Schematic Diagram of Experimental Setup in Optical Diagnostics
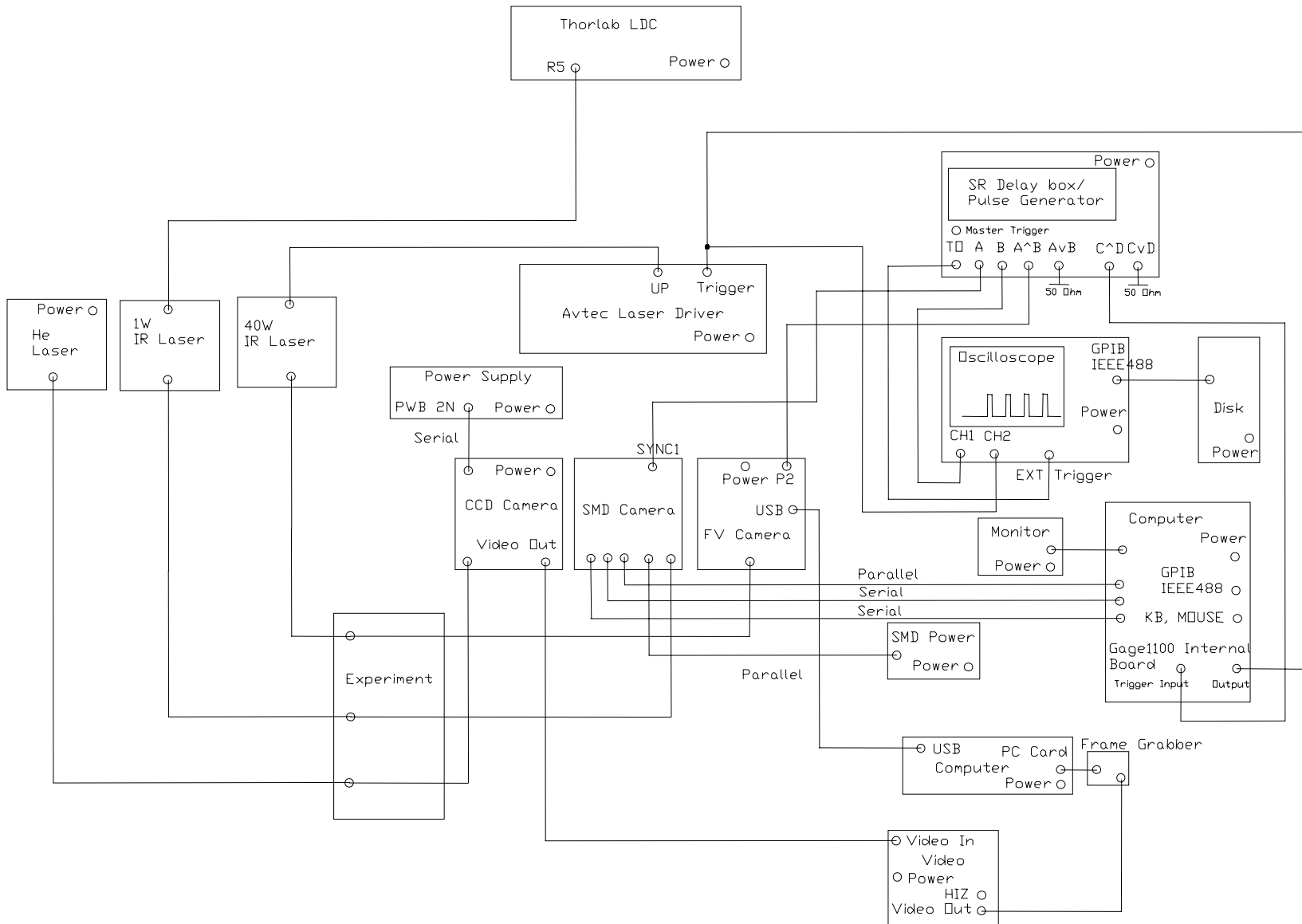## H-J Park (Nov 8, 2006)

Laser Characteristics	Value	Unit
Temperature	25	C
Rated Power	25	W
Current at rated power	40.00	A
Maximum current	43.05	A
Threshold current	6.1	A
Center wavelength	809.9	nm
Linewidth FWHM	1.83	nm

Table 3.1: Specification of high power laser source (BDL25-808-F2 from BrightSolutions).

Laser Characteristics	Value	Unit
CW output power	1.0	W
Numerical aperture	0.14	NA
Center wavelength	830	nm
Slope efficiency	0.7	W/A
FWHM beam divergence , Exiting fiber	14	degree
Threshold current	0.3	A
Operating current	1.7	A
Fiber core diameter	60	μm
Fiber numerical aperture	0.22	NA
Fiber sheath	900	μm

Table 3.2: Specification of high power laser source (SDL-2364-L2 from JDS uniphase).

Connectors	
Laser diode, photodiode, LD ON signal	
Interlock (0 ... 5 V) LD OUTPUT	9-pin D-Sub-jack
Modulation input (-10 V ... +10 V) MOD IN	BNC
Control output (0 ... 10 V) CTL OUT	BNC
Chassis ground	4 mm banana jack
Constant current mode	
Control range (continuously variable)	0 ... ± 2 A
Settling accuracy	± 2 mA
Resolution	0.1 mA
Compliance voltage	$> 4V$
Noise	$< 15\mu$ A
Transients	$< 100\mu A$
Short time fluctuations (15s, 0 ... 10 Hz)	$< 2mA$
Constant power mode	
Control range photodiode current	5 μ A
Resolution photodiode current	0.1 μ A
Resolution optical power	0.1 mW
Laser Current Limit	
Setting range	$> 2A$
Setting accuracy	± 5 mA
Resolution	0.1 mA
Analog modulation/volatage control	
Input resistance	10 $k\Omega$
Small signal 3dB bandwidth (current control)	DC ... 50 kHz
Modulation coefficient	200 mA/V

Table 3.3: Specification of Laser Diode Controller for 1W laser source (LDC220 from Thorlab).

Power (Max)	
+5 V	15 W
+12 V	9 W
-12 V	1 W
-5 V	0.5 W
Features	
Pattern output	Single shot
Record length	4 points min
Record resolution	2 points
Trigger modes	Single, timed, or retriggerable
Digital to Analog conversion	
Output	1 per card
Amplitude	20 V p-p into 1 $k\Omega$, 10 V p-p into 501 Ω
Resolution	12 bits
Accuracy	$\pm2\%$ excluding offset
Clock frequency	Max 80 MHz , Min 1 Hz
Conversion rates	80 MHz, 40 MHz, 20 MHz, ...
Resolution photodiode current	0.1 μ A
Buffer depth	512K, 1M, 2M, 4M, 8M, or 16M samples
Full scale Output range	$\pm100mV$ $\pm5V$
Full scale Output range	Voltages are specified with 50Ω termination.
Output impedeance	50Ω
Filter	Software selectable (5 MHz, 10 MHz, 20 MHz, Infinite)
Output protection	Short-protected up to $\pm50V$
Trigger	
Source	Internal or External
External trigger	0 to 5V TTL
Trigger slope	Rising or Falling
Connector	BNC
External clock	
Clock frequency	Min DC, Max 80 MHz
Voltage	0 to 5V TTL
Connector	BNC
Selection	Software selectable
Multi card systems	
Maximum number of cards	8 (1 master and 7 slaves)
Operating mode	Master/Slave or multiple/independent

Table 3.4: Specification of Arbitrary Waveform Generator (CompuGen 1100 ISA Bus from GaGe).

Application software	CGWin (runs under Win95/98 and Win NT)
Display	
Timebase	1ns/div to 1Ms/div
Vertical scale	5 mV/div to 1 kV/div
File saving	
File format	GageScope binary format
Setups	Binary file
Equations	CompuGen for Windows standard file format
Number of equations per signal descriptions	8

Table 3.5: Specification of Arbitrary Waveform Generator (CompuGen for Windows from GaGe).

Current amplitude	0 to 20A
Voltage amplitude	0 to 40V
Maximum load impedance	2Ω
Pulse width (FWHM)	15 150 ns
Rise time (20 % 80 %)	$\leq 8ns$
Fall time (80 % 20 %)	$\leq 8ns$
Maximum PRF	1MHz
Duty cycle (max)	2 %
Output impedance	$\leq 0.2\Omega$
Average output power	16 W max.
Droop	$\leq 5\%$ at at max. pulse width and max. amp.
GPIB and RS-232C	Standard on B-units
Labview driver	Available
Internet control	Provides control via Telnet or Web
Propagation delay	$\leq 100ns$ (Ext. Trig in to pulse out)
Jitter	$\leq \pm 35ps \pm 0.015\%$ RMS (sync out to pulse out)
Trigger required	External trigger mode : +5 V, 50 to 500 ns (TTL)
Sync delay	0 to $\pm$ 1s. sync out to pulse out
sync output	+3V, 200ns, will drive 50 Ω loads
Gate input	Synchronous or asynchronous, active high or low.
Full scale Output range	Voltages are specified with 50Ω termination.
Supplied output line	AV-CLZ2-60, 1.8Ω, 60cm
Filter	Selectable (5 MHz, 10 MHz, 20 MHz, Infinite)
Output connection	DB-37 male, Pins 1-19=signal, Pins 20-37=ground
Supplied test load	AV-CTL2
Other signal connectors	Trig, Gate, Sync : BNC
DC power conection	AVOZ-B4-B only: 6mm plug/4mm sockets
Chassis material	Anodized aluminum
Dimensions ($H \times W \times D$)	$100 \times 430 \times 375$ mm

Table 3.6: Specification of Pulsed Voltage Laser Diode Drivers (AVOZ-A1A-B from AvTech).

Delay	
Channels	A, B, C, and D
Range	0 to 999.999,999,999,995 seconds
Resolution	5 ps
Accuracy	1500 ps + timebase error $\times$ delay
Timebase	Standard: 25ppm crystal oscillator, External: 10MHz
RMS Jitter	Ext Trig to output: 60 ps + delay $\times 10^{-8}$
RMS Jitter	T0 to output: 50 ps + delay $\times 10^{-8}$
Trig delay	Ext Trig to T0 output: 85 ns, Typical2 %
Internal rate generator	
Rate	Single shot, 0.001 Hz to 1MHz, or Line
Resolutio	0.001 Hz below 10Hz, otherwise 4 digits
Jitter	1:10,000
Settling	< 2 seconds for any rate change
Burst mode	2 to 32766 pulses per burst at integer multiples
Inputs	
External Trigger	Rate: dc to 1/(1 μs + longest delay)
External Trigger	Threshold: $\pm$ 2.56 Vdc
External Trigger	Slope: Trigger on rising or falling edge
External Trigger	Impedance: $1M\Omega$ + 40 pF or 50 Ω
Outputs	T0, A, B, C, D, AB, -AB, CD, and -CD
Output load	50 Ω or high impedance
Output risetime	2 to 3 ns
Output slewrate	1 V/ns
Overshoot	$< 100mV$ + 10% of pulse amplitude
Levels	TTL: 0 to 4 Vdc, normal or inverted
Levels	ECL: -1.8 to -0.8 Vdc, 0 to 4Vdc, normal or inverted
Levels	NIM: -0.8 to 0 Vdc, normal or inverted
Levels	VAR: Adjustable offset/amplitude between -3 and +4 Vdc
Accuracy	$\pm$ 50 mV + 3 % of pulse amplitude
Interface	IEEE 488 Standard GPIB

Table 3.7: Specification of Digital Delay/Pulse Generator (DG535 from Stanfor Research).

Imager	
Sensor	Custom interline transfer CCD
Format	240 × 240 pixels
Pixel size	$56\mu m \times 56\mu m$
Active area	13.4 mm × 13.4 mm
Full well capacity	220 Ke^-
Fill factor	3 %
Camera operating parameters	
Frame rate (max)	10^6 fps, in up to 16 bursts/sec
Sync	Internal/External
Video	12 bit RS-422 or LVDS (4 channels at 10 MHz)
Dynamic range/Optical	
Dynamic range	70 dB
Read noise	Less than 1.3 counts rms
Sensitivity	$8\mu V/e$
Dark current	300 e/pixel per second
Quantum efficiency	18 % max. at 740 nm
Mechanical/Environmal	
Lens mount	C-mount
Dimensions ($W \times H \times L$)	$3.7'' \times 3.7'' \times 4''$
Power	30 Watts
Mass	0.85 kg

Table 3.8: Specification of High Speed Camera (SMD 64K1M from Silicon Mountain Design).

Imager	
Sensor	CMOS digital image sensor
Size	1280 × 1024 × 8 bits at 500 fps (10 bits 400 fps)
Active area	15.36 mm × 12.29 mm
Dynamic range	59 dB
Fill factor	40 %
Shutter efficiency	99.9 %
Noise	58 dB (Nominal pixel of 512 counts)
Timing	
Camera clock	25 85 MHz
Pixel data	LVAL, FVAL and DVAL are true
Camera operating parameters	
Frame rate (max)	500 fps at full resolution
Frame rate (max)	500+ fps, progressive scan
Full frame rate (max)	500,000 fps at 1 × 1280 pixels
Resolution	1280H × 1024V (1.03 megapixel)
Active pixel photodiode	$12\mu m \times 12\mu m$
Color	Monochrome or color(Bayer pattern)
Output ports	10 parallel, 10 bit ADC
Interface format	FPGA, memory based configurable interface
Option	SRAM for ultra fast processing
Option	DDRAM and increased FPGA for processing capability
Shutter	Triggerable electronic
Mechanical/Environmal	
Dimensions ($W \times H \times L$)	$74' \times 79 \times 132$ mm
Power	5 10 Watts

Table 3.9: Specification of High Speed Camera (FastVision13).