

## **Laser automation computer requirements**

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v1.1: 03/12/07

### **1. Introduction**

The laser automation computer ("LGS computer") will provide remote control and performance monitoring of the Chicago Sum Frequency Laser (CSFL).

### **2. Computer Interface Requirements**

#### **2.1. Temperature control**

The temperature of the following devices on the CSFL bench is controlled using McShane temperature controllers and thermoelectric coolers:

- o Tuning etalons (2)
- o Intracavity non-linear crystals (2)
- o Acousto-optic modulators (2)
- o Sum-frequency crystals (1)

Communication to the McShane controllers is via a single serial line.

The LGS computer shall...

2.1.1. Enable/disable temperature control individually on each channel.

2.1.2. Read the temperature on each channel.

2.1.3. Read the percent power output on each channel.

2.1.4. Change the temperature set point on each channel.

#### **2.2. Power display**

There are two sets of photodiodes in the laser and BTO:

- o 4 un-amplified photodiodes on the CSFL bench: 1.06 power, 1.32 power, 0.589 power, 0.589 fluorescence. These are calibrated for linearity and scale using hardware controls in the laser servo control box.
- o 2 amplified photodiodes on the BTO laser diagnostics benches: Coude and Prime Focus.

Both of these will be read out by the ADC "brick" in the laser servo control box, which is interrogated by the LGS computer over a single serial line.

The LGS computer shall...

2.2.1. Read the voltage of each photodiode.

#### **2.3. IR laser phase lock**

Phasing of the IR lasers shall be performed in hardware, using an oscillator at 7 Hz to dither the phase offset between the lasers and maximize the output of the 0.589 power diode. It shall be engaged or disabled using a manual switch on the front of the laser servo control box, and will not be controlled by the LGS computer. However, to assist in identifying a "railed" condition, the LGS software will read, display, and log the phase delay voltage.

The LGS computer shall...

2.3.1. Read the IR laser phase delay voltage.

## 2.4. CSFL frequency servo control

The frequency control servo loop shall be implemented in hardware similarly to the phase control loop, using a 3.5 Hz oscillator-driven tilting etalon in the 1.06  $\mu\text{m}$  laser to dither its frequency and thus maximize the output at the 0.589 fluorescence photodiode. The hardware servo loop shall be engaged or disabled using a manual switch on the front of the laser servo control box. However, provision shall be made to allow the tilting etalons on both lasers to be switched to computer control, to allow more advanced frequency servo loops to be implemented.

The LGS Computer shall...

2.4.1. Switch between hardware and computer control of etalon tilt.

2.4.2. Read the tilt voltage on the 1.06 micron etalon.

2.4.3. Under computer control, set tilt angle of each etalon independently.

## 2.5. Video diagnostics

No video output shall be read or processed by the LGS computer.

## 2.6. Delay Generator

The LGS Computer shall...

2.6.1. Set all parameters of the Thorlabs DG100N delay generator.

Note: As of 3/11/07 we are still investigating whether we have the resources to meet requirement 2.6.1.

## 3. Software requirements

### 3.1. Data calibration

The LGS real-time software shall...

3.1.1. Load an ASCII-formatted calibration file and multiply each measured parameter by a user-settable constant before display or logging.

### 3.2. Data Logging

The LGS real-time software shall log the following data to the AO database:

3.2.1. The control loop state on each temperature control channel (7 on/off flags).

3.2.2. The temperatures on each channel (7 floating point values).

3.2.3. The photodiode power on each channel (6 floating point values).

3.2.4. The IR laser phase delay voltage (1 floating point value).

3.2.5. The control state of the frequency dithering etalons (1 on/off flag).

3.2.6. The tilt voltage of the 1.06 etalons (1 floating point value).

3.2.7. The logging rate shall be settable between 1 and 20 Hz upon software startup.

### 3.3. User Interface

3.3.1. A "real-time" graphical interface displaying the following values at a rate of at least 1 Hz shall be provided:

- Temperature control state (on/off) on each of 7 temperature channels.
- Actual temperature of each of 7 temperature channels.
- Percent power output of each of 7 temperature channels.
- Photodiode average power, in Watts, for each of 6 photodiodes.
- IR laser phase delay voltage.
- Etalon tilt control state (hardware/computer).

- o 1.06 micron talon tilt, in arcseconds.

3.3.2. A command-line interface shall be provided to allow the following parameters to be set:

- o Temperature control state for each of 7 temperature channels.
- o Temperature set point for each of 7 temperature channels.
- o Etalon tilt control state (hardware/software).
- o 2 etalon tilts, in arcseconds (when in software control).
- o Load a specified ASCII format parameter file to the delay generator.
- o Load a specified ASCII format calibration file.

3.3.3. An "offline" graphing tool shall be provided which allows the following plots to be created and updated in near-real-time using AO database access.

- o Temperature on any channel vs. time.
- o Photodiode power on any channel vs. time.
- o IR laser phase delay voltage vs. time.
- o Tilt of either etalon vs. time.