHAMELEON, XR, ULTRA, ULTRA II				
Power Distribution Board	1052803	AH	1084844	AG
CPU Board	1006411	AD	1084981	AD
Mother Board	1005581	AB	1085037	AD
Signal Interconnect Board	1072826	AB	1092539	AC
Vanadate 2 Driver Board	1053479	AC	1085035	AB
OEM Umbi Disconnect Bd	1073039	AA	1092537	AB
Verdi Interface Board	1068690 (D117657)	AD	1114105 (D124757)	AA AA
Chameleon Head Board	1071648 (D118358)	AE	1114402 (D124840)	AJ AI
Chameleon Pump Board (V-18 OEM)	1073076	AA	1085121	AB