Cynergy™

TECHNICAL GUIDE

850-1265-000, Rev. 4

CYNOSURE®

Where art and science meet.

This manual is intended for both U.S. and International distribution.

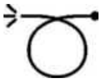
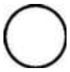
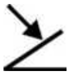
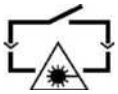
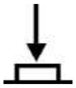
Document #850-1265-000, Rev. 4, 7/06

Table of Contents

Glossary of Symbols and Abbreviations

The following international symbols and abbreviations may be used on the Cynergy lasers and/or in this manual.

Symbols

	Declaration of Conformity to Medical Device Directive 93/42/EEC CE Mark to Directive 93/465/EEC		Optical Fiber Applicator per EN60601-2-22: 1996
	Type B applied part per EN60601-1: 1990		Emergency Laser Stop per EN60601-2-22: 1996
	Attention, consult accompanying documents		Off—power disconnection from mains
	Laser Hazard Warning		On—power connection to mains
	Dangerous Voltage		Foot Switch
	Non-ionizing Radiation	**Other Symbols**	
	Remote Interlock Connector per EN60601-2-22: 1996		Hand Switch

Abbreviations

°C	Degrees Celsius	V	Volts
A	Amperes	DVM	Digital Voltmeter
mA	Milliamp	Hz	Hertz
µA	Microamp	J	Joule
AC	Alternating Current	J/cm²	Joule per square centimeter
cm	Centimeter	kW	Kilowatt
mm	Millimeter	ms	Millisecond
nm	Nanometer	Ω	Ohms
CW	Continuous Wave	mΩ	Milliohms

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Disclaimer

The *Cynergy Technical Guide* is written specifically for service technicians and customers who have received formal training in the servicing of Cynosure laser systems. Cynosure requires that all technicians who plan to service these lasers attend an authorized training program. Information on service training programs may be obtained by contacting Customer Service, see contact information on page 9.

The technical guide provides useful information about the maintenance and servicing of the laser. It is not intended to be a complete guide.

Cynosure does not accept responsibility for personal injury or property damage resulting from the servicing of Cynosure equipment by its customers or by third parties, except where such injury or damage is a direct result of Cynosure's negligence. Customers, by accepting the service manual, agree to indemnify Cynosure against any claims alleging personal injury or property damage resulting from the servicing of Cynosure equipment by the customer or by third parties, except where such injury or property damage is a direct result of Cynosure's negligence. These limitations include situations where Cynosure personnel advise customers on the repair of Cynosure equipment over the telephone.

Any servicing of Cynosure equipment by individuals who have not completed a current Cynosure training program for that equipment will void Cynosure's product warranty.

Contacting Customer Service

If there is a technical problem with the laser, contact the Cynosure Service Department.

Normal Business Hours	Monday–Friday, 7:30 am–7:00 pm EST Call: 1-888-523-2233; or fax to (978) 256-6556 or (978) 256-4888.
After Hours and Weekends	Call: 1-888-692-2966.

If there is a question regarding clinical information call Cynosure.

Normal Business Hours	Monday–Friday, 9:00 am–5:00 pm EST Call: 1-800-886-2966 ext. 443

About the Laser

The Cynergy laser system manufactured by Cynosure is considered to be the ultimate vascular lesion laser workstation. It combines a high performance pulsed dye laser (PDL) operating at 585 nm± 2% with a high performance YAG laser (1064 nm) delivered through one delivery system and selectable with the touch of a button. In addition, selected models of the laser have the capability of delivering both wavelengths in one pulse, separated by a selectable delay, for added clinical benefit.

There are two upgrade paths that are planned for this product. One path involves taking a V-Star in this chassis and adding the YAG resonator and controls to become a Cynergy. The other takes a Cynergy and adds the MultiPlex option which allows the user to deliver both wavelengths in a single pulse.

Figure 1–Cynergy, Cynergy PL and Cynergy III

To further augment the versatility of the workstation, the Cynergy laser serves as a platform for an intense pulsed light source, the Cynergy PL™. Combining the Cynergy with the Cynergy PL yeilds a complete system called the Cynergy III™. The technical guide for the Cynergy PL is covered in another document. This guide covers all aspects of the Cynergy laser, including PDL, YAG and MultiPlex options.

™ Cynergy PL and Cynergy III are trademarks of Cynosure, Inc.

About the Technical Guide

The technical guide provides information on the following topics:

- Equipment Safety
- Laser Description
- Theory of Operation
- Installation
- Service Procedures
- Routine Maintenance
- Troubleshooting
- Calibration Procedures

The *Cynergy Technical Guide* applies to the Cynergy and the Cynergy MultiPlex systems.

The *Cynergy Service Manual,* doc. 850-1270-100*,* includes this technical guide, the operator manual, and a comprehensive drawing set and procedures that will aid in the understanding of salient mechanical and electrical assemblies. Additionally, electrical schematics and technical illustrations are provided. It is important to check the revision level of controlled drawings as designs change. Upon request, Cynosure will provide circuit diagrams, component part lists, descriptions, calibration instructions, or other information not already contained within the service manual to assist appropriately qualified technical personnel to repair those parts of the laser system that are designated by Cynosure as repairable. "Appropriately qualified technical personnel" refers to personnel who have undergone Cynosure's Service Training Course for the Cynergy laser system and have been authorized in its repair.

Service personnel are encouraged to familiarize themselves with the laser and its operation. Make sure all components within the laser can be identified. Understand the Performance Criteria as outlined on page 55. Follow the Troubleshooting Sequence to restore performance if the laser does not meet or exceed the defined performance criteria.

WARNING: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

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Introduction

As with any electrical equipment, there are potential hazards involved with the operation and servicing of the laser system. This section of the technical guide identifies these potential hazards and suggests precautions to avoid them.

Potential Hazards

Optical Hazard

The PDL side of the Cynergy laser generates laser light at a wavelength of 585 nm ± 2% with a maximum energy of approximately 8 joules delivered from the handpiece. The YAG side generates laser light at a wavelength of 1064 nm with a maximum energy of approximately 63 joules delivered from the handpiece. Greater energies can be generated from the laser head especially during service operations. At these wavelengths and energy levels, serious and permanent damage to the eyes can occur when there is direct or even indirect optical exposure.

WARNING: Do not look directly at laser resonator as the flashlamps fire or severe and permanent eye damage may occur. These lasers produce laser light each time the flashlamps fire. Make certain to wear the correct laser eyewear for the wavelength you are servicing.

Please adhere to the following precautions to avoid optical damage during the operation or servicing of the laser:

- Ensure that everyone present during service procedures wears the appropriate protective eyewear recommended by Cynosure.
- Never look directly into the laser light, even while wearing protective eyewear.
- Mark treatment rooms clearly to avoid unexpected entry during treatment or servicing.
- Limit entry to the treatment or servicing room to trained, necessary personnel only.
- Cover windows and other openings in the treatment room to avoid the inadvertent escape of laser light.
- Cover reflective objects, such as jewelry or mirrors, which could reflect the laser beam to an area other than the intended treatment area.
- Put the laser into the standby mode when the laser is not in use.
- Ensure that everyone present during service procedures can shut down the laser in an emergency.

Electrical Hazard

The system requires 220 VAC ± 10%, 30 A, 50-60 Hz, single-phase electrical service to operate.

WARNING: Even when the laser is off and the AC line cord is disconnected, DC voltages on various laser components, such as capacitors may exist. This can present a potentially fatal electrical hazard during service procedures.

Take the following precautions to avoid electrical shock during servicing:

- Always turn the laser off and disconnect the AC line cord from the receptacle before removing the protective housing of the laser system.
- With the laser off, allow the dump resistors to dissipate the energy in the pulse forming network capacitors to a safe level, approximately 45 seconds. Monitor the voltage on the capacitors with a DVM probe to ensure it is at a safe level.

  IMPORTANT: The Cynergy laser system, the capacitor bank does not dump when going between laser states (Ready to Standby) or between laser wavelengths. The only time it dumps is when the user selects Utility. The capacitor bank voltage is displayed on the screen as a quick reference, but the voltage on the lamps should still be checked with a DVM prior to servicing.
- If it is necessary to test or adjust any electrical component while the system power is on, be careful not to touch any electrical components with bare fingers; use appropriate probes or insulated tools only.
- Become familiar with the electrical schematics and layout of the system before attempting to service the laser.

If the AC must be connected during service routines, exercise caution around mains connected components, such as power supply feeds, circuit breakers, key switches, etc. A remote interlock fault condition will reduce high voltage electrical hazards to service personal. This fault condition disables the high voltage power supply control and simmer circuits, as well as ensuring that the dump relay is closed, grounding the potential of the pulse forming network. When possible, remove the remote interlock plug during “live” service routines.

Grounding

Even when the laser is turned off and the AC line cord disconnected, high DC voltage levels may remain. Before performing any procedure, use a shorting stick to ground all interior components.

The main capacitor bank stores large amounts of electrical energy. Measure the voltage on the capacitor bank before attempting any service. Ground the capacitor bank with a shorting stick for at least five seconds.

WARNING: Do not attempt to short directly (i.e., with a screwdriver) or a potentially fatal electrical shock can occur.

Fire Hazard

When the laser beam contacts any exterior surfaces, the surface absorbs the laser energy, which raises the surface temperature of any flammable substance. Service personal must take the following precautions.

- Always keep a small fire extinguisher and water in the treatment room.
- Never direct the laser beam onto any surface except a power meter or an appropriate beam dump.

Chemical Hazard

The Cynergy laser uses a dye medium. Handle the dye with care, both to protect against toxicity and against staining. Operators should follow these precautions:

- Wear rubber or plastic gloves when handling the dye.
- Do not dispose of dye down drains.
- Return empty dye bottles and used filters to Cynosure.
- Avoid spillage on fabrics or on any porous material.

Potential Chemical Accidents and Appropriate Responses

The following table lists potential chemical accidents and their appropriate emergency responses.

Chemical Accident	*Appropriate Emergency Response*
Ingestion of dye or solvent	Drink water, induce vomiting, and seek immediate medical attention.
Excessive inhalation of dye or solvent	Go outdoors and inhale fresh air. Seek medical attention if symptoms appear.
Eyes exposed to dye or dye solvent	Rinse eyes with water. Seek medical attention if symptoms appear.
Skin exposed to dye or dye solvent	Immediately wash the exposed skin area with plain water, then with soap and water.

Hot-Water Hazard

The laser system can possibly reach 65 °C in normal operation. This water is very hot and could scald. Do not perform any maintenance on the water system while hot. Always let the system cool down before changing the deionizing filter or adding deionized or distilled water.

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Calibration

At the factory or during field tests, both the calibration port and resonator port must be calibrated for the system to accurately measure output energy. The resonator port will act similar to the modular Elite laser, where the full energy will be measured. Initially, the resonator port will have to be calibrated at two points for the two wavelength checkpoints used in System Check. The resonator will be used for transmission data only.

Once the two ports are carefully calibrated, the user simply adjusts the laser to the settings they want and either wait 5 seconds for the laser to calibrate automatically, or press the screen where indicated by the instructions on the display to initiate the calibration process. For any change, even fluence (the handpiece must be in the cal port) the laser automatically fires into the cal port and adjusts the PFN voltage to match the setting. During this period, CAL appears in the upper left area of the display. Once the laser arrives at the settings, the upper left will toggle to READY indicating that the handpiece can be removed from the cal port and treatment begun.

Memory

The system defaults to the lower fluence settings on the first start-up after a System Check, but later memorizes the last settings and uses them at start up. This avoids having to set the laser each day or set when switching between lasers.

Operating Modes, User

Normal Operation

In normal operation before the warm-up, a self-check is conducted by the laser to test shutters, simmer circuits, etc. Afterwards, the system warms up for typically less than 15 minutes. During the warm-up period, the system checks the dye concentration. If low, the system will boost the dye concentration until it reaches an acceptable level. Normally this will not significantly delay the warm-up, but in extreme cases this may take up to 30 minutes to resolve itself. After the dye concentration has reached an acceptable level, the system will not adjust the dye concentration unless the laser is restarted.

System Check

System Check consists of testing the laser at one set of operating parameters per wavelength to determine basic, acceptable performance. This is often referenced to as Figure of Merit (FOM) performance.

First: After the laser has warmed up, the dye laser is fired at 750V, 0.5 ms and an output > 4.0 Joules must be recorded at the resonator port and the transmission must be greater than 50%. (A warning is provided at 65% and the output governed). A minimum of three shots should be taken with a sampling of the last.

Second: After the laser has warmed up, the YAG laser is fired at 750V, 5 ms and an output >25 Joules must be recorded at the resonator port and the transmission must be greater than 50%. (A warning is provided at 65% and the output governed). A minimum of three shots should be taken with a sampling of the last.

If upon start-up, the laser cannot meet the minimum acceptable performance, the microprocessor determines the root of the problem in the Performance Diagnostic routine.

Performance Diagnostic Routine

The system determines which laser, if any, is not performing and which transmission, if any, is unacceptable. The system signals for the operator to change handpieces/fibers, notifies the user that only one laser can be used and that service is required, or notifies the user that both lasers are unusable and to call for service.

Cynergy MultiPlex

The Cynergy MultiPlex mode consists first of a PDL pulse, set at any fluence for a 7- or 10-mm HP followed by a YAG laser pulse with similar adjustments. Pulse widths are controlled by 8 pulse groups that assign clinically relevant pulse width combinations to the two lasers. The available delay between pulses will vary for different pulse groups. The delay between pulses is variable, but not without limitations. **NOTE:** The health of the two laser systems are relative to one another will affect the minimum possible delay time. Refer to the *Cynergy Operator Manual* Specification section for pulse group information.

Operating Modes, Service

The above descriptions pertain to the User Mode Program that incorporates safety features, error and warning codes, feed back control of the settings and insures accurate calibrations. Two other modes of operation are Testall and CV (Constant Voltage).

Testall allows service personnel to turn on and off individual or groups of functions for test purposes. CV displays the voltage and does not calibrate to a set fluence, but allows operation at a set voltage. Both have many of the safety features defeated and are only used by service personnel.

Accessing Testall Mode

1. Attach a laptop as detailed in “Appendix A” starting on page 111.
2. Turn on the laser and press “q” and press enter to access the DOS prompt.
3. Type “TN” and then enter to access Testall Mode.

Accessing CV Mode

1. Attach a laptop as detailed in “Appendix A” starting on page 111.
2. Turn on the laser and press “q” and press enter to access the DOS prompt.
3. Type “CV” and then enter to access CV Mode.

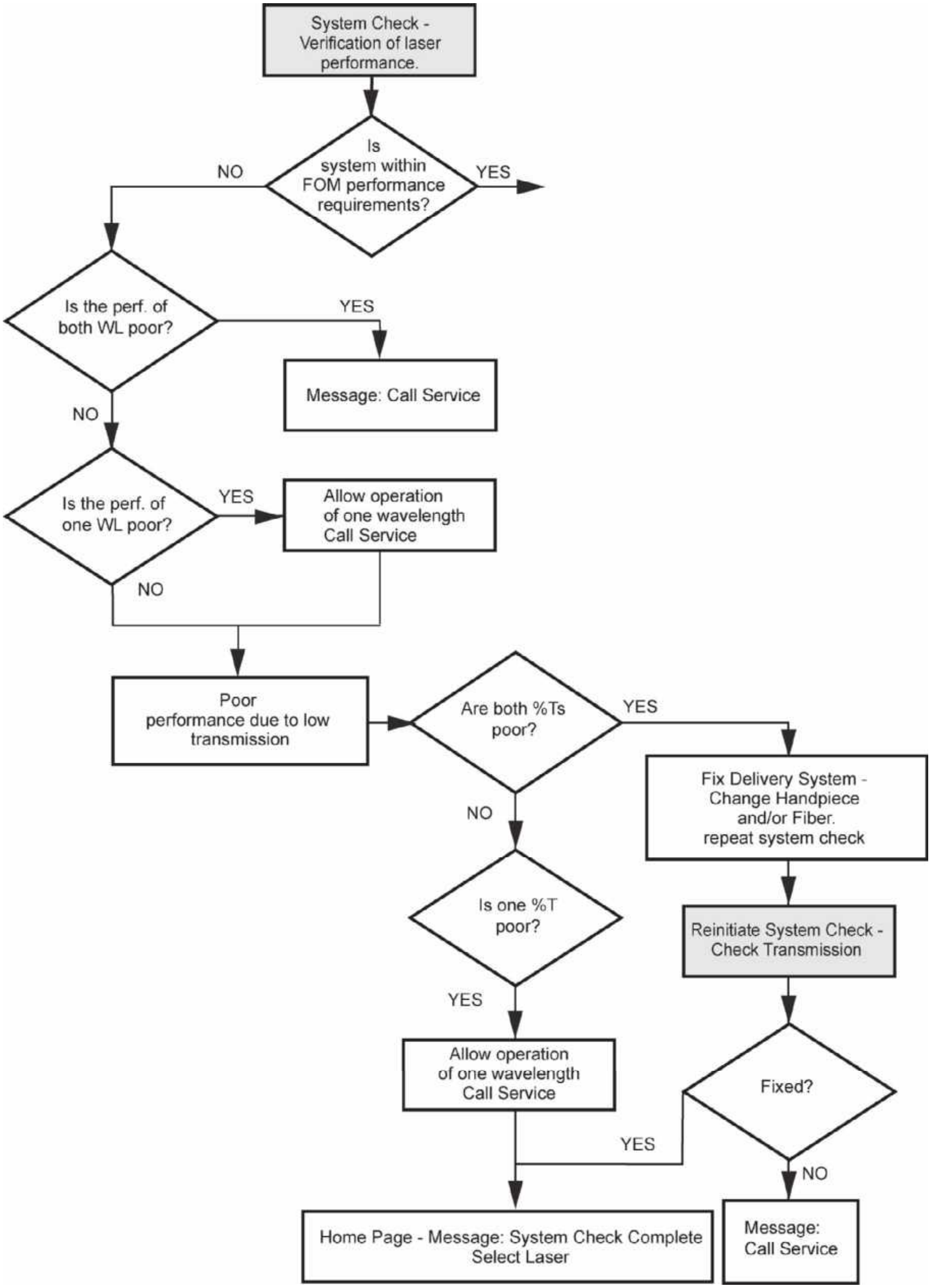

Figure 2A–Performance Diagnostic Flow Diagram

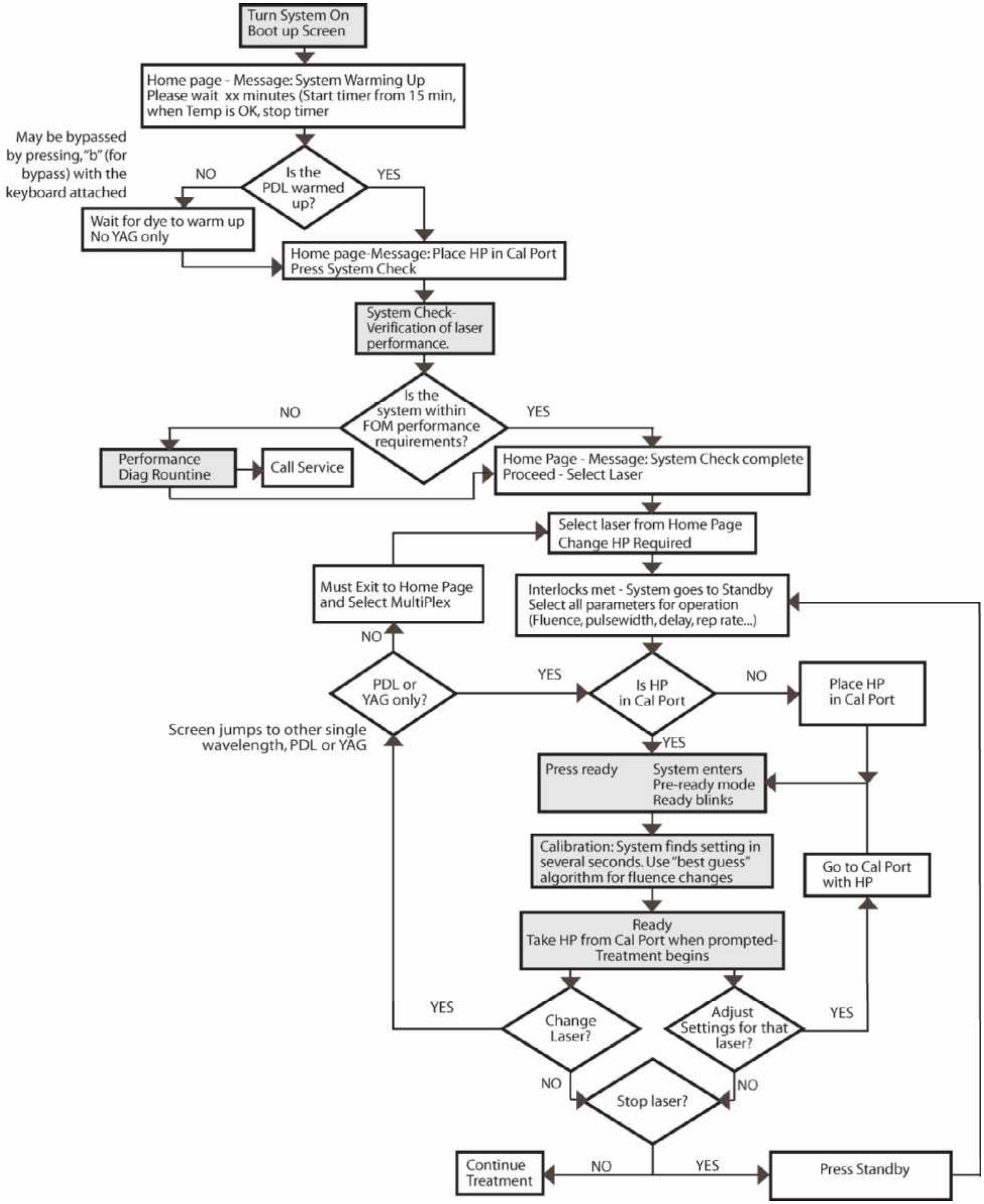

Figure 2B–Normal Operation Flow Diagram

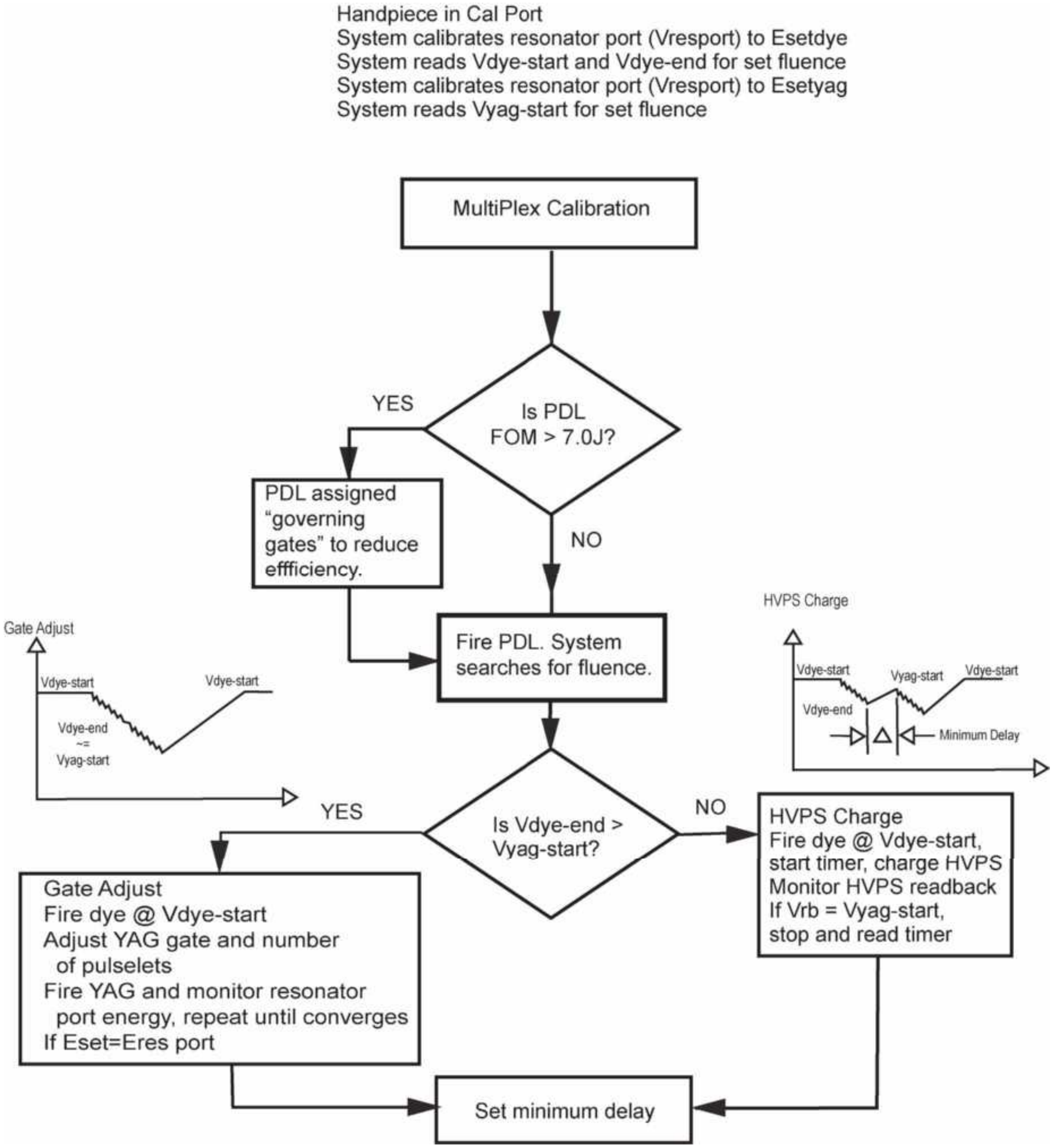

Figure 2C–Cynergy MultiPlex Flow Diagram

This section of the manual gives a detailed description the laser system including block diagrams, identification of the main modules and their related components, and a description of the control philosophy, display and user interface.

Main Modules

Refer to **Figures 3A and 3B** for the location of the main modules that comprise the laser system.

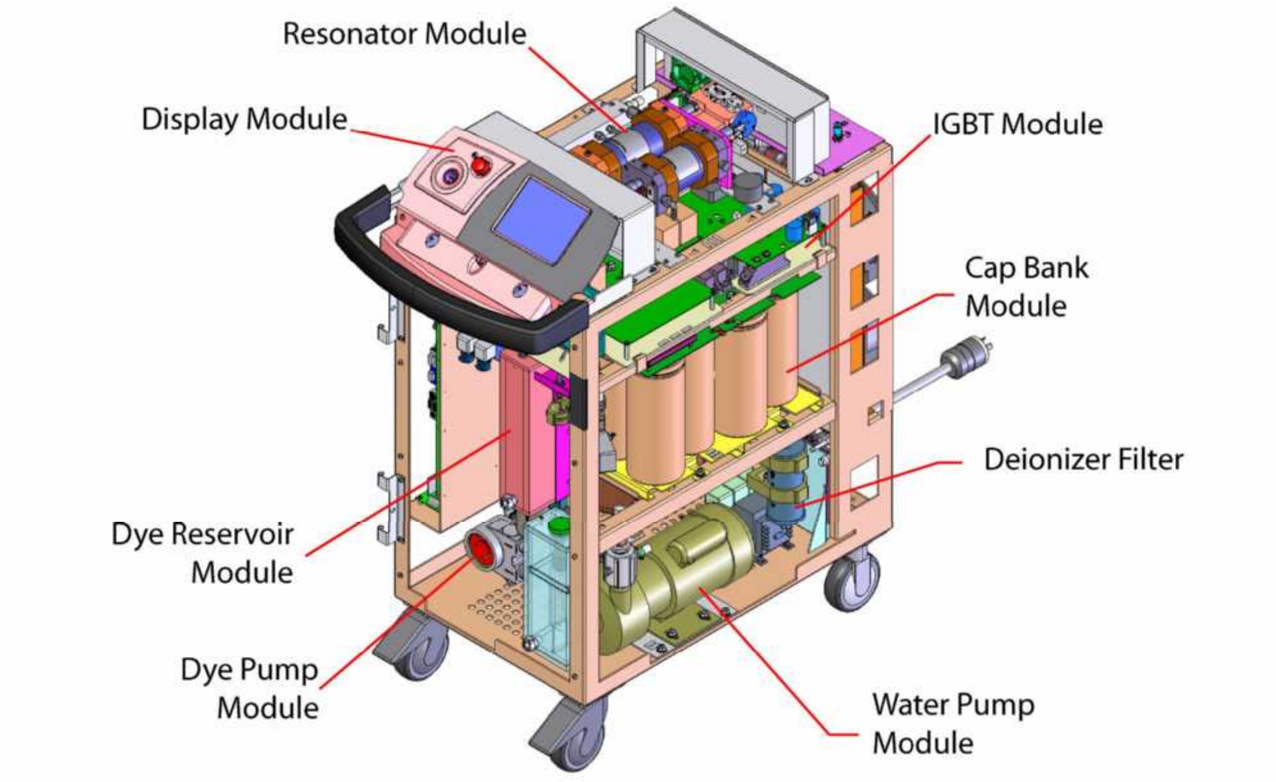

Figure 3A–Main Modules, Front View

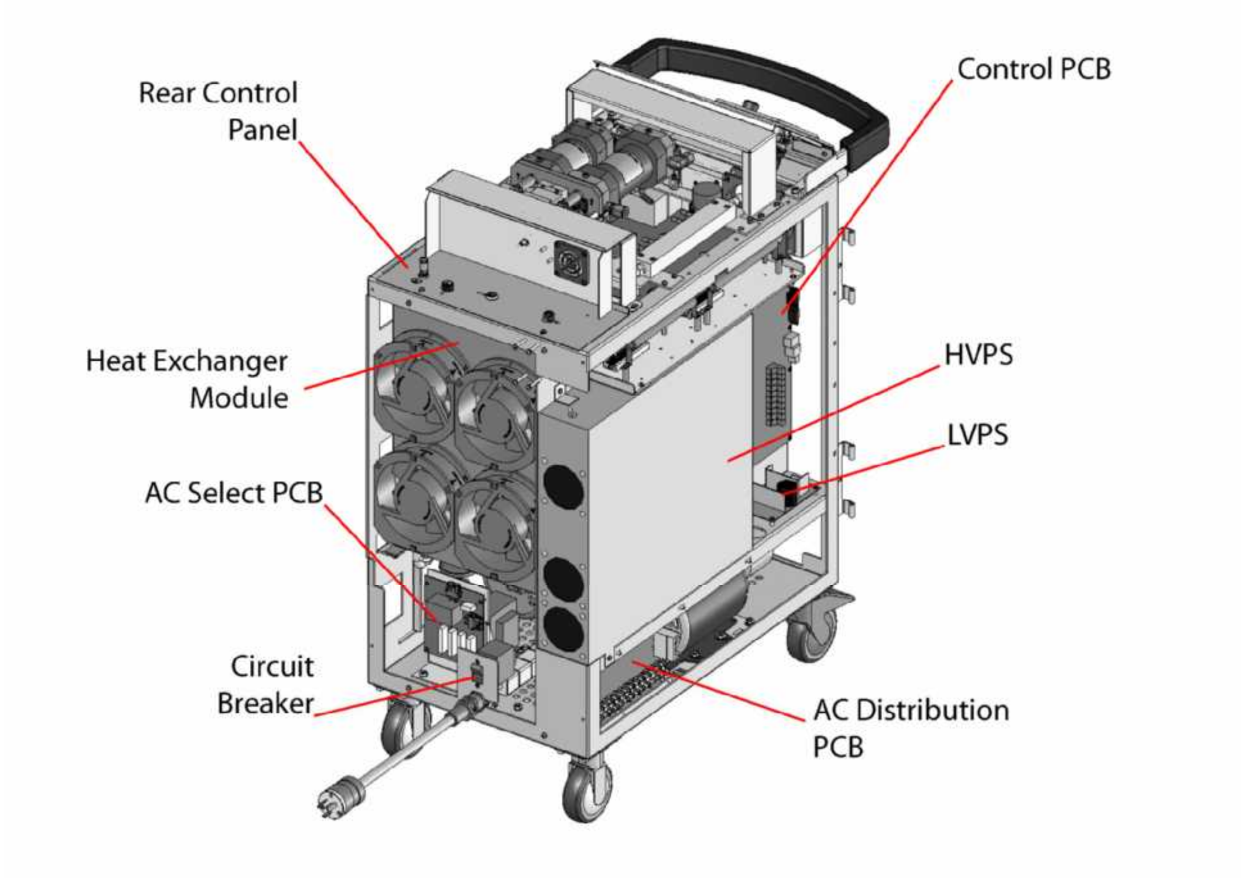

Figure 3B–Main Modules, Rear View

Figure 4 shows the relationships of the main components in the Cynergy laser. The diagram indicates AC is brought into the laser through the voltage select PCB, and then is directed to the HVPS directly and to the isolation transformer. At the AC distribution PCB, the AC is separated into circuits with their own solid-state relays and fusing. The main signals to the control system are shown including two analog optical signals used for calibration. The HVPS charges a capacitor bank, whose charge is gated through the flashlamps by IGBTs on the IGBT shelf under the resonator assemblies. The two-lamp, series drive circuit for the YAG laser is identical to the drive circuit on the Modular Elite, sharing many of the same parts. The two-lamp, parallel-drive circuit is more complex for the dye laser; it involves two IGBTs to switch the current through the individual lamps and another to drive a pulsed simmer. These three IGBTs are driven from the triple diver PCB. The simmer current is initiated in both heads by striking the trigger transformers and a separate DC low-current supply provides a soft, blue glow.

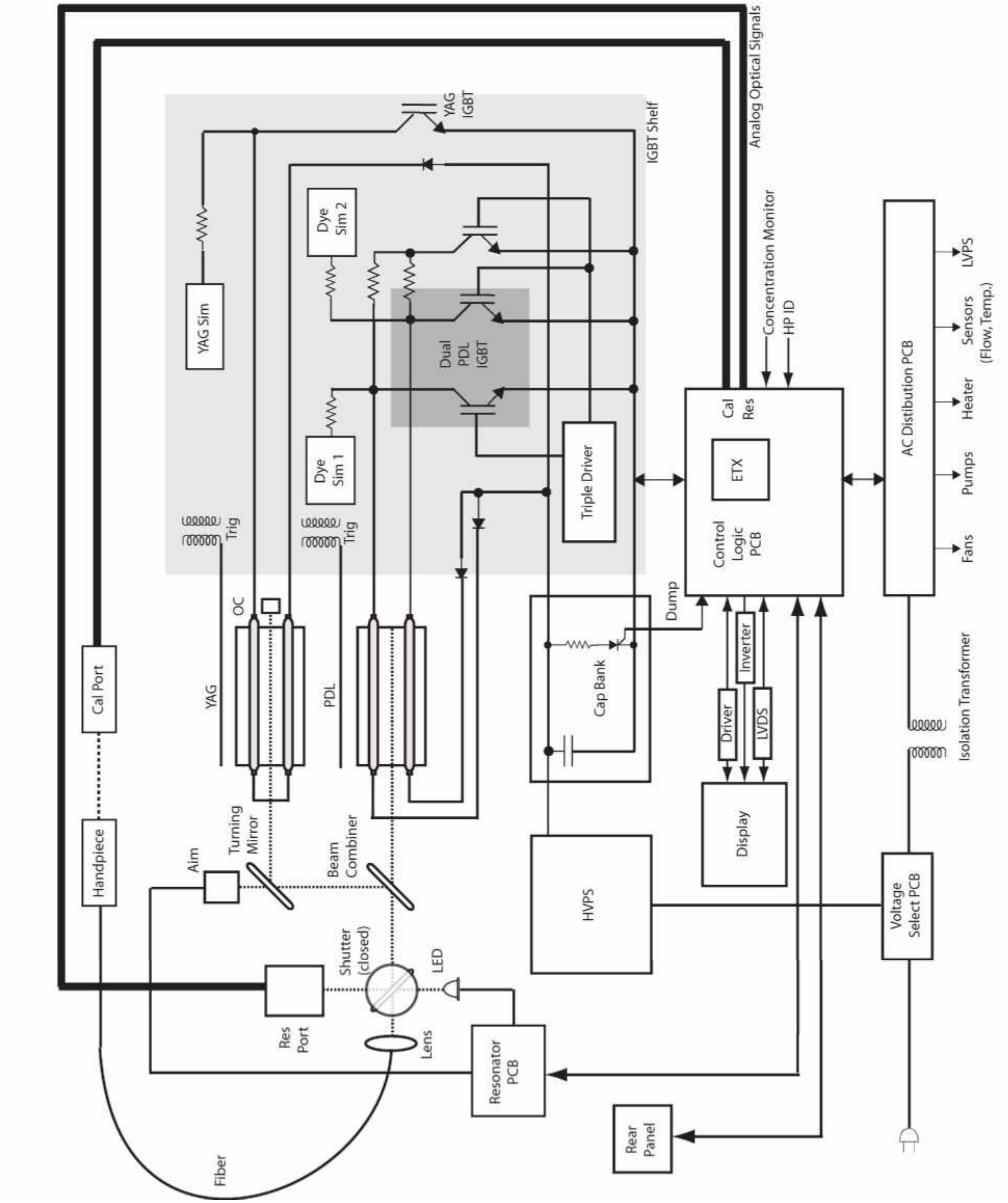

Figure 4–Cynergy System Block Diagram

NOTE: See schematic, 105-1865-000 for a detailed system-wiring diagram.

High Voltage Power Supply Module

The High Voltage Power Supply (HVPS) is a modular inverter capacitor-charging power supply. This device accomplishes the primary energy conversion for the laser. It converts input power of 220 VAC, 50 or 60 Hz, to a controlled, high-voltage direct current. One of two charge rates, 1000J/sec or 4000J/sec, may be set externally by a toggle switch. A software controlled low-voltage analog signal is used to set the appropriate HVPS output voltage level during laser operation. When enabled, the power supply charges the capacitor bank through the capacitor bank fuses. The laser control board also inhibits, enables and regulates high voltage output level depending on the state of the laser.

For demonstration purposes, the system can operate at reduced power with 120VAC, 15Arms input power. In the "low charge rate" or 120V mode, the power supply will charge the 24,000µF capacitor bank in 5.3 seconds (from 750 to 1000VDC). This setting substantially reduces the laser pulse repetition frequency and is intended for demo purposes only. In the "high charge rate" or normal operating mode, the power supply will charge the 24,000µF in 1.3 seconds (750 to 1000VDC). To select the power supply charge rate, see section on setting the voltage" in the *Cynergy Quick Install Guide*.

The power supply control voltage set's the capacitor bank voltage and is a 0 to 8Vdc analog signal which corresponds to "150V_{OUT}/V." This control voltage goes into the module through pin 5 on the control interface cable. The enable/reset signal or the on/off control for the power supply is controlled by grounding pin 1 on the control interface cable. Applying a <1 volt signal to pin 1, the power supply receives an inhibit signal to turn it off and resets the fault latch. Applying + 15VDC to pin 1, enables that power supply to turn it on. A read back signal is generated in the power supply and is transmitted to the front control module through pin 7 on the control interface cable. This read back is an analog output of 0 to 8 volts and is "1V/150V." The end of charge indication is transmitted through pin 13. This signal goes low when the power supply has reached the programmed output voltage (pin 5).

If the power supply charges for more than 20 seconds and does not reach the program voltage, pin 2 goes high indicating an overload condition. This will provide a power supply fault and the laser will go into a fault condition. Power supply fault conditions are sent out on pins 2 and 6.

Capacitor Bank Module

WARNING: High Voltage Danger! The capacitor bank stores dangerous voltage and energy levels during laser operation. Please handle with extreme caution.

The capacitor bank module, see **Figure 5**, consists of twelve 18,000 µF, 400-volt capacitors coupled in a series/parallel configuration to provide a 1200-volt, 17.3-kilojoule stored energy source. This large amount of stored energy must be regarded carefully.

Only a fraction of this stored energy is drained off for a given laser pulse. In a fault condition, the stored energy is discharged through an electronic dump circuit within the module.

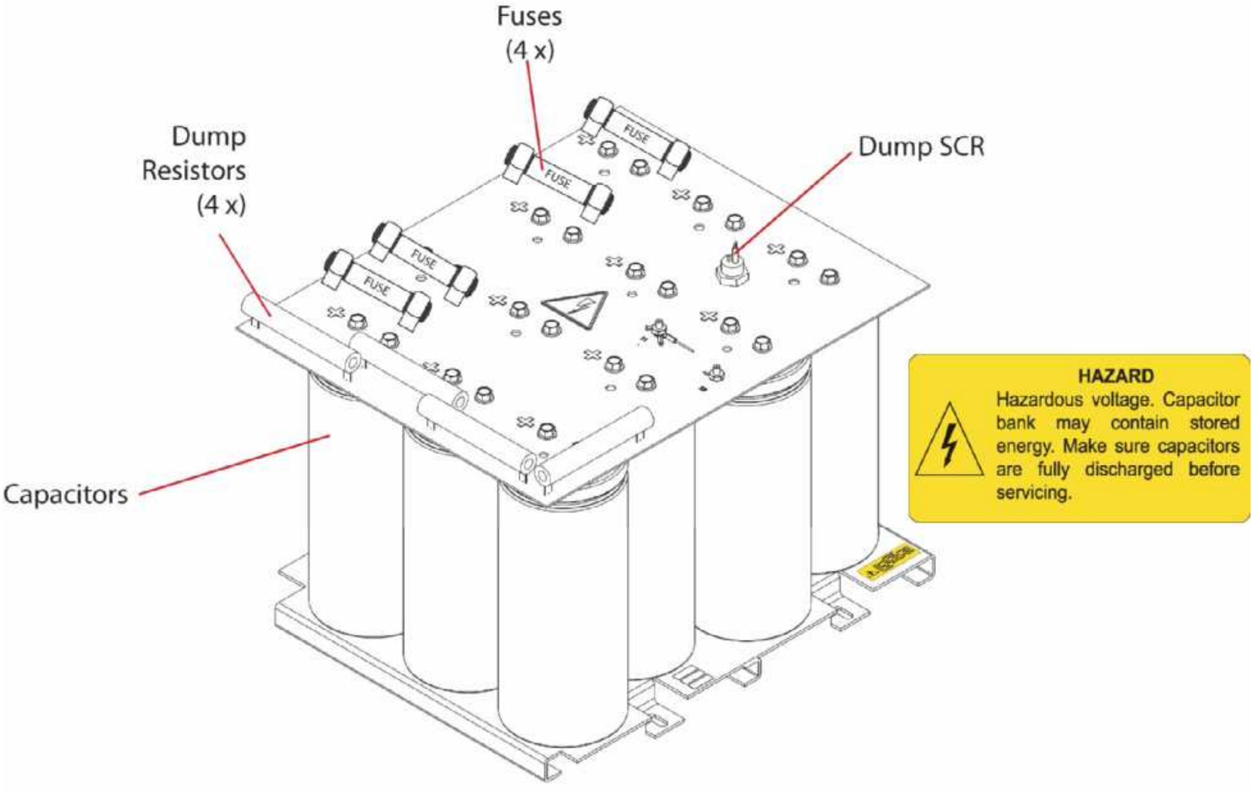

Figure 5–Capacitor Bank Module

To protect the power supply from damaged capacitors, there is fuse protection in the module. There are four 40-amp, 1000-volt, slow-blow fuses. Each fuse is connected to one of the four triad-connected, high-voltage capacitors. The fuse is designed to protect the storage capacitors against any excessive current draw that may occur with a short, such as a flashlamp or another capacitor shorting to ground.

The capacitor bank module also houses the electronic dump circuit. The electronic dump is turned ON and OFF by an optical signal from the control board through fiber TX4 to RX1, opto transistor, on the capacitor fuse bank PBC. An optical signal is illuminated when the laser goes into standby and ready modes. The optical signal turns on RX1, which shorts capacitor C10 keeping SCR Q1, and allowing the HVPS capacitors to charge to the required voltage. When the signal to RX1 is turned OFF, the opto transistor will turn off causing C10 to charge through R17 to about 30-34 volts, and allowing the voltage to dump through the diac (D1). This discharge is the trigger to turn on the SCR (Q1). This allows a direct circuit from the capacitors through four 50-watt, 25-ohm resistors to the ground plane, and the high voltage will discharge. When all of the capacitor voltage goes to zero volts, the current through the SCR stops and the SCR turns off. There is also a signal that goes through TX1 to tell the CPU/Control PCB that the laser is in dump mode. TX1 is also used for the fuse short signal. If TX1 turns on and the laser is not in the dump mode, a fuse short condition is recorded and displayed on the front panel.

IGBT/Simmer Module

WARNING: Use extreme caution while working in the high voltage subsystem. High voltage may be present at any time! Electrical shock or burns can occur. Limit access to factory-trained personnel.

The Insulated Gate Bipolar Transistor (IGBT)/Simmer module is shown in **Figure 6**. Four IGBTs are used in the Cynergy laser. A single IGBT is used to energize the YAG laser. Two IGBTs, driven in parallel, are used to energize the PDL. A fourth, smaller IGBT, is used to provide pulsed simmering for the PDL. The driver for the YAG IGBT is found on the IGBT/simmer PCB. As its name suggests it provides two functions: simmering and IBGT driving. The two IGBTs for the dye laser are driven by the triple IGBT driver PCB. Mounted on it is the small IGBT for the pulsed simmer, while it is mounted on the dual IGBT for energizing the dye laser. Simmering capability for the dye lamps and snubbing for the IGBTs that energize the dye laser are provided by the snubber /simmer PCB, which is mounted to the upper tier of the dual IGBT.

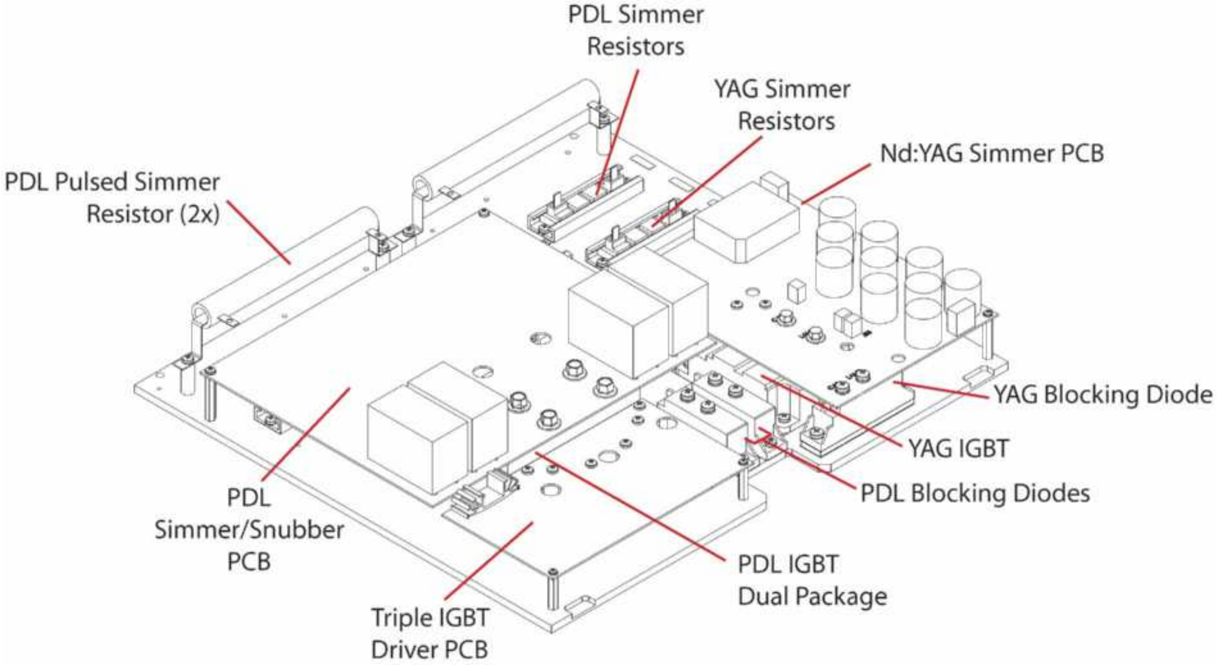

Figure 6–IGBT/Simmer Module

One of the unique features of the Cynergy laser is that both the YAG laser and the PDL use the energy stored in the capacitor bank PCB. Each driver board has its own isolated power supply, mounted to each PCB, ensuring that each IGBT is isolated from primary side AC power and power coming from the LVPS. This will be discussed further in the section on Laser Control.

Important functions of the YAG/IGBT driver board are to control, monitor and report operation of the IGBT using fiber-optic input and output. For example if is an optical pulse of 5msec is received by the IGBT driver board from the laser control board, the driver board will generate an electrical gate pulse for 5msec. This activates the IGBT device for 5msec. Optical transmitters pass on fault status to the laser control board.

Essentially the PDL driver board works in the same way as the YAG driver board, but with these exceptions, It uses dual IGBT from a common optical source, and it drives the pulsed simmer IGBT as required. The latter provides a higher level of simmer current in the PDL immediately before a high-voltage, high-current pulse. Simmering and snubbing capacity for the dual IGBT is provided by the snubber/simmer PCB that is mounted separately.

WARNING: High voltage is always on the flashlamps and the collector of the IGBT, therefore use extreme caution when high voltage is present.

All snubber circuits, see **Figure 7**, function as resistor capacitor diode (RCD) clamps. When the IGBT is turned off, the snubber diode is forward biased and the snubber is activated. The energy trapped in the stray inductance of the PFN is absorbed by the snubber capacitor. When the IGBT is turned on, the snubber capacitor that was charged to bus voltage has a discharge path through the IGBT and the snubber resistor. This reduces the reverse recovery voltage transient, protecting the IGBT from harmful voltage spikes.

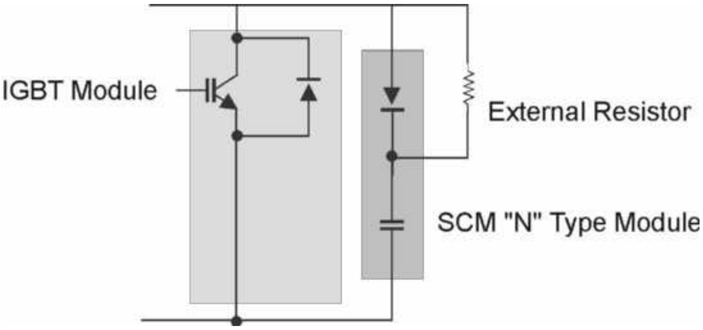

Figure 7–Snubber Circuit

Simmering provides a low level (~100 mA) DC current through the flashlamps. This pre-ionization of the flashlamps improves pulse-to-pulse stability and increases flashlamp lifetime. Simmer is initiated on the simmer board by sending a low energy trigger pulse to the trigger transformer. The transformer steps up this signal to a high voltage trigger pulse on the pump chamber. This high voltage pulse ionizes the gas near the flashlamp electrodes by capacitively coupling through the flashlamps glass envelope. Once breakdown is achieved, a low DC current from the simmer board is maintained through the simmer ballast resistor allowing continuous current flow through the lamps. A current sensing circuit on the simmer board verifies that this current is present. An optical transmitter located on the simmer board will then turn on, sending an optical signal to the laser control board as an indication of simmer status.

Front Control Panel Module

The system control electronics are located in the front panel control module, **Figure 8**. It consists of a color, full VGA display with a touch screen and its associated driver and inverter for the backlighting, a calibration port, and emergency laser stop switch. A shield protects the delicate circuits and cables from inadvertent damage during service operations, and protects the display circuitry from any damage caused by leakage from the maximum reflectors. **IMPORTANT: The shield also protects service personnel from the high voltage on the inverter circuit.**

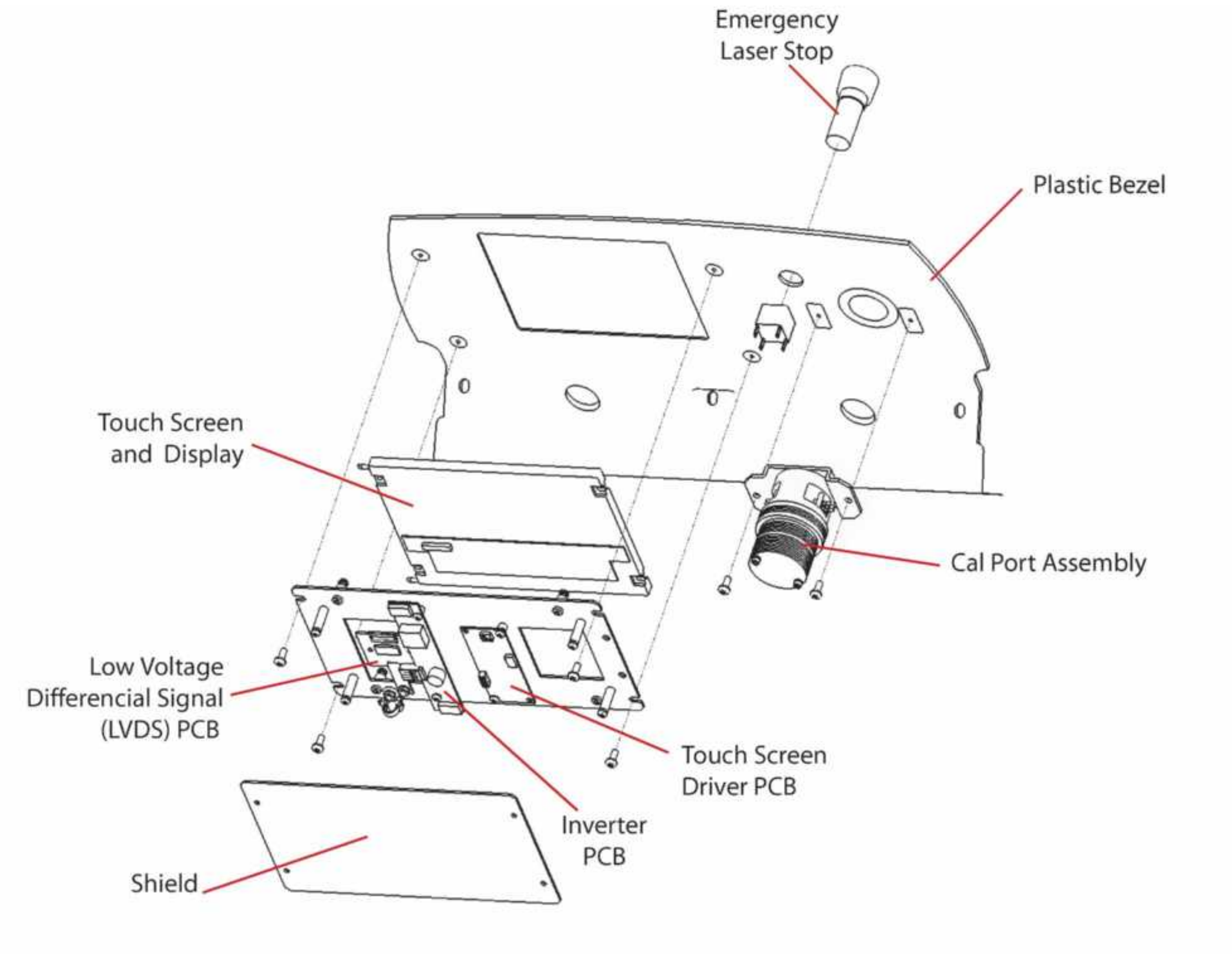

Figure 8–Front Panel Display/Control Module

Cal Port Assembly

The laser utilizes an integrating sphere with a small aperture that is used for fiber optic sampling of a portion of the laser's delivered energy—a true energy meter. This fiber optic is connected to the laser control PCB. A sapphire window is used to protect the ceramic diffuser against damage from dirt and debris. This window should be cleaned periodically to ensure consistent and accurate measurement of laser energy. When the handpiece is inserted into the cal port, two series wired micro-switches detect the presence of the handpiece, and then the switch closure is detected and monitored by the laser control PCB.

Laser Control Board

The laser control board includes the microcontroller, as well as the digital and analog circuits to control laser operation. See **Figure 9.**

Microcontroller

An ETX microcontroller is mounted on the laser control board. The software is on the board in flash memory, and can be updated through a serial port and a laptop connected through the RS-232 connector at J3. Software updates can also be made through the USB port.

Optical Detectors

The optical detectors for the calibration port (CAL) and the Resonator port (RES) reside in the upper portion of the PCB where all analog signals are processed.

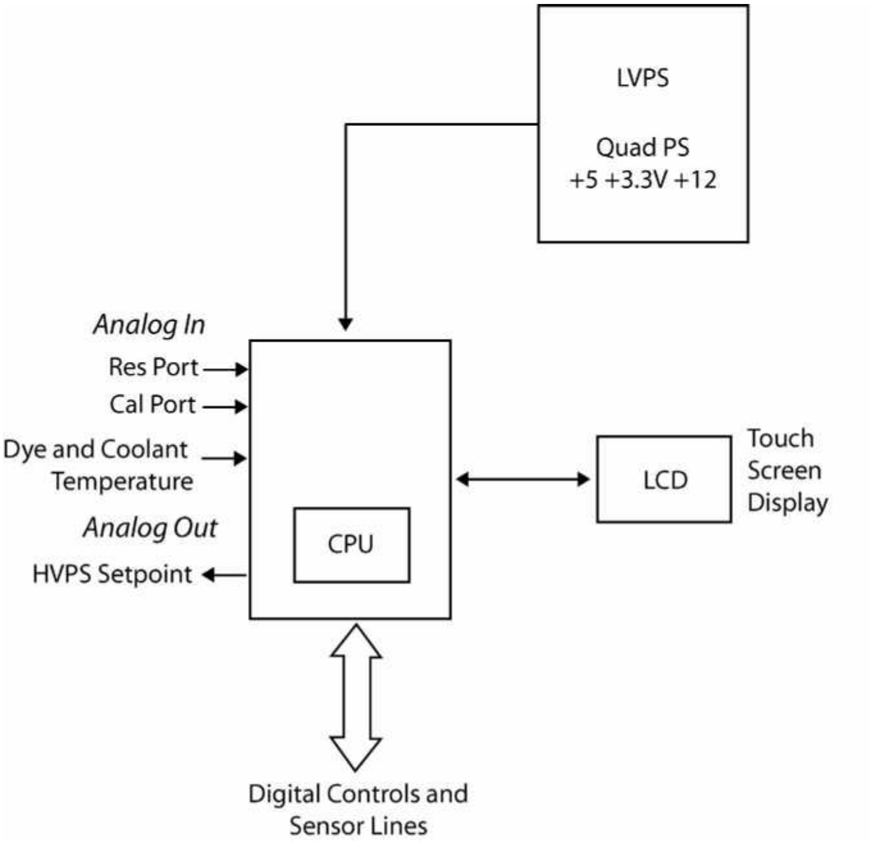

Figure 9–Diagram, Laser Control PCB

High Voltage Controls

The high voltage controls, read back controls, resonator port, and cal port are set by the microcontroller by using the laptop in service mode. In idle state, TP 4 will have > 10 volts applied to pin 1 of the power-supply control cable. See, “High Voltage Power Supply Module,” starting on page 26 for information on other signals.

Software Controls

The ETX computer under software control guides all aspects of laser operation. The following table defines the signal source and connection descriptions for the laser.

RX1	To Cal Port	RX1–ETX
RX2	To Res Port	RX2–ETX
RX3*	To Dye Mon- Etx	RX3–ETX
RX4	To Cap Bank Fuse	TX1–Cap Bank
RX5	To IGBT Flt Pulse Sim	CR6–Multi-IGBT
RX6	To IGBT Flt Dye	CR8–Multi-IGBT
RX7	To IGBT Flt YAG	CR4–IGBT Drv Sim
RX8	Sim Sense Dye	CR1–Snub Sim
RX9	Sim Sense YAG	CR1–IGBT Drv Sim
TX1	To YAG Trig	U4–IGBT Drv Sim
TX2	To Dye Trig	U7–Multi-IGBT
TX3	To Pulse Sim Trig	U6–Multi-IGBT
TX4	To Cap Bank	RX1–Cap Bnk
* No longer used		

I/O Ports

The table below defines the interface functions of the I/O ports.

Connector	Interface Function
J3	Laptop
J4	External Power Input
J5	Ethernet Port
J6	Dual USB Port
J7	Keyboard

Temperature Sensors

There are three temperature sensors. Two temperature sensors, located in the heat exchange module, measure the water temperatures. A third temperature probe is installed on the control board to compensate for any effect temperature has on output power, as well as to monitor the local temperature. These analog signals are digitized and sent to the ETX computer.

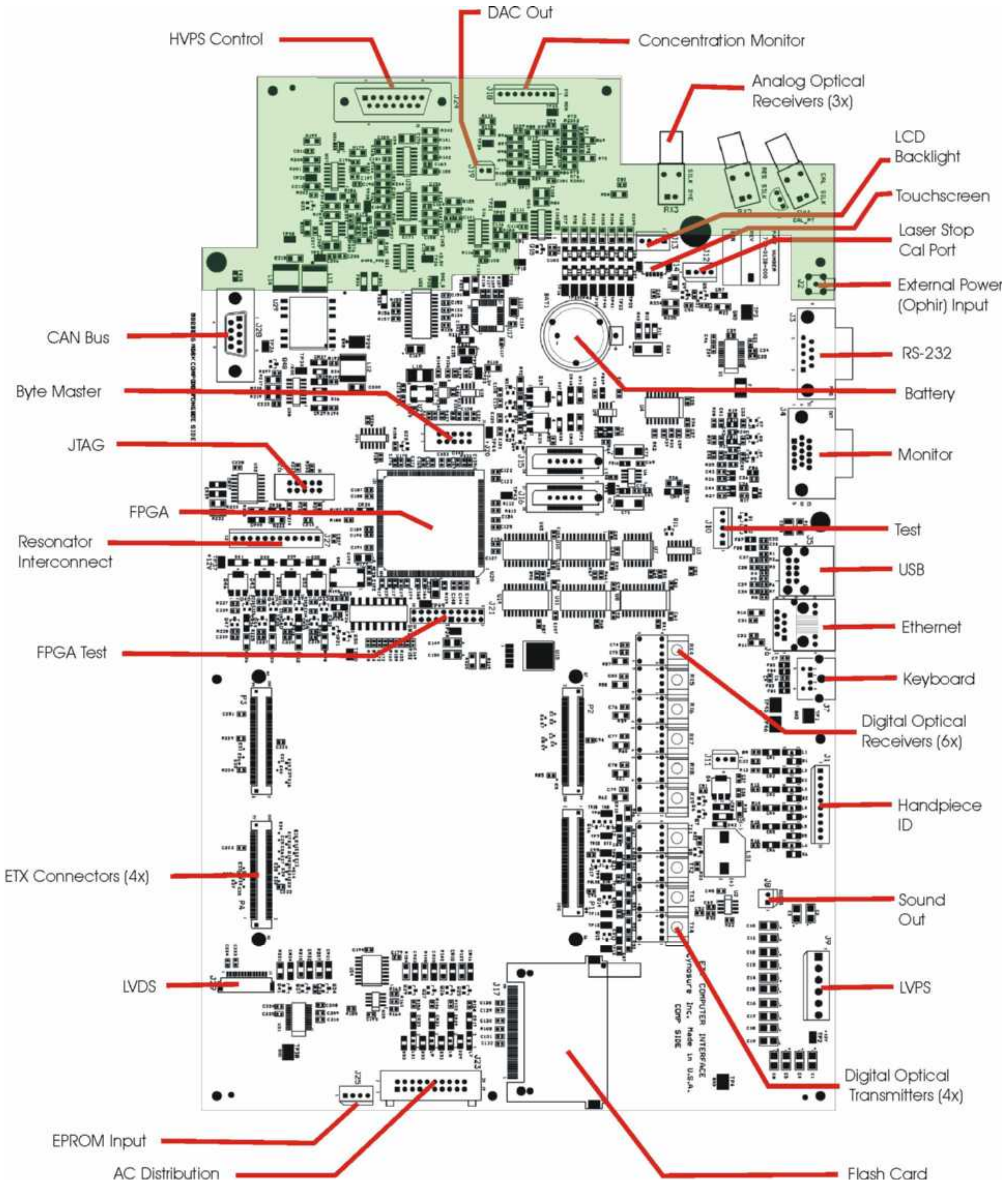

Figure 10–Control PCB

NOTE: Shading area represents analog circuit area.

Rear Control Panel Module

The rear control module, **Figure 11,** consists of the key switch, handpiece filter PCB, bellows trigger switch, and mounting hardware. The key switch turns the laser on and applies power to the frame module and front control panel module. The handpiece filter board interfaces with the laser control board and provides information as to which handpiece is connected to the delivery fiber. The finger switch signal is also transmitted through this board. The remote interlock, used to connect to a door switch as specified by CDRH regulations, is resident on this assembly. For most service operations, the rear control panel stays connected to the chassis. A second piece that frames the SMA fiber connection is removed to service the laser heads. On this removable piece, a DC cooling fan pulls hot air out of the chassis, through the rear panel to help maintain the internal temperature.

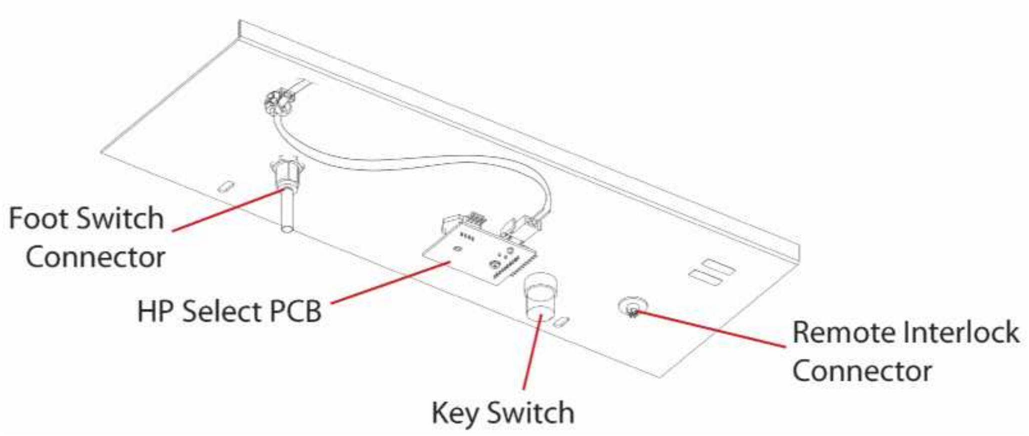

Figure 11–Rear Control Panel Module

Frame with Electrical Module

The frame w/electrical module is the main support for the laser. It consists of the frame itself, wiring harness, AC distribution PCB, voltage selection PCB, Isolation transformer, AC line cord, control logic PCB, see **Figures 12A and 12B**.

The frame is wired from the AC line cord through the isolation transformer to connections for the other modules. The AC distribution PCB contains 4 solid-state relays that turn on the heater, simmer, heat exchanger fans and the water pump. All of the system fuses are on the PCB as well.

The voltage selection PCB is used to set the tap setting on the isolation transformer. This will provide the secondary voltage of 230VAC for the system.

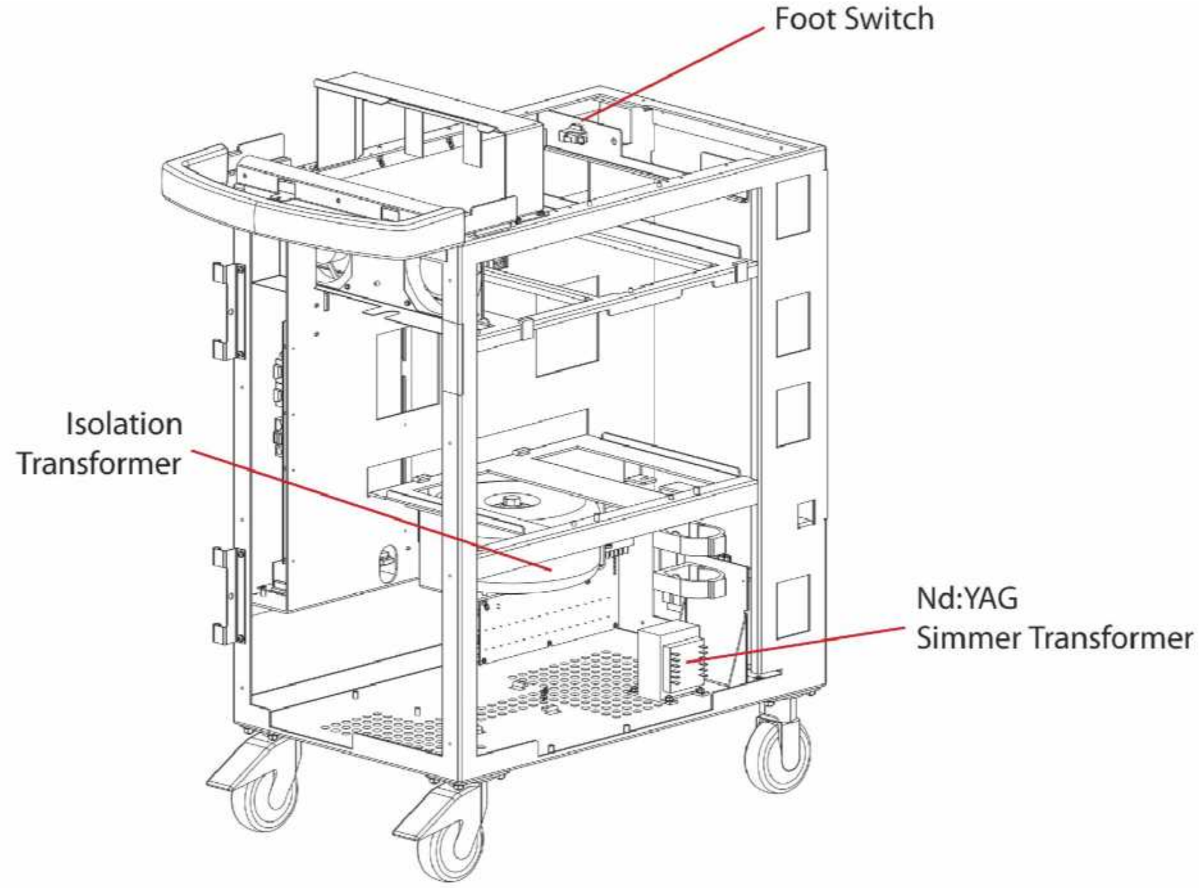

Figure 12A–Frame w/Electrical Module, Front View

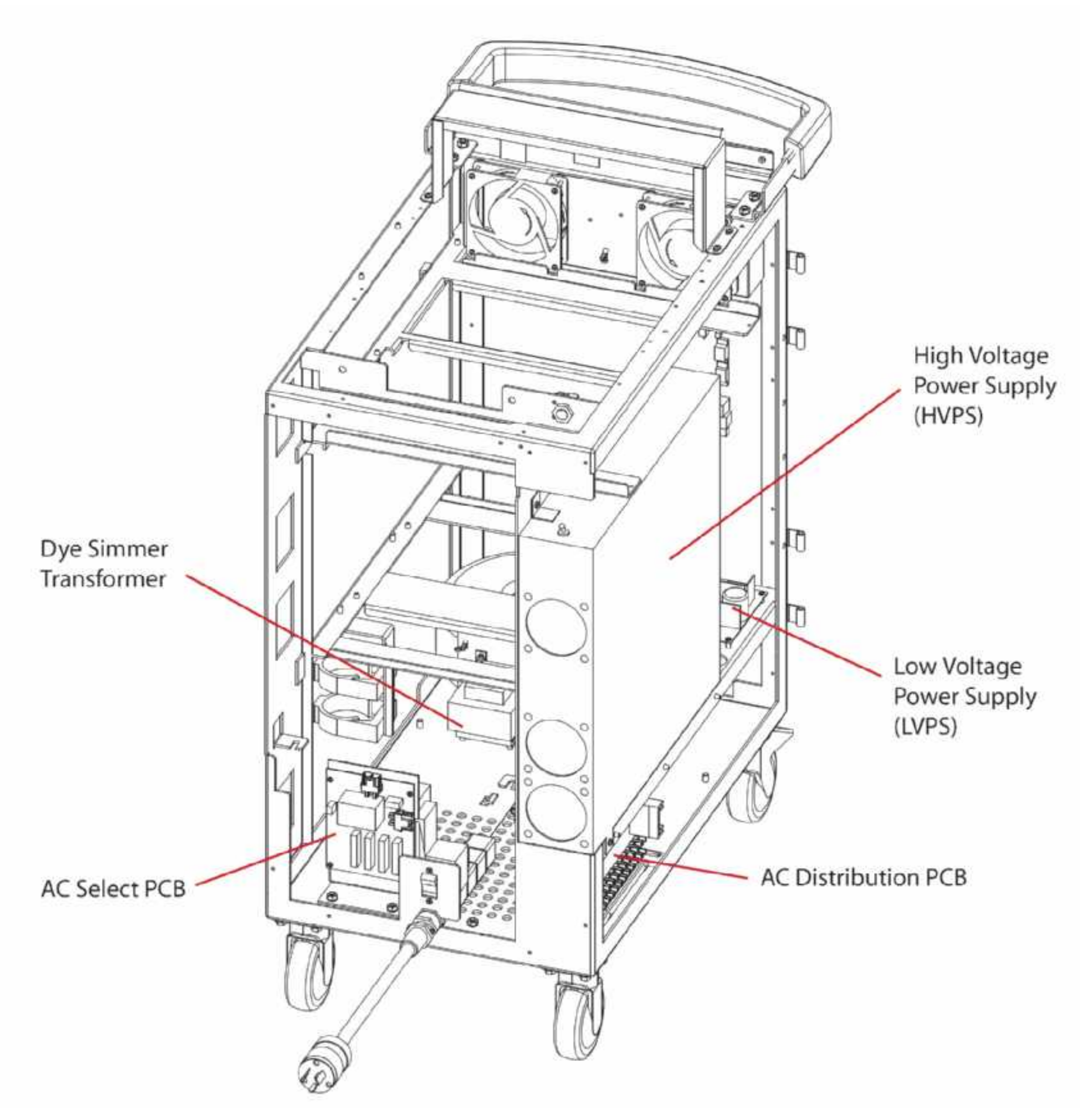

Figure 12B–Frame w/Electrical Module, Rear View

Resonator Rail Module

The resonator rail module consists of the Nd:YAG laser head, the PDL laser head, fiber block, mounting rails, water manifold, resonator interconnect PCB and trigger transformers. See **Figures 13A and 13B** below.

NOTE: Both laser heads are not field serviceable items and must be replaced as an assembly with the exception of the flashlamps and external optics where used. The flashlamps need to be replaced at appropriate intervals.

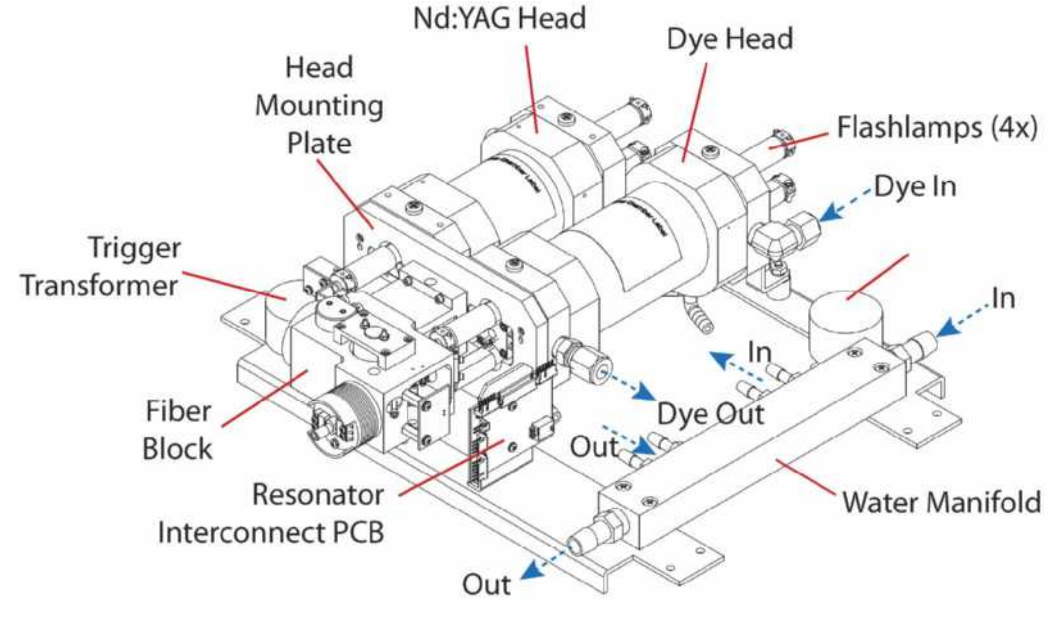

Figure 13A–Resonator Rail Module, Side View

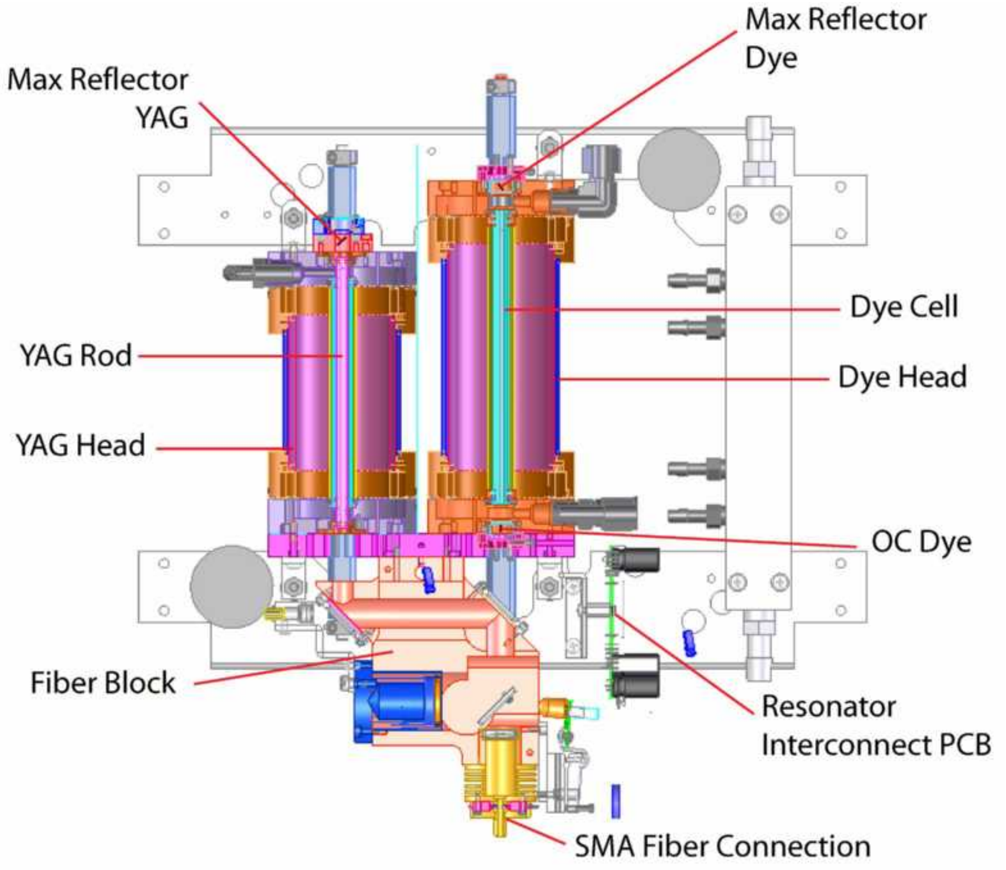

Figure 13B–Resonator Rail Module, Top View

Nd:YAG Laser Head

The Nd:YAG laser head is the diffuse reflector that couples the light energy from the flashlamps into the solid-state laser crystal rod. The two YAG flashlamps, connected in series, emit brief, intense bursts of white light when excited by pulses of electrical current. This light provides the pump energy source for the lasing medium. The anode or positive lead is identified by a red mark on the end of the electrode. Always use finger cots when handling or cleaning the flashlamps. The Nd:YAG rod has an anti-reflective (AR) coating @ 1064 nm at one end (max R) and is uncoated on the other end, which serves as the output coupler (OC). An external maximum reflector is used to complete the optical cavity. This laser head assembly consists of a one-piece main body and end plates that secure and seal the precision glass flow tubes. The flashlamp and rod keepers are secured to the end plates to provide fluid seals.

PDL Laser Head

The PDL laser head is also a diffuse reflector that couples the light energy from the flashlamps into the dye cell. The two, parallel flashlamps emit brief, intense bursts of white light when excited by pulses of electrical current. This light provides the pump energy source for the lasing medium. The anode or positive lead is identified by a red mark on the end of the electrode. Always use finger cots when handling or cleaning the flashlamps. An OC and a max R mirror are used in direct contact with the dye solvent to form the resonator. The PDL head is connected to two fluid circuits, one for the dye solvent and the other for the water-cooling.

Resonator Reflectors

NOTE: Partial and Max R for PDL, Max R only for YAG

With the exception of the partial reflector (output coupler) of the YAG resonator, which is achieved through the uncoated end of the YAG rod, the resonator mirrors are all adjustable through screw adjustments that tilt on three non-orthogonal axes. For the laser to function properly, they must be precisely adjusted.

Fiber Block

The fiber block consists of a monolithic Ultem structure that serves many functions. It serves as mount to the optics involved in turning and combining the two lasers, as well as a safety shutter, a shutter sense switch, aim LED, resonator port, focus lens and fiber sense switches. It mounts to the head mounting plate, which combines and registers the two heads into a stable platform. A description of the major components, as well as **Figures 14A** and **14B** describe the anatomy and two functional modes of the fiber block: Cal and Treatment. With the shutter inactivated, the full energy of the beam is sent to the resonator port. With the shutter activated and open, the beam is directed to the treatment site or the cal port.

Turning/Alignment Mirror

The turning mirror is setup to reflect the YAG laser beam through the fiber block to the beam combiner. The mirror is coated for maximum reflection at 45 degrees, as well as allowing for good transmission of the aim laser. The alignment of this optic is critical to the operation of the laser, and is the only optic that is adjustable in the beam train other than the resonator mirrors.

Beam Combiner/Beam Shutter Solenoid Assembly

The beam combiner is designed to combine the YAG laser beam with the PDL laser beam. The beam combiner is fixed. Both sides of the beam combiner are coated. One side uses an AR coating maximized for 585-nm transmission ± 2% and the other side is coated for maximum reflection of 1064 nm, both at 45 degrees. The aim beam is also reflected off this optic, but because the aim wavelength being similar to the treatment wavelength, a majority of the aim beam passes through this optic and is wasted. A sufficient amount, however, is reflected and delivered through the fiber.

The resonator port is part of the fiber block assembly. The beam shutter has a reflective mirror attached to direct the total power from the laser beam into the resonator port when the shutter is closed. There is an also an amber aiming LED used as an aim beam when the shutter is closed. When the shutter is opened, the laser beam(s) and the red laser aiming diode are sent into the focusing lens and the fiber.

Focus Lens Mount

The focusing lens is fixed inside the focus lens mount. There is no adjustment for the focusing lens. Verify the laser beam position on the SMA centering pin using the fiber alignment fixture (706-0199-000). Once the alignment has been verified on the pin, the fixture is removed and replaced with the brass focus lens assembly. The YAG turning mirror is adjusted to compensate for any misalignment.

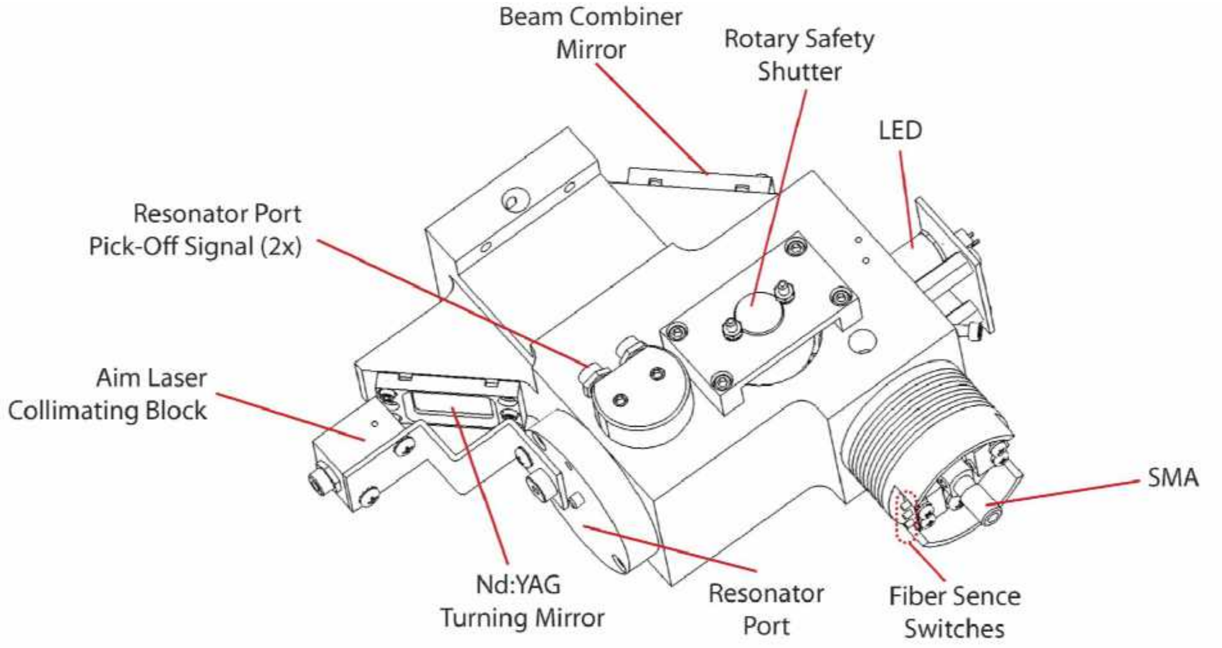

Figure 14A–Fiber Block, Assembly

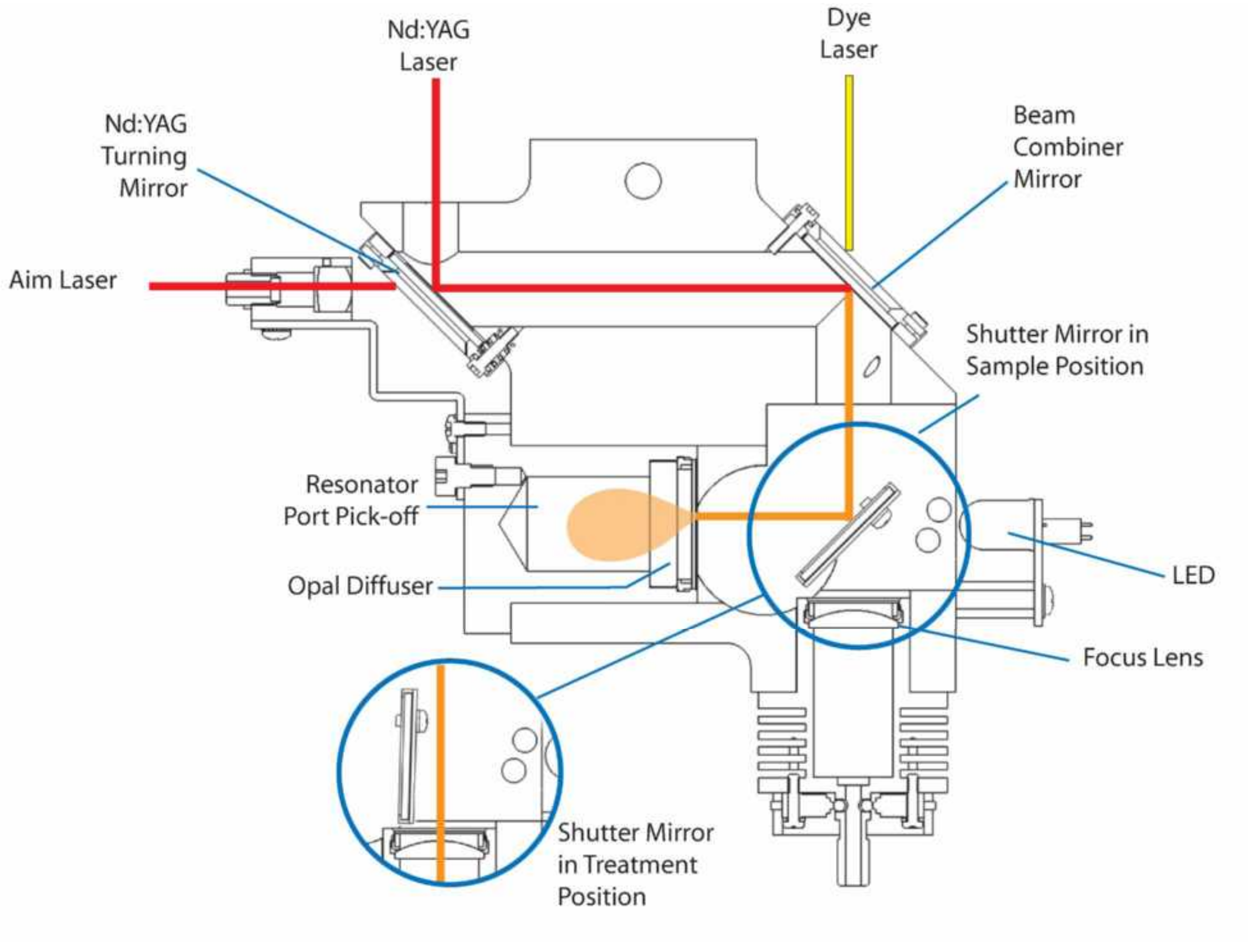

Figure 14B–Fiber Block, Beam Path

Circulation Systems

There are two, separate circulation systems on the Cynergy: the water and the dye solvent circuits as diagrammed in **Figure 15**.

Water Circulation System

The water circulation system maintains the flashlamps (4x), YAG rod and laser heads at a maximum temperature of 65 °C. There is no heater in this circuit. As a result, the operating temperature can range anywhere between slightly above ambient and 65 °C.

The water pump circulates the deionized water through the laser head, heat exchanger and a flow switch. A bypass loop contains a deionizer cartridge that helps maintain low electrical conductivity of the coolant. Level switches located in the upper reservoir are used to provide water level status information to the systems control electronics. The upper level switch indicates when water must be added. The lower level switch, when activated, will not allow laser operation until water is added. **NOTE:** When adding water to laser use deionized or distilled water only.

The solid-state temperature sensor measures the water temperature and provides temperature information back to the microcontroller.

Dye Circulation System

When the laser is operating, the dye pump circulates the dye solution through a loop that starts at the reservoir and passes through the laser head. When the laser fires, the flashlamp light excites the dye in the laser head which results in laser light at a wavelength of 585nm ± 2%. In the same process, the small dye volume in the laser head that was exposed to the flashlamp radiation is chemically altered or degraded.

To compensate for dye degradation, the Cynergy laser uses a charcoal filter that has a selective affinity for absorbing degraded by-products of dye. Thus, the filter "cleans" the solution of degraded dye while supplying fresh dye to replace it. While doing this, it is important that it does not scrub out all of the dye. The solution passes through a dye concentration sensor that measures the concentration of the dye. If the concentration falls below the set value, a dye inject pump and separate reservoir containing dye concentrate boosts the dye concentration to the proper value.

The dye concentrate cannot be injected while the main, high-pressure pump is on, therefore, when the system detects a low dye concentration in warm-up mode, the main dye pump may turn off for a few seconds to allow the inject to enter the system.

The dye solvent is maintained at 40^{o} C with a heater and heat exchanger system. It is necessary to wait approximately 15 minutes for the solvent to reach 40^{o} C if the laser is cold. Dye concentration will change with dye solvent temperature, so it is important to keep the dye temperature at a constant within 38 to 42^{o} C at all times. The dye kit lasts for up to 100,000 pulses at which point the laser may be unable to achieve the higher fluences. The dye kit can be easily replaced by the user. To assure that the proper power and wavelength are maintained, it is important to use the appropriate filters and solvents.

The dye concentration sensor utilizes an LED emitting at ~500 nm, a blue-green color. This color is chosen to be sufficiently absorbed by the dye. This LED is positioned off to one side of a flow tube and a phototransistor picks up the transmitted signal (SIG). A second phototransistor is used for the reference signal (REF) to monitor the LED source for drift. It is the ratio of these signals that is important and the inverse log of the ratio that determines optical density or OD. For a properly operating dye concentration sensor, the signals should be close to 2.5V at the correct dye concentration.

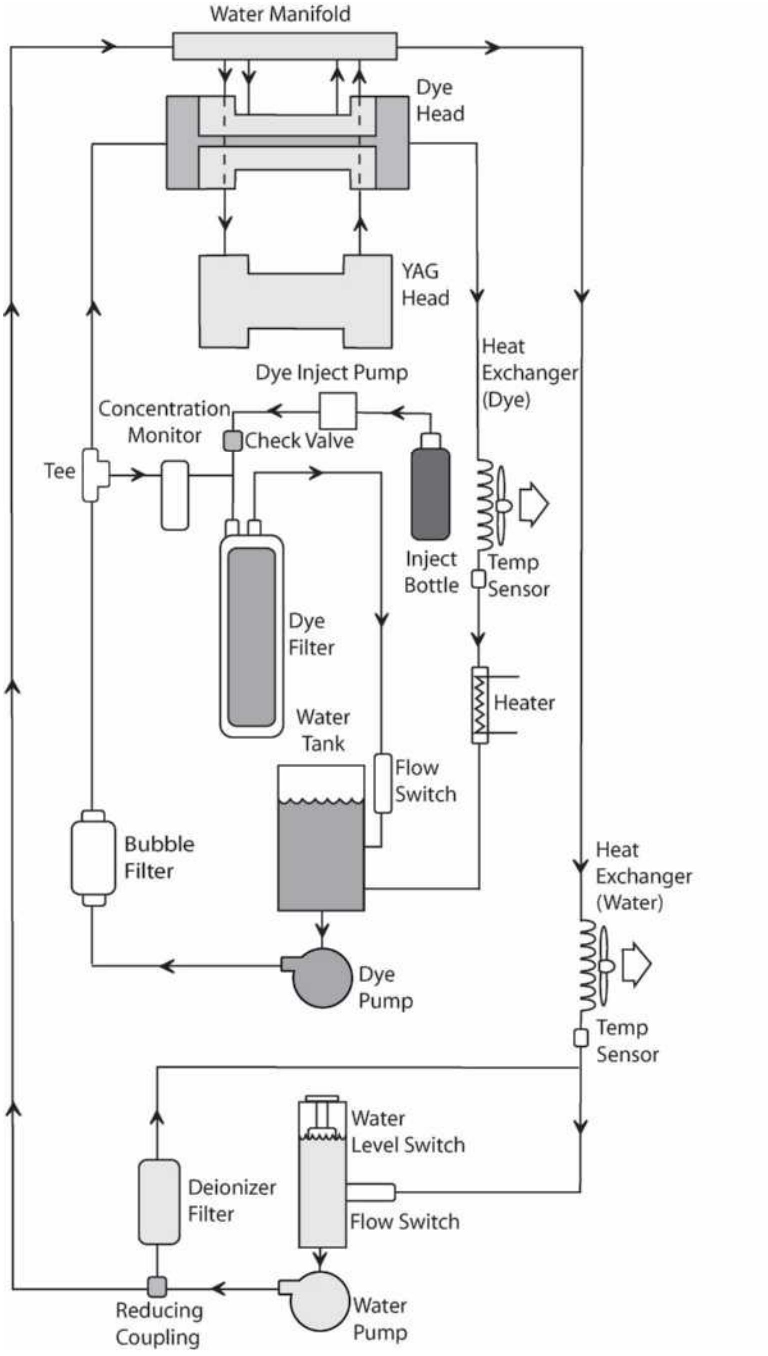

Figure 15–Circulation Systems Flow Diagram

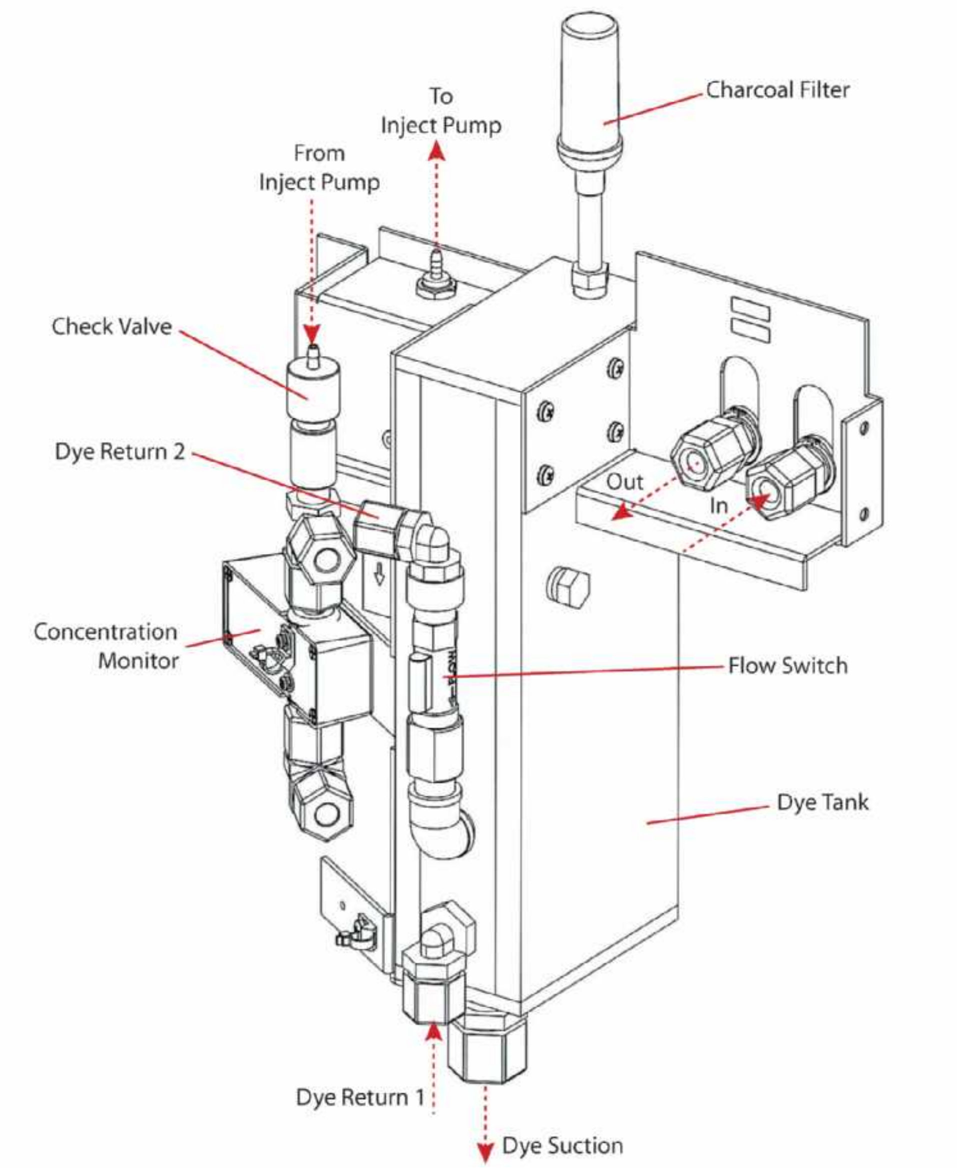

Figure 16–Dye Tank

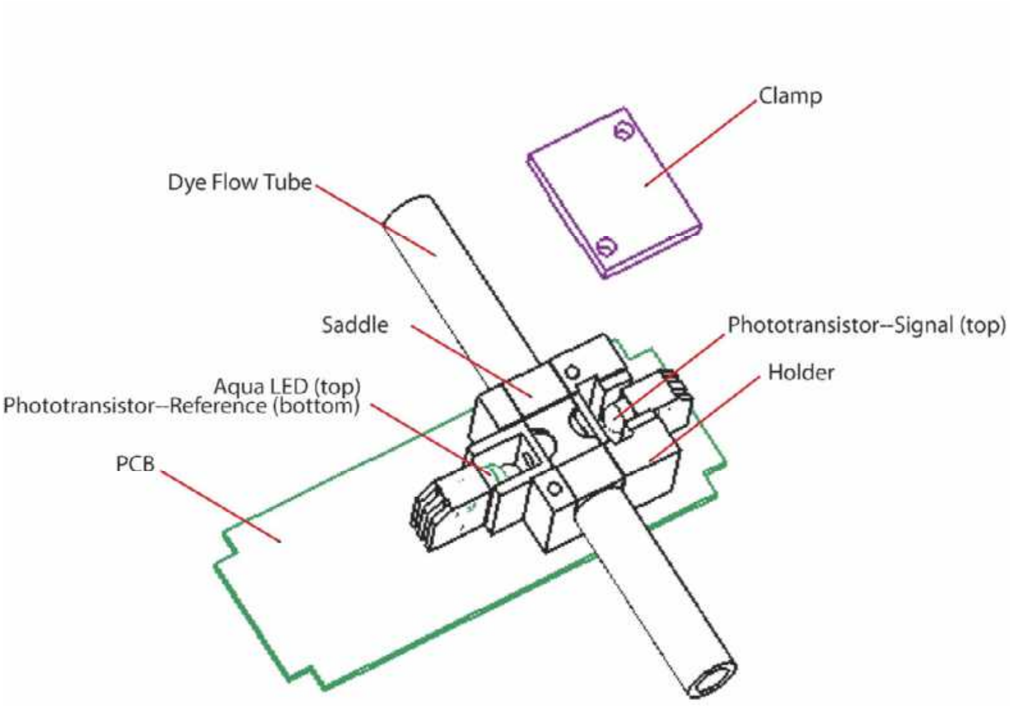

Figure 17–Dye Concentration Sensor

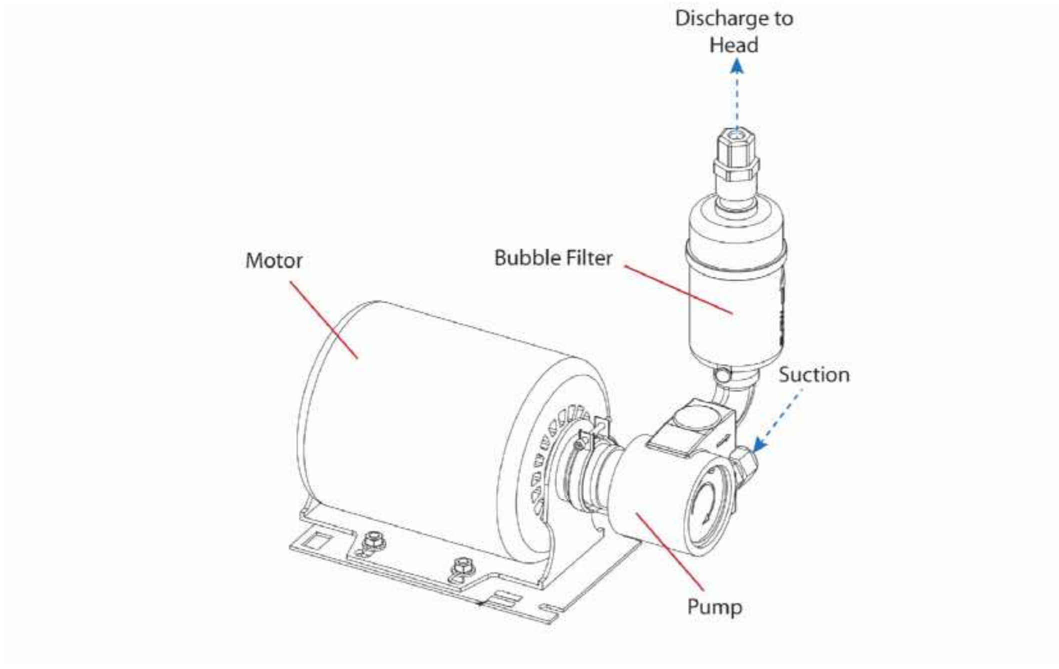

Figure 18–Dye Pump

Heat Exchanger Module

The heat exchanger module is the unit that controls the temperature of the system. It is comprised of two parallel circuits, one for the dye solvent and one for the water. The dye solvent branch contains the heater cartridge, temperature sensor, and resettable temperature sensor. The water side has only a temperature sensor. There are two 120 VAC fans for each circuit for a total of four fans. Air is drawn through the laser system and vented in the rear.

The dye solvent circuit maintains the dye solvent to well within its specified 40 ± 2 C even at elevated room temperatures and full power operation. At approximately 38°C the heater will turn off until the temperature goes back down below 38°C. The signal to turn on the heater is initiated in the CPU and the system control PCB. The signal is sent to the AC distribution PCB to turn on the solid-state relay. When the relay turns on, the heater circuit is closed and the voltage is applied to the heater and resettable temperature sensor.

The specific operating temperature of the dye solvent is less critical as long as it is below the maximum level where the system will shut down through a resettable temperature sensor that turns off the heater cartridge at 80°C. It keeps the heater from going into a run away state and overheating the system. Once the sensor is tripped, the sensor will have to be reset manually before the laser could operate the heater.

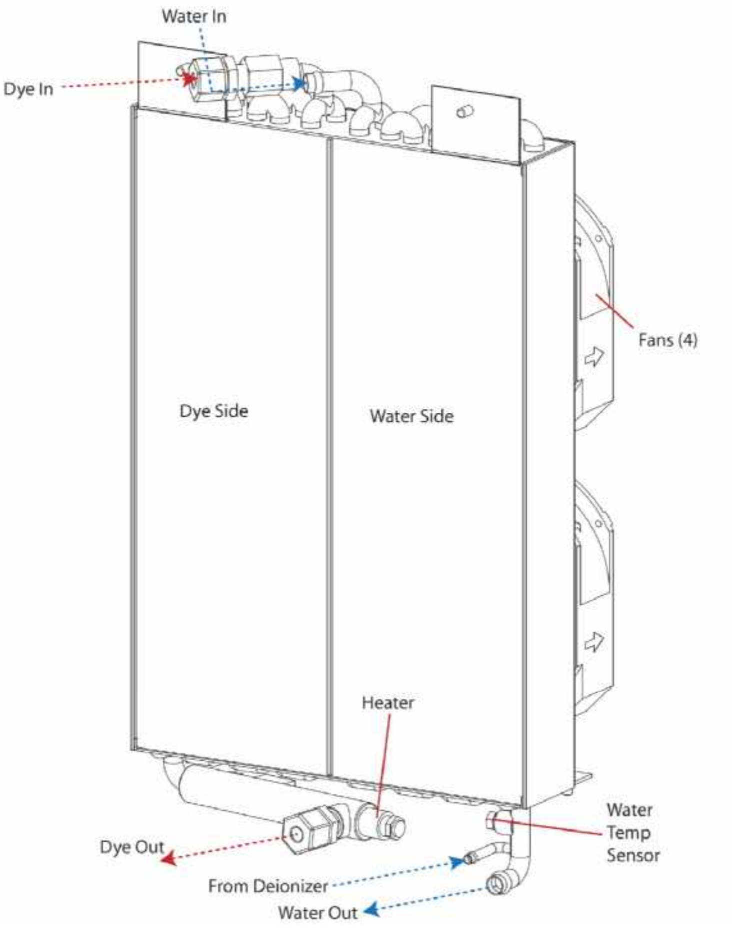

Figure 19–Heat Exchanger Module

Water Pump Module

The water pump module, **Figure 20**, consists of the water reservoir/expansion tank, float/level switch, flow switch, manifold, and the water pump. The water pump receives 230 volts from the AC distribution PCB. This voltage turns on the water pump and will engage the flow switch if the system has enough water in the system. The flow switch is rated for 1 gal/min (gal/min), however, under normal circumstances the water flow should be greater than 2 gal/min. Inside the expansion tank there is a float or level switch. This switch will indicate a low water level condition. The operator will need to fill system up until the “low water condition” is reset. The manifold on the water pump directs the water into the main system and a restricted path to the DI Cartridge.

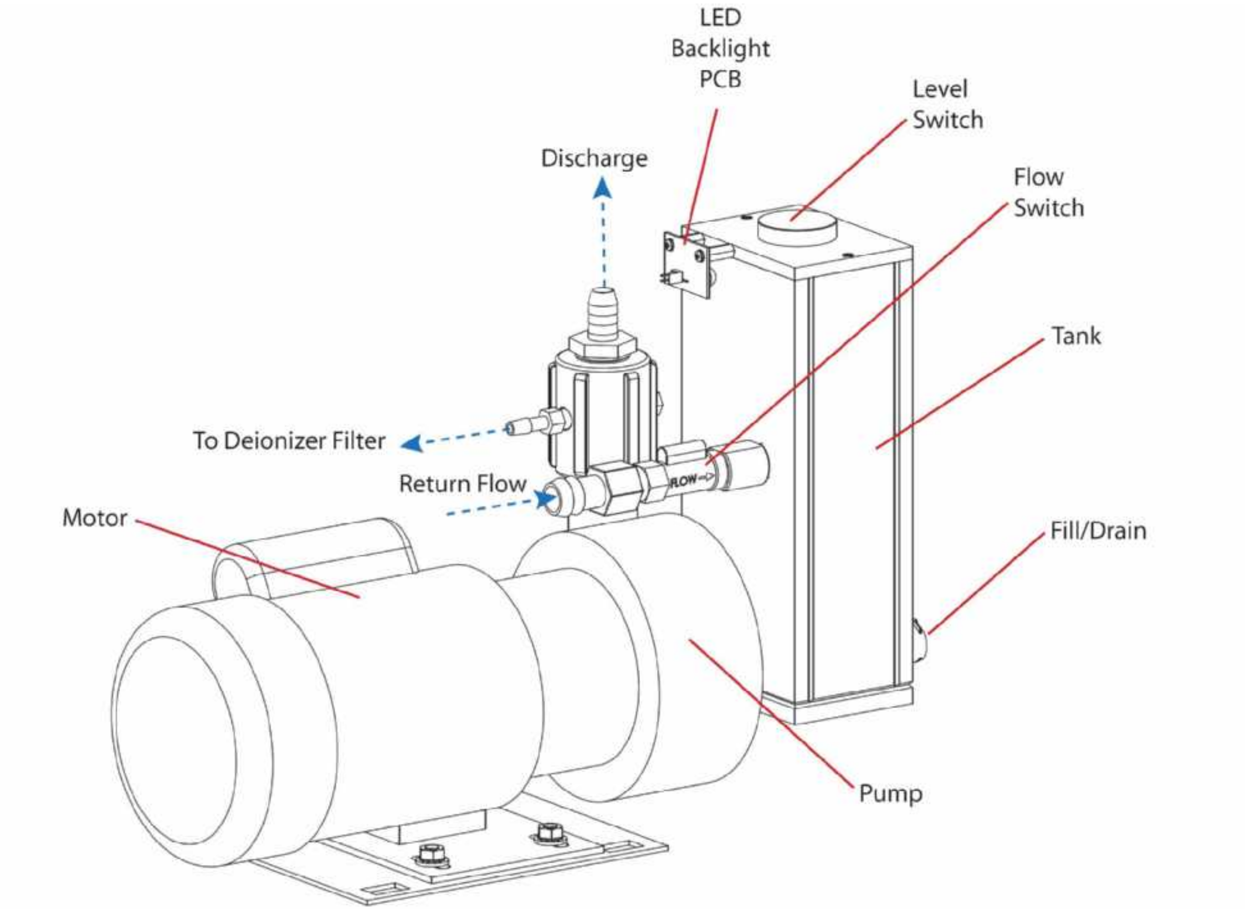

Figure 20–Water Pump Module

Delivery System

Approximately 80% of the energy, which has been coupled into the fiber, reaches the distal or output end of the fiber and enters the handpiece. The handpiece images the light from the fiber into a magnified spot of a specific diameter. The handpiece incorporates a push-button switch for firing the laser, as well as an electrical means of providing identification of the spot diameter to the laser control system. Refer to **Figure 21** for an overview of delivery system components.

Trigger Switches

When the laser system is in ready mode and the delay has passed, activate the laser beam by pressing either the finger switch or the foot switch.

The finger switch is an electrical push button located on the handpiece. See **Figure 21**. The foot switch is a pneumatic switch. To connect it, insert the foot switch connector into the handpiece electrical port on the rear of the laser.

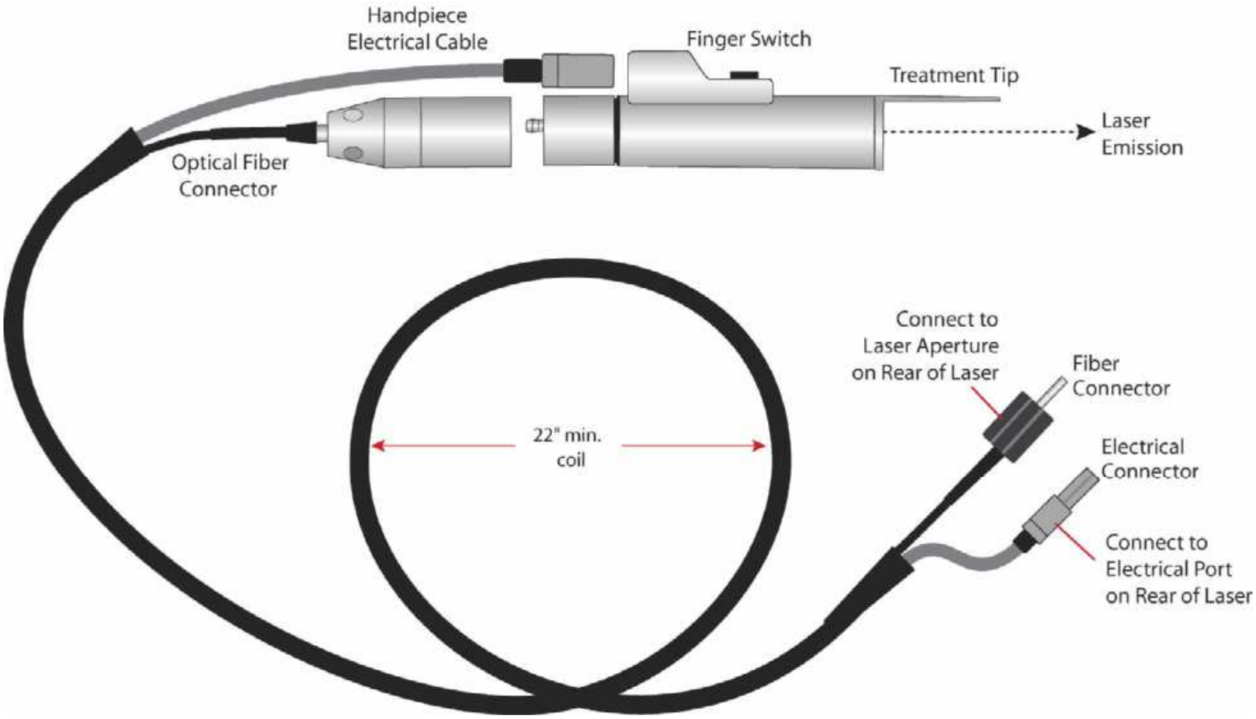

Figure 21–Delivery System

Section 5 Installation

Please refer to the *Cynergy Install Guide* for complete instructions on installing the Cynergy laser system and for verifying its operation.

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Routine Maintenance

In order to ensure proper operation of the Cynergy laser systems, Cynosure recommends that yearly routine maintenance be performed by factory-trained authorized personal.

This maintenance should include the following operations:

- A visual inspection of the lasers overall condition and appearance. The laser should be clean and in a clean environment. Inspect all optical components for dust or damage, including the laser resonator, beam combiner, focusing lens, delivery fiber and handpieces. Replace any component as necessary.
- Flushing of the coolant system and replacement of the deionizer cartridge. Inspect plumbing and tube fittings for leaks.
- Calibration verification of the temperature sensors. Check for proper operation of the temperature regulation circuits as controlled by the heater and heat exchanger fans.
- Calibration verification of factory set points, such as pulse widths, repetition rates, etc.
- Check laser resonator performance as determined by slope efficiency.
- Fiber alignment and fiber coupling efficiency.
- Inspection and calibration verification of the resonator and cal ports.
- Inspection and cleaning of the high voltage power supply.

Service Equipment

A full complement of tools is required to service this laser system. It is expected that service personnel carry at least the following tools to a laser installation or service repair call.

Hand Tools

- Screwdriver set: including Philips and slotted
- Allen wrench or hex head ball driver set
- Nut driver set
- Adjustable wrenches
- Wire cutters
- Wire strippers
- Needle nose pliers
- X-ACTO knife

Electrical Equipment

- Calibrated oscilloscope, 50 MHz or better, 2-channel (LeCroy 9310); or Cynosure # 706-0107-000 TEKSCOPE THS-720 or equivalent
- Calibrated high input impedance hand-held digital multimeter (Fluke 87) or equivalent
- Computer or laptop with any serial communication program, i.e. windows "HyperTerminal" or DOS "COMM," monitor and keyboard. DB9 F-F null modem serial cable

Optical Equipment

- Appropriate protective laser eyewear:
  > 6.0 O.D. at 1064 nm for the YAG laser;
  > 6.0 O.D. at 585 nm ±2% for the PDL laser
- Laser energy/power meter with carbon head (OPHIR AN2 , F250A-HL-SH Detector or equivalent) calibrated for 595 nm/1064 nm operation. Older Scientech models may not be adequate. Check with Cynosure Technical Support for meter compatibility.

Miscellaneous Equipment

- Funnel or small bottle
- Laser alignment thermal-sensitive paper, e.g., ZAP-IT paper
- Distilled water
- Lens tissue
- Methanol and/or acetone for cleaning optics
- Teflon tape
- Finger cots or lint-free gloves
- Pressurized gas-jet lens cleaner (e.g., Coherent bottled nitrogen gas)
- Magnifying/measuring loupe
- Fiber alignment fixture, Cynosure # 706-0199-000
- Fiber SMA centering pin, Cynosure # 706-0054-002
- Ring stand and clamps or tripod
- Wrench, Locknut, Handpiece, Cynosure # 706-0173-000

This section of the technical guide details how to remove the dress panels for accessing and servicing internal components.

Overview

For most common service procedures, such as accessing the control electronics or laser resonator, it is only necessary to remove the side rails and raise the top cover. Exercise care when removing any of the dress panels. Handle all painted items carefully to avoid scratching or damaging them. Store panels away from the work area until any service is complete.

WARNING: Even when the laser is off and the AC line cord is disconnected, DC voltages on various laser components, such as capacitors may exist. This can present a potentially fatal electrical hazard during service procedures. Proceed with caution!

IMPORTANT: Always follow the precautions suggested in the "Electrical Hazard" section detailed on page 14 to avoid electrical shock.

SPECIAL HAZARD NOTICE TO SERVICE PERSONNEL

The Cynergy laser does not dump the capacitor bank as frequently or in as many different modes as previous laser designs. Assume the capacitor bank is charged and dangerous at all times. When the laser is first turned on, the cap bank is not charged until a laser is selected from the Home page. At this initial choice, the capacitor bank is then charged. It remains charged in Standby, Ready, or Cal in addition to changes to PDL, YAG and Multiplex modes and only discharges or dumps in Utility mode. In Utility mode, the value of the high voltage is displayed in the lower left of the screen as a safety measure, but recheck the voltage with a DVM before servicing any components.

Removing the Top Cover

1. Disconnect the AC line cord from the receptacle.
2. Remove the four screws that attach the top cover to the top of the laser chassis.

   NOTE: Two screws are located behind the front door and two screws are located on the rear panel of the laser.
3. Carefully lift the cover off the top of the laser.

Accessing the Laser Resonator

1. Remove the top cover, as detailed in the previous section.
2. Remove the cage and rear bridge to facilitate access to the laser resonator(s). These structures are used to support the Cynergy PL and interfere with most service procedures. **CAUTION: The front bridge of the cage supports the control panel. Use care in pressing on the display with the cage removed as it supports the front display.**

Removing the Side Panels

1. Remove the two screws, located on the rear of the laser, that attach each side panel to the laser.
2. Slide each panel toward the rear of the laser, and then lift panel off the laser.

Removing the Rear Sub-Panels and Rear Panel

NOTE: Removing these panels provide access to the AC Select and HVPS Charge Rate Switch.

Rear Sub-Panels

1. Loosen the two retaining screws that hold each panel to the laser. Removing the upper sub-panel allows access to the HVPS charge rate. Removing the lower sub-panel allows access to the voltage select PCB.
2. Lift the sub-panels off of the laser.

Rear Panel

1. After removing the side panels, remove the six pan head screws around the perimeter of the panel.
2. Lift the panel off the rear of the laser.

Removing the Front Door

1. Decouple the hinges by hand using the hinges' locking mechanism.
2. Remove the door.

This section includes information on evaluating a laser system's performance and provides a path to determine the cause of any problem. The System Check routine performs a series of tests that evaluate the performances of the PDL and YAG resonators, as well as fiber transmissions. The System Check routine can only be performed when the laser is fully warmed to operating temperature.

System Check–Display Results

The System Check specifications are shown in utility format after a System Check:

Format:	**xx.x/xx, xx.x/xx**
Ex:	**4.5/75, 28.5/80**
Meaning:	**PDL J @ 750V, 0.5 ms, 1 Hz/% T, YAG J @ 750V, 5 ms, 1 Hz/% T**

The first number before the slash (4.5 in the example) is the number of joules generated by the PDL laser head as measured by the calibration port. The laser is always set to 750 V, 0.5 ms, and 1.0 Hz. The second number (75 in the example) is the percent transmission of the fiber and handpiece as calculated by a ratio of the cal to resonator ports.

The third number (28.5 in the example) is the number of joules generated by the YAG laser head as measured by the calibration port. The laser is always set to 750 V, 5 ms, and 1.0 Hz. The second number (80 in the example) is the percent transmission of the fiber and handpiece as calculated by a ratio of the cal to resonator ports.

System Check–Performance Criteria

The data for one hundred lasers characterized in final test exhibit the following FOM performance.

	Avg. (n=100)	One SD	Two SDs	Fiber Transmission (n=100)
PDL	8.4 J	6.5–10.3 J	4.6–12.2 J	81.2 ± 5.2% T
YAG	50.4 J	43.9–56.9 J	37.4–63.4 J	81.8 ± 4.5% T

The tolerance given is one standard deviation, which represents approximately 68% of the Cynergy lasers manufactured. By allowing two standard deviations, 95% lasers manufactured are represented. If the current performance is low and greater than two standard deviations, especially if better performance was previously recorded, then service is warranted.

In MultiPlex mode both lasers work in concert, therefore widely spread performance of the two lasers (e.g. great PDL, poor YAG) can result in difficulty achieving short delays settings.

Resonator Performance

The graph below represents typical Cynergy laser performance—actual performance will vary. However, there should be no "roll-over," meaning the output having little or no increase despite an increase in voltage. When "roll-over" occurs it can usually be attributed to poor alignment. See the "System Check" or "Laser Cal Condition Table" on the following page that flags errors once the FOM has been determined. A minimum FOM performance of > 2.5 J (for the PDL) and of > 30 (for the YAG) is required for operation.

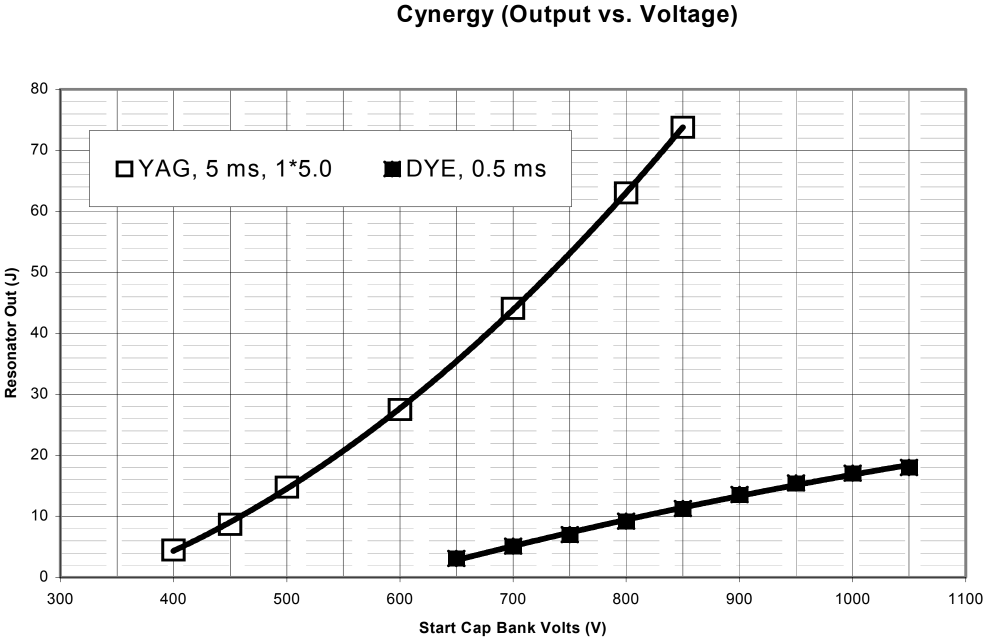

Figure 22–Resonator Performance

A separate performance standard for each laser has been established for the resonator output. In order to meet the system performance criteria, the resonator must normally generate approximately 15-30 % more output to compensate for losses in coupling to the delivery system.

For the PDL laser, the resonator must be capable of generating a minimum of 10 joules/pulse @ 1Hz or 10 Watts. This is based on performance criteria of 10 J/cm^2 with a 10-mm handpiece, which equals ~8 joules/pulse out of the handpiece. Adding a nominal 20% for delivery system losses, this means that the resonator must produce 10 joules/pulse.

For the Nd:YAG laser, the resonator must be capable of generating a minimum of 78.5 joules/pulse @ 1Hz or 78.5 Watts. This is based is based on performance criteria of 80 J/cm^2 with a 10-mm handpiece, which equals 62.8 joules/pulse out of the handpiece. Adding a nominal 20% for delivery system losses, this means that the resonator must produce 78.5 joules/pulse.

If transmission is accepted as low as 52%, the laser heads must be capable of approximately 15 J for the PDL, and approximately 125 J for the YAG. This is difficult for the laser to achieve and failure is imminent because the lost power is overheating some component. Good delivery system transmission is imperative for proper, long-term resonator performance.

System Check or Laser Cal Condition Table

<table>
<tr><th colspan="5">DYE, Sys Check at 750 Volts Eresonator</th></tr>
<tr><th>DYE Eres Joules</th><th>Cap Voltage</th><th>Fiber HP XSM</th><th></th><th>Condition and Message</th></tr>
<tr><td>> 2.5</td><td>750</td><td>> 65%</td><td></td><td>Good resonator cal data with 20%</td></tr>
<tr><td>> 2.5</td><td>750</td><td>> 120%</td><td></td><td>E33: DYE Calibration Error Call Service</td></tr>
<tr><td>> 2.5</td><td>750</td><td>50 to 65%</td><td></td><td>W59: Low Trans. Check Fiber/Handpiece</td></tr>
<tr><td>> 2.5</td><td>750</td><td>< 50%</td><td></td><td>E34: DYE Cal Failed Energy Low Call Service</td></tr>
<tr><td>< 2.5</td><td>750</td><td></td><td></td><td>E34: DYE Cal Failed Energy Low Call Service</td></tr>
<tr><td>> 2.5</td><td>750</td><td>Cal Port <1J</td><td></td><td>E26: No energy check fiber/handpiece</td></tr>
<tr><th colspan="5">DYE, Laser Cal, valid for 0.5 ms</th></tr>
<tr><th>DYE Eres Joules</th><th>Cap Voltage</th><th>Fiber HP XSM</th><th></th><th>Condition and Message</th></tr>
<tr><td>> 5</td><td>< 1000</td><td></td><td></td><td>Good</td></tr>
<tr><td>< 5</td><td>>= 1000</td><td></td><td></td><td>W73:Schedule preventive maintenance</td></tr>
<tr><td>< 4</td><td>>= 1000</td><td></td><td></td><td>E34: DYE Cal Failed Low Energy Call Service</td></tr>
<tr><td>> 12</td><td></td><td></td><td></td><td>W67: Unable to Reach Fluence; Decrease</td></tr>
<tr><td>> 5</td><td>>= 1000</td><td></td><td></td><td>W67: Unable to Reach Fluence; Decrease</td></tr>
<tr><td></td><td></td><td>< 50%</td><td></td><td>E23: Low Trans. Replace Fiber/Handpiece</td></tr>
<tr><th colspan="5">Nd:YAG, Sys Check at 750 Volts Eresonator</th></tr>
<tr><th>DYE Eres Joules</th><th>Cap Voltage</th><th>Fiber HP XSM</th><th></th><th>Condition and Message</th></tr>
<tr><td>> 30</td><td>750</td><td>> 65%</td><td></td><td>Good resonator cal data with 20%</td></tr>
<tr><td>> 30</td><td>750</td><td>> 120%</td><td></td><td>E24: YAG Calibration Error Call Service</td></tr>
<tr><td>> 30</td><td>750</td><td>50% to 65%</td><td></td><td>W59: Low Trans. Check Fiber/Handpiece</td></tr>
<tr><td>> 30</td><td>750</td><td>< 50%</td><td></td><td>E25:YAG Cal Failed Energy Low Call Service</td></tr>
<tr><td>< 30</td><td>750</td><td></td><td></td><td>E25:YAG Cal Failed Energy Low Call Service</td></tr>
<tr><td>> 30</td><td>750</td><td>Cal Port <5J</td><td></td><td>E26: No energy check fiber/handpiece</td></tr>
<tr><th colspan="5">Nd:YAG, Laser Cal, valid for 5 and 10 ms</th></tr>
<tr><th>DYE Eres Joules</th><th>Cap Voltage</th><th>Fiber HP XSM</th><th></th><th>Condition and Message</th></tr>
<tr><td>> 60</td><td>< 1000</td><td></td><td></td><td>Good</td></tr>
<tr><td>< 60</td><td>>= 1000</td><td></td><td></td><td>W69: Schedule Lamp Change</td></tr>
<tr><td>< 50</td><td>>= 1000</td><td></td><td></td><td>E25: YAG Cal Failed Energy Low Call Service</td></tr>
<tr><td>> 95</td><td></td><td></td><td></td><td>W67: Unable to Reach Fluence; Decrease</td></tr>
<tr><td>> 60</td><td>>= 1150</td><td></td><td></td><td>W67: Unable to Reach Fluence; Decrease</td></tr>
<tr><td></td><td></td><td>< 50%</td><td></td><td>E23: Low Trans. Replace Fiber/Handpiece</td></tr>
<tr><th colspan="5">Sys Check at 750 Volts Eresonator Combination</th></tr>
<tr><th>DYE Eres Joules</th><th>Cap Voltage</th><th>Fiber HP XSM</th><th>Dye HP XSM</th><th>Condition and Message</th></tr>
<tr><td>< 30</td><td>< 2.5</td><td></td><td></td><td>E40: DYE and YAG Cal Failed, Call Service</td></tr>
<tr><td>> 30</td><td>> 2.5</td><td>< 50%</td><td>< 50%</td><td>E23: Low Trans. Replace Fiber/Handpiece</td></tr>
<tr><td>> 30</td><td>> 2.5</td><td>< 50%</td><td>< 65%</td><td>E23: Low Trans. Replace Fiber/Handpiece</td></tr>
<tr><td>> 30</td><td>> 2.5</td><td>< 65%</td><td>< 50%</td><td>E23: Low Trans. Replace Fiber/Handpiece</td></tr>
</table>

System Check–Troubleshooting

The System Check data shown at the bottom of the screen after a System Check directs service personnel to follow a diagnostic path to correct the problem. The paths and the sequence of operations that should be followed are covered in the following pages.

Primary Optical Diagnostic Routine

Before any action can be taken to troubleshoot a failing laser, the source of the problem must be determined from the System Check data and a troubleshooting path charted from the flow diagram below. The resulting path to better the system performance could be one or both of two diagnostic routines, Laser Head Performance or Beam Train performance. Laser Head performance is checked first, logically followed by the beam train performance.

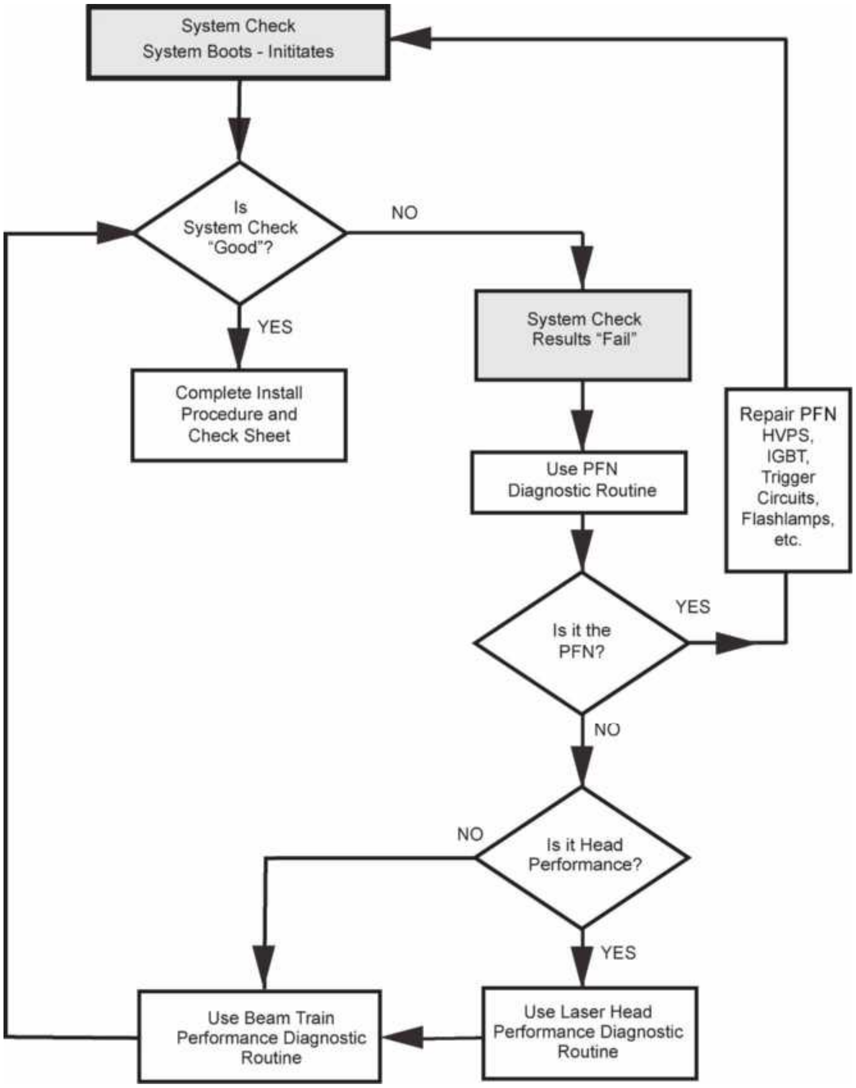

Figure 23A–'Primary Diagnostic Routine' Flowchart

PFN Diagnostic Routine

1. Connect the laser to HyperTerminal to display laser performance parameters, as detailed in “Appendix A,” on page 111.

   NOTE: Performance details may also be accessed from data files via the USB stick. See, “Transferring Diagnostic Data,” on page 109.

2. Read FOM header on HyperTerminal screen.
3. Format and Diagnostic information is as follows:

FOM

PDL	H=750, L=695
YAG	H=750, L=670

‘H’ represents the starting voltage on the capacitor bank. ‘L’ represents the low or ending voltage after discharge.

Analyzing Results

If PDL L < 705, then PFN is fine.	55 V Difference between H and L is normal.
If YAG L< 690, then PFN is fine.	80 V Difference between H and L is normal.
If PDL 720 < L < 750, verify that two lamps are firing.	Causes are simmer sense, broken flashlamp.
If PDL L > 740, then lamps are not firing.	Investigate PFN issues.
If YAG L > 740, then lamps are not firing.	Investigate PFN issues.

Laser Head Diagnostic Routine

This diagnostic routine attaches a priority to the procedures involved in restoring head energy. The procedure is similar for the two heads. Each of the procedures is listed in order and can be found in this manual in more detail in later sections.

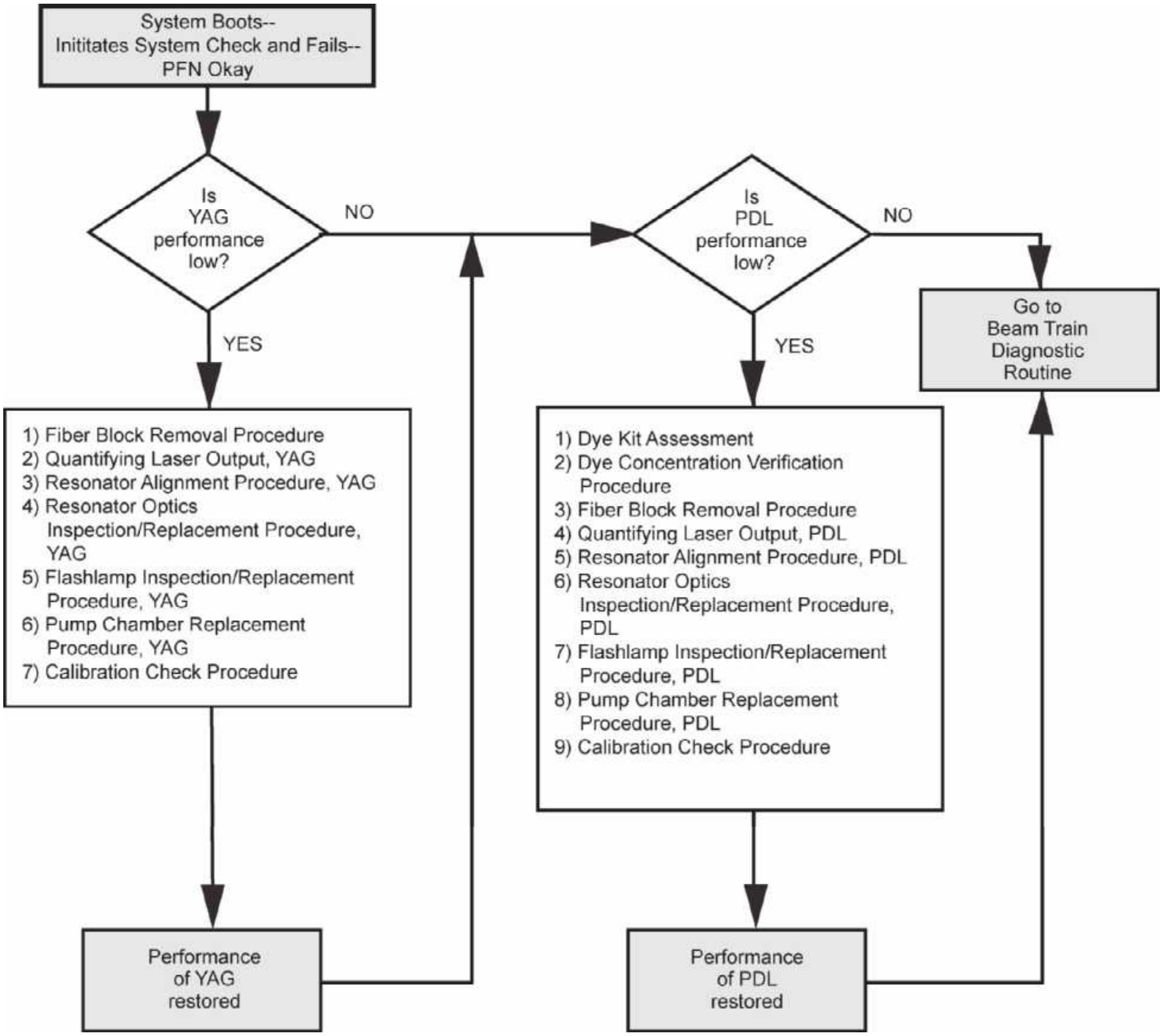

Figure 23B–'Laser Head Diagnostic Routine' Flowchart

Beam Train Diagnostic Routine

The beam train is defined as the optical path of the laser resonator after the output coupler. This includes the turning mirror, beam combiner, shutter mirror, opal, focus lens, fiber and handpiece. Any of the optics can reduce the performance of a healthy head to an unacceptable level. This diagnostic routine attaches a priority to the procedures involved in restoring the transmission of the resonator output to the output of the handpiece.

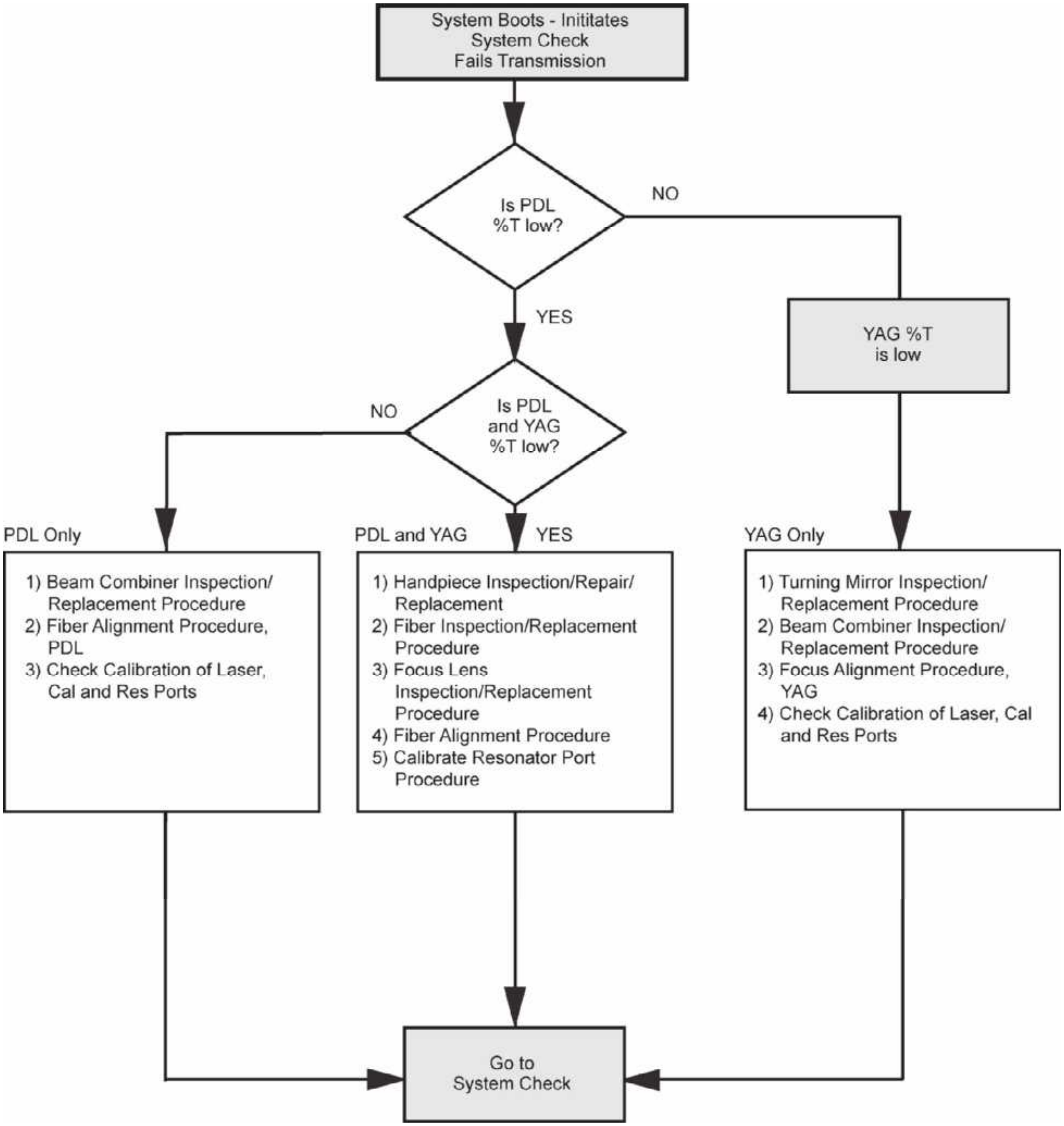

Figure 23C–'Beam Train Diagnostic Routine' Flowchart

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Dye Kit Methodology

The dye laser uses an organic dye suspended in a solvent as the lasing media. The dye filter and the inject bottle serve as reservoirs to maintain an acceptable concentration of fresh dye.

As the dye laser pulses, the dye undergoes a chemical transformation after each pulse and must pass through the dye filter to be rejuvenated. This process can continue so long as the dye filter is less than 12 months old or the filter has less than 100,000 shots after its last change. If either of these conditions is met, the dye kit (dye filter and inject bottle) should be replaced.

The dye concentration is maintained by a monitoring system that will inject more dye as needed. This additional supply of dye is pulled from the inject bottle.

Dye Kit Assessment

Shot Number on Dye Kit: The dye kit is warranted for 100k shots. If this number has been exceeded, the problem could simply be that the consumable needs to be replaced.

Shelf life: Check the expiration date of the dye kit. If it was manufactured more than one year prior to the service date, the kit should be replaced.

Dye laser performance has a complex relationship with dye chemistry that makes it difficult to assess the condition of the dye kit with a simple, go no-go test. Inherent in the PDL design (see dye kit methodology) is that it looses some of its original performance and degrades as the system accumulates pulses, but it is also possible to loose performance by simply sitting idle for long periods. It is documented that frequently used lasers will exceed warranty periods of dye kits, while systems that are not turned on and warmed-up over the course of months may exhibit problems when just reaching the warranted number of shots.

Dye kits do not suddenly drop in performance unless they were subjected to solvent changes or exposure to cold for long periods. A steep change in laser performance should not be assumed to be the dye kit. A system that was working yesterday, but is not working today has little chance of harboring a bad dye kit. Viewing the FOM recorded over several start-ups, as well as the Fault Log will indicate how the system was performing over time. A slow slide in the ABS (absorption value proportional to concentration of the dye in solution) may indicate dye kit problems. Dye kits rarely exhibit chemical changes, only slow changes that cannot be detected by the on-board concentration monitor or any service procedure or tool.

A dye kit must be assessed before the PDL can be diagnosed for poor performance. It is the first thing to question, but only after thorough analysis should it be replaced. Historically, it is has been a common troubleshooting error to replace the dye kit only to find the problem was elsewhere. This can be a costly process. Yet, there are advantages to a good assessment up front, e.g., a dye kit could be sent to the site before a Service Technician to resolve a simple problem. It is the purpose of the following section to outline the logical assessment of dye kits in the field.

NOTE: When new dye kits are proven to be effective at restoring laser energy, the dye shots count is reset from the Utility Screen, and not before that. If the new dye kit did not solve the problem, the old kit should be returned to the system and the new kit sent back to Cynosure.

Dye Kit Assessment Checklist

1. Is dye kit still under warranty? If not, replace at customer's expense.
2. Is ABS in the normal range (0.85–1.1)? If not, diagnose problem. Inspect/replace inject bottle. Is it empty? Is there air in the lines? Check injection sequence on start up. Is ABS increasing? Check dye solvent temperature (38–42 C).
3. Check the dye kit line on the Utility Screen. It is formatted to show the number of shots since the last reset, the number of days the laser was turned on following the last reset, and the date of the reset. In the Fault Log, the reset history can be downloaded. This information can be relayed to the Service department, and then a determination made to send or not send a dye kit prior to the Service Technician. To help with this determination, see the table below.

Shots Recorded on Dye Kit	Time Since Dye Kit Install	Dye Kit Replacement Probability and Rationale
0–20,000	< 6 months	*Very unlikely* to be a dye kit problem—too young
	6–12 months	*Possibly* a dye kit problem, because it has been little used and it may have lost performance
20,000–100,000	< 6 months	*Unlikely* the dye kit problem, because usage is acceptable
	> 6–12 months	*Possibly a dye kit problem,* because the dye kit is increasing in both age and usage
NOTE: Always check the dye kit history in the Utility Screen		

Dye Injection

At startup, the system must warm up in order for the dye solvent to reach and maintain its operating temperature. One the system is warm, the dye concentration is checked. Normally, the dye concentration is correct and the system will complete the startup process. Occasionally, however, additional dye concentrate may be required. When this occurs, the system will automatically add more dye concentrate through a series of inject and mix cycles. This process usually takes only a few minutes, but in extreme cases may take up to thirty minutes. Once the process has finished, the laser will go to the Home Screen and the user may proceed as normal. The system will continue to monitor the dye concentration level, but will not require another injection cycle unless the laser is restarted. If the laser is not started for more than a week, it is more likely that additional dye concentrate will be required.

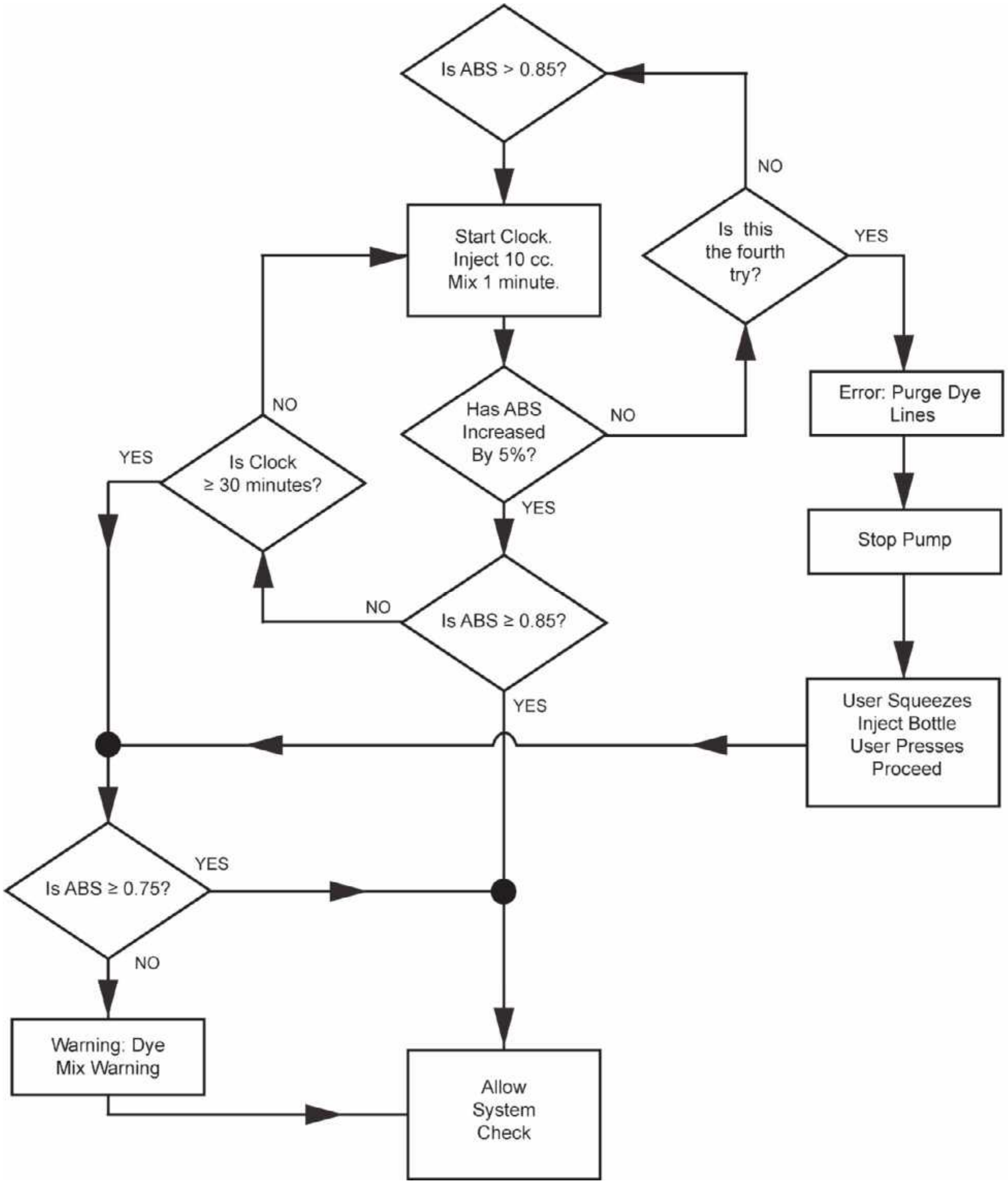

Figure 24–'Dye Injection' Diagnostic Routine Flowchart

Fiber Block Removal Procedure

SMA/Focus Lens Removal

The Fiber Block is the Ultem assembly that combines the two laser beams. One can perform most of the servicing procedures by removing only the brass SMA connector with the focus lens. This is done by removing the two, 4-40 Phillips pan head screws that attach the brass assembly to the Ultem block. In this way, the power meter need only be positioned once to measure the output of both heads. If there is damage to either the turning mirror or beam combiner, measurement by this method will be incorrect and the entire fiber block must be removed to obtain the real head performances.

Fiber Block Removal

Remove the fiber block by removing the 4, 4-40 screws which attach the fiber block to the head mounting plate. No other disconnections need be made—set the assembly aside. Make sure the flats on the flashlamp lead collars are aligned with the flats near the turning mirror and beam combiner frames.

CAUTION: If the flats on the flashlamp lead collars are misaligned, the block assembly may push against the lamp damaging it.

Quantifying Laser Output, PDL

1. Remove the brass SMA focus lens holder. Set aside.
2. In CV, PDL mode, find the voltage near to the threshold of laser action at 0.5 ms. It is typically approximately 500V.
3. Verify that the onset of laser action produces a bright ring pattern. If not, the alignment may need to be adjusted. If the threshold is near to 500 V and the threshold pattern is circular, the laser head is performing acceptably.

Verify FOM, PDL

1. Remove beam combiner block.
2. Position an Ophir detector head 14 to 16 inches from the PDL pump chamber.
3. Turn on laser
4. Initialize CV mode as detailed on page 19.
5. Set laser to the following settings:

Wavelength	PDL
Voltage	750 V
Pulse Width	.5 ms
Rep Rate	1 Hz

6. Fire the laser 10 shots and read the power on the meter.
7. Increase the PDL laser voltage to 850 volts.
8. Fire the laser 6 shots and read the power on the meter.
9. The resonator should measure ≥ 9 watts at ≤ 850 volts.
   NOTE: Do not exceed 14 Watts.
10. Take note of the PDL resonator power at 850 volts.

Resonator Alignment Procedure, PDL

1. Make certain that the laser output coupler (partial) mirror and maximum reflector are free of dirt and dust. If necessary, remove any dust or other particles by blowing with a pressurized gas-jet lens cleaner. Place the head of the energy meter in the beam path.

   CAUTION: The entire beam profile must fill at least 75% of the detector area. Take a burn to confirm the size of the beam and that it is centered on the detector face. Make sure the burn paper is inside a plastic bag to prevent the burn residue and smoke from depositing on the output coupler or other optics.

2. Set up the laser energy/power meter to read average power (watts), on a 3.0 watt range.
3. Fire the laser.
   - 3.1 If the laser is not producing a laser beam, increase the voltage until lasing occurs.
   - 3.2 If no lasing occurs at the highest voltage setting, perform, “Rough Resonator Alignment,” see page 69.

   WARNING: Be cautious adjusting one mirror at a time. The alignment screws are directly adjacent to lethal high voltages. High voltage is present; electrical shock can occur.

4. Using an insulated and extended 1/16" socket head driver (706-0133-000), optimize the output of the maximum reflector. Use all three adjustments. Turn the voltage down as the energy increases during optimization. During alignment, the power should stay between approximately 2.5 to 5.0 watts. Repeat this several times until no further improvement seems possible.
5. Repeat step 5 for the other reflector.
6. Position a piece of ZAP-IT laser alignment paper approximately 6 inches from the partial reflector. Fire a single laser pulse onto the paper.
7. Examine the burn pattern. If necessary, adjust the laser voltage higher or lower, firing a single shot on an unexposed area of the burn paper after each adjustment, until proper exposure is obtained.
8. The burn should be circular with symmetrical edges. The spot should be a round spot with a centrally high intensity, tapering off at the edges. There should be no asymmetrical structures such as rings, spots, shadows or satellites.
9. It may be necessary to reduce the voltage to the threshold of lasing to observe subtle structure to the burn that would be “washed out” at higher voltages. At threshold, the beam appears as a perfect ring.
10. Check that the resonator meets the resonator performance criteria. See section starting on page 56.

Rough Resonator Alignment

If the head has been disassembled or there is reason to believe that the mirrors are no longer aligned (optics have been replaced, etc.), perform the following procedure:

1. Make sure the mirror mounts are tight on the endplates (4, 3/32" hex screws) and the optical surfaces of the optics are clean.
2. Make sure the 3, 1-7 mirror adjustment screws are snug against the optic. This ensures a fluid seal.
3. Make certain the laser is in standby mode.
4. Attach the head alignment fixture (706-0132-000) to the end plate on the maximum reflector end of the laser head. Disconnect the 15-pin D connector P18 to defeat the HVPS definitively.
5. <u>Laser must be in standby with no charge on capacitors. Check position of dump solenoid—it must be closed.</u> Site down the bore of the laser and depress momentary button on fixture to illuminate the dye cell. Position your view to coincide exactly with the optical axis of the dye cell. Fix the position of your head and immediately turn the back illumination off. You should see the reflection of your iris directly on the center of the output coupler. If the reflection is not centered, adjust the optic's position with the three, 1-72 adjustment screws using a 1/16" ball driver. Repeat the procedure, as many times as needed, until you are convinced that the optic is aligned with the center of the dye cell.
6. Once the partial reflector optic is aligned, change the position of the fixture to the output coupler end. Repeat the sighting procedure for this end. The light sensor assembly needs to be removed for this procedure. The laser head should now be coarsely aligned, but if care was taken, could be aligned exactly.

   NOTE: This procedure can be done without the fixture if a method to illuminate the back is employed. An additional person holding a flashlight works well.
7. Check that the dye cell is cleared of obstructions, such as misplaced wire screens or debris caught in the screens.

Resonator Optics Inspection/Replacement Procedure, PDL

1. Unplug the system.
2. Remove the fiber block.
3. Remove and lay the display assembly module down on the main chassis handle.
4. Remove the internal monitor assembly.
5. Inspect the maximum reflector and output coupler carefully for burns or other degradation. Use a flashlight and compressed air to aid in the inspection. If any damage is noted, remove the optic with the mount and clean it. First, loosen a compression fitting on the head for the dye solvent to drain the solvent away—the lines should appear clear before an optic is replaced.
6. Remove the four, 4-40 screws that hold the optic to the end plate.
7. Clean the optic carefully using methanol and a lens tissue or cotton swab. If the optic cannot be cleaned, replace it.
8. Install the optic with the mount.
9. Normally, if the damaged optic was aligned, its replacement should have sufficient alignment to lase. If the alignment process is being done from scratch, tighten the four screws that attach the holder to the end plate, and then tighten the three screws that align the optic using the compliance of the O-ring. Fully compress the O-ring, and then back off one turn for adjustment on each of the three screws.

Pump Chamber Replacement Procedure

CAUTION: Before removing the pump chamber, always remove the lasers AC line cord from the wall receptacle. Use a digital voltmeter to make certain that there is no voltage present on the capacitor bank.

1. Access the laser resonators.
2. Remove the rear bridge and disconnect the fan.
3. Remove the fiber block.
4. Drain the water.
5. Disconnect the coolant lines from the pump chamber being serviced. Disconnect the dye lines for the PDL head. The dye solvent does not have to be drained at this time.
6. Disconnect the lamp leads from the lamp(s) to be replaced by loosening the 2, 4-40 socket heads on each of the flashlamp collars.
7. Disconnect the red wire from the trigger transformer that is attached to the pump chamber.
8. Remove the rear 10-32 nut that holds the end plate of the resonator to the rubber mount.
9. Remove the four 4-40 socket head screws that secure the pump chamber to the head mounting plate. Carefully remove the pump chamber from the laser.

Quantifying Laser Output, YAG

1. Remove the brass SMA focus lens holder. Set aside.
2. In CV, YAG mode, find the voltage near to the threshold of laser action at 5ms. It is typically 400V.
3. Verify that the onset of laser action, ~25V above threshold produces a circular, homogenous pattern. If not, the alignment may need adjusting. If the threshold is near to 400 V and the threshold pattern is circular, the laser head is performing acceptably.

Verify FOM, YAG

1. Remove beam combiner block.
2. Position an Ophir detector head 14 to 16 inches from the YAG pump chamber.
3. Turn on the laser.
4. Initialize CV mode as detailed on page 19.
5. Set laser to the following settings:

Wavelength	YAG
Voltage	750 V
Pulse Width	.5 ms
Rep Rate	1 Hz

6. Fire the laser 10 shots and read the power on the meter.
7. Increase the YAG laser voltage to 850 volts.
8. Fire the laser 6 shots and read the power on the meter.
9. The resonator should measure ≥ 55 watts at ≤ 850 volts.

   NOTE: Do not exceed 85 Watts.
10. Take note of the YAG resonator power at 850 volts.

Resonator Alignment Procedure, YAG

NOTE: The YAG resonator uses only one external laser optic, the maximum reflector.

1. Before aligning, inspect the rod and maximum reflector for damage.
2. Remove the fiber block.

WARNING: High voltage, hazardous high temperatures and rotating fan blades are exposed when the panels are off, and laser is running. Exercise extreme caution when operating the laser. Always wear appropriate laser safety glasses when operating the laser systems.

3. Initiate ‘CV’ mode. In CV mode, the voltage is changed by the up/down arrows, not fluence.
4. Position the Ophir energy detector head approximately 18" from the YAG resonator chamber. Align the energy detector so it is facing towards the resonator output.

Set: NOVA II meter	Set: LASER
Menu = Power(Watts)	Voltage = 350 V
Range = Auto	Pulse width = 5 ms
Average = 1-second	Rep rate = 1 Hz
Laser wavelength = 1064	

5. Center a piece of laser alignment paper in front of the energy detector disk. Fire a single shot into the paper. Verify the burn on the energy detector disk. Reposition the energy detector if necessary so that the burn pattern on the paper is centered on the energy detector disk.
6. Press and hold down the footswitch to fire the laser, while adjusting the three max reflector adjustment screws for a maximum reading on the energy/power meter.
7. Release the foot switch.
8. Examine the burn pattern. It should be circular with sharp edges.
9. Adjust the YAG max reflector to optimize the quality of the burn, on the burn paper.
10. Power should be between 3 to 7 watts when the burn is symmetric and uniform. There should be no internal structure, such as rings or spots.
11. Fire a single shot on an unexposed area of the burn paper after each adjustment until proper exposure is obtained.

Resonator Optics Inspection/Replacement Procedure, YAG

NOTE: This section applies to the YAG lasers only.

1. Inspect the maximum reflector carefully for burns or other degradation. Use a flashlight and compressed air to aid in the inspection. If any damage is noted, remove the optic with the mount and clean it.
2. Clean the optic carefully using methanol and a lens tissue or cotton swab. If the optic cannot be cleaned, replace it. Be sure to follow the sequence of reassembly outlined in the break-out illustrations.
3. Install the optic with the mount, and then verify alignment. Align the resonator if necessary.
4. When making energy measurements, the entire beam profile must fill at least 75% of the detector area. Take a burn to confirm the size of the beam, and to confirm that it is centered on the detector face.

   CAUTION: Be sure that the burn paper is inside a plastic bag to prevent any burn residue and smoke from depositing on the laser rod or other optics.
5. Inspect both surfaces of the rod using at least a 7x eye loupe for scratches, pinholes, burns, etc. If there is any problem with the rod, note the location and severity of damage on the service report.
6. If dirt is present, clean the end of the rod very carefully as detailed in the steps below. Use only optics grade methanol, or acetone for heavy-duty spots, and tightly wound cotton swabs. Make certain that the cotton swabs do not contain an adhesive.
7. Soak the end of cotton swab with methanol.
8. Shake off any excess methanol from the swab.
9. Using light pressure, move the swab in a circular motion starting in the middle of the rod, and then gradually working outward to the edge of the rod.
10. Dispose of the swab when finished.
11. Reinspect the rod, and repeat as necessary.
    NOTE: Use a new cotton swab each time the rod surface cleaning is repeated.

Flashlamp Inspection/Replacement Procedure

Before replacing the flashlamps, always record the flashlamp pulse count on the *Service and Repair Report* along with the performance data of System Check. Note the location of the red spot on each flashlamp end. This indicates the anode or "+" electrode of the lamp.

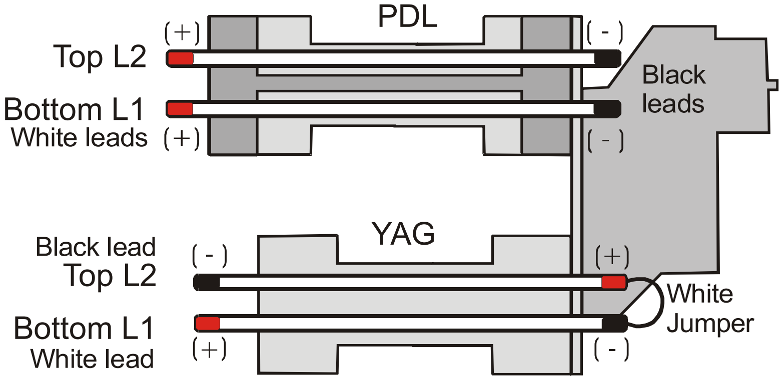

Figure 25–Flashlamps

1. Drain the water.
2. Remove the fiber block.
3. Carefully remove the flashlamp collars from the lamps.

   CAUTION: Do not handle the flashlamps with bare fingers. Skin oils can damage the quartz envelope of the lamp. Always use finger cots or cotton gloves
4. Remove the old lamps, bottom lamp first (allowing the head to drain and reduces drip over the optic), noting the correct position of the flashlamp anode.
5. Clean the new lamps with methanol before installing.
6. Inspect and replace O-rings if necessary.
7. Inspect and clean rod or resonator optics if any water dripped on them during disassembly.
8. Reverse steps 3–4 of this section to install the new flashlamps.
9. Reset the appropriate lamp and rod counters as follows:
   - 9.1 Enter Testall, and then press <space> to prompt the menu screen.
   - 9.2 Press 'w' to set to the appropriate wavelength. Set to "0" for the PDL or "1" for the YAG laser. **NOTE:** If replacing both sets of flashlamps, perform steps 9.3–9.4 at both wavelength settings.
   - 9.3 Press lowercase 'q' on the computer keyboard. Press uppercase 'Z' on the computer keyboard. This resets the flashlamp counter to zero.
   - 9.4 Press uppercase 'Q' on the computer keyboard. Press uppercase letter 'Z' on the computer keyboard. This resets the rod counter to zero.

Beam Combiner Inspection/Replacement Procedure

The beam combiner is coated on both sides to maximize the optical paths of both the PDL and YAG lasers. The first surface (from the perspective of the PDL head) is AR coated for the dye wavelengths and the second surface is coated to maximize the transmission of the dye and to reflect most of the YAG. There is some reflection and leakage, respectively, so care should be exercised when servicing to not look into the beam path at this point. The resonator-interconnect PCB support serves as a beam stop.

1. Inspect the surface of the beam combiner with a flashlight. Any discoloration aside from a pristine, uniform surface may represent damage. It may be necessary to remove the resonator interconnect PCB and its sheet metal mount to gain viewing access to the optic.
2. Remove the entire fiber block to gain access to the hold down screws (3x). Remove the optic and frame.
3. Attempt to clean the surface with lens tissue and methanol. If it cannot be cleaned, replace the optic.
4. When replacing the optic, tighten the screws firmly until the frame seats against the Ultem block.

Fiber Alignment Procedure, PDL

In a properly assembled laser, there is no adjustment necessary. Both the beam combiner and the focus lens are not adjustable, however, it may be necessary to confirm that the focus spot is on the center of the alignment pin in order to rule out a mechanical issue, such as a loose or cocked focus lens. Follow the Fiber Alignment Procedure, YAG, but operate the PDL laser slightly above threshold.

Turning Mirror Inspection/Replacement Procedure

The turning mirror is a vital part of the beam train—it represents the only optic that is adjustable in the beam train. Because of this, the replacement of this optic should be done very carefully.

1. Move the aim beam collimator out of the way. First remove the 4-40 screw that clamps the collimator assembly to the resonator port, and then move the assembly out of the way.
2. Inspect the surface of the turning mirror with a flashlight. Any discoloration aside from a pristine, uniform surface may represent damage.
3. Remove the three 4-40 adjustment screws and the compression springs. It may be easier to remove the entire fiber block to gain better access to the screws.
4. Attempt to clean the surface with lens tissue and methanol. If it cannot be cleaned, replace the optic.
5. When replacing the optic, compress the springs fully until the frame seats against the Ultem block, and then back them off each approximately one turn. This positions the optic correctly, maximizes the resistance of the threads to eliminate the screws backing out, and allows enough adjustment range.

Fiber Alignment Procedure, YAG

The turning mirror is a vital part of the beam train—it represents the only optic that is adjustable in the beam train. Use the alignment fixture(s) to position the YAG beam on the center of the fiber alignment pin.

1. Remove the brass SMA mount and set aside. The electrical connection can be maintained.
2. With the system operating in CV mode, bring the YAG voltage down to just above threshold where the spot is round and appears gray after the burn (1-3 W).
3. Insert the “flower” fixture and fire the laser.
4. Adjust the turning mirror to position the beam in the center of the fixture to generate a symmetrical pattern.
5. Replace the “flower” fixture with the fiber alignment fixture. Either mark the tip with a black permanent marker or use the technique to deposit a small circle of burn paper to the end of the fiber alignment pin.
6. Take a burn.
7. Adjust the turning mirror to center the focused beam onto the pin.

Handpiece Inspection/Repair/Replacement

Some optics within the system are more susceptible to damage than others. After a long period of use, certain optics need to be inspected and unless their condition is pristine, replaced. The first optics to inspect are the handpiece lenses. Any dirt or discoloration in the coating surface will affect the handpiece transmission and thus the overall efficiency of the laser.

WARNING: Never look directly into the handpiece while the laser is on, even when wearing protective eyewear; serious eye injury can occur.

1. Be sure that the laser is off.
2. Disconnect the fiber from the handpiece. Remove the treatment tip if attached. Inspect the window and replace if damaged.
3. Examine the condition of the handpiece lenses, by sighting down the barrel. A handpiece in good working order provides a clear (uniform tinting is normal) unobstructed view through the lens. See examples below.

Dirty Lenses, Unacceptable

Clean Lenses, Good

4. If the handpiece lenses appear dirty, scratched, discolored, or pitted, then test the laser with a good handpiece and repair or replace the damaged lenses/handpieces.
5. If handpiece lenses are replaced, verify the spot size. If necessary re-spot the actual spot size of the handpiece in accordance with Cynosure's recommended procedures for handpiece repair.

Fiber Inspection/Replacement Procedure

The fiber ends should be inspected to insure that they are round, smooth, and clean. If any chips, dust, corrosion, or obvious concentricity errors are apparent, replace the fiber. Generally, the laser does not cause fiber wear, but at times the ends of the delivery fiber can be chipped due to rough handling.

WARNING: Never look directly into the distal end of the fiber while the laser is on, even when wearing protective eyewear; serious eye injury can occur.

1. Be sure that the laser is off.
2. Disconnect the fiber by pulling the fiber from the handpiece and unscrewing the SMA connector from the laser.
3. Using a 7-10X eye loupe, examine both fiber ends. The ends should be round, clear of debris and smooth. See examples below.

Protruding Fiber

Good Fiber

4. If either fiber end is missing, protruding, dirty, blackened, chipped or rough in appearance, do not use. Replace with a new fiber.
5. Hold one fiber end to a bright source, a ceiling light, sunny window, etc., and look at the other end. The fiber end should be illuminated brightly as compared to when it is not pointed at a light source.

Focus Lens Inspection/Replacement Procedure

IMPORTANT: At each service call, the focusing lens must be inspected.

1. Verify that the laser is off.
2. Access the resonator rail module.
3. Remove the two 4-40 Phillips head screws that secure the brass SMA/focus lens mount to the Ultem fiber block.
4. Using a bright lamp, inspect the surface of the focusing lens for inspection. Any pitting or discoloration to the antireflection coating constitutes damage and requires that the optic be replaced. Haze may not be easily detected with poor lighting.
5. Loosen and remove the locking ring with the lens holder key.
6. Wearing finger cots or gloves, clean all parts with methanol and allow them to dry.
7. Carefully drop a new, clean lens into the lens holder. The lens is plano-convex, so orientation is critical. **NOTE:** The curved side of lens faces the laser resonator.
8. Reinstall the locking ring. Gently blow out any debris or dust. Reinspect the lens for cleanliness.
9. Install the focus lens mount on the rail.
10. Spot the laser onto the fiber ferrule using the fiber alignment fixture (706-0199-000) and the technique described on page 40. Verify that fiber transmission is at least 75% of the resonator energy.

Calibration Procedures

Refer to the calibration section of this manual for the calibration procedures. After any optic is replaced, cleaned or adjusted or the internal monitor detached, a calibration check, at a minimum, should be performed. Typically, a full calibration is required.

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Replacing the Front Control Panel Module

1. Turn off the laser power and disconnect the AC from the wall.
2. Remove all connectors between the display and the control PCB.
3. Remove three screws securing the front display bezel to the front of the frame.
4. Remove four screws securing the display/touch screen assembly to the plastic bezel.
5. Replace the display assembly by reversing the steps above.

Calibrating the Touch Screen

1. Turn on the laser.
2. Type ‘ts cal’ from the C prompt.
3. Follow the displayed instruction, verifying that each time a coordinate is touched and released, the display blinks. Complete the display calibration.

Replacing and Calibrating the ETX PCB

IMPORTANT: If the compact flash is faulty on the ETX PCB being replaced, then the new ETX PCB must ship to the field with a new compact flash. The new compact flash should be preprogrammed with software, including MultiPlex, if currently installed on the laser being serviced.

1. Turn off the laser power and disconnect the AC from the wall.
2. Remove the side panels.
3. Remove all connectors from the ETX PCB.
4. Remove the six 4-40 screws that attach the ETX to the sheet metal.
5. Switch the compact flash from the old ETX PCB into the replacement ETX PCB.
6. Install the new ETX PCB by reversing steps 0–4.
7. Turn on the laser and verify that serial number is correct, and that the MultiPlex option is available, if originally installed.
8. Calibrate the dye temp sensor, see page **Error! Bookmark not defined.**
9. Calibrate the resonator and cal port see sections starting on page 97.
10. Calibrate the HVPS, see page 83.

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Replacing the High Voltage Power Supply Module

1. Disconnect the laser from the AC service.
2. Unplug AC from the HVPS.
3. Remove the flat ribbon control cable from the power supply.
4. Remove the four, 8-32 screws that hold the HVPS to the chassis wall and tip the module out of the laser.
5. Unplug high voltage cables from the top of the power supply.
6. Reverse the above steps when installing a new module.
7. Calibrate the high voltage power supply as described in the following section.

Calibrating the HVPS

1. Turn on the laser.
2. If the self test fails, move DIP Switch 7 to the ON position on the ETX PCB.
3. Initialize CV Mode as described on page 19.
4. Attach DVM leads as follows:

DVM Lead	**Test Point**
Red	TP1 +VCAP
Black	-TP2 Ground

5. Press ‘Utility.’
6. Press ‘Calibration.’
7. Press ‘Calibration HVPS.’
8. Follow the instructions displayed on the Utility Screen.
9. When the calibration is complete, verify that DIP Switch 7 is in the OFF position on the ETX PCB. If not move DIP Switch 7 to the OFF position.
10. Press ‘exit’ and cap bank will dump the voltage.
11. Press ‘System Check’ to verify operation.

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Replacing IGBT/Simmer Module Shelf

1. Unplug PS2 to the IGBT driver and simmer PCB.
2. Remove HV cable from CAP+, CAP-, LAMP+ and LAMP- connections on the IGBT driver and simmer PCB.
3. Remove the trigger wire from the Nd:YAG laser head.
4. Remove the trigger wire from the Alex laser head.
5. Unplug two low voltage power supply connectors from the low voltage power supply.
6. Unplug connector PT1 from the simmer transformer.
7. Slowly slide the module out, and unplug the PS5 in the middle of the IGBT driver and simmer PCB.
8. Remove four optical fibers—CR2, CR4, CR6 and U4
9. Slide the module out of the laser.
10. Reverse the above steps when installing a new module.
11. Verify the low voltage power supply as described in the section below.

Replacing Low Voltage Power Supply

There is one low voltage power supply (LVPS) on this system mounted to the chassis below the EXT PCB. This supply has two +12 V outputs, -12V and 5 V that are used for the logic control and power for the different solenoids. Replace the low voltage power supply as follows.

1. Disconnect the AC input and DC output connectors.
2. Remove the four mounting screws.
3. Install new power supply in place.

Replacing IGBT Triple Driver PCB, PDL

1. Unplug the Fastons connecting the PCB to the triple driver PCB. Keep track of which wire goes to which connector, e.g., Faston 1 goes to Faston 2, Faston 2 goes to Faston 1.
2. Remove the mounting screws for the PCB and the screws that mount direct to the IGBT. All screws should be accessible with a long #2 Phillips.
3. Remove the optical connectors, keeping track of their locations on reassembly.
4. Slide the PCB out the side and reverse the procedure to install a new PCB.

Replacing Simmer/Snubber PCB, PDL

1. Unplug the AC.
2. Remove the mounting screws for the PCB and the screws that mount direct to the IGBT. All screws should be accessible with a long #2 Phillips.
3. Slide the PCB out the side and reverse the procedure to install a new PCB.

Replacing the Trigger Transformers

The trigger transformers strike a rapid high voltage spike to initiate breakdown of the lamps to start the low current simmer. Once triggered, the lamps break down noticeably and produce a brief blue glow. This is an indication that the transformer is working.

To replace the trigger transformers, perform the following steps.

1. Detach the AC input to the trigger transformer and all other electrical terminations.
2. Unscrew the transformer from the resonator mount.
3. Remove the old simmer trigger transformer.
4. Attach the new simmer trigger transformer.

Replacing the Simmer Transformers

The AC provided to the simmer supplies passes through two transformers, one for the YAG (135 VA) and one for the PDL (170 VA). These are both located on the lower chassis near the isolation transformer. One reason to replace the simmer transformers is if the AC is not present at the input to the simmer PCBs, yet the fuses are good.

To replace the simmer transformers, perform the following steps.

1. Remove the side skins. Identify the transformer that needs replacement.
2. Remove the damaged simmer transformer.
3. Attach the new simmer transformer.
4. Verify that the low current simmer is maintained.

WARNING: Even when the laser is off and the AC line cord is disconnected, DC voltages on various laser components, such as capacitors may exist. This can present a potentially fatal electrical hazard during service procedures. Proceed with caution!

Removing the Cap Bank Module

Hazardous voltage. Capacitor bank may contain stored energy. Make sure capacitors are fully discharged before servicing

1. Turn off and unplug the laser. Check the remaining charge on the cap bank with a DVM.
2. Disconnect the two high voltage wires (red and black) to the blocking diodes of the IGBT shelf.
3. Disconnect the two signal fibers from the cap bank module.
4. Loosen the two 1/4-20 nuts at the bottom of the cap bank shelf, and then slide the module a third of the way out of the laser.
5. WARNING: Be careful not to injury yourself when removing and installing the module—it weighs sixty pounds and should be handled with care.
6. Disconnect the two high voltage wires from the output of the HVPS.
7. Remove the entire module.
8. Reassemble by reversing the previous steps.
9. Recalibrate the High voltage power supply and the high voltage readback as described in “Calibrating the HVPS” on page 83.

WARNING: Do not attempt to short directly (i.e., with a screwdriver) or a potentially fatal electrical shock can occur.

Replacing a Cap Bank Fuse

1. Turn off and unplug the laser.
2. Using a shorting stick, discharge each capacitor unto zero volts is reached.
3. Remove the fuse. If the fuse cannot be reached, remove the cap bank module as detailed in the section above.
4. Install the new fuse, and then reassemble.

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Draining the Coolant System

When it becomes necessary to drain the coolant system, use the quick disconnect fluid coupling provided. It is located on the main water reservoir of the water pump assembly behind the front door.

CAUTION: When the laser is transported or shipped it is important that the coolant system is completely drained to avoid damaging the laser components. Use the quick disconnect underneath the laser for this purpose only.

Draining the Water

1. Place a pan under the front of the laser under the quick disconnect marked WATER FILL/DRAIN.
2. Snap a mating 3/8" quick disconnect fitting into the fitting. This will drain the system.
3. Run the pump for a few seconds by turning the key on.
4. Disconnect the quick disconnect fitting.

Replacing the Water Pump

1. Remove the front and side panels. Drain the water from the system.
2. Disconnect all electrical connectors for the following:
    - Water Pump AC Line
    - Flow Switch
    - Level Sensors
3. Remove the following water lines from the manifold:
    - 1/2" line to head
    - 3/8" line to D.I. cartridge
4. Remove the 1/2" water line connecting the heat exchanger and flow switch assembly.
5. Remove the two nuts holding the pump plate to the laser chassis. Remove and replace the water pump module.
6. Reassemble by reversing the previous steps.

Replacing the Water Flow Switch

1. Drain the water from the tank.
2. Unplug JT5 from PA5.
3. Disconnect 1/2" tube from the switch.
4. Unscrew the flow switch from the water reservoir.
5. Clean any residual Teflon tape from the threads of the fitting connected to the tank. Rewrap the fitting with Teflon tape.
6. If the wires of the new flow switch have not been terminated with a 2-pin plug, cut the wires from the old switch, and then butt-splice onto the new switch.
7. Replace with a new flow switch. Plug JT5 back into PA5.
8. Fill the tank with water. Check for leaks.

Replacing the Heat Exchanger Module

1. Drain the water and dye solvent from the tank.
2. Unplug P2 from the AC distribution PCB.
3. Disconnect the water tubing from the manifold as it exits to the top of the heat exchanger. Blow into the tubing segment that is still attached to purge the fluid from the heat exchanger. Loosen the dye tubing at the compression fitting on the head exiting to the heat exchanger. The solvent will drain once a vent is created. Use another piece of clean tubing to blow out any remaining solvent from the heat exchanger.
4. Remove the tubing attached to the heat exchanger, top and bottom.
5. Remove the 4 nuts that hold the heat exchanger to the frame.
6. Slide the heat exchanger off the mounts, and then remove from the laser
7. Reassemble by reversing the previous steps.

Replacing the Temperature Sensor(s)

There are two temperature sensors on the Cynergy laser, one for temperature of the dye solvent and one for temperature of the water. They are the same assembly and one must be careful to attach them to the proper spot on the AC Distribution PCB.

1. Drain the water (or dye solvent) from the tank. If dye solvent is drained, disconnect the dye filter from the connections behind the front door and set aside.
2. Unplug P13 (or P12) from the AC distribution PCB.
3. Unscrew the temperature sensor from the heat exchanger.
4. Wrap the threads of the new temperature sensor with Teflon tape.
5. Install the new temperature sensor into the heat exchanger.
6. Plug P13 (or P12) back into the AC distribution PCB.
7. Fill the tank with water (or dye solvent). Reconnect the dye filter. Check for leaks.

Replacing the Deionizer (DI) Cartridge

1. Drain the water.
2. Remove the right side panel as detailed on page 54.
3. Remove the old deionizer, located on the frame assembly by removing the tubing at the fittings, and then opening the clamps. Remove the old cartridge.
4. Insert a new cartridge, and then attach the tubing. If the cartridge does not have fittings, the fittings must be transferred. Clean the threads of any old Teflon tape first. Then place approximately 1.5 turns of new Teflon tape on the male threads, turning by hand until tight.

Calibrating the Dye Concentration Monitor

1. Turn on the laser.
2. Enter Testall Mode as detailed on page 19.
3. Attach the red lead from the DVM to TP20. Attach the black lead from the DVM to TP3 (ground).
4. From Testall mode, press lowercase ‘l’ to increase or uppercase ‘L’ to decrease the voltage until the DVM reads from 1.99V to 2.010V.

Calibrating the Dye Temperature

1. Turn on the laser.
2. Enter Testall Mode as detailed on page 19.
3. Place thermocouple probe into the dye reservoir through the hole provided for the charcoal filter.
4. Press lowercase ‘y’ and then enter the temperature reading on the DVM.

Replacing the Dye Flow Switch

1. Drain the dye from the tank.
2. Unplug JT15 from PA6.
3. Disconnect 1/2" tube from the switch.
4. Unscrew the flow switch from the water reservoir.
5. Clean any residual Teflon tape from the threads of the fitting connected to the tank. Rewrap the fitting with Teflon tape.
6. If the wires of the new flow switch have not been terminated with a 2-pin plug, cut the wires from the old switch, and then butt-splice onto the new switch.
7. Replace with a new flow switch. Plug JT15 back into PA6.
8. Fill the tank with dye. Check for leaks.

Replacing the Dye Pump

1. Remove top cover, left panel (as viewed from front), front door, dye filter, concentration bottle and inner black plastic panel.
2. Install the dye filter bypass tube (p/n 706-0211-000) and drain the dye reservoir into a clean container.
3. Enter Testall Mode as detailed on page 19.
4. Run the dye pump to purge the dye lines of any residual solvent. Drain out any solvent that is left in the reservoir.
5. Turn off the laser, and then unplug the line cord.
6. Remove the dye pump motor plug, PA7, from the AC distribution PCB.
7. Using a 1″ wrench remove the dye inlet tube at the dye pump.
8. Remove the dye outlet lines from the “TEE” connector.
9. Using a 7/16 wrench, remove the two 1/4–20 nuts that secure the dye pump mounting plate to the lower chassis. Push the dye pump assembly towards the rear of the laser, and then lift and pull the back to clear mounting tabs on frame, remove the assembly from the laser chassis.
10. Reverse steps 6 through 9 to install a new dye pump.
11. Make certain all fluid and electrical connections are properly secured.
12. Refill dye reservoir, check for leaks using Testall Mode.
13. Remove the dye filter bypass tube.
14. Replace all the panels
15. Install a new dye filter.

Replacing the Dye Concentration Monitor

1. Unplug laser, and then remove the top cover, side panels, front door, dye filter, dye concentration bottle and inner black plastic panel.
2. Locate and remove the dye concentration monitor connector PC18 at the top of the ETX control PCB. Remove any cable ties securing the dye monitor cable.
3. Locate and remove the four screws that secure the dye concentration monitor PCB assembly to the dye concentration monitor housing.
4. Carefully rotate the dye concentration monitor PCB assembly, and then remove the two screws that secure the clamp to the dye monitor tube. Remove the assembly from the laser.
5. To install a new dye monitor PCB, reverse steps 1 through 4.
6. Calibrate the dye concentration monitor as detailed on page 92.

Note that the frame module can only be replaced at the factory.

Replacing the Voltage Selection PCB

1. Disconnect the laser from the wall.
2. Disconnect all wire connectors from the PCB.
3. Remove the four mounting screws from the central portion of the PCB.
4. Replace the PCB and reverse the previous steps. Make sure the correct line voltage is selected.
   NOTE: This board has no calibration.

Replacing the AC Distribution PCB

1. Disconnect the laser from the wall.
2. Remove al connectors from the PCB. Pay particular attention to the temperature sensors as the connectors can be interchanged.
3. Loosen the lower screws.
4. Remove the upper and remove the PCB.
5. Replace the PCB and reverse the previous steps. **NOTE:** This board has no calibration.

AC Fuses

The AC fuses on the AC Distribution PCB are located under the HVPS on the left side of the laser. The fuses are described in the *System Wiring Diagram*.

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Schedule for Calibration

Cynosure calibrates the laser's energy meter at the factory prior to shipment. The energy meter should be calibrated once a year by authorized service personnel. Call your local Cynosure representative to arrange for annual calibration by authorized personnel. The energy meter is calibrated by checking that the displayed fluence value corresponds to the actual laser pulse energy as measured by an independent energy meter of known accuracy.

Overview

The laser is provided with a built-in energy meter that allows the laser to be calibrated by measuring the actual energy delivered from the handpiece. Energy measurements are obtained by inserting the handpiece into the cal port, and then firing the laser. The front panel display indicates the energy per unit area (or fluence in joules per square centimeter, J/cm^2), taking into account the area of the laser focal spot for the handpiece in use.

The energy meter consists of these main components:

- The cal port built into the front panel. The cal port includes an internal switch to sense the presence of the handpiece, which allows the laser to fire while in calibration mode only if a handpiece is inserted.
- A sapphire window that protects the internals of the cal port and is damage resistant. It should be cleaned frequently using a tissue or cloth.
- A pinhole within the cal port that allows only a small fraction of the incident light through a fiber optic cable to an optical sensor.
- An optical sensor that receives the laser light incident on it, and produces an electrical signal proportional to the absorbed optical pulse energy. The signal is amplified and calibrated at the Laser Control PCB.
- A front panel display that shows the selected fluence in $joules/cm^2$.

Required Equipment

CAUTION: The accuracy of the calibration depends completely upon the measurement of laser pulse energy using a separate instrument as an independent calibration standard. If the calibration standard is inaccurate or not used correctly, then the built-in energy meter will also be inaccurate after calibration.

- An accurate, NIST-traceable, laser power meter for use as a calibration standard. The selected calibration standard must be accurate for the appropriate wavelength and range of pulse energies. The meter’s sensor element or input attenuator must withstand, without damage, the range of fluence and peak power per unit area typical of the laser.
- Laptop computer with RS-232 interface

Calibration Procedures

There are three detectors in the system: 1) a resonator port that samples the full energy of the beam prior to coupling into the optical fiber, 2) a calibration port that samples the full energy leaving the handpiece, and, 3) the internal monitor for monitoring pulse-to-pulse stability of the dye laser. All three detectors must be calibrated as part of a complete service calibration. These calibration procedures are detailed in the following pages.

Before starting the calibration, however, verify that these preparatory steps are taken.

- Verify that the cal port window is clean.

  WARNING: Failure to keep the cal port window clean may result in incorrect calibration.
- Be sure that the fiber optic is properly routed and secured.
- Install a 7-mm handpiece.

Calibrating the Resonator Port, YAG

1. Remove the SMA focusing mount from the rail assembly.
2. Type ‘CV’ from the C:\ prompt**.**
3. Set laser to the following settings
   Wavelength = YAG
   CV Voltage = 450
   Pulse Width = 5 ms
   Rep Rate = 1 Hz
4. Set NOVA II power meter to the following settings:
   Laser type = “NIR”
   Average = 3 seconds
5. Connect NOVA II power meter analog out to laser J2.
6. Align the Ophir detector so it is facing toward the beam combiner output within 14 to 16 inches.
7. Fire the laser one shot, and then verify the energy pulse is not clipping on the Ophir detector head.
8. Set the CV Voltage to approximately 750V.
9. Continue to fire the laser adjusting the laser voltage until the NOVA II power meter reads from 44W to 46W. Make note of the NOVA II power meter reading.
10. Make note of the laser voltage setting.
11. Press lowercase ‘d’ to keep the external shutter closed while firing the laser.
12. Set laser resonator gain to 7.
13. Fire the laser six shots and read the resonator voltage from the CV screen.
14. Verify the voltage is from 0.5 to 1.25 volts.

    If the voltage is too low, increase the gain number (press uppercase ‘M’).

    If the voltage is too high, decrease the gain number (press lowercase ‘m’).
15. Fire the laser six shots again, and read the resonator voltage from the CV screen.
16. Make note of the resonator voltage.
17. Make note of the resonator gain.
18. Press lowercase ‘u’, and then enter the NOVA II power meter reading from step 9.
19. Fire the laser again into the resonator port, and then verify that the resonator energy measures from 43W to 47W.
20. Press lowercase ‘e’ to return the external shutter to normal function.

Calibrating the Resonator Port, PDL

1. Remove the SMA focusing mount from the rail assembly.
2. Type 'CV' from the C:\ prompt.
3. Set laser to the following settings
   Wavelength = PDL
   CV Voltage = 600
   Pulse Width = .5 ms
   Rep Rate = 1 Hz
4. Set NOVA II power meter to the following settings:
   Laser type = "VIS"
   Average = 3 seconds
5. Verify that NOVA II power meter analog out is connected to laser J2.
6. Align the Ophir detector so it is facing toward the beam combiner output within 14 to 16 inches.
7. Fire the laser one shot, and then verify the energy pulse is not clipping on the Ophir detector head.
8. Set the CV Voltage to approximately 700V.
9. Fire the laser adjusting the laser voltage until the NOVA II power meter reads from 7.5W to 8.5 W. Make note of the NOVAII power meter reading.
10. Make note of the laser voltage setting.
11. Press lowercase 'd' to keep the external shutter closed while firing the laser.
12. Set laser resonator gain to 2.
13. Fire the laser six shots and read the resonator voltage from the CV screen.
14. Verify the resonator voltage is from 0.5 to 1.25 volts.
    If the resonator voltage is too low, increase the gain number (press uppercase 'M').
    If the resonator voltage is too high, decrease the gain number (press lowercase 'm').
15. Fire the laser six shots again, and read the resonator voltage from the CV screen.
16. Make note of the resonator voltage.
17. Make note of the resonator gain.
18. Press lowercase 'u', and then enter the NOVA II power meter reading from step 9.
19. Fire the laser again into the resonator port, and then verify that the resonator energy measures from 7W to 9W.
20. Press lowercase 'e' to return the external shutter to normal function.

Calibrating the Cal Port, YAG

1. Remove the SMA focusing mount from the rail assembly.
2. Type ‘CV’ from the C:\ prompt.
3. Set laser to the following settings

   Wavelength = YAG
   CV Voltage = 700
   Pulse Width = 5 ms
   Rep Rate = 1 Hz
4. Set NOVA II power meter to the following settings:

   Range = “AUTO”
   Laser type = “NIR”
   Average = 3 seconds
5. Verify that NOVA II power meter analog out is connected to laser J2.
6. Position the handpiece, so that is facing the Ophir detector head.
7. Press lowercase ‘e’ to allow the external shutter to open when the laser is fired.
8. Fire the laser adjusting the laser voltage until the NOVA II power meter reads from 34W to 36W. Make note of the NOVA II power meter reading.
9. Make note of the laser voltage setting.
10. Move the handpiece to the cal port.
11. Set YAG cal port gain to 10.
12. Fire six shots into the cal port.
13. Verify cal port voltage reads from 0.50 to 1.25 volts.

    If the cal port voltage is too low, increase the gain number (press uppercase ‘C’).

    If the cal port voltage is too high, decrease the gain number (press lowercase ‘c’).

    NOTE: Most gain is 0; least gain is 15.
14. Fire the laser six shots again, and read the cal port voltage from the CV screen.
15. Make note of the cal port voltage.
16. Make note of the cal port gain.
17. Press uppercase ‘U’, and then enter the NOVA II power meter reading from step 8.
18. Fire the laser again into the cal port, and then verify that the cal port energy measures from 34W to 36W.

Calibrating the Cal Port, PDL

NOTE: Before this calibration is performed, the dye temperature should be approximately 39 °C.

1. Remove the SMA focusing mount from the rail assembly.
2. Type 'CV' from the C:\ prompt.
3. Set laser to the following settings
   - Wavelength = PDL
   - CV Voltage = 700
   - Pulse Width = 5 ms
   - Rep Rate = 1 Hz
4. Set NOVA II power meter to the following settings:
   - Range = 30W
   - Laser type = "VIS"
   - Average = 3 seconds
5. Verify that NOVA II power meter analog out is connected to laser J2.
6. Position the handpiece, so that is facing the Ophir detector head.
7. Press lowercase 'e' to allow the external shutter to open when the laser is fired.
8. Fire the laser adjusting the laser voltage until the NOVA II power meter reads from 5W to 7W. Make note of the NOVA II power meter reading.
9. Make note of the laser voltage setting.
10. Move the handpiece to the cal port.
11. Set YAG cal port gain to 3.
12. Fire six shots into the cal port.
13. Verify cal port voltage reads from 0.50 to 1.25 volts.

    If the cal port voltage is too low, increase the gain number (press lowercase 'C').

    If the cal port voltage is too high, decrease the gain number (press uppercase 'c').

    NOTE: Most gain is 0; least gain is 15.
14. Fire the laser six shots again, and read the cal port voltage from the CV screen.
15. Make note of the cal port voltage.
16. Make note of the cal port gain.
17. Press uppercase 'U', and then enter the NOVA II power meter reading from step 8.
18. Fire the laser again into the cal port, and then verify that the cal port energy measures from 5.5W to 6.5W.

The section of the technical guide is to make certain that repaired Cynergy lasers pass all functional and physical performance requirements before being released back to a customer.

Final Check Procedure

NOTE: If a laser fails a step, record the discrepancy on a *Service & Repair Report*, as well as the corrective action taken.

1. Verify that the system contains distilled water. Turn on the laser with the key switch and verify that the front control panel features light, the system warms up and the Home Page appears after the warm up.
2. Verify that System Check performance results are “Good.”
3. Check the dye kit manufacturing date, and the remaining contents of the dye inject bottle.
4. Record the dye pulses, and then reset the dye kit count after a dye kit change.
5. Record the flashlamp and system shot number for both heads.
6. Confirm that the aim beams, amber LED and red laser are bright.

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Troubleshooting

Faults

The user may encounter faults while operating the laser system. When a fault occurs a fault code appears on the display followed by a brief text message. There are two types of faults: 1) errors, or 2) warnings.

Errors faults are critical and will cause the laser to stop operating. These faults codes begin with the prefix 'E' meaning error. Some of these errors require that you contact the Cynosure Service Department.

Warnings are faults that indicate an improper laser state or operator error. These fault codes begin with the prefix 'W' meaning warning. For example, an attempt to fire the laser without a fiber present causes a warning fault to occur. The operator can usually correct these faults.

All faults codes and messages are listed in the following table, along with the probable cause and corrective action if applicable.

Fault Code Table

Fault Code and Text Message		**Probable Cause/Corrective Action**
E01	Water Flow Fault; Cycle Power	Broken water pump or blown fuse. Needs service.
E02	Open Shutter Fault	Safety shutter stuck closed. Do not use laser until serviced.
E03	Close Shutter Fault	Safety shutter stuck open. Do not use laser until serviced.
E04	Fuse Open; Call Service	Blown capacitor bank fuse or shorted dump circuit. Needs service.
E05	Checksum Error; Call Service	Computer program memory error. Needs service.
E07	IGBT Fault - YAG	YAG IGBT overload sensed. Cycle power to continue.
E08	Heater Fault; Call Service	Open thermostat or heater. Blown heater fuse. Needs service.
E09	Coolant Sensor Fault; Call Service	Open thermistor sensor or unplugged. Needs service.
E10	No High Voltage	Capacitor bank or HVPS wire shorted. No read back voltage. Needs service.
E13	No Simmer YAG	Broken lamp or blown fuse. Needs service.
E14	HVPS Fault	HVPS over-temperature.
E15	Dump Fault; Call Service	Fuse fault at power up. Needs service.
E16	Dump Fault; Call Service	Dump always on. Needs service. Dump shorted. Failed dump TX. HVPS failed.
E17	Dump Fault; Call Service	Dump not working. Needs service. Fiber connections broken to cap bank. HVPS disconnected or failed.
E18	H2o Flowmeter	Defective water flow sensor. Needs service.
E19	HVPS Fault	HVPS over-voltage or open-circuit.
E23	Low Trans; Replace Fiber/Handpiece	Damaged fiber, handpiece or focus lens, needs replacement.

Fault Code and Text Message		Probable Cause/Corrective Action
E24	YAG Calibration Error; Call Service	Incorrect Resonator Port or Cal Port sensor calibration. Needs service.
E25	YAG Cal Failed, Energy Low; Call Service	YAG cal port energy too low to use. Needs service.
E26	No Energy; Check Fiber/Handpiece	Broken fiber or severely damaged focus lens. Needs replacement.
E27	DYE Flow Fault	No dye filter or it is not installed properly. Broken pump. Blown fuse
E28	IGBT Fault - Dye	Dye IGBT overload sensed. Cycle power to continue.
E29	IGBT Fault - Pulse Simmer	Pulse simmer IGBT overload sensed. Cycle power to continue.
E30	No Simmer PDL	Broken lamp or blown fuse. Needs service.
E32	Flow Switch DYE	Broken dye pump or blown fuse. Needs service.
E33	PDL Calibration Error, Call Service	Transmission too high. Miscalibrated resonator or cal port sensor. Needs service.
E34	PDL Cal Failed, Energy Low; Call Service	Low delivered dye energy. Needs service
E35	PDL Misfire	Possible dye simmer fault. Service if problem reoccurs.
E36	YAG Misfire	Possible yag simmer fault. Service if problem reoccurs.
E37	Simmer Sensor PDL	Failed dye simmer control module. Needs service.
E38	Simmer Sensor YAG	Failed YAG simmer control module. Needs service.
E39	HVPS Adjust Error	HVPS readback incorrect. Defective HVPS. Needs service.
E40	PDL and YAG Cal Failed, Call Service	Fiber, handpiece, or focus lens damaged. Needs service.
E41	Display Fault; Call Service	Corrupted internal display files. Needs service.
E42	Blocking Diode; Call Service	Shorted blocking diodes. Needs service.
E43	Ext Shutter	Shutter positioning failure on power-up. Retry. If continued failure, do not use laser until serviced.
E44	Keypad	Object on touchscreen. Broken touchscreen.
E45	File Open Error; Call Service	Defective compact flash memory card. Corrupted internal files. Needs service.
E46	PDL Temp Sensor Fault; Call Service	Open dye thermostat or heater. Blown heater fuse. Needs service.
E47	Internal Math Error; Call Service	Corrupted program or data file. Needs service.
E48	Checksum Error; Call Service	Computer calibration data error. Needs service.
W50	Open Interlock; Check Interlock	Install remote interlock connector or, if using interlock, close laser room door.
W51	No Fiber; Connect Fiber	Install delivery fiber and handpiece.
W52	Wavelength Unavailable	Wavelength use disabled. See second line message for the reason.
W53	Low Water; Add Water	Water is low. Add water to reservoir.
W54	HVPS EOC Warning	High fluence when using 120 VAC. Press standby to continue using laser.
W56	Invalid Handpiece; Change Handpiece	Handpiece from another laser model or handpiece not allowed for selected wavelength. Install correct handpiece.
W57	No Handpiece; Install Handpiece	Install handpiece.

Fault Code and Text Message		Probable Cause/Corrective Action
W58	Handpiece Changed	Handpiece changed. Press screen message box to continue.
W59	Low Trans; Check Fiber and Handpiece	Fiber, handpiece, or focus lens damaged but still useable.
W60	YAG Cal Failed, Energy Low; Call Service	Low delivered yag energy. Needs service
W61	PDL Cal Failed, Energy Low; Call Service	Low delivered dye energy. Needs service
W63	Fluence Meter Error; Call Service	Miscalibrated cal port meter. Defective cal port. Needs service.
W64	Internal Meter Error; Call Service	Miscalibrated res port meter. Defective res port. Needs service.
W65	Energy Out of Range, YAG	Capacitor bank did not recharge properly or overcharged. Retry operation.
W66	Handpiece Removed	Handpiece removed from cal port during system check or calibration.
W67	Unable to Reach Fluence; Decrease	Max fluence reached for handpiece and/or treatment settings. Lamps near end-of life.
W68	Schedule Lamp Change, PDL	Lamps for dye laser approaching end-of-life. Schedule lamp replacement.
W69	Schedule Lamp Change, YAG	Lamps for Nd:YAG laser approaching end-of-life. Schedule lamp replacement.
W70	Coolant Over Temp; Let Laser Cool	Water is too hot for continued operation. Fans are on to cool laser. Let laser cool.
W71	Add Water Soon	Water level low - refill water reservoir.
W72	Energy Out of Range, PDL	Capacitor bank did not recharge properly or overcharged. Retry operation.
W73	PDL Over Temp; Let Laser Cool	Dye is too hot for continued operation. Fans are on to cool laser. Let laser cool.
W74	Warning: Purge Dye Concentrate Bottle	Air in dye line, squeeze bottle
W75	Dye Mix Warning; Call Service	<ABS 0.85 after 30 min cycle (30 injects)

Self Test

During startup, the laser runs a self test. If the fault occurs during this process, consult the fault code chart above for information on resolving the fault.

Troubleshooting Chart

Problem	Possible Cause	Solution
Laser does not turn on.	Power lines are not properly connected.	Check and secure power cables.
	Laser circuit breaker is in OFF position.	Turn on circuit breaker (near power cord in back.
	Main panel circuit breaker of wall service is in OFF position.	Turn circuit breaker on at panel.
	Key switch is not in the ON position.	Turn the key switch to the ON position.
Laser turns on (display lights and pumps on), but does not stay running.	Multiple causes: Self check failure displayed	Follow prompt on text message area to resolve. If unable to resolve, call Cynosure Service Dept.
Laser does not go into the PDL mode.	Dye solvent is not warmed up to 40 °C	Wait for warm up.
Laser unable to inject dye during warm-up mix cycle	Extremely low dye concentration Inject bottle depleted	Check dye inject bottle is properly connected and that the dye inject bottle is not empty.
	Air in inject lines	Turn system off, gently squeeze inject bottle for approximately 5 seconds to remove air bubbles. Check ABS reading. Manually press dye inject button via the Option screen to speed up process. If unable to resolve, call Cynosure Service Dept.
Laser does not enter Ready or Standby modes.	The delivery optical fiber or handpiece is disconnected.	Connect the optical fiber and the electrical connector to the handpiece.
The laser does not fire from Ready mode.	Foot switch is not connected or hand switch wires are broken.	Fully seat foot switch connection and make sure hose is not kinked or crushed by equipment. Replace handpiece to try another.
Laser will not enter Ready mode from Standby mode	Foot switch or hand switch is depressed	Release switch.

NOTE: If any problems occur that are not covered in the troubleshooting chart, or the suggested solutions do not work, call the Cynosure Service Department, see page 9 for contact information.

Transferring Diagnostic Data

During a live troubleshooting event, you may be asked to download data from the laser via a USB stick (use only a SanDisk USP flash drive with a minimum of 128 MB storage) and forward that data to Cynosure service personnel for analysis. This data helps service personnel to diagnose the condition of the laser and be prepared should a service call be necessary. To access the USB slot and download data, follow these steps.

1. Open the front door of the laser, and locate the access panel that covers the USB slot, see **Figure 26A**.
2. Using a flathead screwdriver or a coin, turn the access panel screw one quarter turn to the right. Take off the panel and place aside.

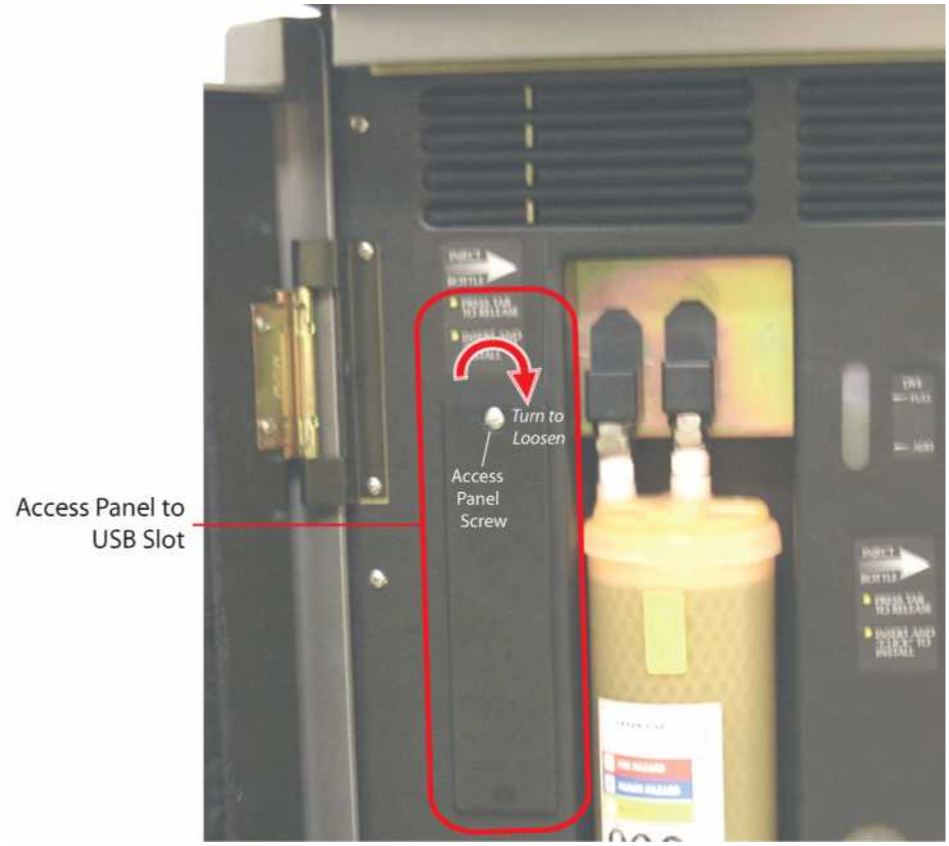

Figure 26A–USB Access Panel Location

3. Once the panel is off, locate the USB slot, and then insert the USB stick into the slot. See **Figure 26B**. Make sure the LED is illuminated on the USB stick.

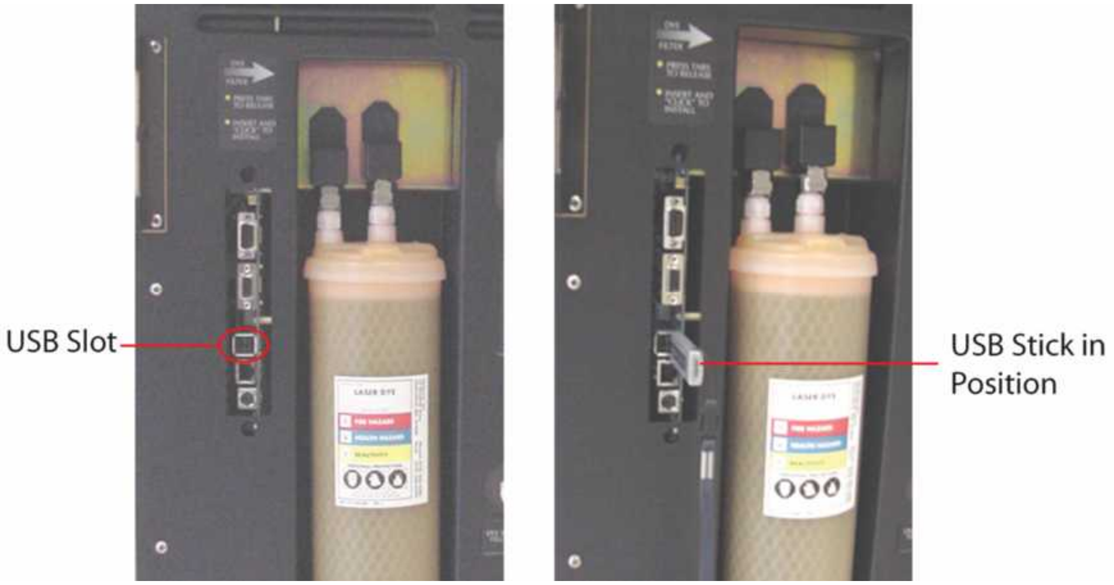

Figure 26B–USB Slot Location

4. Verify that the laser is on and the handpiece is in the Cal Port.
5. Initiate and complete a System Check.
6. Access the Option Screen from the Utility Screen from the Home Screen. Press Diagnostic on the Option Screen. This initiates a test sequence lasting several minutes where the laser fires into the cal port.
7. When the report is complete a summary will appear on the screen. Press Dump Data to USB to download results to USB stick.
8. Remove the USB stick from the slot, and then email the data files electronically as directed by Cynosure service personnel.
9. Replace the panel, and then tighten the screw in place by turning it in the opposite direction.

Attaching a Laptop Computer

For communication and diagnosis of the laser, a laptop computer with a Windows DB9 to DB9 Null-modem serial cable (pins 2-3 swapped), and HyperTerminal or an equivalent serial terminal program is needed.

The laptop must have a RS232 serial port and operate on COM1. For USB adaptors, the adaptor must be setup to operate on COM1 so that HyperTerminal will operate correctly. When upgrading the laser software, COM1 must be setup.

NOTE: The following section is for setting up HyperTerminal the first time only. Other RS232 terminal programs should be setup using the same parameters.

HyperTerminal Setup

1. Start HyperTerminal program (from start menu–programs–accessories–communications).
2. Set ‘CONNECT USING’ to ‘DIRECT TO COM1:’ or the com port being used.
   Click OK. (screen changes)
3. Set ‘Bits per second’ (BAUD) to 115200.
4. Set ‘Data bits’ to 8.
5. Set ‘Parity’ to NONE.
6. Set ‘Stop bits’ to 1.
7. Set ‘flow control’ to NONE. Click OK.

NOTE: HyperTerminal should be running and the laser status should be displaying on the computer.

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Tabbed Page

Final Test/Calibration

WARNING:
This document and procedures are to be used **ONLY** by a certified Cynosure technician. This document is not for distribution and is intended for internal use only.

Cynergy™

Final Test Procedure

CYNOSURE®
Where art and science meet.

REVISION HISTORY

Rev.	**ECO #**	**Description**	**Changed by:**	**Date**
1	ECN00217	Release Cynergy Final Test procedure to Engineering	R Coppinger	8/31/05
2	ECO05698	release to production	R. Coppinger	12/6/05
3	ECO05817	Add Multiplex verification	R. Coppinger	2/01/06
4	ECO05883	Change Multiplex Setup. Correct typo mistakes Change how user logs onto laser	R. Coppinger	3/10/06
5	ECO05906	Modify “Verify Fiber Alignment” section.	R. Coppinger	3/23/06

Table of Contents

Purpose

1.1 The purpose of this procedure is to ensure that assembled Cynergy lasers are calibrated, tested and functioning properly before final QC inspection.

2 Tools Required

- Calibrated hand-held digital multimeter (Fluke 87 or equivalent)
- Funnel, approx.4”
- Thermocouple Digital Thermometer
- OPHIR NOVA II Energy/Power meter
- OPHIR F250A-HL Detector Head
- OPHIR PD300 –BB-SH Photodiode Detector Head
- ‘ZAP-IT’ laser alignment paper
- PS2 Keyboard
- .05 Allen wrench
- Latex gloves
- Optics Alignment Tool #706-0133-000
- Pocket Colorimeter #706-0148-000
- Pressure Test Gage assembly #706-0212-000
- Dye Filter Bypass tube # 706-0211-000
- Dye Inject bottle with clear solvent
- Dye Test Filter
- Dye Test Inject bottle
- YAG Turning Mirror Alignment fixture #706-0198-000
- Fiber alignment Lens fixture #706-0199-000 assembled with
  (805-1836-004 focus lens)
  (130-7000-084 lock ring)
  (801-1000-007 Window Rect)
- Wrench and screwdriver sets
- Ring stand and clamps
- Computer or Laptop with any Serial Communication Program, i.e. windows “HyperTerminal” or DOS “COMM”, Monitor and keyboard, DB9 F-F Null Modem Serial Cable
- 3,5,7,10,12,15mm Hand piece with trigger switches
- Cynergy data sheet #991-4909-000

3 Overview

3.1 This document describes how to calibrate and test the Cynergy laser System.

4 Stress Test

4.1 Verify that the water tubing is properly connected and that all fittings are tight.

4.2 Inspect the system for loose wires and hardware.

4.3 Run the laser over the path of the vibration test fixture three times.

5 Test Resistance of Ground Connection

5.1 Set the Fluke Model 87 digital multimeter to read 4½-digit display by depressing the yellow button and turning the select knob to Ω (Ohms) while holding the yellow button for three seconds.

5.2 Connect the red lead to the ground pin of the laser AC line cord.

5.3 Connect the black lead to the chassis ground.

5.4 Measure the ground resistance and verify that it is ≤100mΩ (≤ 0.100Ω).

6 Set AC Voltage Selection

6.1 Set digital multimeter to measure AC Voltage (‘AC Volts’ or ‘V RMS’ scale).

6.2 Measure the line voltage at the wall outlet that the laser’s AC line will be plugged into.

6.3 Insert the leads of the multimeter to the ‘hot’ and ‘neutral’ terminals of the wall outlet.

6.4 Locate the AC voltage selection PCB #710-0124-000, accessible from the back of the laser. There are four connectors on the board for the voltage selection.

6.5 Connect the 6-pin AC Select plug to the correct connector based on the line voltage measured from the wall outlet.

Measured Line Voltage		**Connector**
110V - 181V	DO NOT USE	120V Connector (DEMO ONLY)
195V – 200V	plug into	200V Connector
201V - 220V	**plug into**	**220V Connector**
221V - 245V	plug into	240V Connector

6.5 Set the HVPS charge rate switch to the (4000 J/sec) position. The switch is located on the top of the HVPS.

7 Set Up the ETX Computer Interface Board

7.1 Verify that the DIP-switches on the ETX Board (#710-0138-000) are set as follows.

Dip Switch Funtions on Control Logic PCB

Switch S1	
1	**OFF**
2	**OFF**
3	**OFF**
4	**OFF**
5	**OFF**
6	**OFF**
7	**ON = BYPASS SELFTEST**
8	**OFF**

8 Pre Power on Setup

8.1 Verify beam combiner block is removed from rail.

8.2 Verify all fluid and electrical connections are routed and secured properly.

8.3 Connect the funnel to the water tank; add ~ 1 liter of distilled water until the water level is within ½ inch from the top of tank.

8.4 Install the Dye Filter Bypass Tube **#706-0211-000**.

8.5 Add V-Star solvent **#102-0024-000** to the dye tank until the solvent level is ~1.5 inches from the top of the tank.

8.6 Install dye inject bottle with V-Star solvent, squeeze bottle to prime the dye inject pump.

9 Initial Power-up

WARNING: exercise extreme caution when the laser panels are off and the line cord is connected. You are exposed to high voltage and rotating fan blades when the panels are off.

9.1 Plug the line cord of the laser system into the wall outlet.

9.2 Connect external monitor, keyboard, and computer.

9.3 Open up HyperTerminal session and set the following parameters:
baud rate =115200
Data bits = 8
Parity = None
Stop Bits = 1

9.4 Power on laser

9.5 After Cynosure logo appears type, <**CLS**> (brings you to “C:\” prompt).

10 Calibrate Touch Screen

10.1 Power on laser

10.2 Type <**tscal>** from the “C:\” prompt. Follow the displayed instructions, verify that each time a coordinate is touched and released, display blinks. Complete the touch screen calibration.

11 Load Software, Serial#, Set Time,Date

11.1 Power on laser

11.2 Type <**NN>** from the “C:\” prompt.

11.3 Wait for prompt to display S:\Software\TestEng.

11.4 Type <**cytest**>.

11.5 Press key “**2**” and follow instructions to update laser software.

11.6 Press key “**3**” and enter laser serial #.

11.7 Press key “**5**” and enter date.

11.8 Press key “**6**” and enter Time.

12 Enable Multiplex Mode

12.1 Power on laser

12.2 Type <**NN>** from the “C:\” prompt.

12.3 Wait for prompt to display S:\Software\TestEng.

12.4 Type <**cytest**>.

12.5 Press key “**4**” to Enable Multiplex option.

13 Zero DYE Lamp Counter

13.1 Power on laser and go to the C:\.
13.2 Type <**TN>** from the “C:\” prompt (TESTALL mode).
13.3 Prompt the MENU screen by pressing <**Space**> on the keyboard.
13.4 Press lower case letter ‘**w’** on the computer keyboard (**set wavelength to 0 DYE).**
13.5 Press lower case letter ‘**q’** on the computer keyboard.
13.6 Press upper case letter ‘**Z’** on the computer keyboard (Zero DYE flashlamp counter).
13.7 Press upper case letter ‘**Q’** on the computer keyboard.
13.8 Press upper case letter ‘**Z’** on the computer keyboard. (Zero DYE counter)

14 Zero YAG Lamp/Rod Counter

14.1 Press lower case letter ‘**w’** on the computer keyboard (**Set wavelength to 1 YAG).**
14.2 Press lower case letter ‘**q’** on the computer keyboard.
14.3 Press upper case letter ‘**Z’** on the computer keyboard (Zero YAG flashlamp counter).
14.4 Press upper case letter ‘**Q’** on the computer keyboard.
14.5 Press upper case letter ‘**Z’** on the computer keyboard. (Zeros YAG Rod counter)

15 Calibrate Dye Temp Sensor

15.1 Power on laser

15.2 Type <**tn**> from the “C:\” prompt (TESTALL mode).

15.3 Place thermocouple probe into the dye reservoir.

15.4 Press lower case “**y**” and enter the temperature

16 Calibrate Dye Concentration Monitor LED

16.1 Power on laser

16.2 Type <**tn**> from the “C:\” prompt (TESTALL mode).

16.3 Attach Red lead from DVM to TP20 and black lead to TP3 (GND)

16.4 From Test All press lower case “**l**” to increase voltage or upper case “**L**” to decrease voltage until the meter reads between **1.990 to 2.010 volts**.

17 Adjust Dye Pump Output Pressure

17.1 Remove the Dye Filter Bypass tube

17.2 Install Pressure Gauge (#706-0212-000) into the left hand dye filter quick connect fitting.

17.3 Remove the “Acorn” nut located on the bottom of the dye pump.

17.4 Turn pressure check valve ~two turns counter clockwise.

17.5 Power on laser

17.6 Type <**tn**> from the “C:\” prompt (TESTALL mode).

17.7 Turn on dye pump, adjust pressure check valve so that gauge reads **55 to 60 PSI.**

17.8 Shut off pump.

17.9 Reinstall the acorn nut; make certain that the o-ring in nut is properly seated.

17.10 Turn on Dye Pump; verify dye pump pressure still reads between **55 to 60**-PSI.

17.11 Remove gauge and reinstall bypass tube.

18 Test HVPS & Dump Circuit

18.1 Connect DVM red lead to TP1 on the cap bank PCB

18.2 Connect DVM black lead to TP2 on the cap bank PCB

18.3 Power on laser

18.4 Type <**cv**> from the “C:\” prompt (CV mode).

18.5 Select Nd:YAG.

18.6 Verify voltage charges to ~400 VDC in ~5 seconds.

18.7 Press “Home”

18.8 Press “Utility”

18.9 Verify voltage starts to decrease to 0 (cap bank dumps).

19 Calibrate HVPS

19.1 Power on laser

19.2 Type <**cv>** from the "C:\" prompt (CV mode).

19.3 Press "Utility" button

19.4 Press "Calibration" button

19.5 Press "Calibrate HVPS" button

19.6 Follow instructions displayed on the utility screen.

19.7 When cal is completed press the "EXIT" button to dump the high voltage.

19.8 Return S1 to normal operation, Set S1 **position 1- 8 OFF** on the ETX Board (#710-0138-000).

20 Align ND: YAG Maximum Reflector

20.1 Remove the beam combiner block.
20.2 Power up laser
20.3 Type <**cv>** from the "C:\" prompt (CV mode).

20.4 Position the Ophir F250A-HL detector head between **14" to 16**" from YAG resonator chamber. Align the F250A-HL detector disk with the YAG resonator output.

Set: NOVA II Power Meter
Menu = Power(Watts)
Range = Auto
Average = 1-second
Laser wavelength = NIR or 1064.

20.5 **Set: Cynergy Laser**
Voltage = 450 V (set voltage to obtain ~ 3watts)
Pulse width =5 ms
Rep rate = 1 Hz

20.6 Center a piece of 'ZAP-IT' laser alignment paper in front of the F250A-HL detector disk.
20.7 Fire laser a single shot into the 'ZAP-IT' paper.
20.8 Verify the burn is centered on the F250A-HL detector disk. Re-position the energy detector if necessary.
20.9 Using the optics alignment tool, adjust the 3 screws on the max. reflector for a circular burn pattern with sharp edges.
20.10 Fire a single shot on an unexposed area of the "ZAP-IT" paper after each adjustment, until proper exposure is obtained.
20.11 When correctly adjusted the burn should be circular and uniform with no internal structure, such as rings or spots on the "ZAP -IT" paper.
20.12 Once satisfied with the burn pattern, lock the mirror adjustment crews in position.

20.13 Fire laser one more time onto "ZAP-IT" paper to verify that tightening the mirrors did not affect the burn pattern.

21 Verify YAG F.O.M

21.1 Remove beam combiner block.

21.2 Position the Ophir detector head **14 to 16** inches from the YAG pump chamber.

21.3 Power up laser

21.4 Type <**cv**> from the "C:\" prompt (CV mode).

21.5 **Laser Setup:**
Set laser WL = YAG (1064)
Voltage = 750v
Pulse Width = 5msec
Rep Rate = 1Hz

21.6 Fire the laser 10 shots and read the power on the meter.

21.7 Increase the YAG laser voltage to 850 volts.

21.8 Fire the laser 6 shots and read the power on the meter.

21.9 The resonator should measure **≥ 55 watts @ ≤ 850 volts**. NOTE: (Do not EXCEED 85 Watts).

21.10 Record the YAG resonator power @ 850 volts on Data Sheet **#991-4909-000.**

22 Calibrate Dye Absorbance

22.1 Install the Dye Test filter.

22.2 Install the Dye Test inject bottle.

22.3 Squeeze the Dye bottle until the Dye input tubing line is filled with Dye.

22.4 Power up laser

22.5 Type <**cv**> from the "C:\" prompt (CV mode).

22.6 Select laser wavelength to PDL (PDL Laser).

22.7 Let laser run until DYE temp is ~ 39 degrees C. (**Approx. 15 Min**)

22.8 Remove the Dye tank charcoal filter located on top of tank.

22.9 Using the syringe from the colorimeter kit (#706-0148-000), take a sample of dye out of the Dye tank.

22.10 Place the Dye sample into the glass tube and measure the optical density using the colorimeter #706-0148-000.

22.11 With a properly charged test filter, the sample should measure between **0.75 to 1.1**

22.12 Press lower case "**z**" and enter the **value measured** in step 22.10.

22.13 Record the DYE Absorbance value on Data Sheet **#991-4909-000.**

23 Align DYE Resonator

23.1 Verify beam combiner block is removed.

23.2 Power up laser

23.3 Type <**cv**> from the “C:\” prompt (CV mode).

23.4 **Set laser voltage = 625v:**

23.5 **Set laser Pulse width = .5 ms**
Set laser Rep rate = 1 Hz

23.6 Press the footswitch and take a burn. Examine the burn pattern. It should be circular with sharp edges.

23.7 Use insulated alignment tool (706-0133-000) for adjusting the mirrors.

23.8 Adjust the maximum reflector to optimize the quality of the burn, on burn paper. Power should be optimized when the burn is symmetric and uniform. There should be no internal structure such as rings or spots. If necessary, adjust the laser voltage up or down, firing a single shot on an unexposed area of the burn paper after each adjustment, until proper exposure is obtained.

23.9 Hold down the footswitch and fire the laser, while adjusting the max. reflector, for a maximum reading on the Energy/Power meter, approximately > 1watt when firing the laser at 625volts.

24 Verify DYE F.O.M

24.1 Verify beam combiner block is removed

24.2 Position the Ophir detector head **14 to 16** inches from the DYE pump chamber.

24.3 Power up laser

24.4 Type <**cv**> from the “C:\” prompt (CV mode).

24.5 **Laser Setup:**
Set laser WL = DYE (595)
Set laser volatge = 750v
Set laser Pulse width = .5 ms
Set laser Rep rate = 1 Hz

24.6 Fire the laser 10 shots and read the power on the meter.

24.7 Increase the PDL laser voltage to 850 volts.

24.8 Fire the laser 6 shots and read the power on the meter.

24.9 The resonator should measure **≥ 9 watts @ ≤ 850 volts**. NOTE: (Do not fire laser more then 10 shots at a time if resonator EXCEEDs 14 Watts).

24.10 Record the DYE resonator power @ 850 volts on Data Sheet **#991-4909-000.**

25 Align Nd:YAG turning Mirror

25.1 Verify the beam combiner block is installed onto the rail.

25.2 Remove the SMA/focus lens assembly from the beam combiner block.

25.3 Install mirror alignment fixture **#706-0198-000** to the beam combiner block.

25.4 Power up laser

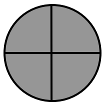
25.5 Type <**cv**> from the “C:\” prompt (CV mode).

25.6 **Set laser**:
Wavelength = YAG
voltage = 450
Pulse Width = 5msec
Rep Rate = 1Hz

25.7 Fire the YAG laser at low energy through the mirror alignment fixture.

25.8 Adjust the YAG turning mirror adjustment screws to center the burn pattern on the Zap it paper through the mirror alignment fixture.

25.9 Remove mirror alignment fixture **#706-0198-000**.



26 Verify YAG Fiber Alignment

26.1 Verify the beam combiner block is installed onto the rail.

26.2 Install the lens fixture **#706-0199-000** to the beam combiner block.

26.3 Power up laser

26.4 Type <**cv**> from the “C:\” prompt (CV mode).

26.5 Punch out a hole of adhesive ZAP-IT paper, using a large Amp pin extractor.

26.6 Stick the adhesive ZAP-IT paper onto the end of an SMA Fiber Alignment test pin.

26.7 Insert the SMA test pin into the Lens fixture.

26.8 Insert a glass slide into the Lens fixture.

26.9 **Set laser:**
Wavelength = YAG
voltage = 450
Pulse Width = 5 msec
Rep Rate = 1Hz

26.10 Fire laser one shot into SMA test pin with ZAP-IT paper.

26.11 Remove the SMA test pin, verfiy burn spot is centered on the ZAP-IT paper ◙.

26.12 If necessary, re-adjust the YAG turning mirror to center burn spot on the SMA test pin.

26.13 Attach the YAG ZAP-IT paper burn spot to data sheet **#991-4909-000.**

27 Verify Dye Fiber Alignment

27.1 Verify the beam combiner block is installed onto the rail.

27.2 Install the lens fixture **#706-0199-000** onto the beam combiner block.

27.3 Power up laser

27.4 Type <**cv**> from the “C:\” prompt (CV mode).

27.5 Punch out a hole of adhesive ZAP-IT paper, using a large Amp pin extractor.

27.6 Stick the adhesive ZAP-IT paper onto the end of an SMA Fiber Alignment test pin.

27.7 Insert the SMA test pin into the Lens fixture.

27.8 Insert a glass slide into the Lens fixture.

27.9 **Set laser:**
Wavelength = PDL
voltage = 600
Pulse Width = .5 msec
Rep Rate = 1Hz

27.10 Fire laser one shot into SMA test pin with ZAP-IT paper.

27.11 Remove the SMA test pin, verfiy burn spot is centered on the ZAP-IT paper ◙.

27.12 **NOTE:** If the burn spot is positioned at 4’oclock add the metel shim between beam Combiner block and DYE head. If burn spot is at 11’oclock remove the metel shim

27.13 Attach the DYE ZAP-IT paper burn spot to data sheet **#991-4909-000.**

28 Calibrate YAG Resonator Port

28.1 Verify the beam combiner block is installed onto the rail.

28.2 Remove the SMA/focus lens assembly from beam combiner block.

28.3 Power up laser

28.4 Type <**cv**> from the "C:\" prompt (CV mode).

Set Laser	**Set NOVA II Meter**
WL = YAG	Laser Type = NIR or 1064
Voltage = 500	Average = 3sec
Pulse Width = 5ms	Range = auto
RepRate =1Hz	Measurement = power

28.5 Position the Ophir detector 14" to 16" away facing towards the beam combiner output.

28.6 Fire the laser one shot and verify energy pulse is not clipping on the Ophir Detector head.

28.7 Set laser voltage to 750 volts.

28.8 Fire the laser and adjust the laser voltage until the NOVA II power meter reads **45W +/- .5W**. Make note of the power reading it will be used in a later step.

28.9 Record the laser voltage setting on Data Sheet **#991-4909-000.**

28.10 Press lower case "**d**" to keep EXT shutter closed, and direct energy into Res port.

28.11 Fire the laser 6 shots and read the "res" voltage from CV screen.

28.12 Verify YAG "res" voltage reads between **.5 and 1.25 volts**.

28.13 If YAG "res" voltage is to low decrease the gain #. (press "**m**" valid gain values are 1 -15).

28.14 If YAG "res" voltage is to high increase the gain #. (press **"M"** valid gain values are 1 -15).

28.15 Re- Fire the laser 6 shots and read the YAG "res" voltage from CV screen.

28.16 Press lower case '**u'** and enter the <u>actual Ophir meter reading</u> from step 28.8

28.17 Fire laser again into the resonator port and verify YAG "res" energy measures **45Watts +/- 1 Watt.**

28.18 Record YAG 5ms "res" voltage value on Data Sheet **#991-4909-000.**

28.19 Record YAG 5ms "res" gain value on Data Sheet **#991-4909-000**.

28.20 Record YAG 5ms "res" j/v value on Data Sheet **#991-4909-000**.

28.21 Set laser pulse width = **0.3ms.**

28.22 Press lower case ‘**e**’ to return Ext shutter to normal function.

28.23 Fire the laser and adjust the laser voltage until the NOVA II power meter reads **8W +/- .5W.** Make note of the power reading it will be used in a later step.

28.24 Record the laser voltage setting on Data Sheet **#991-4909-000**.

28.25 Press lower case “**d**” to keep EXT shutter closed, and direct energy into Res port.

28.26 Fire the laser 6 shots and read the Res voltage from CV screen.

28.27 Adjust gain value until Res voltage measures between **.5 and 1.25 volts**.

28.28 If YAG “res” voltage is to low decrease the gain # (press lower case “**m**”).

28.29 If YAG “res” voltage is to high increase the gain # (press upper case “**M**”)

28.30 Re- Fire the laser 6 shots and read the YAG “res” voltage from CV screen.

28.31 Press lower case ‘**u’** and enter the actual Ophir meter reading from step 28.22

28.32 Fire laser again into the resonator port and verify YAG “res” energy measures

8 watts +/- 1 Watt.

28.33 Record YAG .3ms “res” voltage value on Data Sheet **#991-4909-000**.

28.34 Record YAG .3ms “res” gain value on Data Sheet **#991-4909-000.**

28.35 Record YAG .3ms “res” j/v value on Data Sheet **#991-4909-000**.

28.36 Press lower case ‘**e**’ to return Ext shutter to normal function.

29 Calibrate DYE Resonator Port

29.1 Verify the beam combiner block is installed onto the rail.

29.2 Verify SMA/focus lens assembly is removed from the beam combiner block.

29.3 Power up laser

29.4 Type <**cv**> from the “C:\” prompt (CV mode).

Set Laser	**Set NOVA II Meter**
WL = PDL	Laser Type = VIS or <655
Voltage = 750v	Average = 3sec
Pulse Width = .5ms	Range = 30W
RepRate =1Hz	Measurement = power

29.5 Position the Ophir detector 14” to 16” facing towards the beam combiner output.

29.6 Fire the laser one shot and verify energy pulse is not clipping on the Ophir Detector head.

29.7 Set laser CV voltage to 750 volts.

29.8 Fire the laser and adjust the laser voltage until the NOVA II power meter reads **8W +/- .5W**. Make note of the power reading it will be used in a later step

29.9 Record the laser voltage setting on Data Sheet **#991-4909-000**.

29.10 Press lower case “**d**” to keep EXT shutter closed, and direct energy into Res port.

29.11 Fire the laser 6 shots and read the DYE “res” voltage from CV screen.

29.12 Verify DYE “res” voltage reads between **.5 and 1.50** volts.

29.13 If DYE “res”voltage is to low decrease the gain # (Press “**m**” valid gain values are 1 -15).

29.14 If DYE “res” voltage is to high increase the gain # (Press “**M**”valid gain values are 1 -15).

29.15 Re- Fire the laser 6 shots and read the DYE “res” voltage from CV screen.

29.16 Press lower case_‘**u**’ and enter the actual Ophir meter reading from step 29.8

29.17 Fire laser again into resonator port and verify DYE “res” energy measures **8 Watts +/- .4 Watt.**

29.18 Record DYE “res voltage value on Data Sheet **#991-4909-000**.

29.19 Record DYE “res” gain value on Data Sheet **#991-4909-000**.

29.20 Record DYE “res” j/v value on Data Sheet **#991-4909-000**.

29.21 Press lower case ‘**e**’ to return Ext shutter to normal function.

30 Calibrate DYE Cal Port

NOTE: For the following test the DYE temperature should = ~39 C°
Use a 7-mm hand piece.

30.1 Verify the beam combiner block is installed onto the rail.

30.2 Install the SMA/focus lens assembly onto the beam combiner block.

30.3 Screw the beam combiner block to the rail.

30.4 Power up laser

30.5 Type <**cv**> from the “C:\” prompt (CV mode).

Set Laser	**Set NOVA II Meter**
WL = PDL	Laser Type = VIS or <655
Voltage = 700v	Average = 3sec
Pulse Width = .5ms	Range = 30W
RepRate =1Hz	Measurement = power

30.6 Position the 7mm handpiece so it is facing into the OPHIR detector head.

30.7 Press lower case ‘**e**’ which allows Ext shutter to open.

30.8 Fire the laser and adjust the laser voltage until the NOVA II power meter reads **6watts +/- .5W.** Make note of the power reading it will be used in a later step

30.9 Record laser voltage setting on Data Sheet **#991-4909-000.**

30.10 Move the 7mm handpiece into the Cal Port.

30.11 Set DYE Cal Port Gain = **3**.

30.12 Fire laser six shots.

30.13 Verify DYE Cal voltage measure between **.5 and 1.50 volts**.

30.14 If DYE Cal voltage is to low, decrease the gain # (press lower case “**c**”).

30.15 If DYE Cal voltage is to high,increase the gain # (press upper case “**C**”).

30.16 **Note:** valid gain values are 1 -15.

30.17 Re- Fire the laser 6 shots and read the DYE Cal voltage from CV screen.

30.18 Press upper case ‘**U’** and enter the actual Ophir meter reading from step 30.8

30.19 Fire laser again into Calport and verify DYE Cal Port energy measures **6 Watts +/- .5 Watt.**

30.20 Record DYE “cal” voltage value on Data Sheet **#991-4909-000**.

30.21 Record DYE “cal” gain value on Data Sheet **#991-4909-000**.

30.22 Record DYE “cal” j/v value on Data Sheet **#991-4909-000**.

31 Calibrate YAG Cal Port

31.1 Verify the beam combiner block is installed onto the rail.

31.2 Install the SMA/focus lens assembly onto the beam combiner block.

31.3 Screw the beam combiner block to the rail.

31.4 Install fiber cable into SMA connector

31.5 Install a **7-mm** hand piece onto fiber cable.

31.6 Power up laser

31.7 Type <**cv**> from the "C:\" prompt (CV mode).

Set Laser	**Set NOVA II Meter**
WL = YAG	Laser Type = NIR or 1064
Voltage = 700	Average = 3sec
Pulse Width = 5ms	Range = AUTO
RepRate =1Hz	Measurement = power

31.8 Position the 7mm handpiece so it is facing into the OPHIR detector head.

31.9 Press lower case '**e**' to allow Ext shutter to open when laser is fired.

31.10 Adjust the laser voltage and re-fire the laser and until the NOVA II power meter reads **35watts +/- .5W.** Make note of the power reading to be used in a later step.

31.11 Record the laser voltage setting on Data Sheet **#991-4909-000.**

31.12 Move the 7mm handpiece into the Cal Port.

31.13 Set YAG Cal Port Gain = **10**.

31.14 Fire laser six shots.

31.15 Verify YAG Cal voltage measure between **.5 and 1.25 volts**.

31.16 If YAG "cal" voltage is to low, decrease the gain # (press lower case "**c**").

31.17 If YAG "cal" voltage is to high, increase the gain # (press upper case "**C**").

31.18 **Note:** valid gain values are 1 -15.

31.19 Re- Fire the laser 6 shots and read the YAG "cal" voltage from CV screen.

31.20 Press upper case '**U'** and enter the <u>actual Ophir meter reading</u> from step 31.10

31.21 Fire laser again into Calport and verify YAG Cal Port energy measures

35 Watts +/- .5 Watt.

31.22 Record YAG 5ms "cal" voltage value on Data Sheet **#991-4909-000**.

31.23 Record YAG 5ms "cal" gain value on Data Sheet **#991-4909-000**.

31.24 Record YAG 5ms "cal" j/v value on Data Sheet **#991-4909-000**.

31.25 Set laser pulse width = 0.3ms

31.26 Position the 7mm handpiece so it is facing into the OPHIR detector head.

31.27 Press lower case ‘**e**’ to allow Ext shutter to open when laser is fired.

31.28 Adjust the laser voltage and re-fire the laser until the NOVA II power meter reads **6W +/- .5W**. Make note of the power reading to be used in a later step.

31.29 Record the laser voltage setting on Data Sheet **#991-4909-000.**

31.30 Move the 7mm handpiece into the Cal Port.

31.31 Fire the laser 6 shots and read the Cal voltage from CV screen.

31.32 Adjust gain value until Cal voltage measures between **.5 and 1.25 volts**.

31.33 If YAG “cal” voltage is to low, decrease the gain # (press lower case “**c**”).

31.34 If YAG “cal” voltage is to high, increase the gain # (press upper case “**C**”).

31.35 **Note:** Least attenuation is 1, Maximum attenuation is 15.

31.36 Re- Fire the laser 6 shots and read the YAG “cal” voltage from CV screen.

31.37 Press upper case ‘**U’** and enter the <u>actual Ophir meter reading</u> from step 31.28

31.38 Fire laser again into Calport and verify YAG Cal Port energy measures

6 Watts +/- .5 Watt.

31.39 Record YAG .3ms “cal” voltage value on Data Sheet **#991-4909-000**.

31.40 Record YAG .3ms “cal” gain value on Data Sheet **#991-4909-000**.

31.41 Record YAG .3ms “cal” j/v value on Data Sheet **#991-4909-000**.

32 Verify YAG Fiber Transmission

32.1 Verify the beam combiner block is installed onto the rail.

32.2 Install the SMA/focus lens assembly onto the beam combiner block.

32.3 Insert the fiber cable into the SMA.

32.4 Install a 7mm handpiece on to the fiber cable.

32.5 Power up laser

32.6 Type <**cv**> from the "C:\" prompt (CV mode).

32.7 **Set laser:**
Wavelength = YAG
Voltage = 850 volts.
Pulse width = 5ms
Rep Rate = 1Hz

32.8 Place the 7mm handpiece into the calport

32.9 Fire the laser 10 shots

32.10 Read the YAG cal energy from the HyperTerminal screen **(YagfiberPower).**

32.11 **YAG Transmission = (YagfiberPower / YAG Res Power @850V)** from step **21.10**

32.12 Verify YAG transmission is ≥ 75% but less then 100%

32.13 Record YAG Transmission value on Data Sheet **#991-4909-000.**

33 Verify DYE Fiber Transmission

33.1 Verify the beam combiner block is installed onto the rail.

33.2 Install the SMA/focus lens assembly onto the beam combiner block.

33.3 Insert the fiber cable into the SMA.

33.4 Install a 7mm handpiece on to the fiber cable.

33.5 Power up laser

33.6 Type <**cv**> from the "C:\" prompt (CV mode).

33.7 **Set laser:**
Wavelength = PDL
Voltage = 850volts.
Pulse width = .5ms
Rep Rate = 1Hz

33.8 Place the 7mm handpiece into the calport

33.9 Fire the laser 10 shots

33.10 Read the DYE cal energy from the HyperTerminal screen **(DyefiberPower).**

33.11 **DYE Transmission = (DyefiberPower / Dye RES Power@850V)** from step **24.10**

33.12 Verify DYE transmission is ≥ 70% but less then 100%

33.13 Record DYE Transmission value on Data Sheet **#991-4909-000.**

34 Adjust the Aiming Beam

34.1 Connect the PD300-BB-SH photodiode detector head to the NOVA II meter.

34.2 Turn on the NOVA II meter.

34.3 **Nova II Setup:**
Range = dBm
Average = 1 second
Menu = Power
dB_0 = dB_0

34.4 **NOTE:** aiming beam light <u>must not</u> be facing towards the photodiode detector before selecting dB_0.

34.5 **NOTE:** After pressing dB_0, the Ophir meter <u>must read between</u> 0dB and .50 dB.

34.6 Install fiber cable

34.7 Connect the **10mm** hand piece to the fiber cable.

34.8 Power on the laser

34.9 Type <**cy**> from the “C:\” prompt (operating mode).

34.10 Position the hand piece so it is facing into the PD300 detector lens, about 1.5 inches away.

34.11 Adjust the two aiming beam screws until the NOVA II meter reads **> 3dB < 10dB**. (Orange Beam)

34.1 Record the measured value on data sheet **#991-4909-000**.

34.2 Press the **<Utility>** button.

34.3 Select **<AIM 5>** button. (This sets the RED laser beam to Max intensity)

34.4 Verify the NOVA II meter reads **≥ 2.5dB**. (RED Beam)

34.5 Record the measured value on data sheet **#991-4909-000**.

35 System Check Performance (7mm HP)

35.1 Install fiber cable

35.2 Connect the **7mm** hand piece to the fiber cable.

35.3 Place hand piece into the CalPort.

35.4 Power up laser.

35.5 Type <**cy**> from the “C:\” prompt (operating mode).

35.6 Start a system check by pressing the **“System Check”** key.

35.7 When System check has completed go to the **“Utility”** page.

35.8 Record the FOM: values for DYE and YAG on the Data Sheet **#991-4909-000**.

36 Calibration Accuracy Test (PDL)

36.1 Verify Dye Test filter is installed

36.2 Verify Dye Test inject bottle is installed.

36.3 Verify Dye input tubing line is filled with Dye.

36.4 Power up laser

36.5 Type <**cy**> from the "C:\" prompt (operating mode).

36.6 Set laser wavelength to PDL.

36.7 Verify each test point as listed in **Table 1** in the Data Sheet **#991-4909-000**.

37 Calibration Accuracy Test (YAG 1064nm)

37.1 Power up laser

37.2 Type <**cy**> from the "C:\" prompt (operating mode).

37.3 Set laser wavelength to YAG.

37.4 Verify each test point as listed in **Table 2** in the Data Sheet **#991-4909-000**.

38 Calibration Accuracy Test (Multiplex mode)

38.1 Verify Dye Test filter is installed

38.2 Verify Dye Test inject bottle is installed.

38.3 Verify Dye input tubing line is filled with Dye.

38.4 Power up laser

38.5 Type <**cy**> from the "C:\" prompt (operating mode).

38.6 From the home page press select Multiplex.

38.7 Setup Ophir meter to measure ENERGY, Laser = NIR or 1064nm, Range = 300J.

38.8 Select the settings listed on the multiplex accuracy table on the data sheet.

38.9 Fire the laser one shot into the OPHIR detector, and record the energy reading.

38.10 Verify each test point as listed in **Table 3** in the Data Sheet **#991-4909-000**.

39 Remote Interlock Verification

39.1 Power up laser
39.2 Type <**cy**> from the “C:\” prompt (operating mode).
39.3 Wait for laser to come up to the main menu page.
39.4 Unplug the connector from the jack on the back of the upper chassis.
39.5 A warning message should appear on the display.
39.6 Replace the jumper plug.
39.7 The warning message should clear from the display.

40 Test Emergency Stop

40.1 Power up laser
40.2 Type <**cy**> from the “C:\” prompt (operating mode).
40.3 Wait for laser to come up to the main menu page.
40.4 Press down on the EMERGENCY STOP switch.
40.5 Verify that the laser system fans and pump shut off.
40.6 Turn the EMERGENCY STOP switch to the right
40.7 Verify the fans and pump re-start.

41 Re-Set DYE Lamp Counter

41.1 Power on laser and go to the C:\.
41.2 Type <**TN>** from the “C:\” prompt (TESTALL mode).
41.3 Prompt the MENU screen by pressing <**Space**> on the keyboard.
41.4 Press lower case letter ‘**w’** on the computer keyboard (**set wavelength to 0 DYE).**
41.5 Press lower case letter ‘**q’** on the computer keyboard.
41.6 Press upper case letter ‘**Z’** on the computer keyboard (Zero DYE flashlamp counter).
41.7 Press upper case letter ‘**Q’** on the computer keyboard.
41.8 Press upper case letter ‘**Z’** on the computer keyboard. (Zero DYE counter)

42 Re-Set YAG Lamp/Rod Counter

42.1 Power on laser and go to the C:\.
42.2 Type <**TN>** from the “C:\” prompt (TESTALL mode).
42.3 Press lower case letter ‘**w’** on the computer keyboard (**Set wavelength to 1 YAG).**
42.4 Press lower case letter ‘**q’** on the computer keyboard.
42.5 Press upper case letter ‘**Z’** on the computer keyboard (Zero YAG flashlamp counter).
42.6 Press upper case letter ‘**Q’** on the computer keyboard.
42.7 Press upper case letter ‘**Z’** on the computer keyboard. (Zeros YAG Rod counter)

43 Disable Multiplex Option

43.1 Power on laser unit.

43.2 Perform the following steps to DISABLE multiplex mode.

43.3 Type <**NN>** from the “C:\” prompt.

43.4 Wait for prompt to display S:\Software\TestEng.

43.5 Type **“cytest”**

43.6 Press key “**4”** to disable multiplex option.

44 Back Up Cal Data Files

44.1 Power on laser unit.

44.2 Perform the following steps to back up laser data files to the network.

44.3 Type <**NN>** from the “C:\” prompt.

44.4 Wait for prompt to display S:\Software\TestEng.

44.5 Type **“cytest”**

44.6 Press key **“7”** to back up files to the network.

45 Create Ship batch file

45.1 Power on laser unit.

45.2 Type <**NN>** from the “C:\” prompt.

45.3 Wait for prompt to display S:\Software\TestEng.

45.4 Type **“cytest”**

45.5 Press key “**8**” to update autoexec.bat with ship.bat file.

46 Final Check

46.1 Inspect the laser to ensure that all connectors are plugged in correctly.

46.2 Verify wires are properly routed and not touching fans or surfaces that could cut into insulation.

Cynergy Final testing is complete.

Appendix A – CYNERGY Error Codes

Cynergy Error and Warning Codes, October 6, 2005		Possible Cause
Error #	**Message Text**	**Manual Suggestions**
E01	Water Flow Fault; Cycle Power	Broken water pump or blown fuse. Needs service.
E02	Open Shutter Fault	Safety shutter stuck closed. Do not use laser until serviced.
E03	Close Shutter Fault	Safety shutter stuck open. Do not use laser until serviced.
E04	Fuse Open; Call Service	Blown capacitor bank fuse or shorted dump circuit. Needs service.
E05	Checksum Error; Call Service	Computer program memory error. Needs service.
E07	IGBT Fault - YAG	YAG IGBT overload sensed. Cycle power to continue.
E08	Heater Fault; Call Service	Open thermostat or heater. Blown heater fuse. Needs service.
E09	Coolant Sensor Fault; Call Service	Open thermistor sensor or unplugged. Needs service.
E10	No High Voltage	Capacitor bank or HVPS wire shorted. No read back voltage. Needs service.
E13	No Simmer YAG	Broken lamp or blown fuse. Needs service.
E14	HVPS Fault	HVPS over-temperature.
E15	Dump Fault; Call Service	Fuse fault at power up. Needs service.
E16	Dump Fault; Call Service	Dump always on. Needs service. Dump shorted. Failed dump TX. HVPS failed.
E17	Dump Fault; Call Service	Dump not working. Needs service. Fiber connections broken to cap bank. HVPS disconnected or failed.
E23	Low Trans; Replace Fiber/Handpiece	Damaged fiber, handpiece or focus lens, needs replacement.
E24	YAG Calibration Error; Call Service	Incorrect Resonator Port or Cal Port sensor calibration. Needs service.
E25	YAG Cal Failed, Energy Low; Call Service	YAG cal port energy too low to use. Needs service.
E26	No Energy; Check Fiber/Handpiece	Broken fiber or severly damaged focus lens. Needs replacement.
E27	DYE Flow Fault	No dye filter or it is not installed properly. Broken pump. Blown fuse
E28	IGBT Fault - Dye	Dye IGBT overload sensed. Cycle power to continue.
E29	IGBT Fault - Pulse Simmer	Pulse simmer IGBT overload sensed. Cycle power to continue.
E30	No Simmer DYE	Broken lamp or blown fuse. Needs service.

E32	Flow Switch DYE	Broken dye pump or blown fuse. Needs service.
E33	Dye Calibration Error, Call Service	Transmission too high. Miscalibrated resonator or cal port sensor. Needs service.
E34	DYE Cal Failed, Energy Low; Call Service	Low delivered dye energy. Needs service
E35	DYE Misfire	Possible dye simmer fault. Service if problem reoccurs.
E36	YAG Misfire	Possible yag simmer fault. Service if problem reoccurs.
E37	Simmer Sensor Fault DYE	Failed dye simmer control module. Needs service.
E38	Simmer Sensor Fault YAG	Failed YAG simmer control module. Needs service.
E39	HVPS Adjust Error	HVPS readback incorrect. Defective HVPS. Needs service.
E40	DYE and YAG Cal Failed, Call Service	Fiber, handpiece, or focus lens damaged. Needs service.
E41	Display Fault; Call Service	Corrupted internal display files. Needs service.
E42	Blocking Diode Fault; Call Service	Shorted blocking diodes. Needs service.
E43	Ext Shutter	Shutter positioning failure on power-up. Retry. If continued failure, do not use laser until serviced.
E44	Keypad	Object on touchscreen. Broken touchscreen.
E45	File Open Error; Call Service	Defective compact flash memory card. Corrupted internal files. Needs service.
E46	DYE Temp Sensor Fault; Call Service	Open dye thermostat or heater. Blown heater fuse. Needs service.
E47	Internal Math Error; Call Service	Corrupted program or data file. Needs service.
E48	Checksum Error; Call Service	Computer calibration data error. Needs service.

Appendix B – CYNERGY Warning Codes

Warning #	Message Text	Manual Suggestions
W50	Open Interlock; Check Interlock	Install remote interlock connector or, if using interlock, close laser room door.
W51	No Fiber; Connect Fiber	Install delivery fiber and handpiece.
W52	Wavelength Unavailable	Wavelength use disabled. See second line message for the reason.
W53	Low Water; Add Water	Water is low. Add water to reservoir.
W54	HVPS EOC Warning	High fluence when using 120 VAC. Press standby to continue using laser.
W56	Invalid Handpiece; Change Handpiece	Handpiece from another laser model or handpiece not allowed for selected wavelength. Install correct handpiece.
W57	No Handpiece; Install Handpiece	Install handpiece.
W58	Handpiece Changed	Handpiece changed. Press screen message box to continue.
W59	Low Trans; Check Fiber and Handpiece	Fiber, handpiece, or focus lens damaged but still useable.
W60	Calibration Failed; Call Service	
W63	Fluence Meter Error; Call Service	Miscalibrated cal port meter. Defective cal port. Needs service.
W64	Internal Meter Error; Call Service	Miscalibrated res port meter. Defective res port. Needs service.
W65	Energy Out of Range, YAG	Capacitor bank did not recharge properly or overcharged. Retry operation.
W66	Handpiece Removed	Handpiece removed from cal port during system check or calibration.
W67	Unable to Reach Fluence; Decrease	Max fluence reached for handpiece and/or treatment settings. Lamps near end-of life.
W68	Schedule Lamp Change, Dye	Lamps for dye laser aproaching end-of-life. Schedule lamp replacement.
Warning #	**Message Text**	**Manual Suggestions**

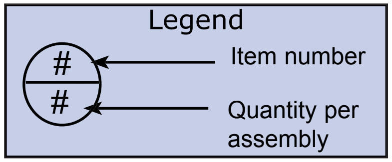
W69	Schedule Lamp Change, YAG	Lamps for Nd:YAG laser aproaching end-of-life. Schedule lamp replacement.
W70	Coolant Over Temp; Let Laser Cool	Water is too hot for continued operation. Fans are on to cool laser. Let laser cool.
W71	Add Water Soon	Water level low - refill water reservoir.
W72	Energy Out of Range, Dye	Capacitor bank did not recharge properly or overcharged. Retry operation.
W73	Dye Over Temp; Let Laser Cool	Dye is too hot for continued operation. Fans are on to cool laser. Let laser cool.

Tabbed Page

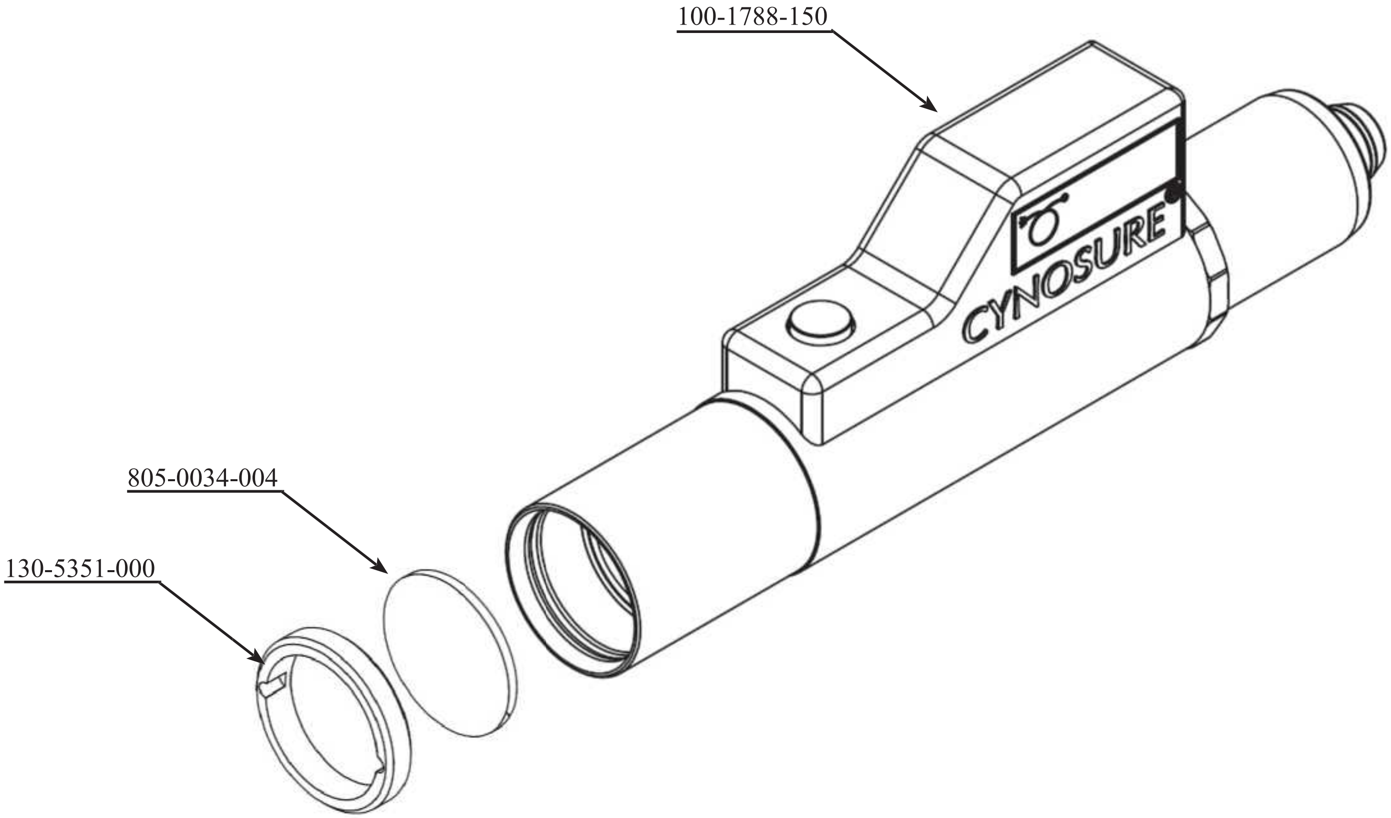
Drawing Sets

FOR REFERENCE ONLY
CHECK FOR CURRENT REVISION

ILLUSTRATED BREAK OUT
100-1753-120 Rev 6
12MM HANDPIECE, ASSY
CYNERGY



PART NUMBER	DESCRIPTION	QTY
101-1753-120	12mm HANDPIECE, ASSY	1
100-1788-150	ASSY,TRIG SW,12MM HP,CYNERGY	1
805-0034-004	WINDOW,.625DIA,AR 595 &1064NM	1
130-5351-000	LOCK RING,DUST WINDOW,3MM HP	1



FOR REFERENCE ONLY
CHECK FOR CURRENT REVISION

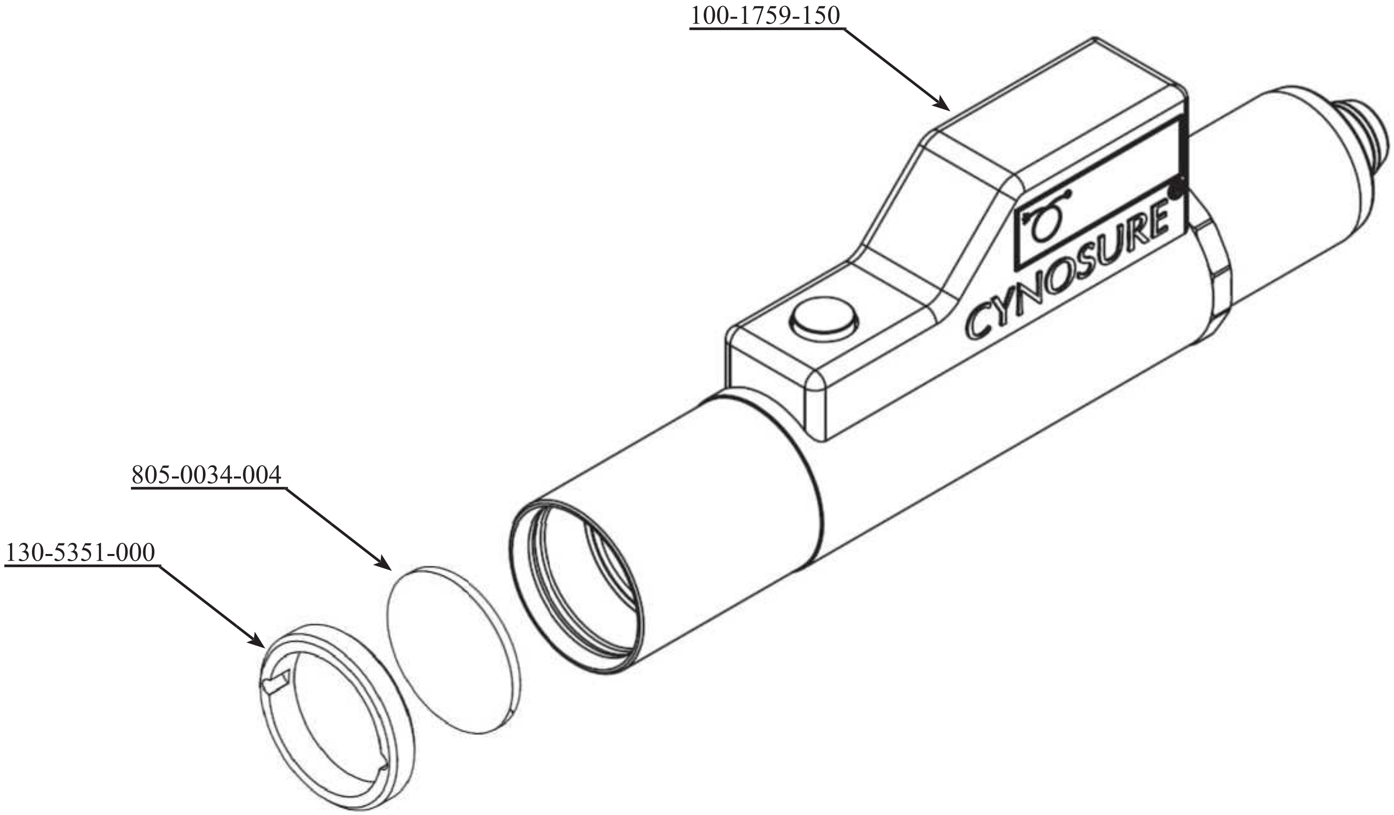
ILLUSTRATED BREAK OUT

100-1754-150 Rev 6

15MM HANDPIECE, ASSY
CYNERGY

Legend
Item number
Quantity per assembly

PART NUMBER	DESCRIPTION	QTY
100-1754-150	15mm HANDPIECE, ASSY	1
100-1759-150	ASSY,TRIG SW,15MM HP,CYNERGY	1
805-0034-004	WINDOW,.625DIA,AR 595 &1064NM	1
130-5351-000	LOCK RING,DUST WINDOW,3MM HP	1

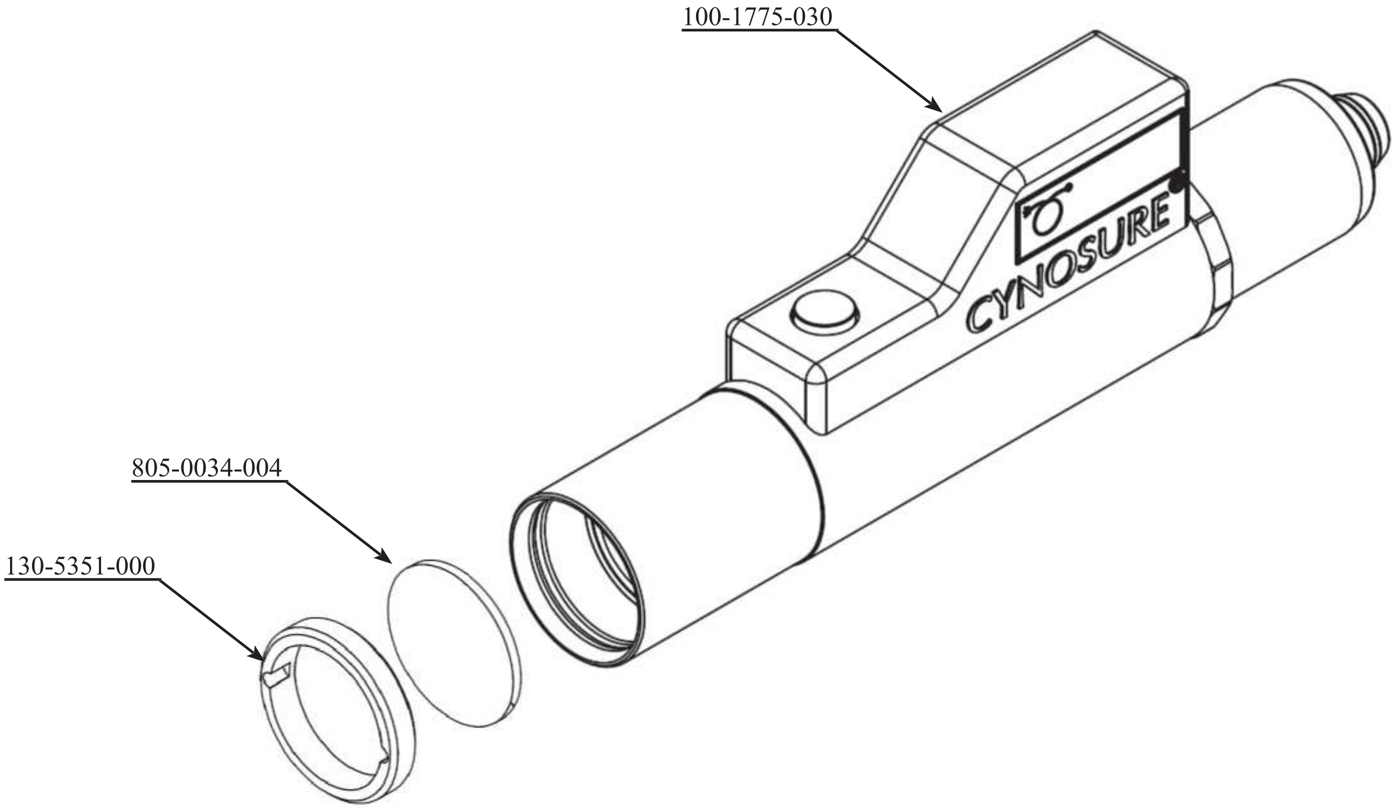


FOR REFERENCE ONLY
CHECK FOR CURRENT REVISION

ILLUSTRATED BREAK OUT
100-1755-030 Rev 5
3MM HANDPIECE, ASSY
CYNERGY

Legend
→ Item number
→ Quantity per assembly

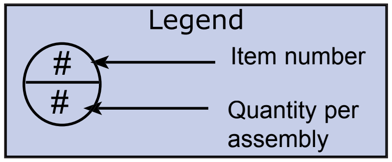
PART NUMBER	DESCRIPTION	QTY
100-1755-030	3mm HANDPIECE, ASSY	1
100-1775-030	ASSY,TRIG SW,3MM HP,CYNERGY	1
805-0034-004	WINDOW,.625DIA,AR 595 &1064NM	1
130-5351-000	LOCK RING,DUST WINDOW,3MM HP	1



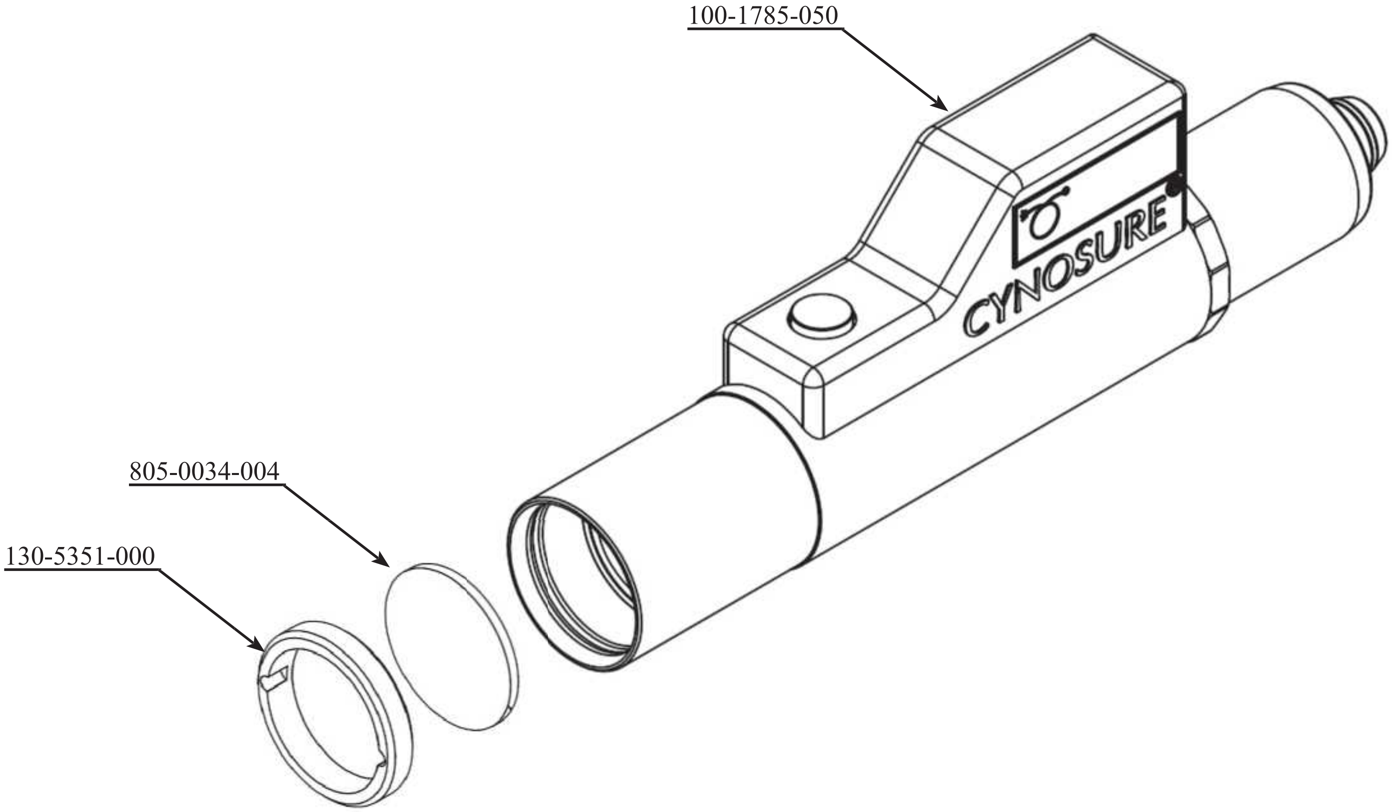
FOR REFERENCE ONLY
CHECK FOR CURRENT REVISION

ILLUSTRATED BREAK OUT
100-1756-050 Rev 6
5MM HANDPIECE, ASSY
CYNERGY

Legend

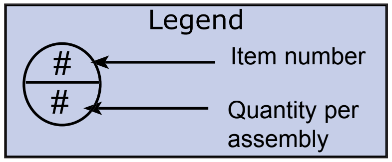


PART NUMBER	DESCRIPTION	QT
100-1756-050	5mm HANDPIECE, ASSY	1
100-1785-050	ASSY,TRIG SW,5MM HP,CYNERGY	1
805-0034-004	WINDOW,.625DIA,AR 595 &1064NM	1
130-5351-000	LOCK RING,DUST WINDOW,3MM HP	1

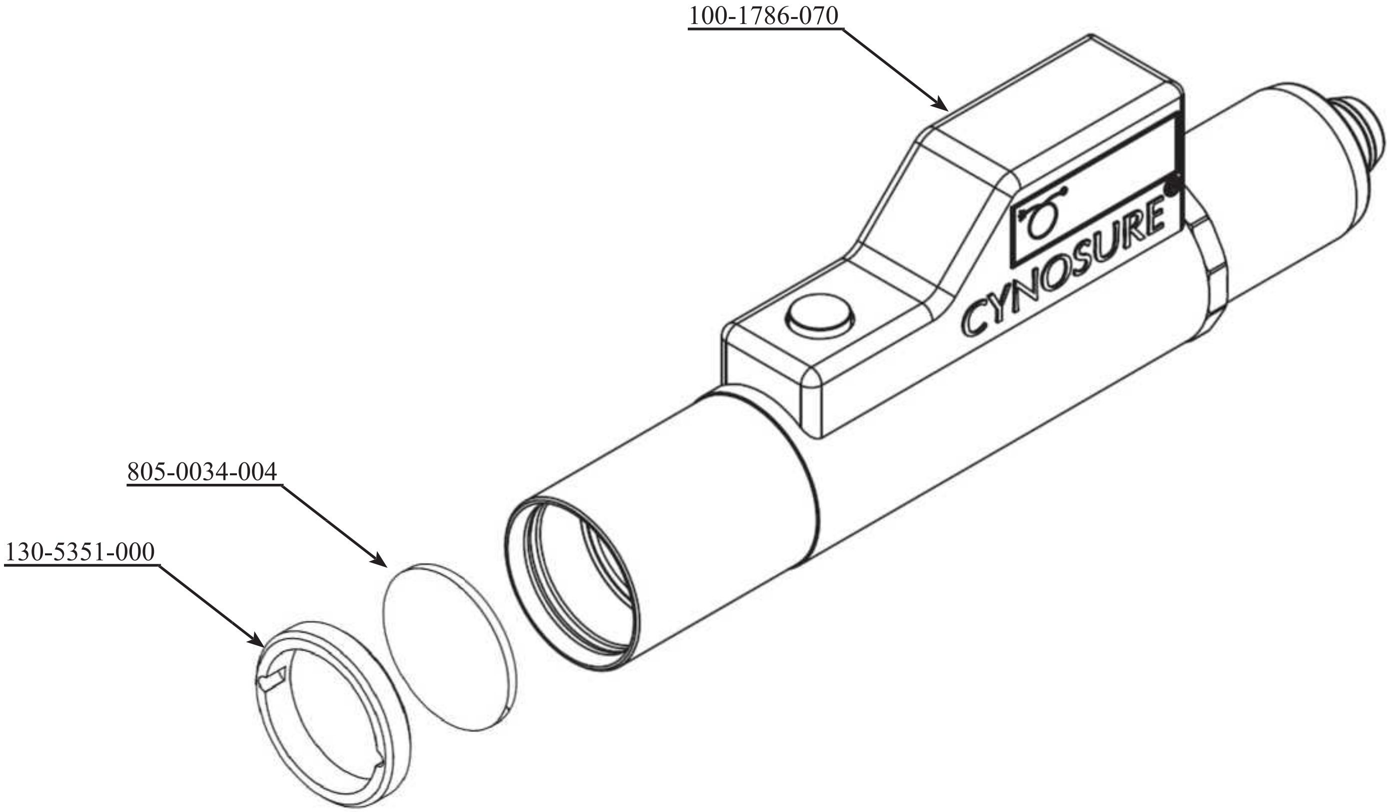


FOR REFERENCE ONLY
CHECK FOR CURRENT REVISION

ILLUSTRATED BREAK OUT
100-1757-070 Rev 5
7MM HANDPIECE, ASSY
CYNERGY

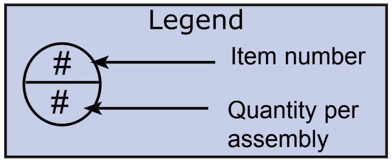
Legend


PART NUMBER	DESCRIPTION	QT
100-1757-070	7mm HANDPIECE, ASSY	1
100-1786-070	ASSY,TRIG SW,7MM HP,CYNERGY	1
805-0034-004	WINDOW,.625DIA,AR 595 &1064NM	1
130-5351-000	LOCK RING,DUST WINDOW,3MM HP	1

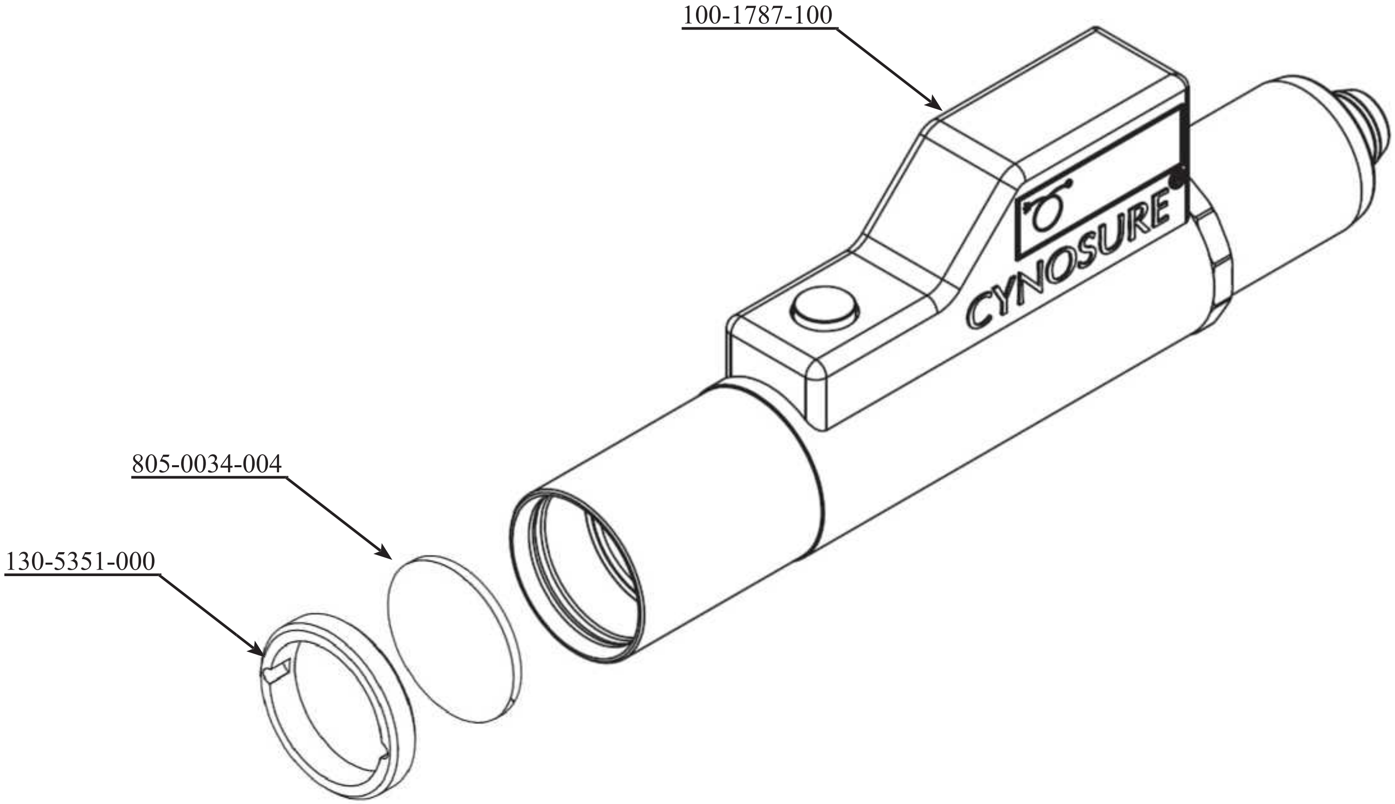


FOR REFERENCE ONLY
CHECK FOR CURRENT REVISION

ILLUSTRATED BREAK OUT
100-1758-100 Rev 5
10MM HANDPIECE, ASSY
CYNERGY



PART NUMBER	DESCRIPTION	QTY
100-1758-100	10mm HANDPIECE, ASSY	1
100-1787-100	ASSY,TRIG SW,10MM HP,CYNERGY	1
805-0034-004	WINDOW,.625DIA,AR 595 &1064NM	1
130-5351-000	LOCK RING,DUST WINDOW,3MM HP	1

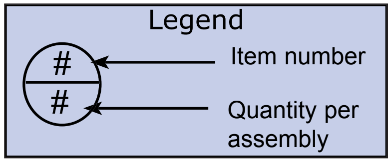


FOR REFERENCE ONLY
CHECK FOR CURRENT REVISION

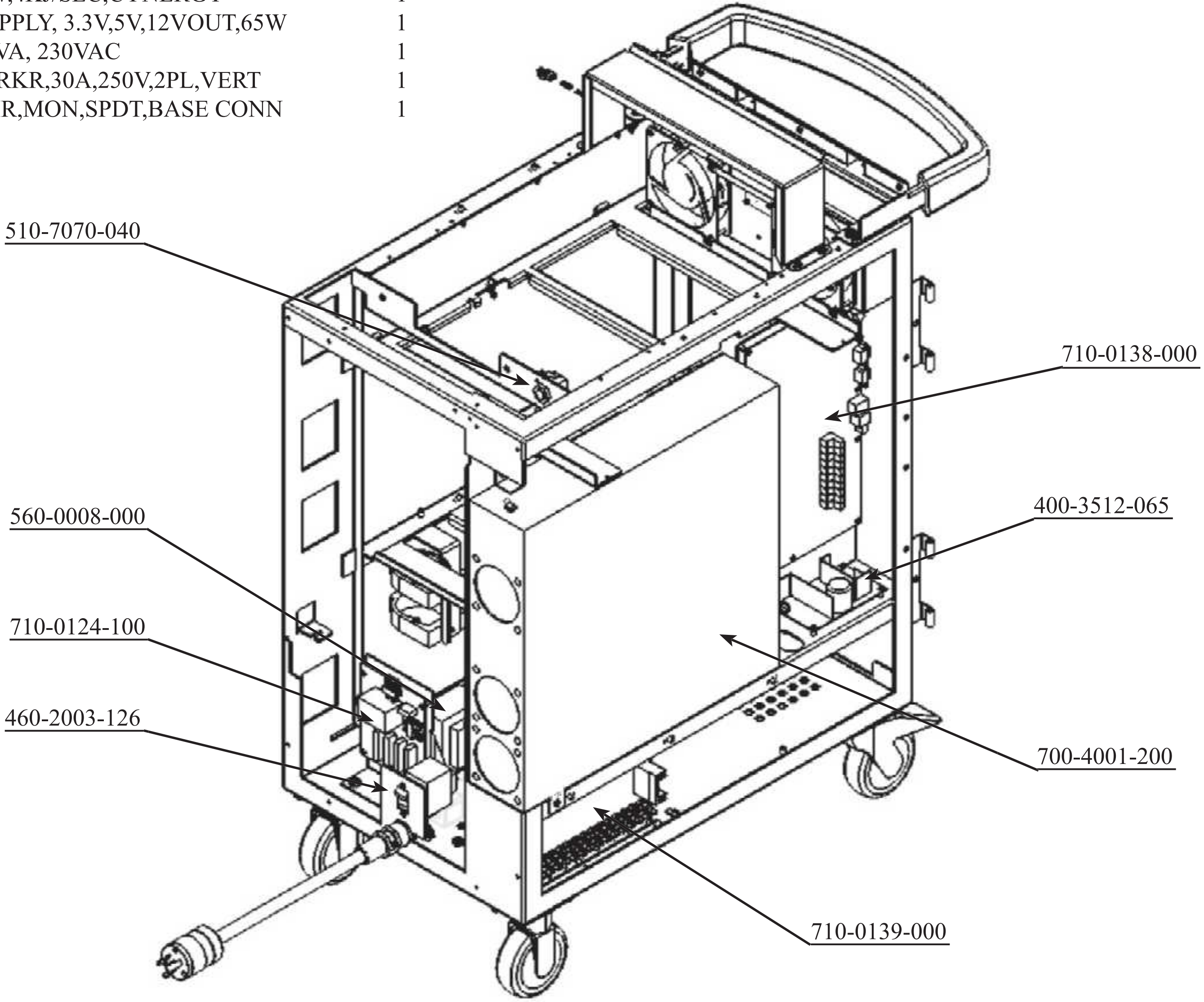
ILLUSTRATED BREAK OUT

100-7002-040 Rev 20

FRAME, ELECTRICAL, ASSY
CYNERGY



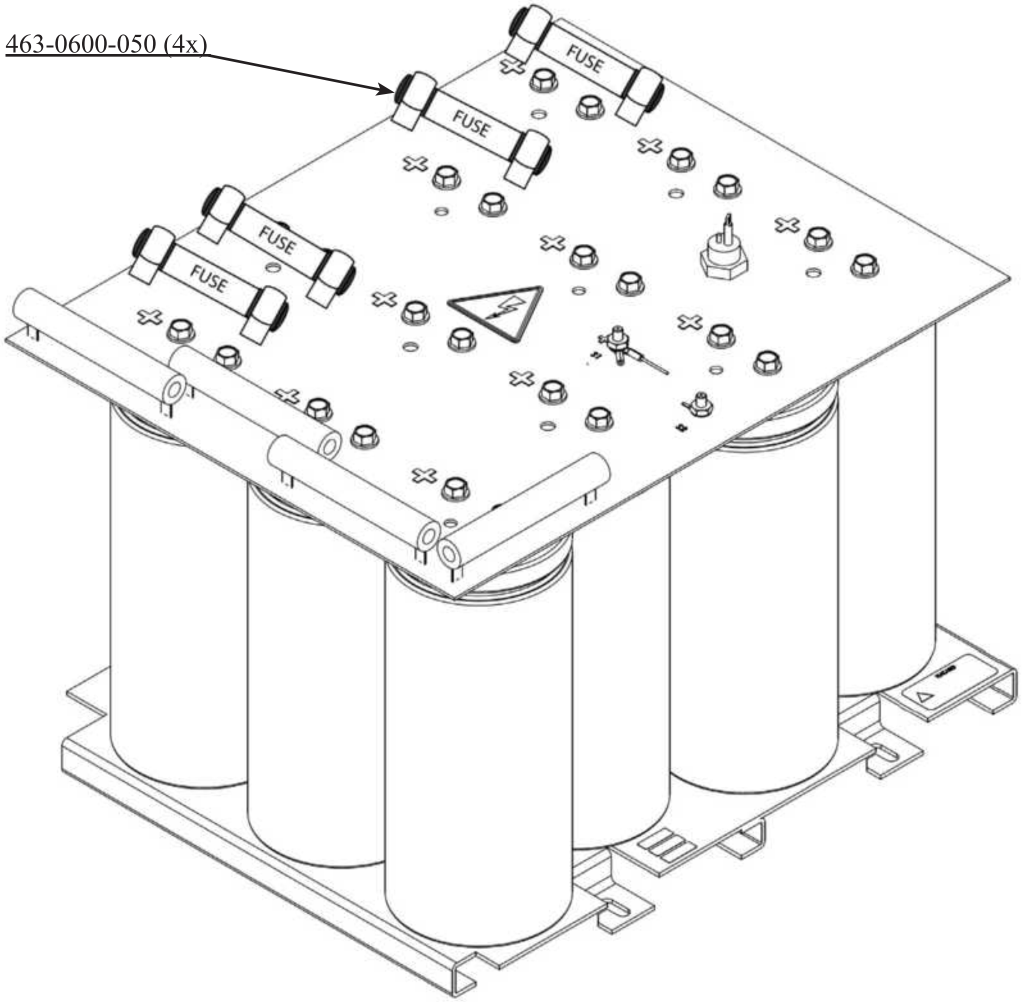
PART NUMBER	DESCRIPTION	QTY
710-0138-000	ASSY PCB,ETX COMPUTER INTERFACE	1
710-0139-000	ASSY,PCB, CYNERGY AC DIST	1
710-0124-100	ASSY,PCB,AC VOLT.SELECT FUSED	1
700-4001-200	HVPS,1200V,4KJ/SEC,CYNERGY	1
400-3512-065	POWER SUPPLY, 3.3V,5V,12VOUT,65W	1
560-0008-000	XFMR, 130VA, 230VAC	1
460-2003-126	CIRCUIT BRKR,30A,250V,2PL,VERT	1
510-7070-040	SWITCH,AIR,MON,SPDT,BASE CONN	1

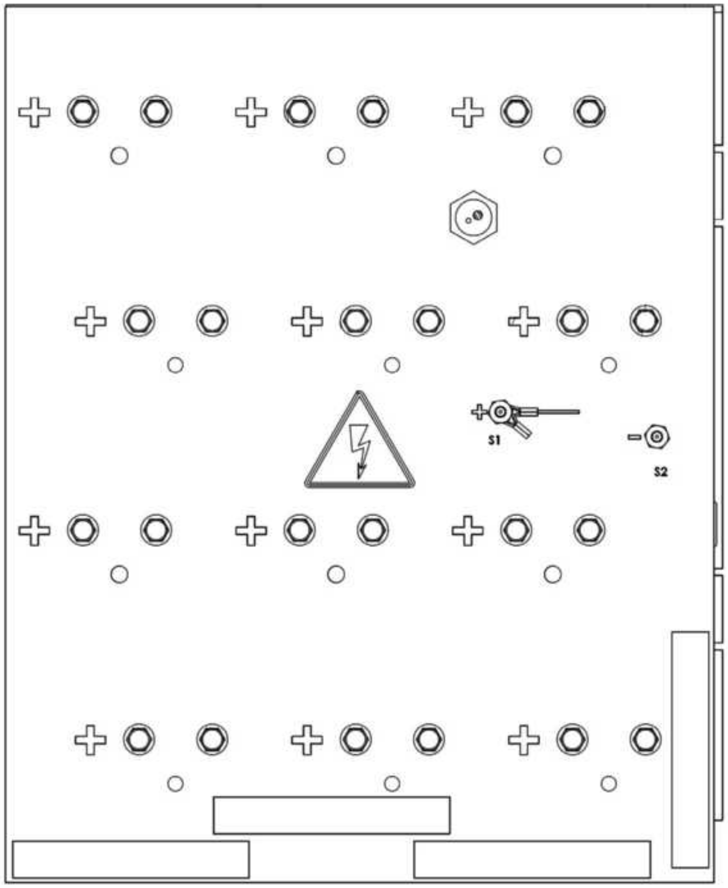


ILLUSTRATED BREAK OUT
100-7002-030 Rev 8
CAPACITOR BANK, ASSY
CYNERGY

Legend
Item number
Quantity per assembly

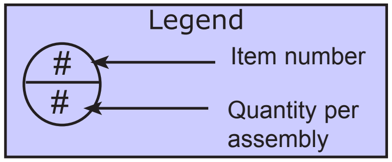
PART NUMBER	DESCRIPTION	QTY
100-7002-030	ASSY, CAPACITOR BANK,CYNERGY	1
463-0600-050	FUSE,ATM4,30/50	4



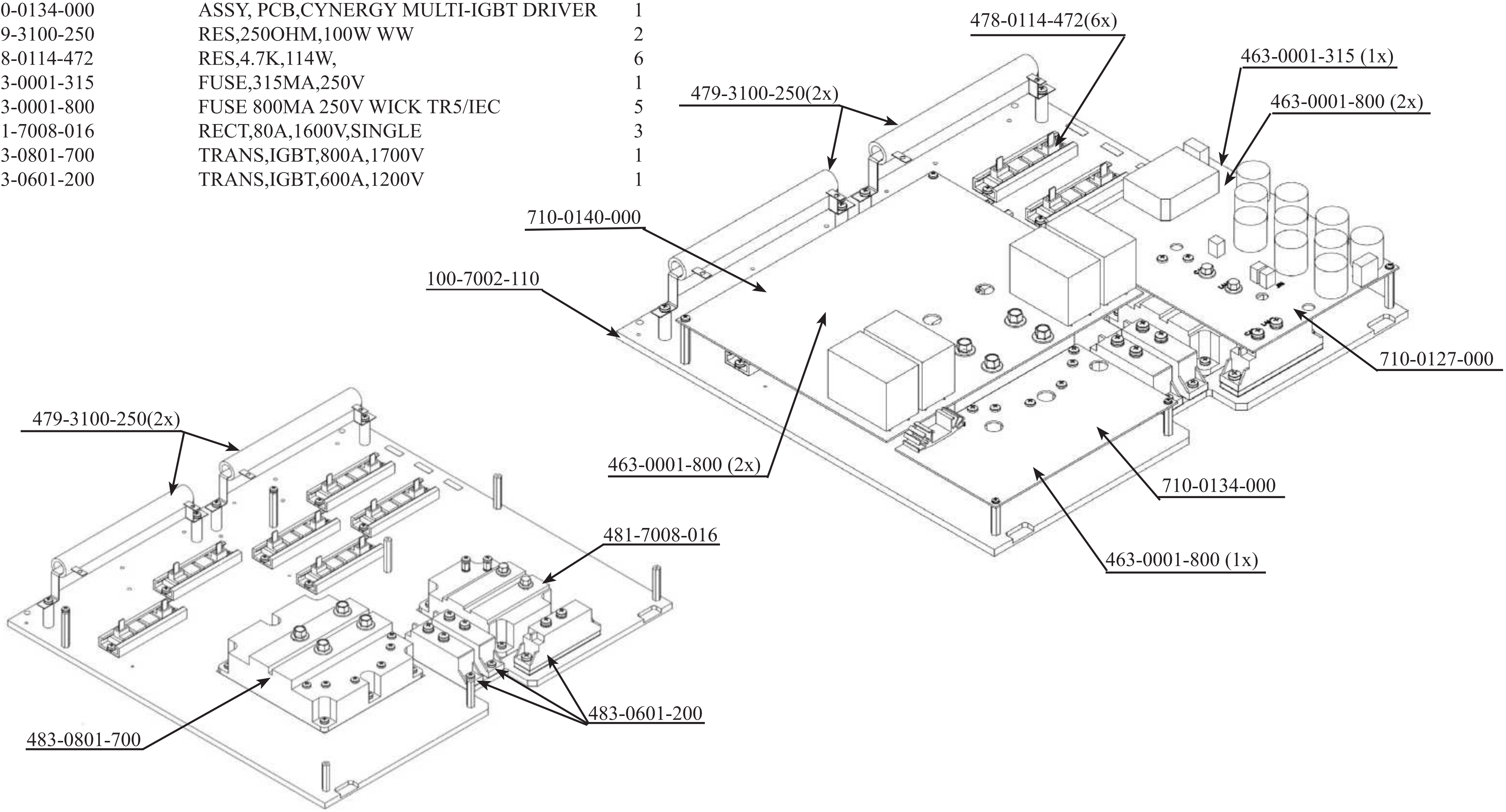


FOR REFERENCE ONLY
CHECK FOR CURRENT REVISION

ILLUSTRATED BREAK OUT
100-7002-110 Rev 14
IGBT / SIMMER, ASSY
CYNERGY

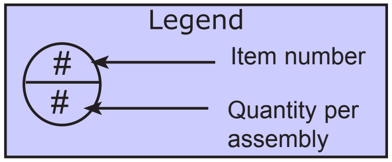


PART NUMBER	DESCRIPTION	QTY
100-7002-110	ASSY, IGBT/SIMMER, CYNERGY	1
710-0127-000	ASSY,PCB,IGBT DRIVER AND SIMMR	1
710-0140-000	ASSY,PCB,CYNERGY SNUBBER/SIMMER	1
710-0134-000	ASSY, PCB,CYNERGY MULTI-IGBT DRIVER	1
479-3100-250	RES,250OHM,100W WW	2
478-0114-472	RES,4.7K,114W,	6
463-0001-315	FUSE,315MA,250V	1
463-0001-800	FUSE 800MA 250V WICK TR5/IEC	5
481-7008-016	RECT,80A,1600V,SINGLE	3
483-0801-700	TRANS,IGBT,800A,1700V	1
483-0601-200	TRANS,IGBT,600A,1200V	1

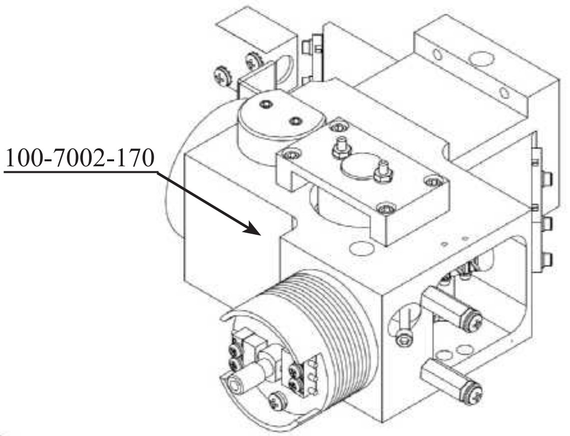


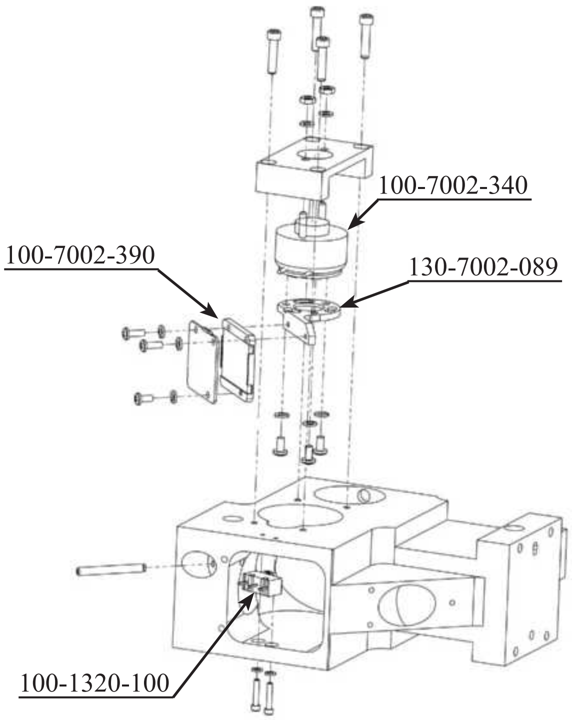
FOR REFERENCE ONLY
CHECK FOR CURRENT REVISION

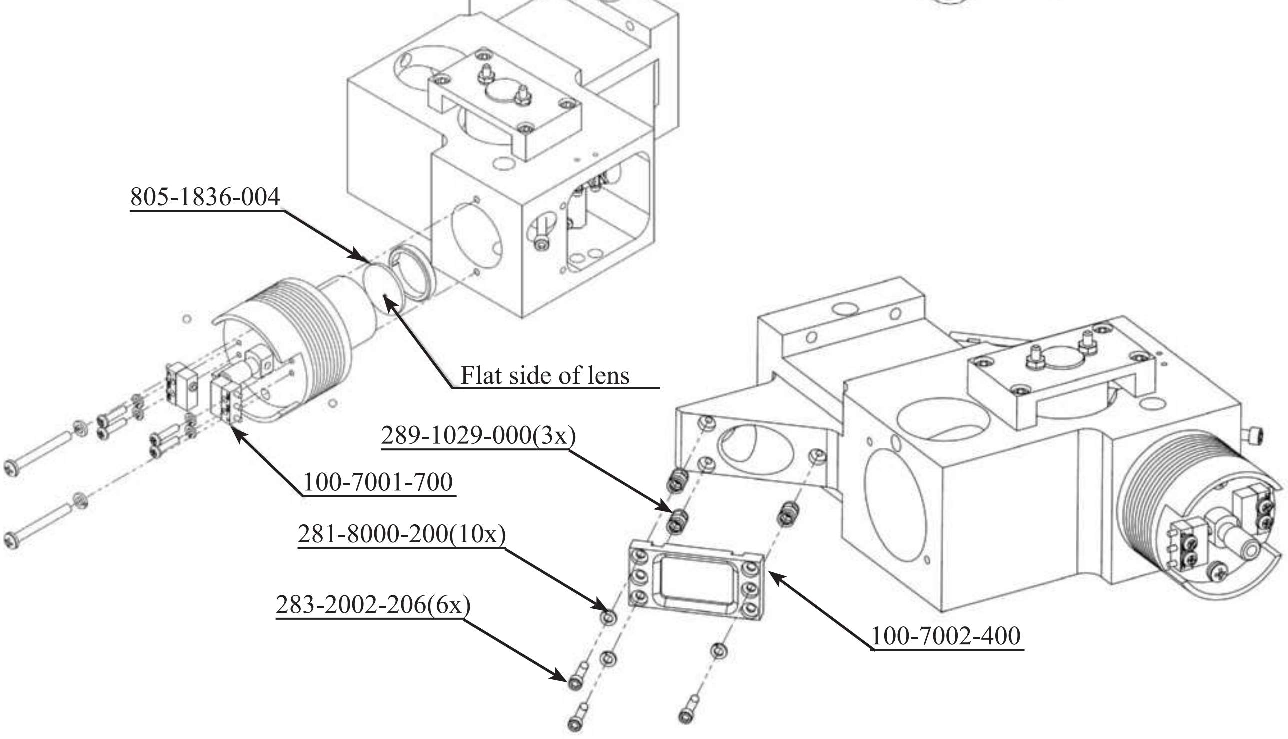
ILLUSTRATED BREAK OUT
100-7002-170 Rev 14
BEAM BLOCK, ASSY
CYNERGY



PART NUMBER	DESCRIPTION	QTY
100-7002-170	ASSY, BEAM BLOCK, CYNERGY	1
100-7001-700	ASSY,CBL,SWITCH,LENS MOUNT,MD	1
100-1320-100	ASSY,VSTAR SWITCH,LINEAR SHUTT	1
100-7002-340	ASSY,SOLENOID, BEAM BLOCK	1
710-0132-000	ASSY,PCB,AIMING DIODE,MD	1
800-7001-000	DIFFUSER,OPAL 1”DIA.X 1/4”THK	1
805-1836-004	LENS,PL/CVX,18X36FL,AR595&1064	1
100-7002-410	ASSY,BEAM COMBINER,BEAM BLOCK	1
100-7002-400	ASSY, MAX REFL, BEAM BLOCK	1
100-7002-390	ASSY,BEAM COMBINER,BEAM BLOCK	1
281-8000-200	WASHER,LOCK,SPLIT,#2,SS	10
283-2002-206	SCR,SOC HD CAP,2-56x3/8”	6
298-1029-000	COMP SPR,.180 ODX.029W X .25LG	3
130-7002-089	SHUTTER MOUNT,BEAM BLOCK,CYNERGY	1







Note: Hardware and springs must be ordered as needed.

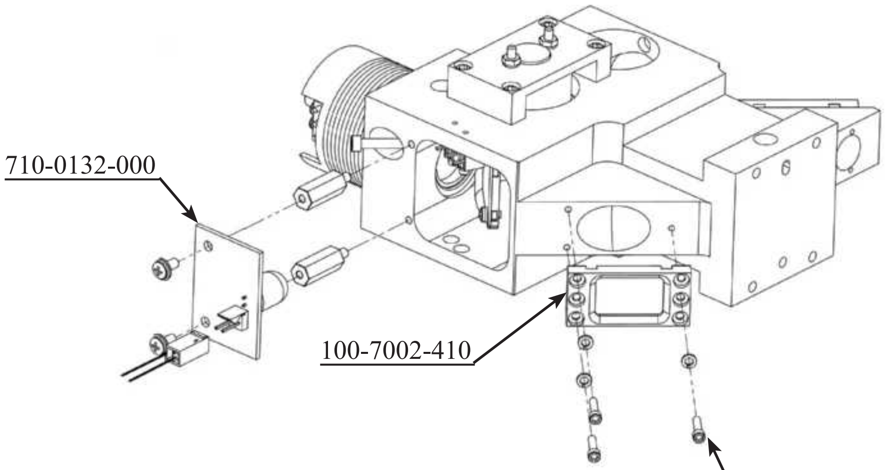
FOR REFERENCE ONLY
CHECK FOR CURRENT REVISION

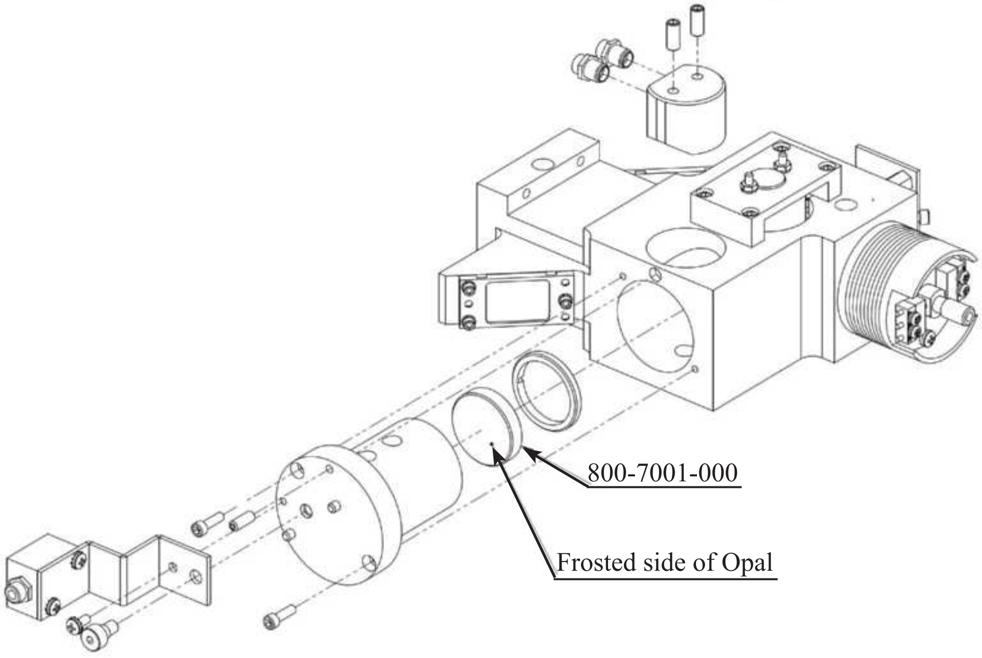
ILLUSTRATED BREAK OUT

100-7002-170 Rev 14

BEAM BLOCK, ASSY
CYNERGY

Legend
Item number
Quantity per assembly

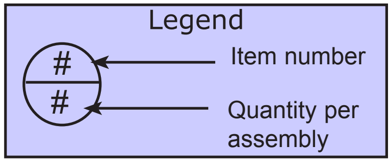




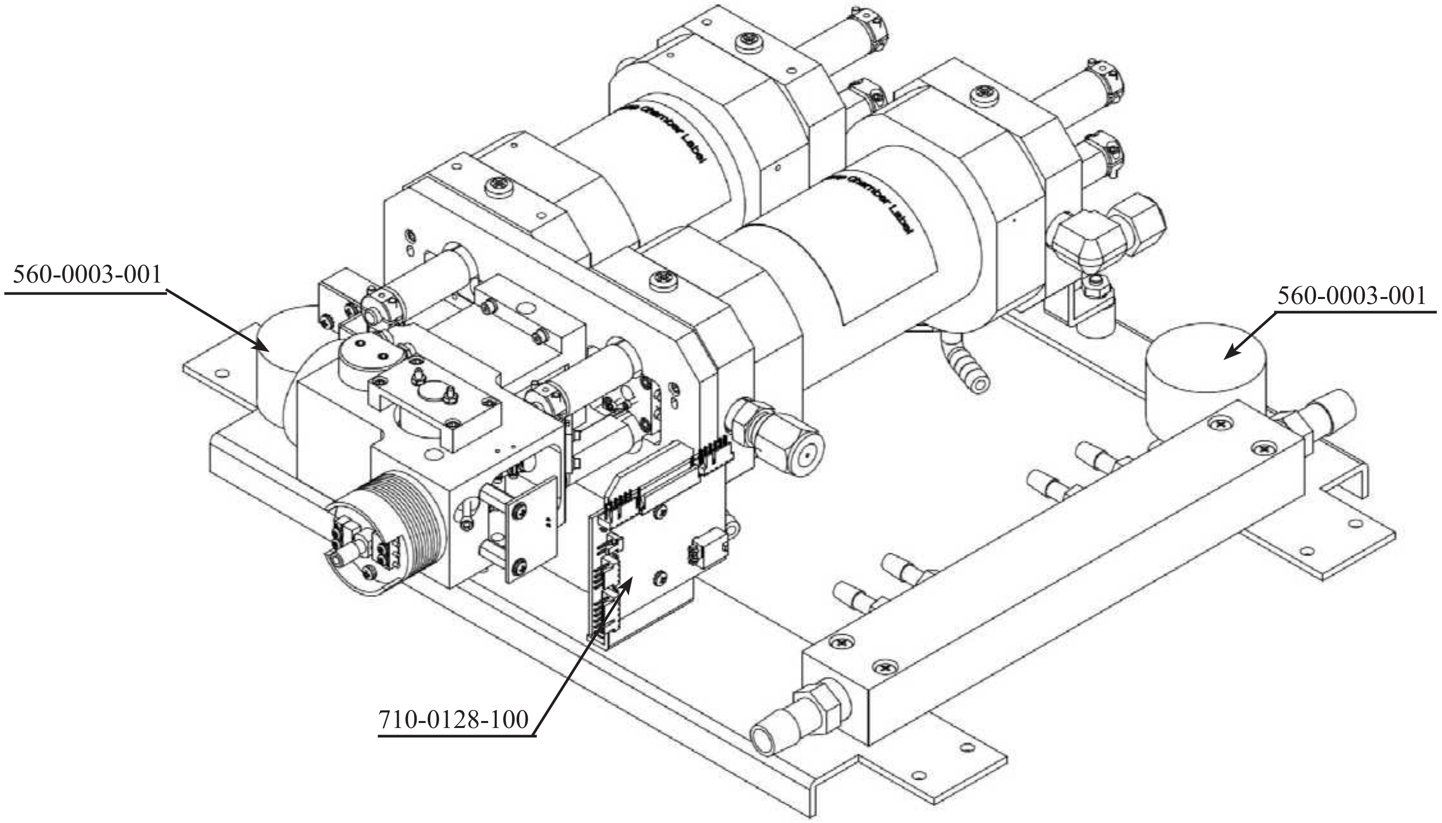
Note: Hardware and springs must be ordered as needed.

FOR REFERENCE ONLY
CHECK FOR CURRENT REVISION

ILLUSTRATED BREAK OUT
100-7002-070 Rev 17
DUAL HEAD, ASSY
CYNERGY



PART NUMBER	DESCRIPTION	QTY
100-7002-070	ASSY, DUAL HEAD, CYNERGY	1
560-0003-001	XFMR,TRIGGER	2
710-0128-100	ASSY,PCB,RES I-CONN,MD&CY	1

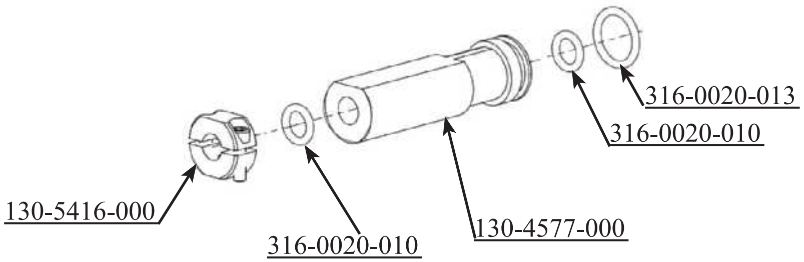


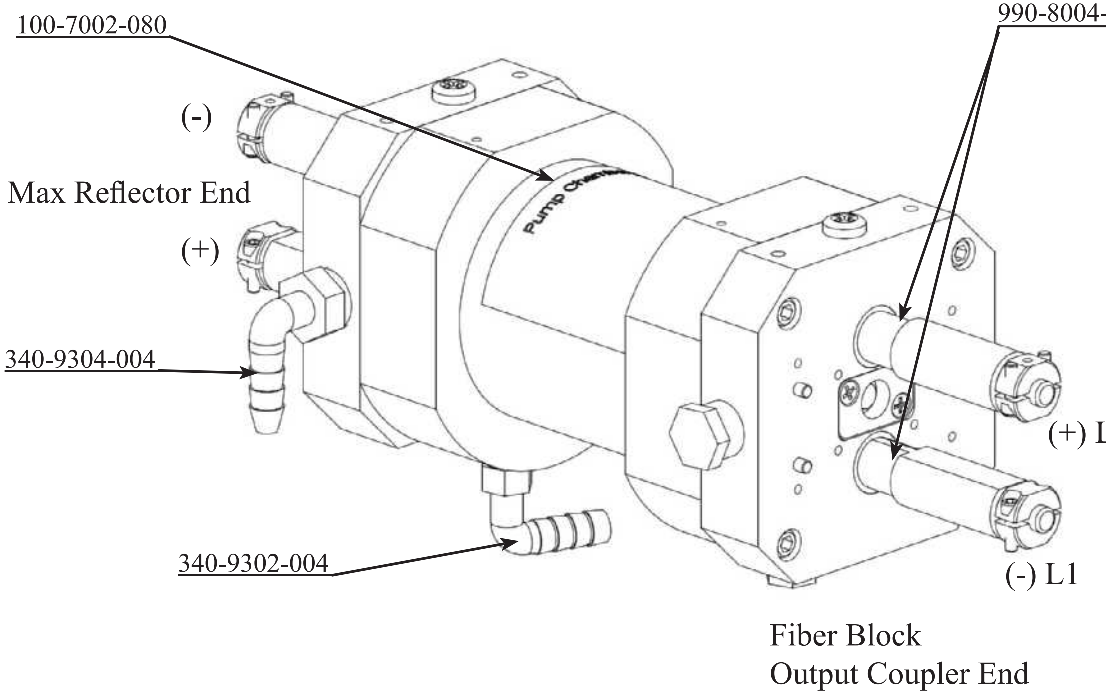
FOR REFERENCE ONLY
CHECK FOR CURRENT REVISION

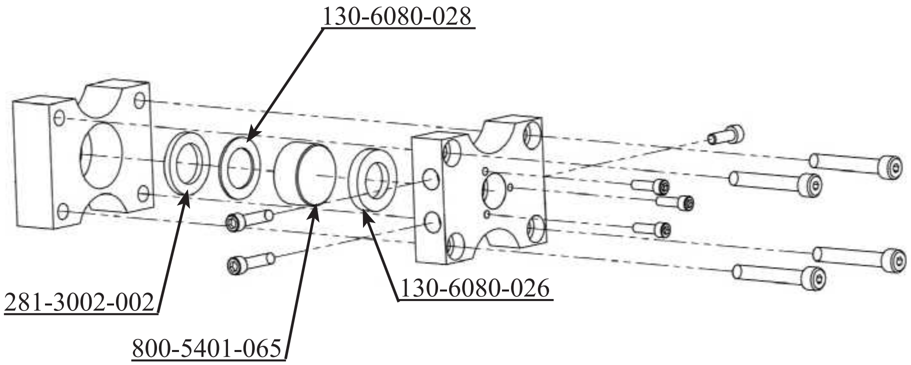
ILLUSTRATED BREAK OUT
100-7002-080 Rev 12
LASER HEAD,YAG, ASSY
CYNERGY

Legend
Item number
Quantity per assembly

PART NUMBER	DESCRIPTION	QTY
100-7002-080	ASSY, LASER HEAD, YAG, CYNERGY	1
130-4577-000	HLDR,FLHLMP,12"PUMP CHAMBER	4
130-5416-000	CLAMP,ROUNDHEAD 1PC .252 ID	4
281-3002-002	WASHER,WAVE,SPR,.325ID,.500OD	1
130-6080-028	WASHER,REFL PROTECTION,TRISTAR	1
130-6080-026	SPACER PLATE,MAX REFL.,TRISTAR	1
316-0020-010	O-RING,SIL,1/4" X 3/8"	10
316-0020-013	O-RING, SLCONE 7/16" ID	4
800-5401-065	REFL,MAX,1MCC,1.064UM,.5",FS	1
340-9302-004	ELBOW,BARB,1/8NPTx1/4T,KYN	1
340-9304-004	ELBOW BARB 1/4NPTx1/4T,KYN	1
990-8004-501	FLSHLMP,LIN,4.5"ARC,7X9MM,500T	2







Note: Coated surface faces towards the head.

FOR REFERENCE ONLY
CHECK FOR CURRENT REVISION

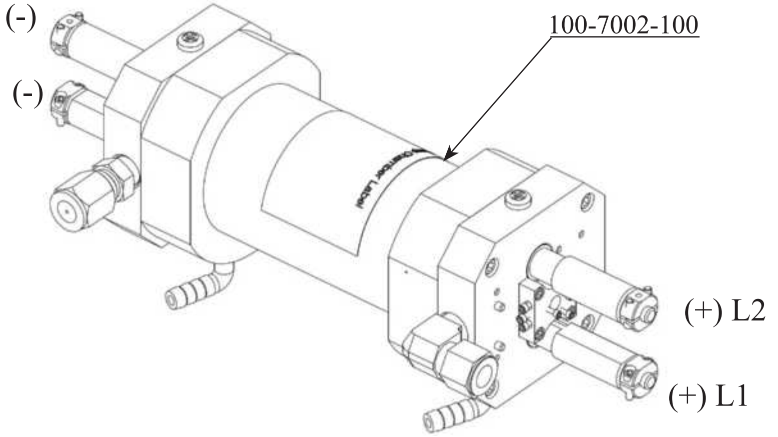
ILLUSTRATED BREAK OUT

100-7002-100 Rev 7

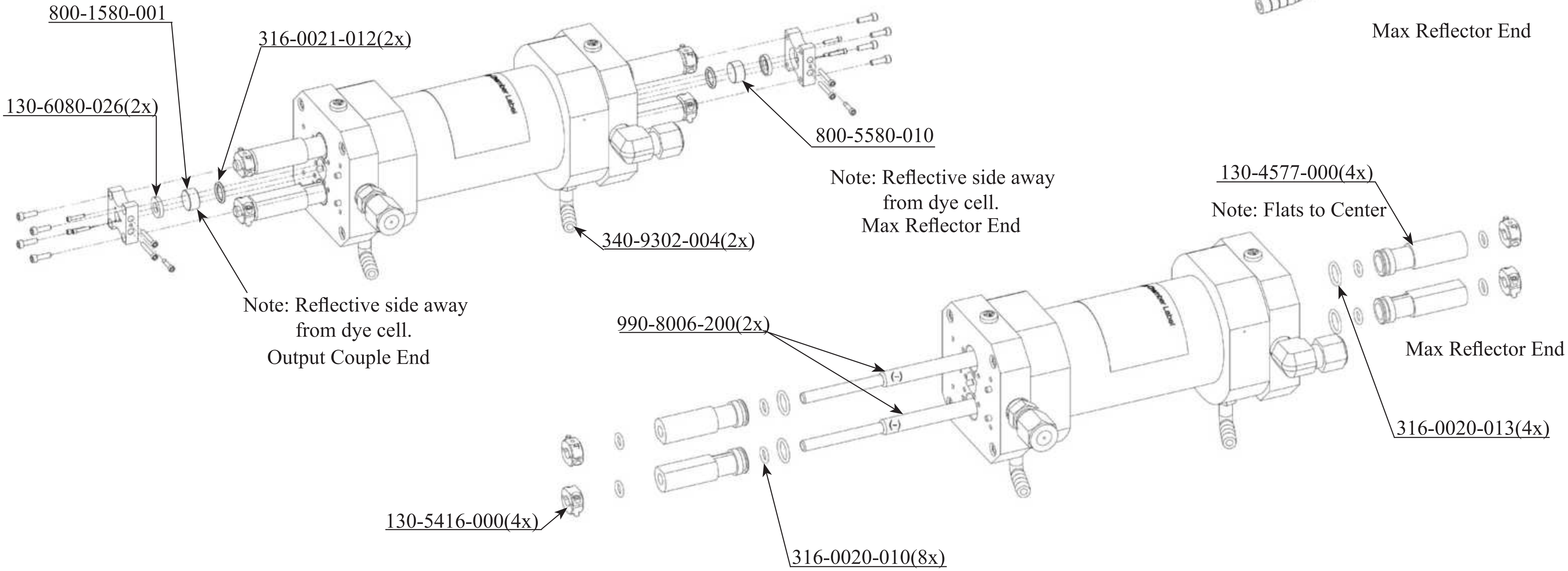
DYE HEAD, ASSY
CYNERGY

Legend
Item number
Quantity per assembly

PART NUMBER	DESCRIPTION	QTY
100-7002-100	ASSY, DYE HEAD,CYNERGY	1
130-5416-000	CLAMP,ROUNDHEAD 1PC .252 ID	4
130-6080-026	SPACER PLT,MAX REFLECTOR	2
130-4577-000	HLDR,FLHLMP,12"PUMP CHAMBER	4
316-0020-010	O-RING,SIL,1/4" X 3/8"	8
316-0020-013	O-RING, SLCONE 7/16" ID	4
316-0021-012	O-RING,SIL,CLEAR,3/8IDX1/2OD	2
800-1580-001	REFL,PARTIAL,70%R,585NM	1
800-5580-010	REFL,FLAT MAXR 585 F SIL 2ND S	1
340-9302-004	ELBOW,BARB,1/8MPTX1/4T,KYN	2
990-8006-200	FLASHLAMP,LIN,6"ARC,7X9MM,200T	2



Max Reflector End



Note: Reflective side away from dye cell. Max Reflector End

Note: Flats to Center

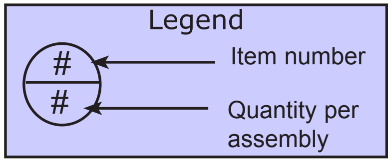
Note: Reflective side away from dye cell. Output Couple End

Max Reflector End

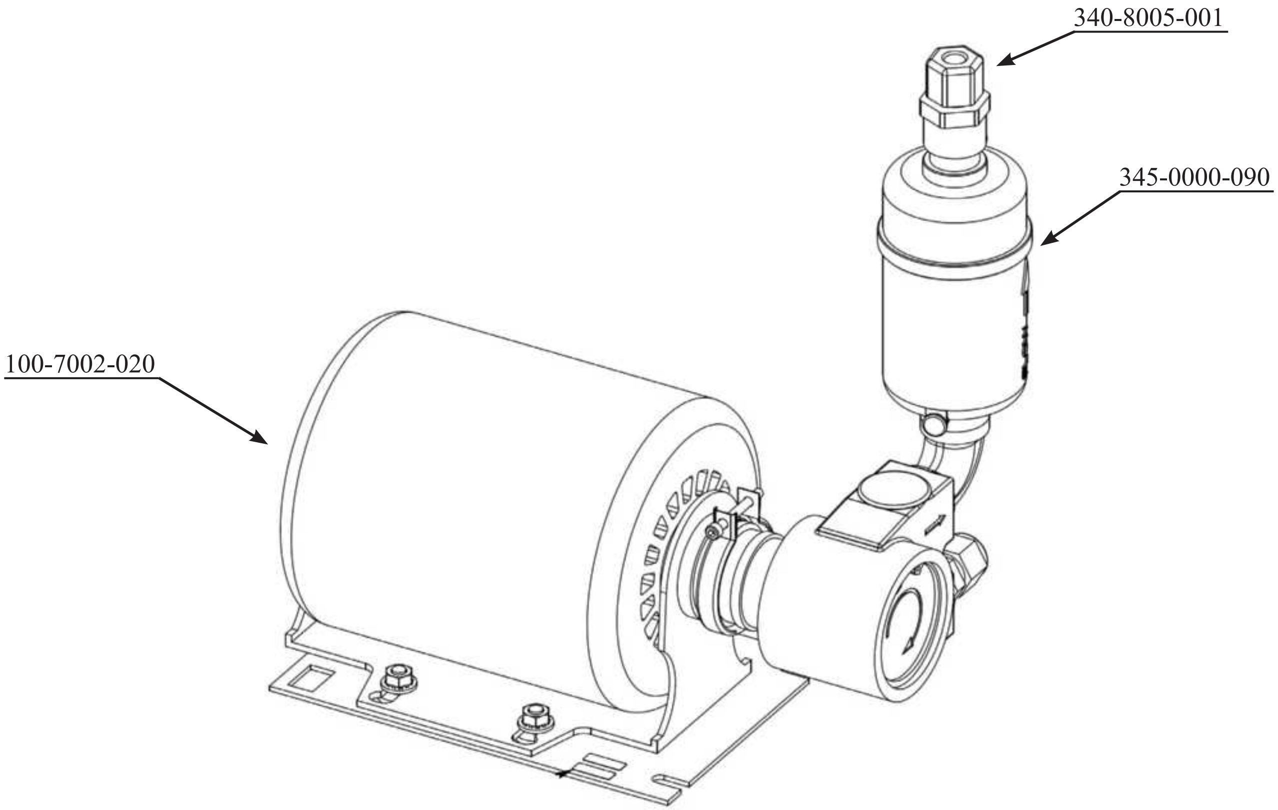
ILLUSTRATED BREAK OUT

100-7002-020 Rev 9

DYE PUMP, ASSY
CYNERGY



PART NUMBER	DESCRIPTION	QTY
100-7002-020	ASSY, DYE PUMP,CYNERGY	1
345-0000-090	FILTER,ASSY,DISPOSABLE	1
340-8005-001	CONN,FEMALE,3/8T X 1/2FPT	1

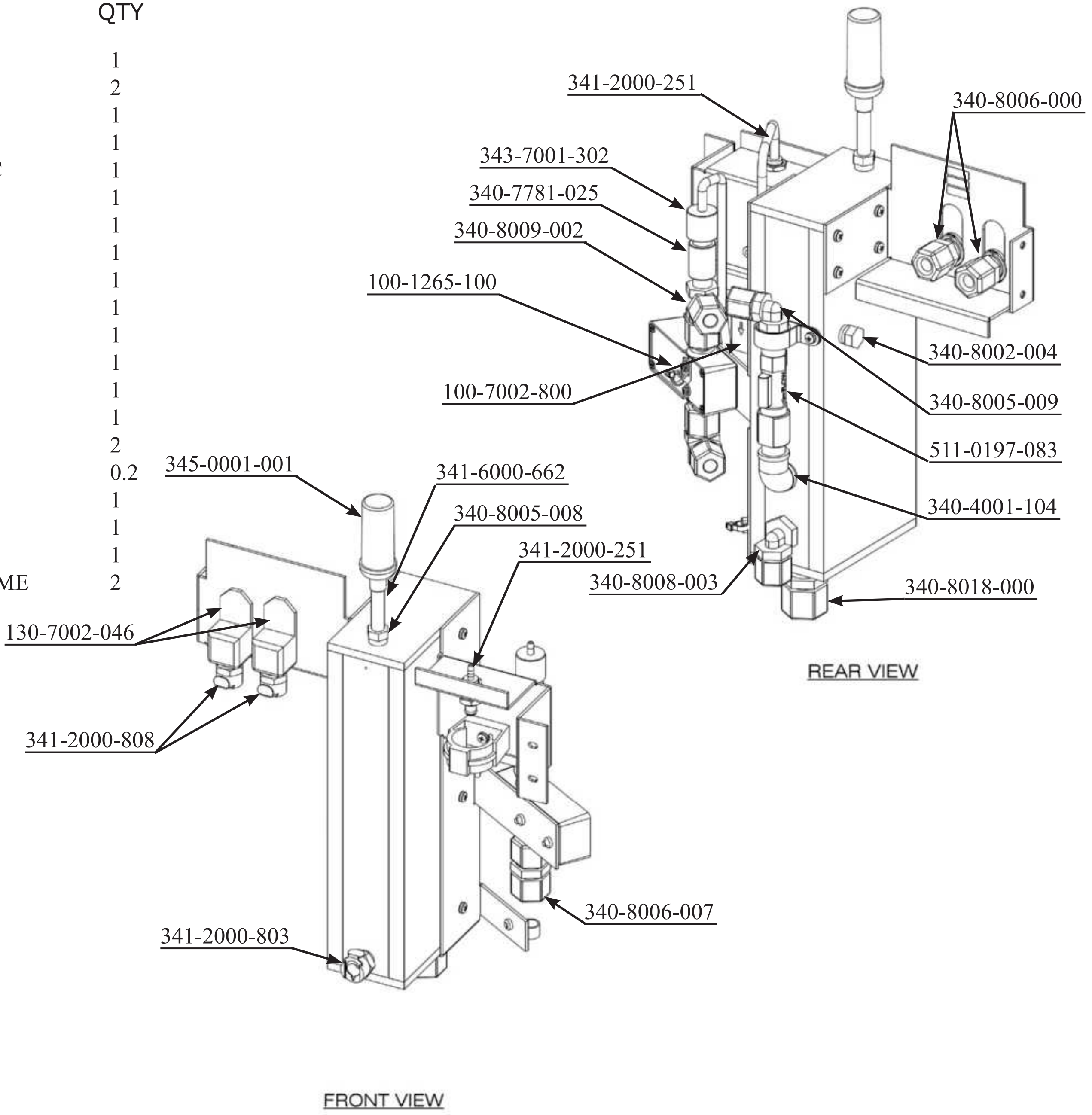


FOR REFERENCE ONLY
CHECK FOR CURRENT REVISION

ILLUSTRATED BREAK OUT
100-7002-090 Rev 10
DYE INJECT, FILTER, ASSY
CYNERGY

Legend
\# Item number
\# Quantity per assembly

PART NUMBER	DESCRIPTION	QTY
100-7002-100	ASSY, DYE HEAD,CYNERGY	1
130-7002-046	DYE FILTER MANIFOLD, CYNERGY	2
100-1265-100	ASSY,DYE CONC. MONITOR,MINI V	1
511-0197-083	SWITCH,FLOW,1GPM,W/AMP,211992	1
341-2000-803	CPLG,BODY,W/VALVE,1/4MPT,PLSTC	1
343-7001-302	CHK VALVE,1/4MPT,1/8BARB,2GPM	1
340-8018-000	CONN,MALE 5/8T X 1/2MPT	1
340-4001-104	ELBOW,ST,3/8FPTX3/8MPT,PROPROP	1
340-8006-007	ELBOW,UNION 3/8T PP	1
340-8009-002	TEE,MALERUN,3/8T X 1/4MPT	1
340-7781-025	CPLG,1/4FPT,SCHED 80 PVC	1
100-7002-800	ASSY,DYE INJECT PUMP, CYNERGY	1
341-2000-251	INSERT,1/8BARB,PNL,W/SO,ACETAL	1
340-8005-009	ELBOW,FEMALE 3/8T X 3/8FPT,WHT	1
340-8008-003	ELBOW,MALE 3/8T X 3/8MPT	2
341-6000-662	TUBING,POLYETHYLENE 3/8" OD	0.2
345-0001-001	CARTRIDGE,CARBON VENT	1
340-8005-008	CONN,MALE,BRB 1/4MPT X 1/4IDT	1
340-8002-004	PLUG,PIPE,HEX,1/4MPT	1
341-2000-808	CPLG,BODYW/VALVE,1/4MPT,CHROME	2

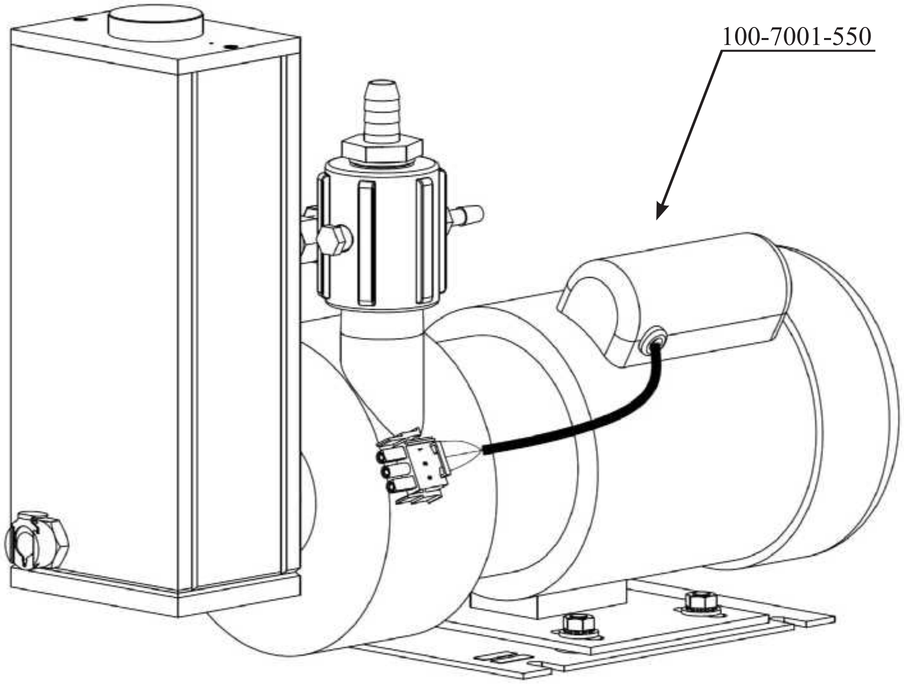


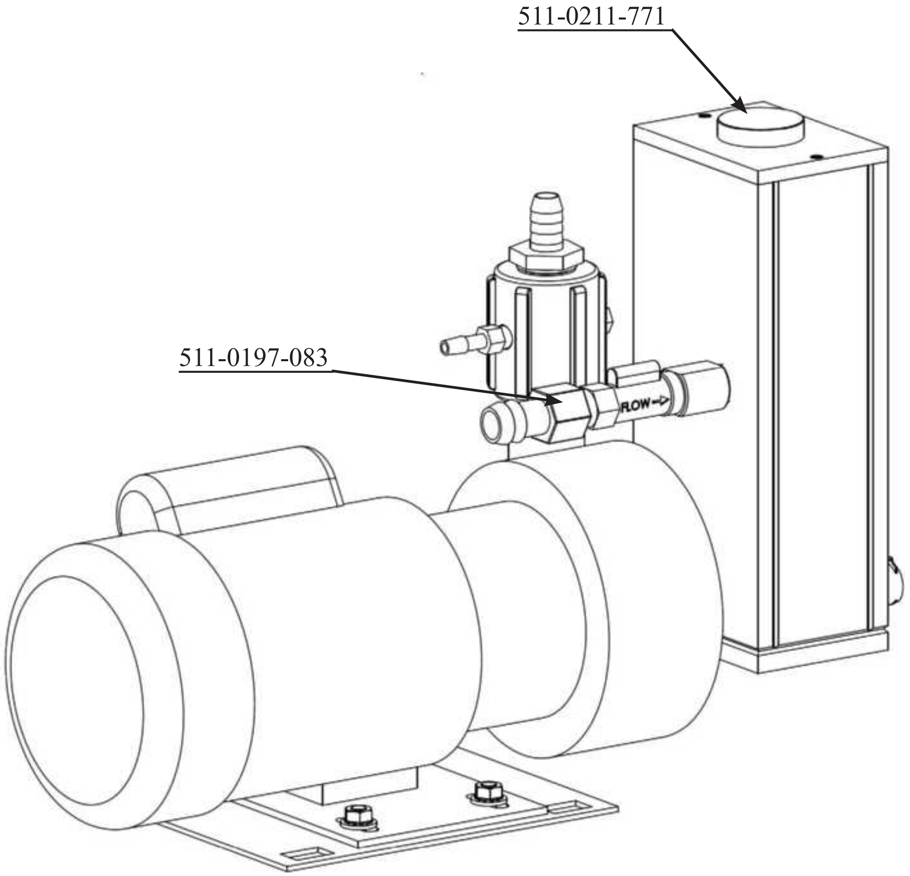
FOR REFERENCE ONLY
CHECK FOR CURRENT REVISION

ILLUSTRATED BREAK OUT
100-7001-550 Rev 10
PUMP/RESERVOIR, ASSY
CYNERGY

Legend
\# Item number
\# Quantity per assembly

PART NUMBER	DESCRIPTION	QTY
100-7001-550	PUMP/RESERVOIR,MD	1
511-0211-771	SWITCH,FLOAT,W/AMP CONN,211771	1
511-0197-083	SWITCH,FLOW,1GPM,W/AMP,211992	1



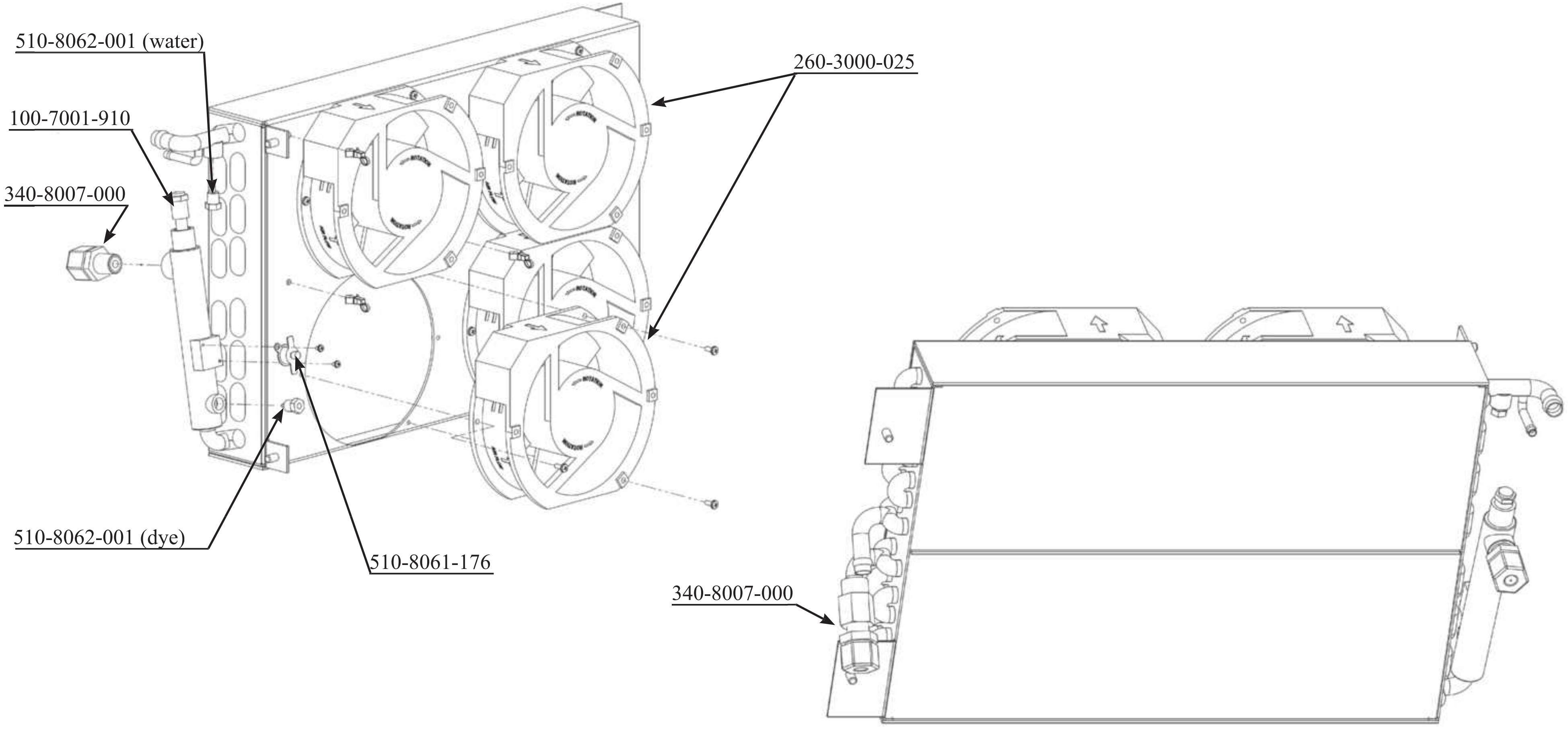


FOR REFERENCE ONLY
CHECK FOR CURRENT REVISION

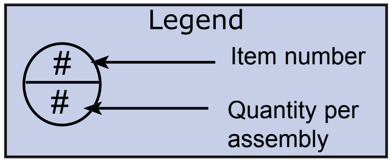
ILLUSTRATED BREAK OUT
100-7002-150 Rev 13
HEAT EXCHANGER,4 FAN, ASSY
CYNERGY

Legend
\# Item number
\# Quantity per assembly

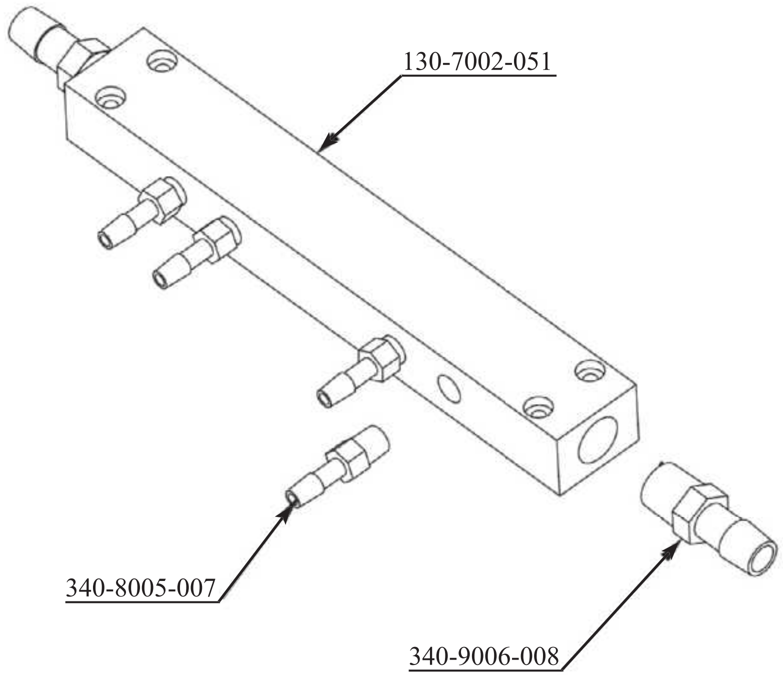
PART NUMBER	DESCRIPTION	QTY
100-7002-150	ASSY, HEAT EXCH, CYNERGY	1
100-7001-910	ASSY,HEATER CARTRIDGE,MD	1
510-8062-001	SENSOR,THERM,15-80 C,W/CONN	2
510-8061-176	THERMO,MNL RESET,OPENS @176F	1
340-8007-000	CONN,MALE 3/8T X 3/8MPT	2
260-3000-025	FAN,6”X2”,235CFM,230V,50/60HZ	4

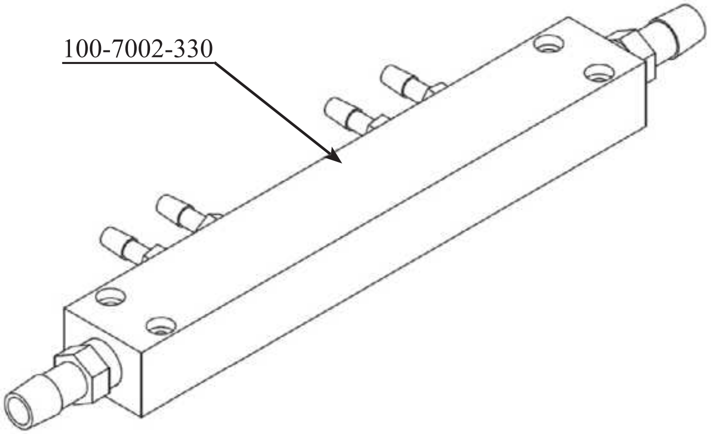


ILLUSTRATED BREAK OUT
100-7002-330 Rev 3
WATER MANIFOLD, ASSY
CYNERGY



PART NUMBER	DESCRIPTION	QTY
100-7002-330	ASSY,WATER MANIFOLD, CYNERGY	1
130-7002-051	WATER MANIFOLD, CYNERGY	1
340-9006-008	CONN,M,BARB,3/8MPT,1/2BARB,PP	2
340-8005-007	CONN,MALE,BRB 1/8MPTX1/4IDT,KYN	4



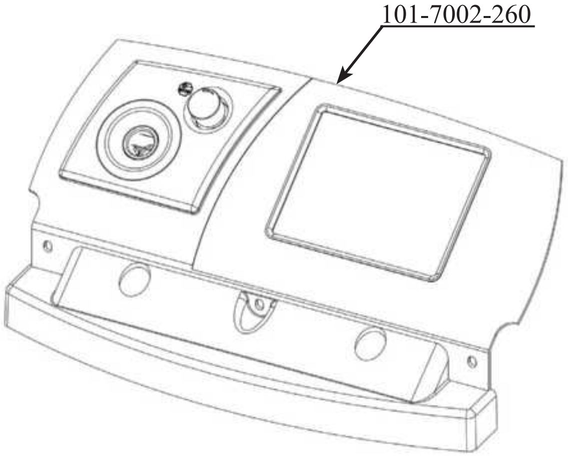


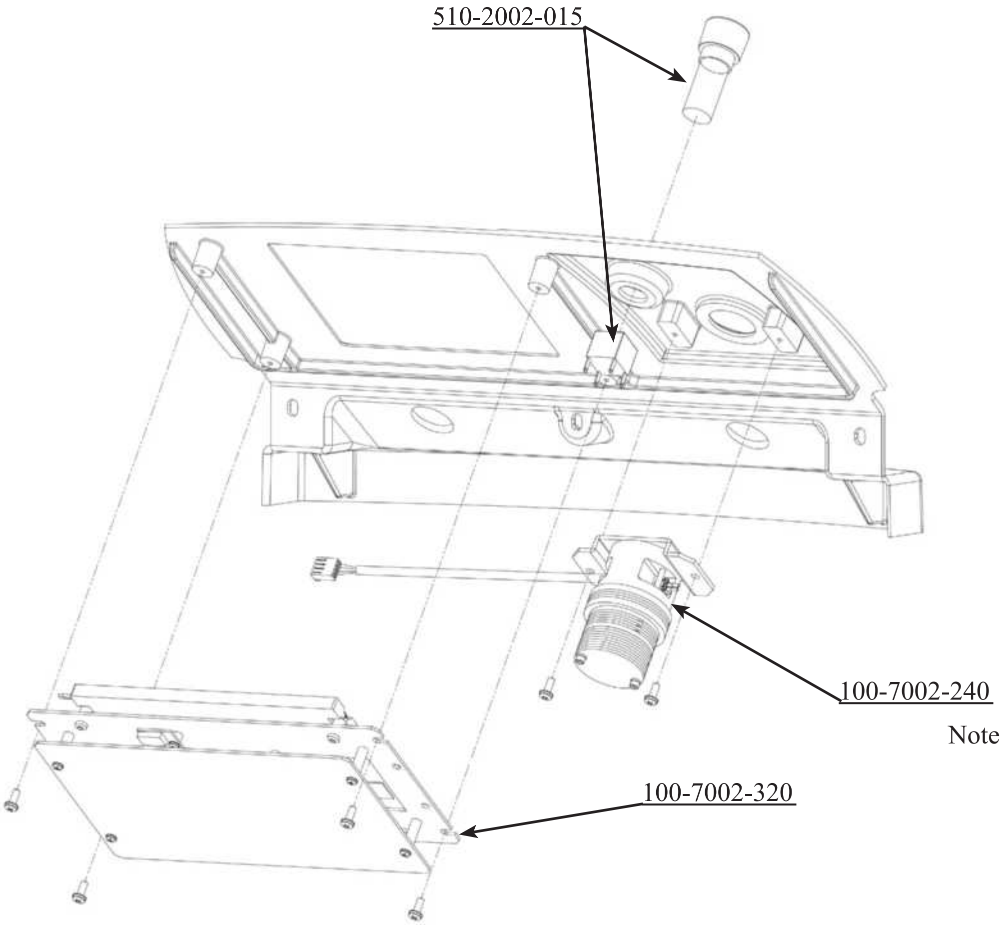
FOR REFERENCE ONLY
CHECK FOR CURRENT REVISION

ILLUSTRATED BREAK OUT
100-7002-260 Rev 12
FRONT BEZEL, ASSY
CYNERGY

Legend
\# Item number
\# Quantity per assembly

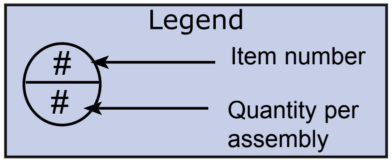
PART NUMBER	DESCRIPTION	QTY
101-7002-260	ASSY,FRONT BEZEL,CYNERGY	1
100-7002-240	ASSY, CAL PORT, CYNERGY	1
100-7002-320	ASSY, DISPLAY, CYNERGY	1
510-2002-015	SWITCH,PB,MOM,W/CAP,E-STOP	1



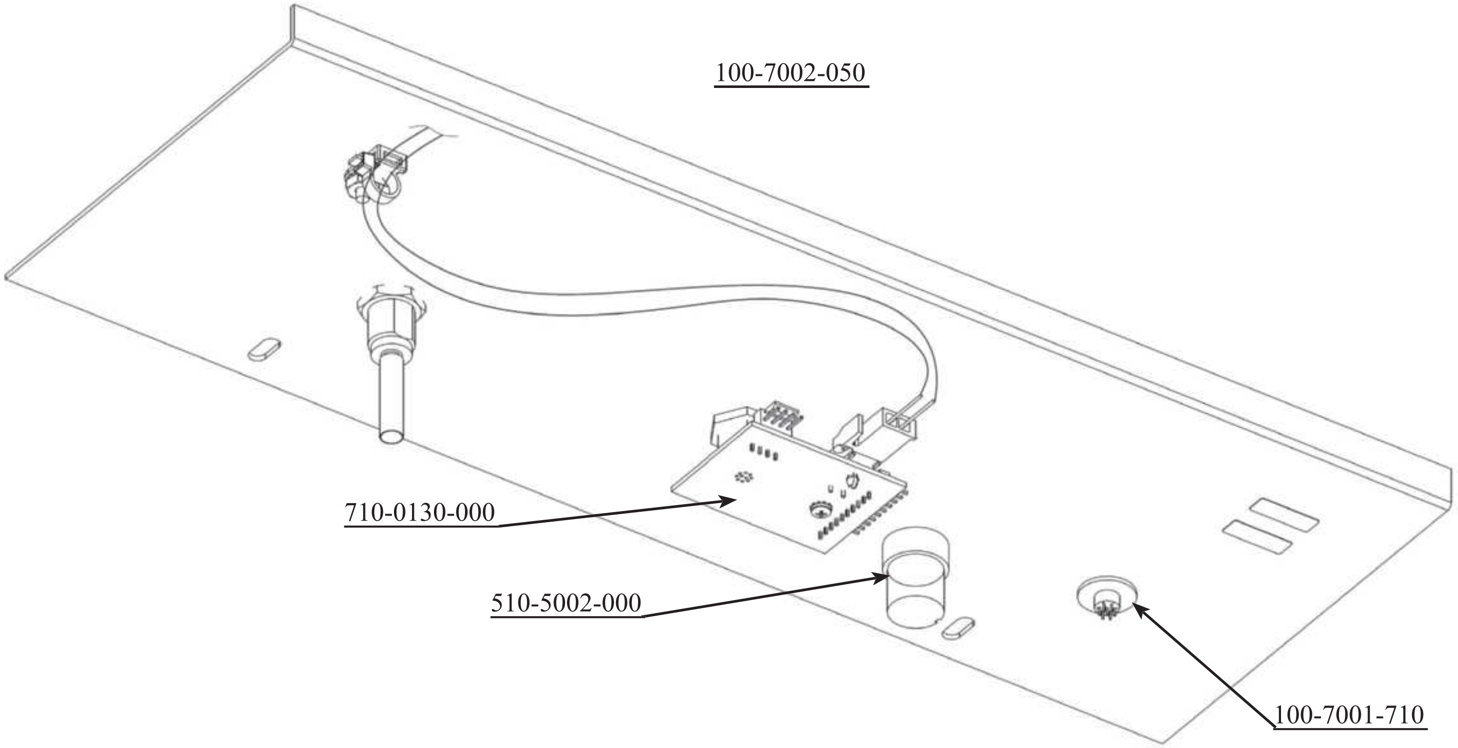


Note: Switches face up.

ILLUSTRATED BREAK OUT
100-7002-050 Rev 6
REAR CNTL PANEL, ASSY
CYNERGY

Legend


PART NUMBER	DESCRIPTION	QTY
100-7002-050	ASSY, REAR CONTROL PNL,CYNERGY	1
100-7001-710	ASSY,INTERLOCK PLUG,MD	1
510-5002-000	SWITCH,ACTUATOR,2POS KEY	1
710-0130-000	ASSY,PCB,REAR INTERCONNECT	1



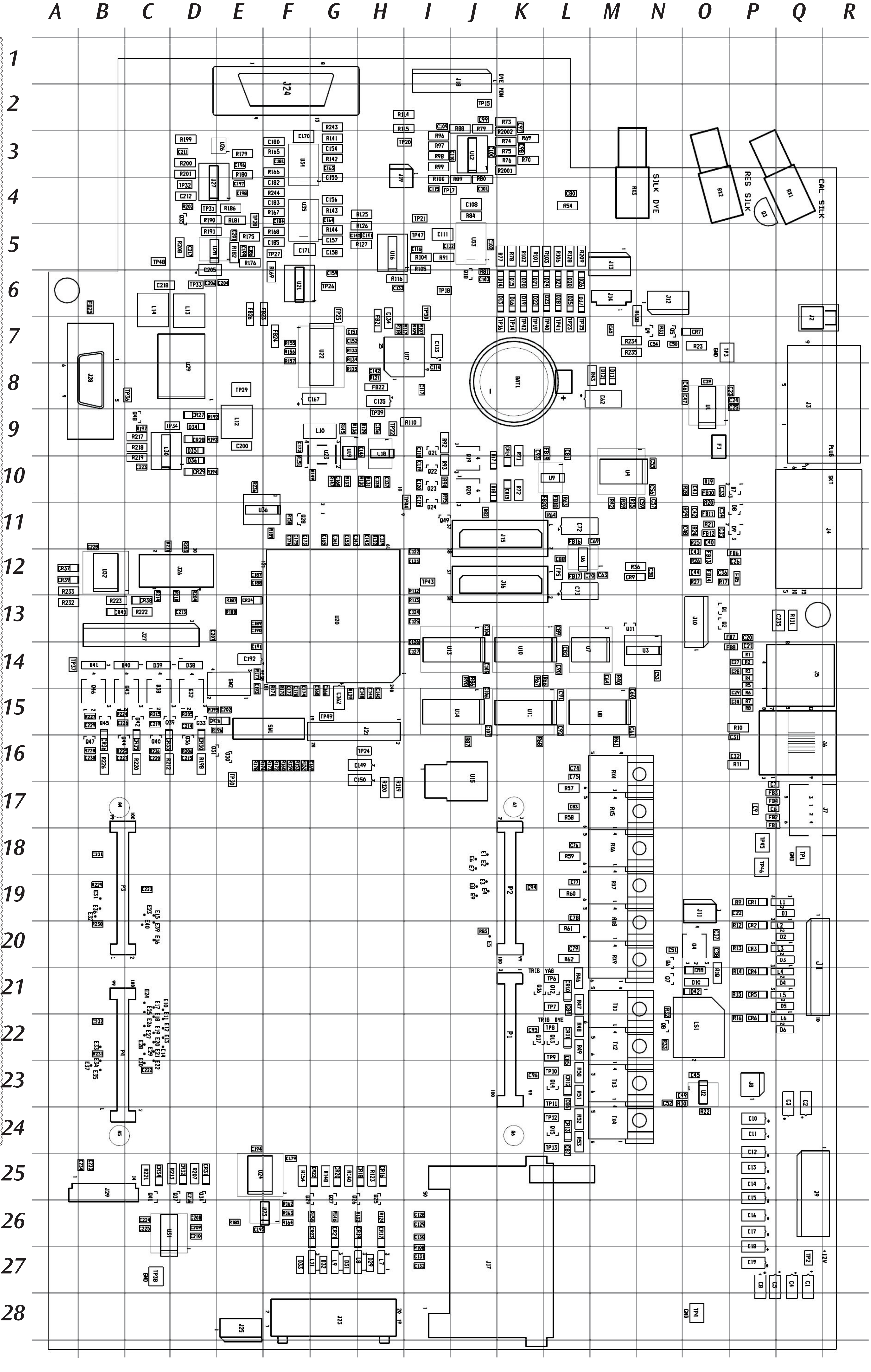
Tabbed Page

Schematics

CYNERGY CONTROL PCB

710-0138-000

TP1	Q,18
TP2	Q,27
TP3	O, 7
TP4	O,28
TP5	L,12
TP6	L,21
TP7	L,21
TP8	L,22
TP9	L,22
TP10	L,23
TP11	L,23
TP12	L,24
TP13	L,24
TP14	K,7
TP15	J,2
TP16	K,7
TP17	I-J,4
TP18	I,6
TP19	K,7
TP20	H-I,3
TP21	I,4
TP22	H,9
TP23	L,7
TP24	H,16
TP25	G,6-7
TP26	G,6
TP27	F,5
TP28	E,4
TP29	E,8
TP30	E,16
TP31	D,4
TP32	D,4
TP33	D,6
TP34	C-D,9
TP35	L,7
TP36	C,8
TP37	A,14
TP38	C,27
TP39	I,9
TP40	L,7
TP41	L,7
TP42	K,7
TP43	I,12
TP44	I,10-11
TP45	P,18
TP46	P,18
TP47	I,5
TP48	C,5
TP49	NA
TP50	NA
SW1	E-F,15



REVISIONS				
REV.	ECO/ECN	DESCRIPTION	APPD	DATE
1	ECN00131	PRELIMINARY RELEASE	R.V.	6/7/05
2	ECN00168	ADDED 100-7002-970,SEE OMNIFY	R.V	8/2/2005
3	ECN00198	SEE OMNIFY	R.V.	8/18/2005
4	ECO 05745	CHANGED HP TRIG SWITCH NUMBERS	R.V.	10/12/05
5	ECN00275	UPDATE PER ECN00275	R.V.	11/15/2005
6	ECO 05850	TREE CLEANUP	R.V.	2/13/06
7	ECN 00433	710-0128-200 WAS 710-0128-100	R.V.	3/8/06

991-4909-000	TEST DATA SHEET CYNERGY
991-5122-000	PROC,CONFIG DATA SHEET
991-5121-000	PROC,IN TRAVELER,CYNERGY
991-4908-000	PROC,FNL TST & CAL, CYNERGY 585
991-5116-000	PROC, DYE KIT INSTRUCTIONS, CYNERGY
991-5115-000	PROC, DYE CHANGE KIT, CYNERGY
991-4330-000	PROC, MIXING, RECIPE 13
991-4607-000	PROC, KI, MIXING
991-5117-000	PROC, DYE KIT, ENERGY PACK
991-4329-000	PROC,RECIPE 12, MIXING
991-4380-000	PROC, STAR SHOT DYE INJECT BOTTLE
991-4506-364	PROC, HP FOCUS ADJUST.
991-4903-000	PROC, STRESS TEST, CYNERGY
850-1265-100	SERVICE MANUAL, CYNERGY
991-4904-000	PROC. FINAL QC & INSPECTION, CYNERGY
991-4905-000	PROC, PROGRAM ETX CONTROLLER
991-4906-000	PROC, FINAL TEST & CALIB, CYNERGY
991-4907-000	LASER FLOW WORKSHEET, CYNERGY
850-1065-000	OPERATORS MANUALS, CYNERGY
850-1265-000	TECHNICAL GUIDE, CYNERGY
850-5065-000	CRATE LETTER, CYNERGY
110-0065-000	SOFTWARE, CYNERGY
105-1865-000	WIRING SCHEMATIC, CYNERGY
110-0065-010	SOFTWARE, SOURCE, CYNERGY

VENDOR NOTICE: FAILURE TO RECEIVE WRITTEN AUTHORIZATION FOR ANY REV/PRINT CHANGES MAY RESULT IN THE REJECTION OF ANY OR ALL MANUFACTURED PIECE PARTS

MATERIAL: -----------

FINISH: -----------

PROPRIETARY

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DESIGNER: D.TASHJIAN	DATE 8/5/04
DRAFTER: J.SOUCY	DATE 5/20/05
CHECKED BY: R.VEILLEUX	DATE 3/7/06
DRAWN BY: MAB	DATE 3/7/06

DO NOT SCALE THIS DRAWING

DIMENSIONS IN INCHES (MM)

UNLESS OTHERWISE SPECIFIED
.X±.030 [0.76]
.XX ± .010 [0.25]
.XXX ± .005 [0.13]
X°±30'
◎ TO BE .005 MAX
ALL SURFACES: 63✓

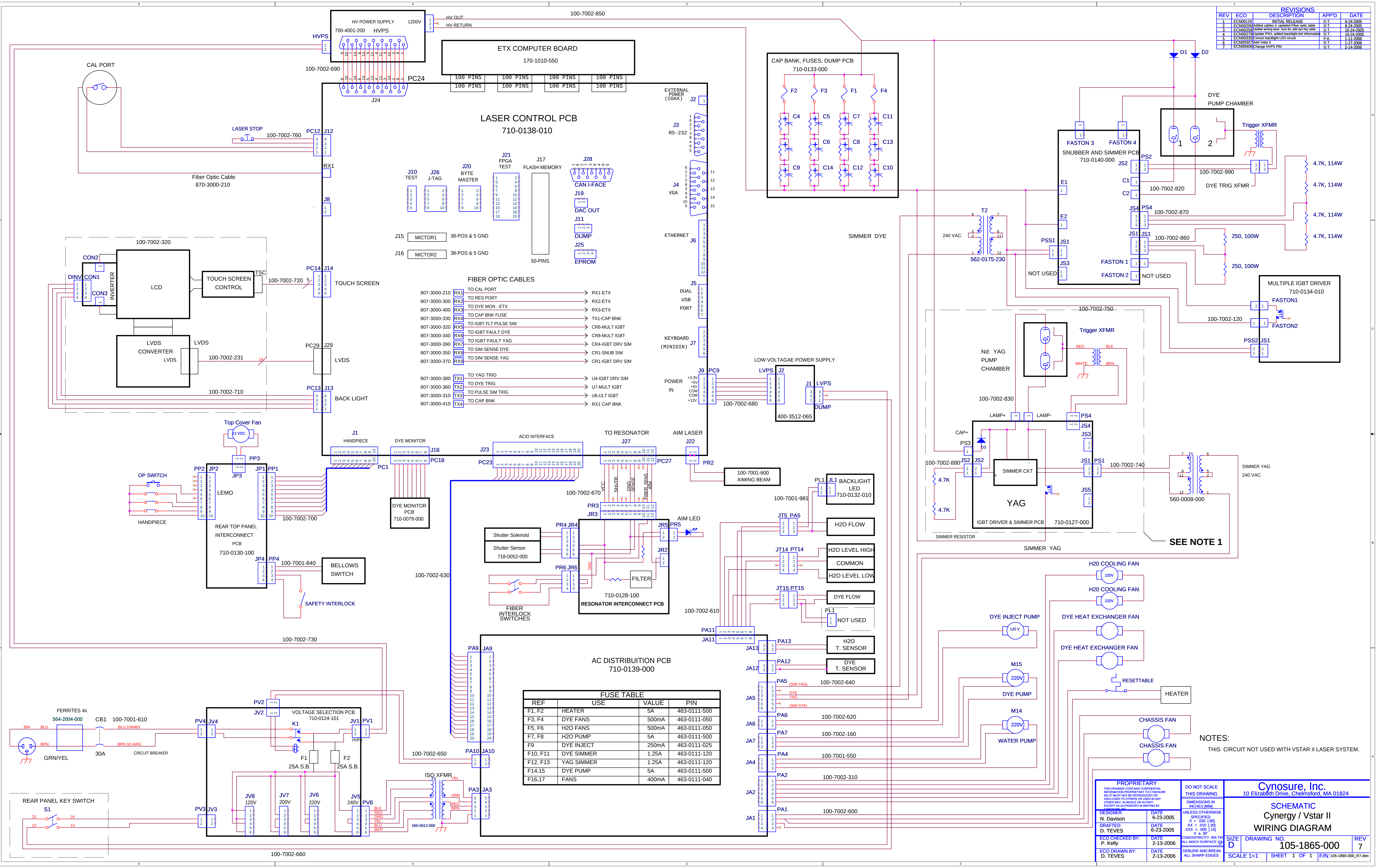
DEBURR AND BREAK ALL SHARP EDGES

Cynosure, Inc.
5 Carlisle Rd., Westford, MA 01886 USA

FAMILY TREE,
CYNERGY,
SYSTEM

SIZE D | 105-2065-000 | REV. 7

SCALE: 1:1 | SHEET 1 OF 1



REVISIONS				
REV	ECO	DESCRIPTION	APP'D	DATE
1	ECN00119	INITIAL RELEASE	D.T.	6-24-2005
2	ECN00200	Added cables #, updated Fiber optic table	D.T.	8-24-2005
3	ECN00258	Update aiming laser, fuse tbl, add dye trig cable	D.T.	10-24-2005
4	ECN00279	Update PN's, added backlight led information	D.T.	10-24-2005
5	ECN00335	Correct backlight LED circuit	P.K.	1-11-2006
6	ECN00357	Add Vstar II	D.T.	1-27-2006
7	ECN00406	Change HVPS P/N	D.T.	2-14-2006

AC DISTRIBUITION PCB
710-0139-000

FUSE TABLE			
REF	USE	VALUE	PIN
F1, F2	HEATER	5A	463-0111-500
F3, F4	DYE FANS	500mA	463-0111-050
F5, F6	H2O FANS	500mA	463-0111-050
F7, F8	H2O PUMP	5A	463-0111-500
F9	DYE INJECT	250mA	463-0111-025
F10, F11	DYE SIMMER	1.25A	463-0111-120
F12, F13	YAG SIMMER	1.25A	463-0111-120
F14,15	DYE PUMP	5A	463-0111-500
F16,17	FANS	400mA	463-0111-040

NOTES:

THIS CIRCUIT NOT USED WITH VSTAR II LASER SYSTEM.

DESIGNER: N. Davison	DATE 6-23-2005
DRAFTED: D. TEVES	DATE 6-23-2005
ECO CHECKED BY: P. Kelly	DATE 2-13-2006
ECO DRAWN BY: D. TEVES	DATE 2-13-2006

DO NOT SCALE THIS DRAWING

DIMENSIONS IN INCHES [MM]

UNLESS OTHERWISE SPECIFIED
.X = .030 [.80]
.XX = .010 [.30]
.XXX = .005 [.15]
X ± 30'
CONCENTRICITY .005 TIR
ALL MACH SURFACE: 63

DEBURR AND BREAK ALL SHARP EDGES

Cynosure, Inc.
10 Elizabeth Drive, Chelmsford, MA 01824

SCHEMATIC
Cynergy / Vstar II
WIRING DIAGRAM

SIZE D
DRAWING NO. 105-1865-000
REV 7
SCALE 1=1
SHEET 1 OF 1
F/N: 105-1865-000_R7.dsn

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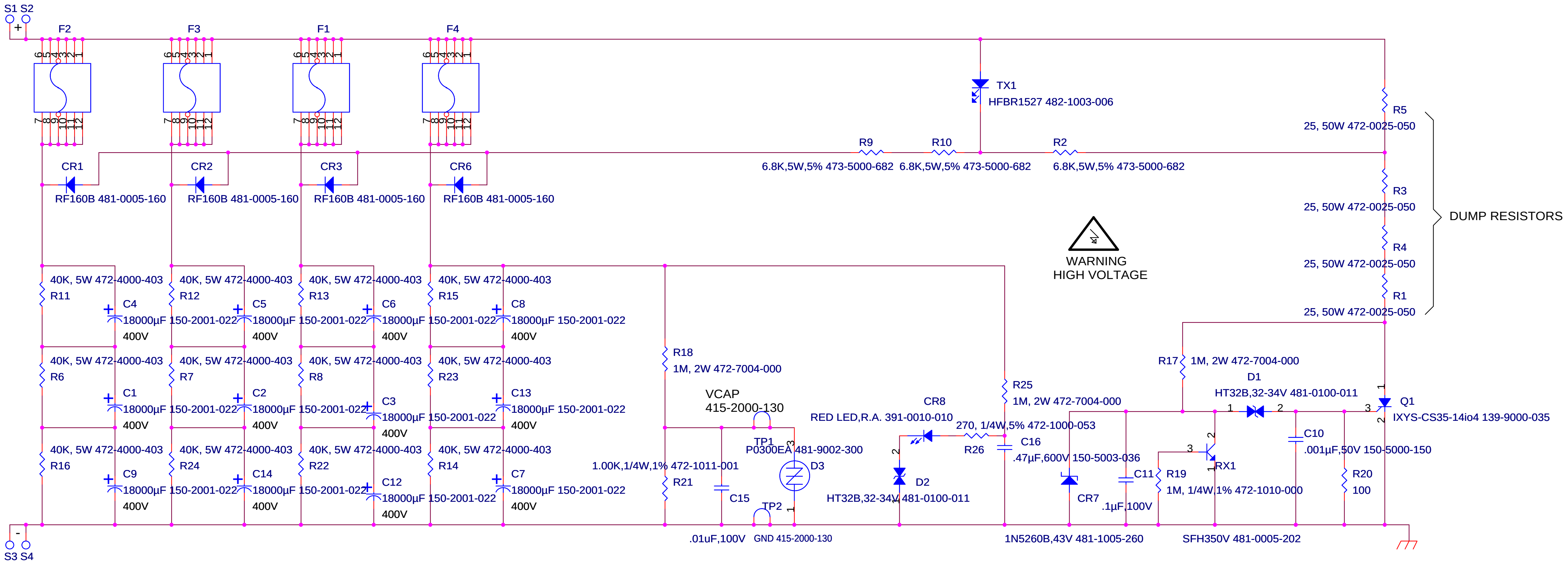
REVISIONS

REV	ECO	DESCRIPTION	APP'D	DATE
01	ECN 00033	INTIAL RELEASE	D.T.	01/27/2005
02	ECN 00077	Parts change, corrections board mods	D.T.	03/29/2005



PROPRIETARY

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DESIGNER: N. Davison	DATE 11-13-04
DRAFTED: N. Davison	DATE 11-13-04
ECO CHECKED BY: N. Davison	DATE 03-29-2005
ECO DRAWN BY: D. Teves	DATE 03-29-2005

DO NOT SCALE THIS DRAWING

DIMENSIONS IN INCHES [MM]

UNLESS OTHERWISE SPECIFIED
.X = .030 [.80]
.XX = .010 [.30]
.XXX = .005 [.15]
X ± 30'
CONCENTRICITY .005 TIR
ALL MACH SURFACE: 63

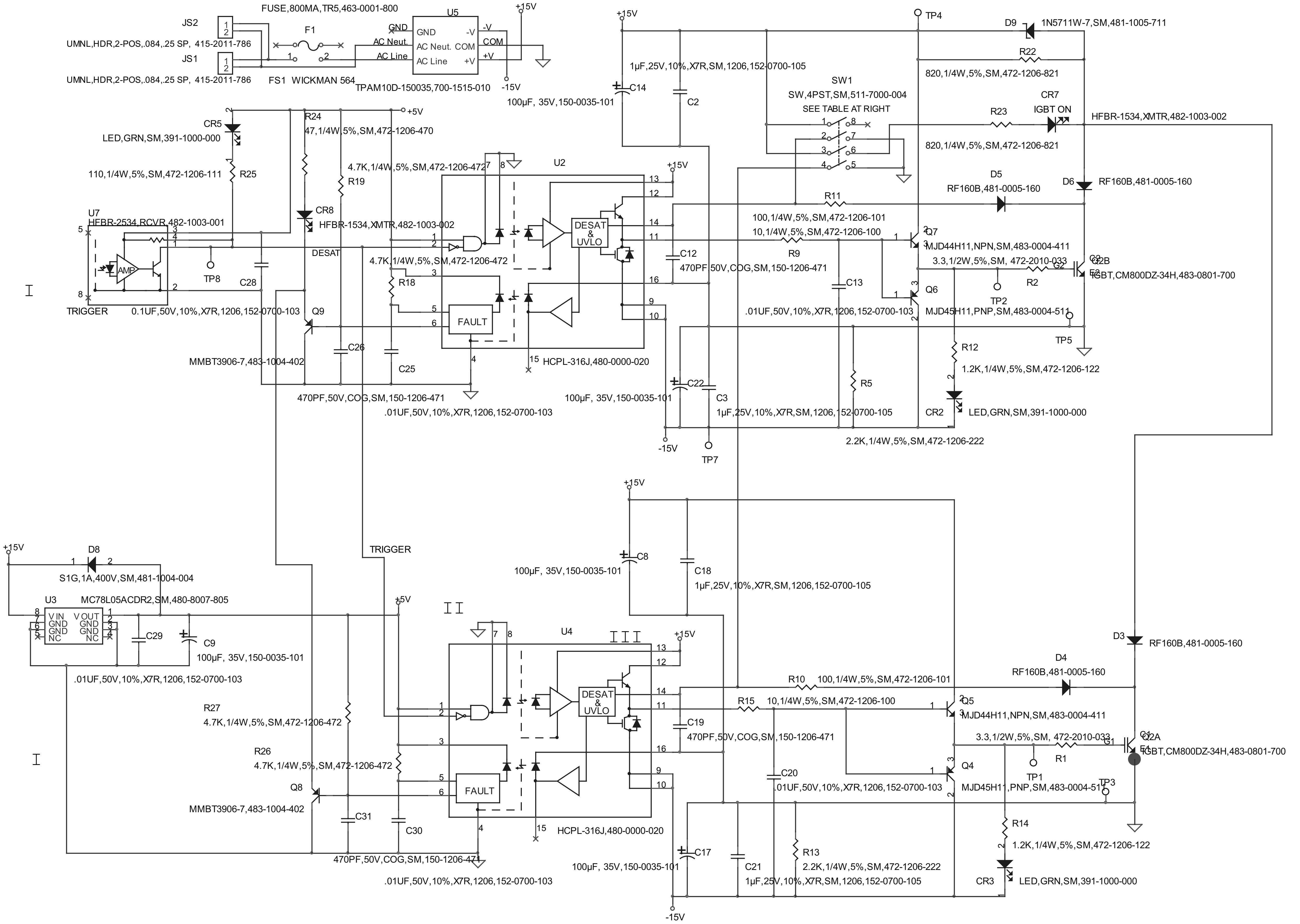
DEBURR AND BREAK ALL SHARP EDGES

Cynosure, Inc.
10 Elizabeth Drive, Chelmsford, MA 01824

SCHEMATIC

SCHEMATIC, DYE-YAG CAPACITOR BANK PCB

SIZE C	DRAWING NO. 718-0133-000	REV 02
SCALE 1=1	SHEET 1 OF1	F/N: 0133_02



SW1 OPERATION

Normal
1-8 Closed
2-7 Open
3-6 Closed
4-5 Open

NOTES:-

1. ALL RESISTORS ARE 1/4 WATT, 5% UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN uFARADS UNLESS OTHERWISE SPECIFIED.

VENDOR NOTICE: FAILURE TO RECEIVE WRITTEN AUTHORIZATION FOR ANY REV / PRINT CHANGES MAY RESULT IN THE REJECTION OF ANY OR ALL MANUFACTURED PIECE PARTS

MATERIAL —

FINISH —

PROPRIETARY

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DESIGNER: E. Koschmann
DATE 07/15/2004

DRAFTER: I. Pisman
DATE 07/15/2004

ECO CHECKED BY: DATE

ECO DRAWN BY: DATE

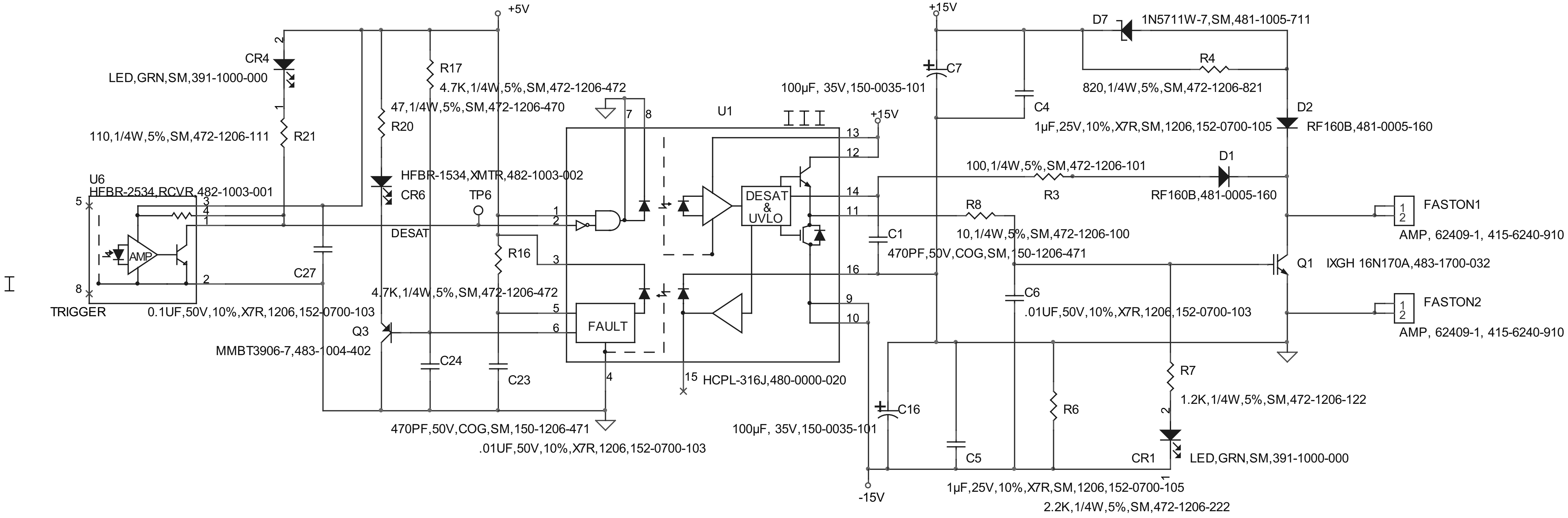
DO NOT SCALE THIS DRAWING

DIMENSIONS IN INCHES [MM] UNLESS OTHERWISE SPECIFIED
.X = .030 [.80]
.XX = .010 [.30]
.XXX = .005 [.15]
X 30'
CONCENTRICITY .005 TIR
ALL MACH SURFACES 63
DEBURR AND BREAK ALL SHARP EDGES

Cynosure, Inc.
10 Elizabeth Drive, Chelmsford, Ma. 01824

SCHEMATIC
D-Y MULTIPLE IGBT DRIVER

SIZE C
DRAWING NO. 718-0134-000
REV 01
SCALE 1=1
SHEET 1 OF 1
F/N: Filename
Thursday, February 10, 2005



PROPRIETARY

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DESIGNER: E. Koschmann	DATE 07/15/2004
DRAFTER: I. Pisman	DATE 07/15/2004
ECO CHECKED BY:	DATE
ECO DRAWN: BY:	DATE

DO NOT SCALE
THIS DRAWING

DIMENSIONS IN
INCHES [MM]
UNLESS OTHERWISE
SPECIFIED
.X = .030 [.80]
.XX = .010 [.30]
.XXX = .005 [.15]
X 30'
CONCENTRICITY .005 TIR
ALL MACH SURFACES 63 ✓

DEBURR AND BREAK
ALL SHARP EDGES

Cynosure, Inc.
10 Elizabeth Drive, Chelmsford, Ma. 01824

SCHEMATIC
D-Y MULTIPLE IGBT DRIVER

SIZE C	DRAWING NO. 718-0134-000	REV 01
SCALE 1=1 Thursday, February 10, 2005	SHEET 2 OF 2	F/N: Filename

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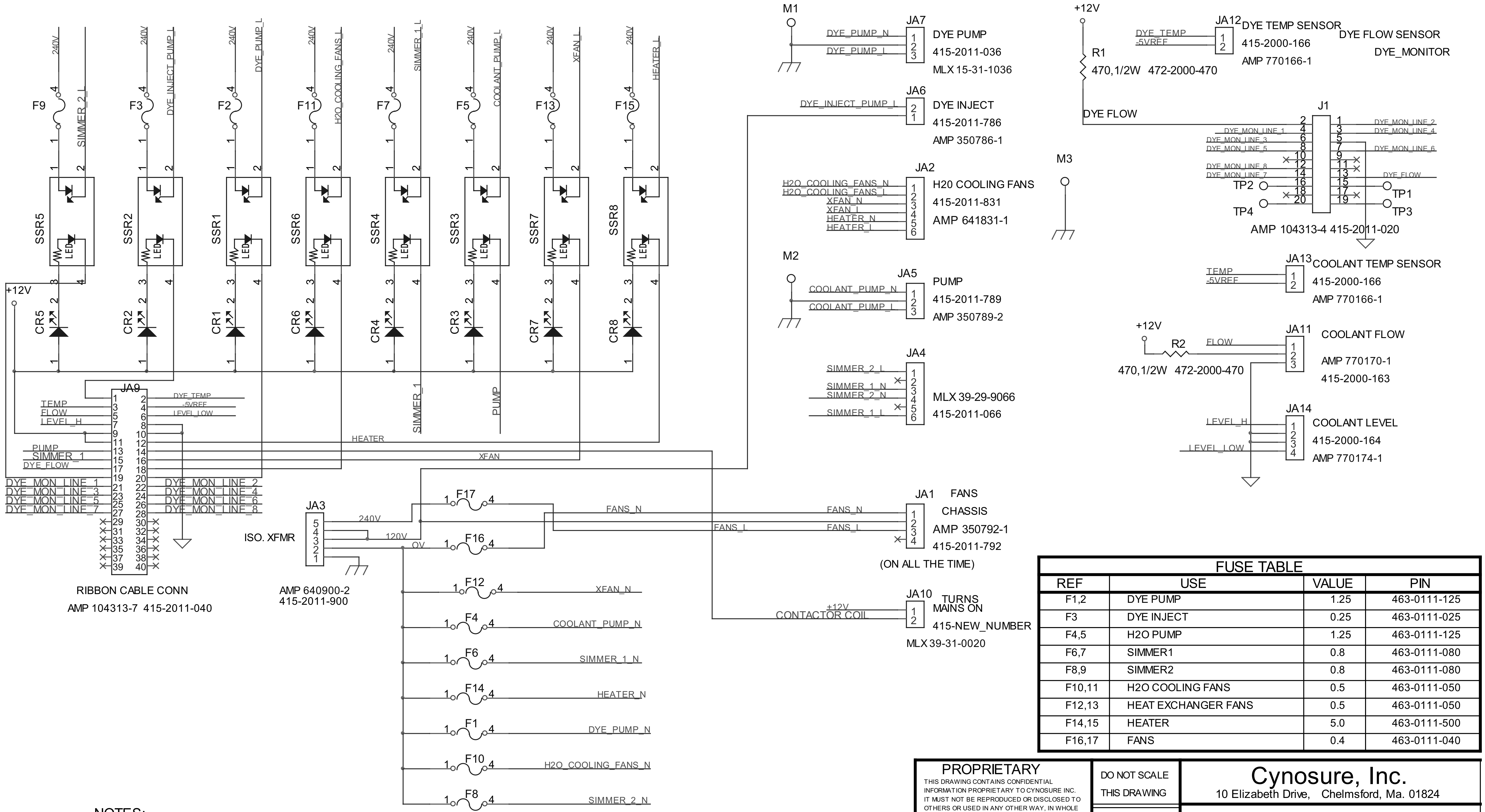

FUSE TABLE

REF	USE	VALUE	PIN
F1,2	DYE PUMP	1.25	463-0111-125
F3	DYE INJECT	0.25	463-0111-025
F4,5	H2O PUMP	1.25	463-0111-125
F6,7	SIMMER1	0.8	463-0111-080
F8,9	SIMMER2	0.8	463-0111-080
F10,11	H2O COOLING FANS	0.5	463-0111-050
F12,13	HEAT EXCHANGER FANS	0.5	463-0111-050
F14,15	HEATER	5.0	463-0111-500
F16,17	FANS	0.4	463-0111-040

NOTES:-

1. ALL RESISTORS ARE 1/4 WATT, 5% UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN uFARADS UNLESS OTHERWISE SPECIFIED.

VENDOR NOTICE: FAILURE TO RECEIVE WRITTEN AUTHORIZATION FOR ANY REV / PRINT CHANGES MAY RESULT IN THE REJECTION OF ANY OR ALL MANUFACTURED PIECE PARTS

MATERIAL —

FINISH —

PROPRIETARY

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DESIGNER: N.Davison	DATE 11/24/2004
DRAFTER: I.Pisman	DATE 11/24/2004
ECO CHECKED BY:	DATE
ECO DRAWN BY:	DATE

DO NOT SCALE
THIS DRAWING

DIMENSIONS IN INCHES [MM]
UNLESS OTHERWISE SPECIFIED
.X = .030 [.80]
.XX = .010 [.30]
.XXX = .005 [.15]
X 30'
CONCENTRICITY .005 TIR
ALL MACH SURFACES 63
DEBURR AND BREAK ALL SHARP EDGES

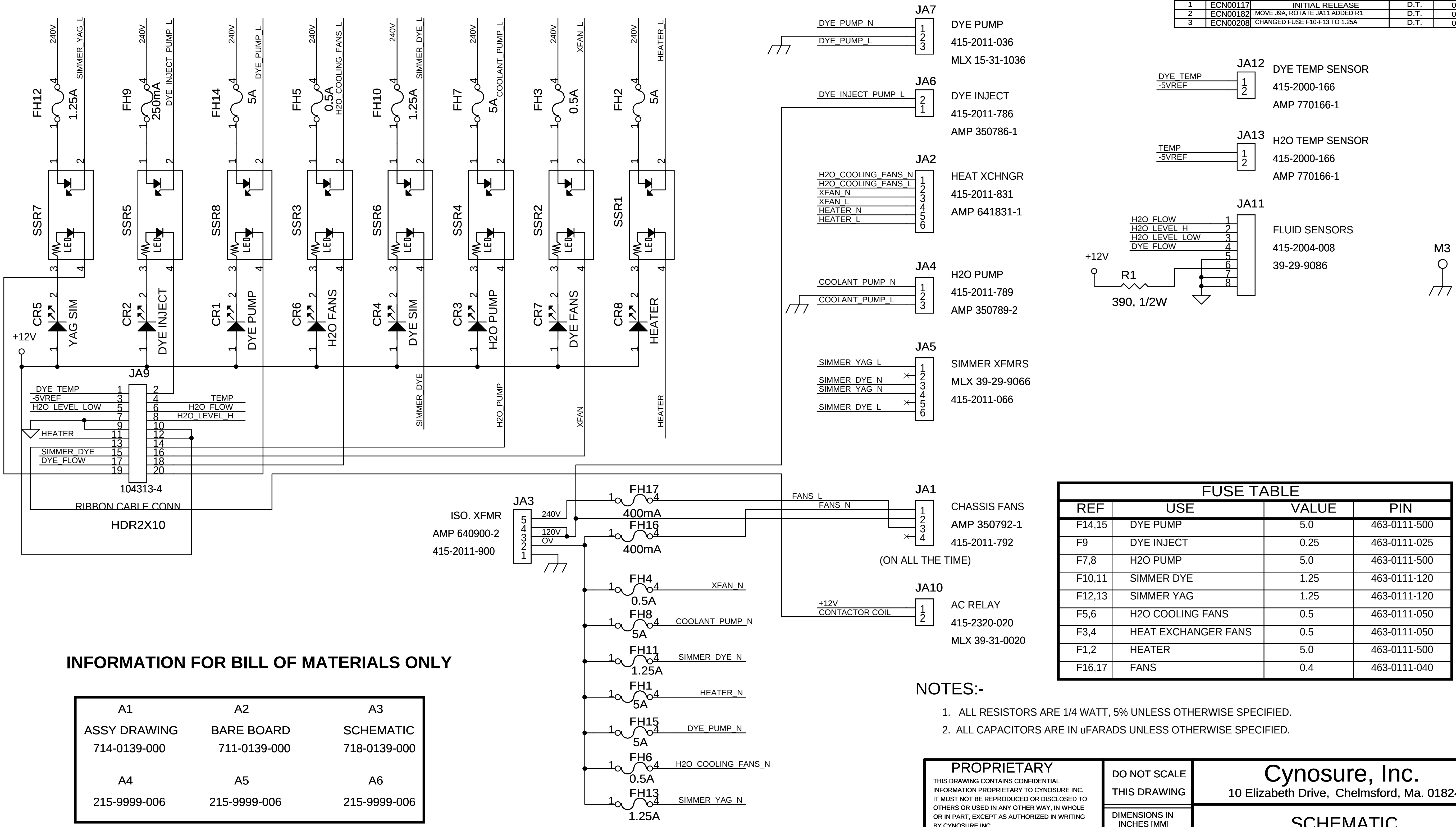
Cynosure, Inc.

10 Elizabeth Drive, Chelmsford, Ma. 01824

SCHEMATIC
DYE-YAG AC DISTRIBUTION PUMP LEVEL INTERCONNECT

SIZE B
DRAWING NO. 718-0135-000
REV 01
SCALE 1=1
SHEET 1 OF 1
F/N: 0135_01.dsn

REVISIONS				
REV	ECO	DESCRIPTION	APP'D	DATE
1	ECN00117	INITIAL RELEASE	D.T.	05/20/05
2	ECN00182	MOVE J9A, ROTATE JA11 ADDED R1	D.T.	07/29/05
3	ECN00208	CHANGED FUSE F10-F13 TO 1.25A	D.T.	09/17/05



FUSE TABLE			
REF	USE	VALUE	PIN
F14,15	DYE PUMP	5.0	463-0111-500
F9	DYE INJECT	0.25	463-0111-025
F7,8	H2O PUMP	5.0	463-0111-500
F10,11	SIMMER DYE	1.25	463-0111-120
F12,13	SIMMER YAG	1.25	463-0111-120
F5,6	H2O COOLING FANS	0.5	463-0111-050
F3,4	HEAT EXCHANGER FANS	0.5	463-0111-050
F1,2	HEATER	5.0	463-0111-500
F16,17	FANS	0.4	463-0111-040

INFORMATION FOR BILL OF MATERIALS ONLY

A1	A2	A3
ASSY DRAWING	BARE BOARD	SCHEMATIC
714-0139-000	711-0139-000	718-0139-000
A4	A5	A6
215-9999-006	215-9999-006	215-9999-006

NOTES:-

1. ALL RESISTORS ARE 1/4 WATT, 5% UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN uFARADS UNLESS OTHERWISE SPECIFIED.

PROPRIETARY

DO NOT SCALE THIS DRAWING

Cynosure, Inc.
10 Elizabeth Drive, Chelmsford, Ma. 01824

SCHEMATIC
AC DISTRIBUTION CYNERGY

DESIGNER: N.Davison	DATE 04/29/2005
DRAFTER: D. TEVES	DATE 04/29/2005
ECO CHECKED BY: N. DAVIDSON	DATE 09/15/2005
ECO DRAWN: BY: D. TEVES	DATE 09/15/2005

DIMENSIONS IN INCHES [MM]
UNLESS OTHERWISE SPECIFIED
.X = .030 [.80]
.XX = .010 [.30]
.XXX = .005 [.15]
X 30'
CONCENTRICITY .005 TIR
ALL MACH SURFACES 63 ✓
DEBURR AND BREAK ALL SHARP EDGES

SIZE	DRAWING NO.	REV
B	718-0139-000	3

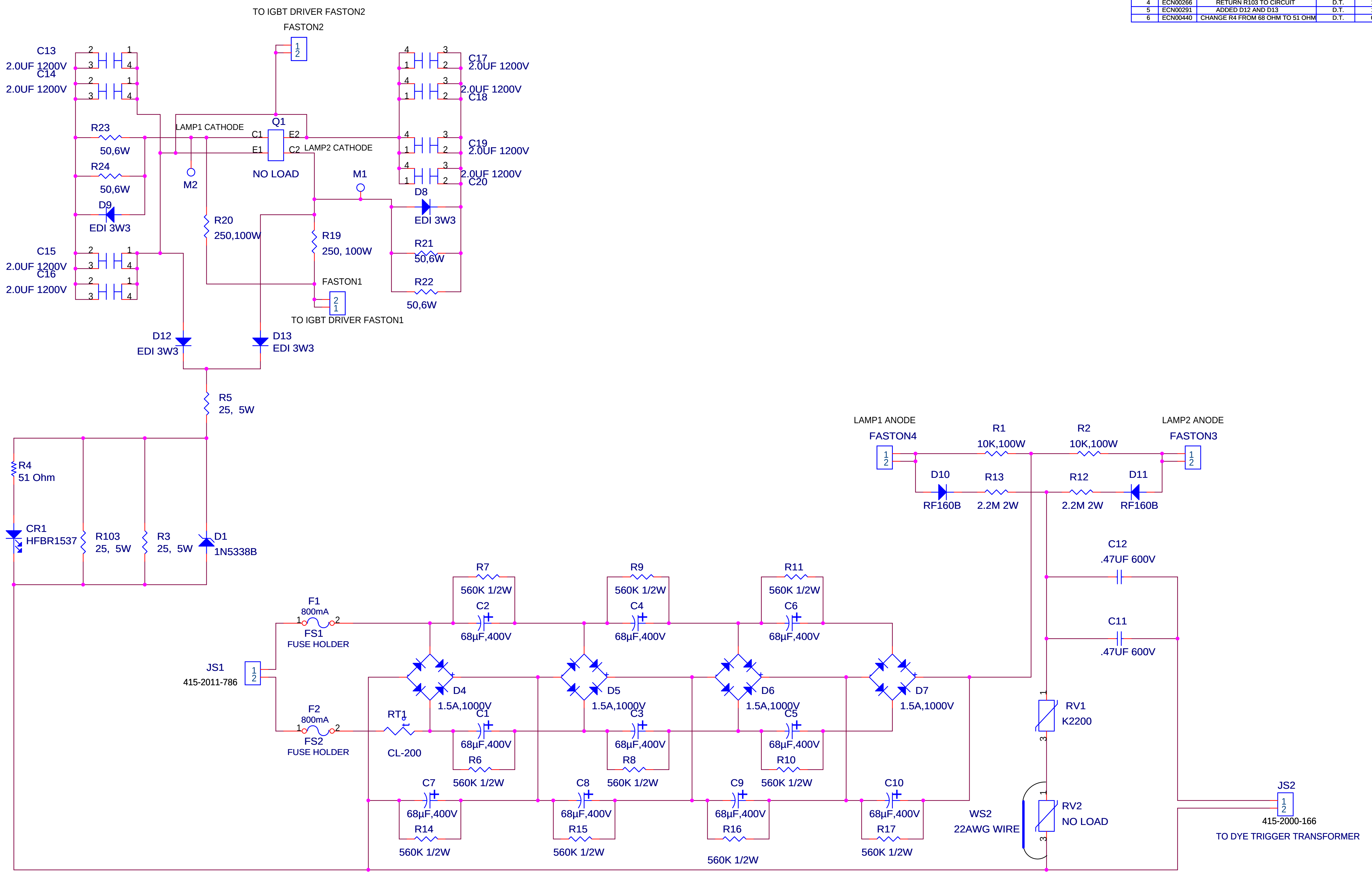
SCALE 1=1 SHEET 1 OF1 F/N: 0139_R3.dsn

VENDOR NOTICE: FAILURE TO RECEIVE WRITTEN AUTHORIZATION FOR ANY REV / PRINT CHANGES MAY RESULT IN THE REJECTION OF ANY OR ALL MANUFACTURED PIECE PARTS

MATERIAL —

FINISH —

REVISIONS				
REV	ECO	DESCRIPTION	APP'D	DATE
1	ECN00046	INITIAL RELEASE	D.T.	12/31/2004
2	ECN00082	ENG. RELEASE	D.T.	4/12/2005
3	ECN00233	REMOVED R103 & RV2.	D.T.	10/05/2005
4	ECN00266	RETURN R103 TO CIRCUIT	D.T.	11/01/2005
5	ECN00291	ADDED D12 AND D13	D.T.	11/23/2005
6	ECN00440	CHANGE R4 FROM 68 OHM TO 51 OHM	D.T.	03/06/2006



NOTES:-

1. ALL RESISTORS ARE 1/4 WATT, 5% UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN uFARADS UNLESS OTHERWISE SPECIFIED.

VENDOR NOTICE: FAILURE TO RECEIVE WRITTEN AUTHORIZATION
FOR ANY REV / PRINT CHANGES MAY RESULT IN THE REJECTION
OF ANY OR ALL MANUFACTURED PIECE PARTS

MATERIAL —
FINISH —

PROPRIETARY

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DESIGNER: E. Koschmann	DATE 07/15/2004
DRAFTER: I. Pisman	DATE 07/15/2004
ECO CHECKED BY: S. WELCHES	DATE 03/06/2006
ECO DRAWN: BY: D. TEVES	DATE 03/06/2006

DO NOT SCALE
THIS DRAWING

DIMENSIONS IN
INCHES [MM]

UNLESS OTHERWISE
SPECIFIED
.X = .030 [.80]
.XX = .010 [.30]
.XXX = .005 [.15]
X 30'
CONCENTRICITY .005 TIR
ALL MACH SURFACES 63

DEBURR AND BREAK
ALL SHARP EDGES

Cynosure, Inc.

10 Elizabeth Drive, Chelmsford, Ma. 01824

SCHEMATIC
IGBT SNUBBER & SIMMER PMC

SIZE	DRAWING NO.	REV
C	718-0136-000	06

SCALE 1=1 SHEET 1 OF 1 F/N: 0136-06.DSN

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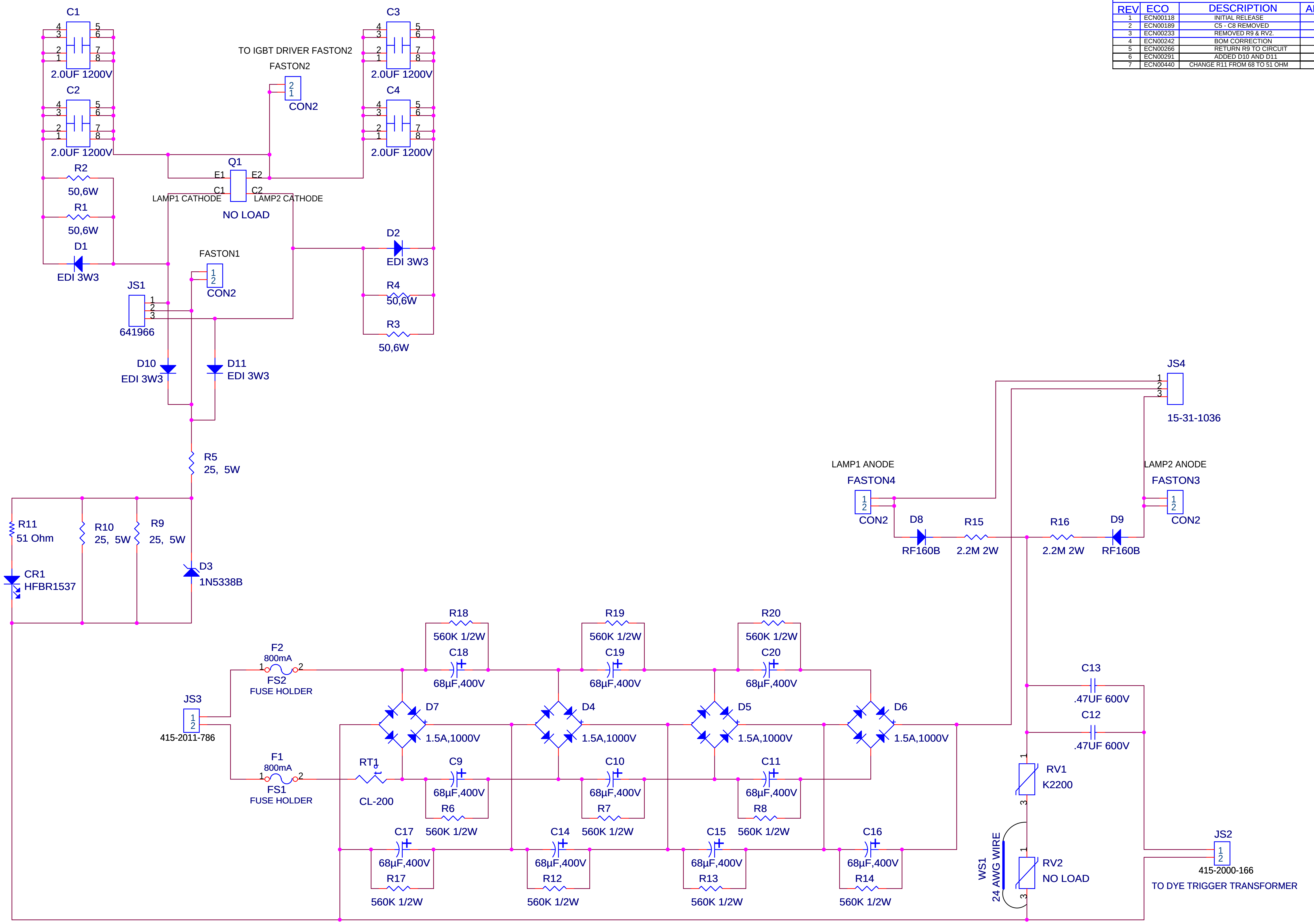
REVISIONS

REV	ECO	DESCRIPTION	APP'D	DATE
1	ECN00118	INITIAL RELEASE	D.T.	05/20/2005
2	ECN00189	C5 - C8 REMOVED	D.T.	08/10/2005
3	ECN00233	REMOVED R9 & RV2.	D.T.	10/05/2005
4	ECN00242	BOM CORRECTION	D.T.	10/14/2005
5	ECN00266	RETURN R9 TO CIRCUIT	D.T.	11/07/2005
6	ECN00291	ADDED D10 AND D11	D.T.	11/23/2005
7	ECN00440	CHANGE R11 FROM 68 TO 51 OHM	D.T.	03/06/2006



INFORMATION FOR BOM ONLY

A1	A2	A3	A4
ASSY DRAWING	BARE BOARD	SCHEMATIC	LABEL

NOTES:-

1. ALL RESISTORS ARE 1/4 WATT, 5% UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN uFARADS UNLESS OTHERWISE SPECIFIED.

VENDOR NOTICE: FAILURE TO RECEIVE WRITTEN AUTHORIZATION
FOR ANY REV / PRINT CHANGES MAY RESULT IN THE REJECTION
OF ANY OR ALL MANUFACTURED PIECE PARTS

MATERIAL —

FINISH —

PROPRIETARY

DESIGNER: N. DAVISON	DATE 05/05/2005
DRAFTER: D. TEVES	DATE 05/05/2005
ECO CHECKED BY: S. WELCHES	DATE 03/06/2006
ECO DRAWN: BY: D. TEVES	DATE 03/06/2006

DO NOT SCALE
THIS DRAWING

DIMENSIONS IN
INCHES [MM]

UNLESS OTHERWISE
SPECIFIED
.X = .030 [.80]
.XX = .010 [.30]
.XXX = .005 [.15]
X 30'
CONCENTRICITY .005 TIR
ALL MACH SURFACES 63

DEBURR AND BREAK
ALL SHARP EDGES

Cynosure, Inc.
10 Elizabeth Drive, Chelmsford, Ma. 01824

SCHEMATIC
IGBT SNUBBER & SIMMER PMC

SIZE C
DRAWING NO. 718-0140-000
REV 7

SCALE 1=1
SHEET 1 OF 1
F/N: 0140-07.DSN
Monday, March 06, 2006

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