



### MVAT DATA SUMMARY

CUSTOMER NUMBER: 532

SYSTEM SN: 07021301

SYSTEM PN: UL742J11

DATE: 21 Feb 2007

Attenuator	$E_{OUT}(mJ)$ 266 nm
0%	0
10%	.07
20%	.18
30%	.34
40%	.57
50%	.85
60%	1.18
70%	1.5
80%	1.89
90%	2.28
100%	2.7

Stability	266nm	nm	nm
$\sigma$ [%]	1.075		
Peak	6.7		

Data taken at spec energy

Record calibration factor minimum 0CE0

Record attenuator software revision .11V

Record backlash compensation factor 0

Beam profiles printed for all wavelengths, NF & FF

MVAT lifetest completed and results copied to DHR

Verified by: Marley Kunzler

Date: 2 / 21 /07



## Data Summary

System SN:	<input type="text" value="07021301"/>	Customer:	<input type="text" value="Triumf"/>
Power Supply SN:	<input type="text" value="07010802"/>	Customer #:	<input type="text" value="532"/>
Laser Head SN:	<input type="text" value="07020801"/>	System WO#:	<input type="text" value="70263"/>

Beam Parameters	Principal		Residual	
	1064nm	532nm	266nm	*
Energy (mJ)	*	*	2.6	*
Near Field Beam Diameter (mm)	*	*	1.7	*
Pulse Width - FWHM (nsec)	*	*	8.8	*
Divergence at 86.5% (mrad)	*	*	1.8	*
Far Field Fit Gaussian (%)	*	*	95	*

*~115 mJ/cm<sup>2</sup>*

Hold-off (steady state):  J  
 Hold-off (turn-on):  J  
 Threshold:  J

PRF Limit:  Hz  
 High Voltage Limit:  V =  J  
 Cap:  μF

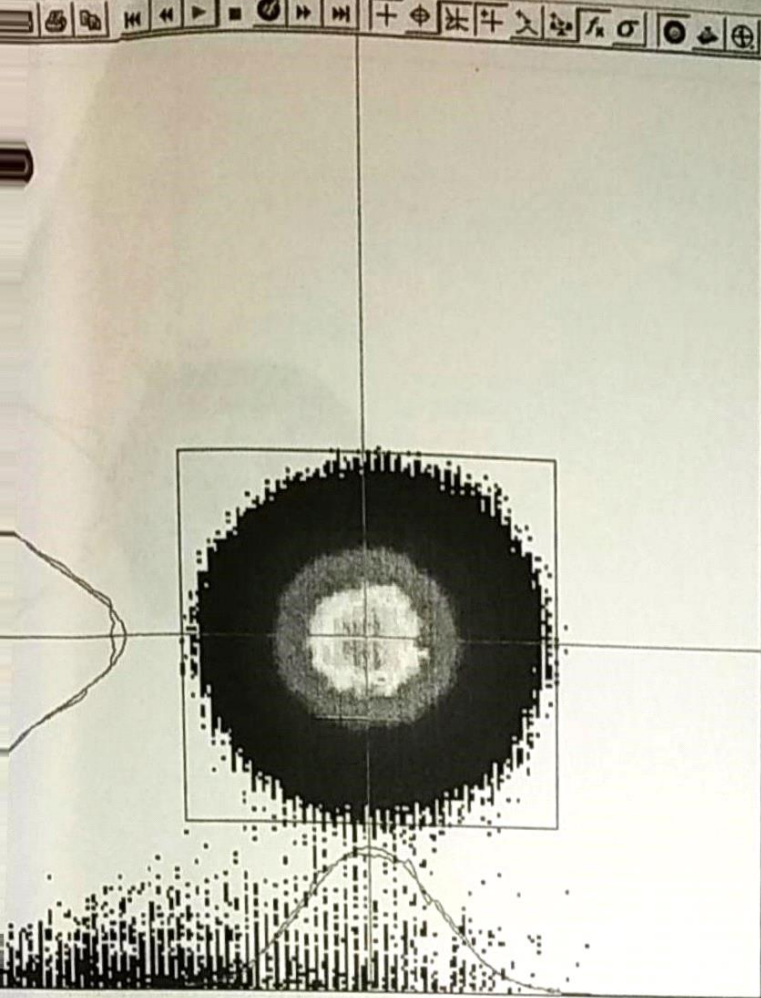
Power Supply Setting	Pulse Rate (Hz)	Energy In (Joules)	Qsw Fire-every (# pulses)	Qsw Delay (μsec)	Qsw Turn-On Delay (# pulses)	Qsw Ramp (# pulses)	Q-Sw. (OFF)	Shutter (OFF)
Configuration #1	50	3.03	1	160	0	0	yes	manual
Configuration #2	50	3.03	1	160	0	0	yes	manual
Configuration #3	50	3.03	1	160	0	0	yes	manual
Configuration #4	50	3.03	1	1	0	0	yes	manual

Notes, Special Features, Precautions, etc...
Spectral purity > 95%

**IMPORTANT: CUSTOMER PLEASE READ!**

- Be sure to fill cooler with distilled water.
- Cooler filled with 50:50 Ethylene Glycol and Distilled Water mix.





Sample: U2, Feb 21, 2007, 04:56:29 PM

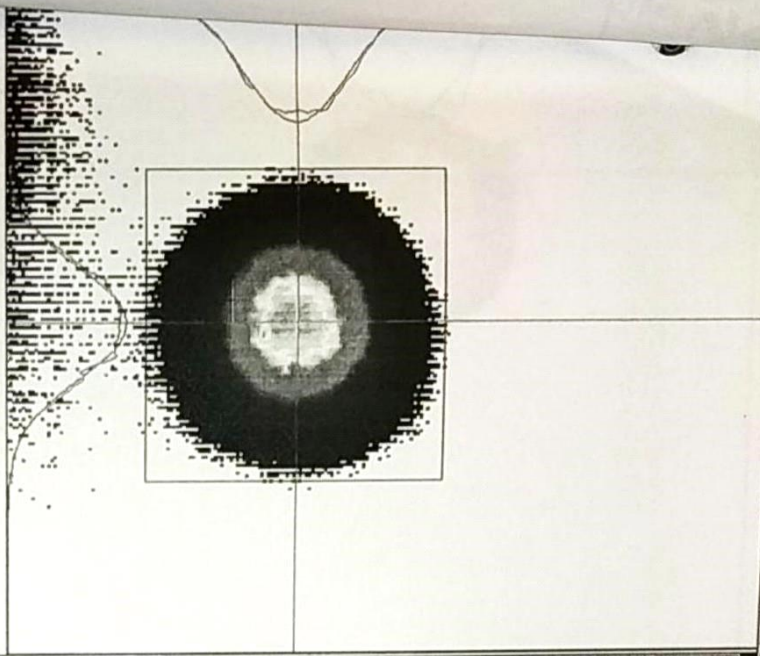
Peak X,Y/R ± [μrad]	(160.615, 665.963) 685.057
Centroid X,Y/R ± [μrad]	(183.614, 561.292) 590.561
Peak % Resp. [%]	71.4
Total Rel. Energy [mJ]	13.304
Eff. Area [mm²]	1.348
Eff. Diameter 86.5% [mm]	1.760
Aper. Diameter 86.5% [mm]	1.791
d4 Sigma Diam [mm]	1.801
Divergence 86.5% [mrad]	1.791
Knife Edge 84.0% [mm]	1.865, 1.797
Ellipticity	
Major, Minor 86.5% [mm]	1.778, 1.731
Angle [degrees]	30.913
Circularity	0.974
Gaussian Fit 86.5%	
Coefficient	0.952, 0.952
Centroid [mm]	2.726, 3.979
Peak Intensity [digital]	189.8, 195.5
Diameter [mm]	1.818, 1.705
Roughness of Fit [%]	7.7, 10.4
Peak To Avg.	2.105
Aperture Uniformity	
Min, Mean, Max [digital]	10.0, 71.0, 182.0
Sigma, RMS [digital]	51.1, 87.6
% Energy in Aper. [%]	91.0
Image Uniformity	
Min, Mean, Max [digital]	0.0, 36.5, 182.0

FF@2.5mJ.ATS saved

X:0.0, 20.8] 22.3 [pixel] Int:175.0 [digital] x1 Full Pulse Cont BG Pass WARN 1

FF @ 266nm



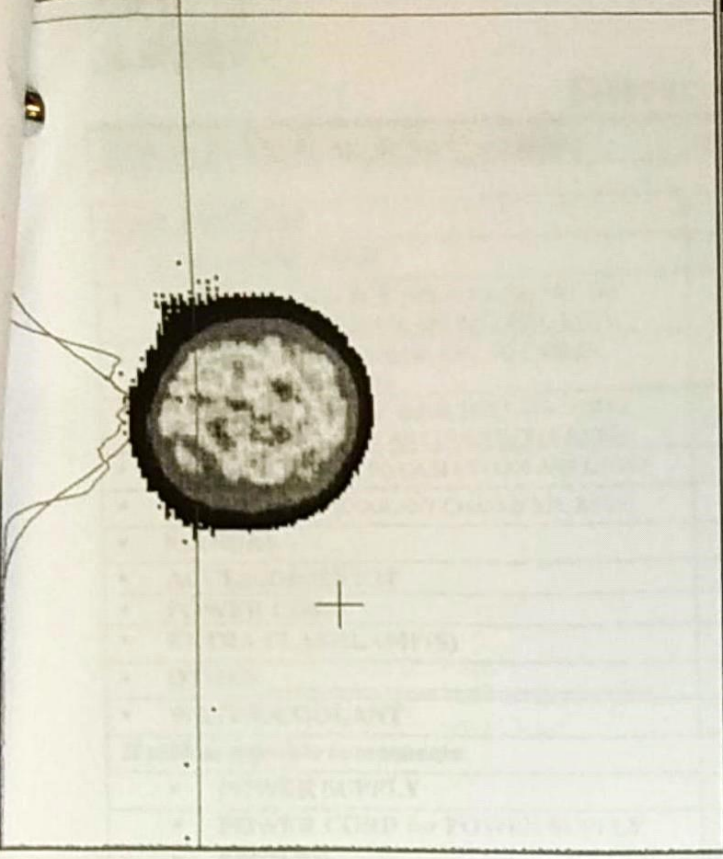
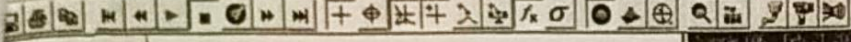


Peak K/V/R 3 (umol)	(150.615, 655.963) 695.057
Centroid K/V/R 3 (umol)	(182.614, 561.263) 590.561
Peak 3 FWHM [x]	71.4
Total Peak Energy [mJ]	13.304
EL Area [mm <sup>2</sup> ]	1.348
EL Diameter 66.5% [mm]	1.750
Aper. Diameter 66.5% [mm]	1.791
dL Sigma (umol) [mm]	1.801
Diameter 66.5% [mm]	1.791
Peak Energy 64.0% [mm]	1.885, 1.787
Energy	
Major Axis 66.5% [mm]	1.778, 1.731
Minor Axis [mm]	36.913
Area [degrees]	0.974
Circle	
Gaussian Fit 66.5%	
Coefficient	0.952, 0.952
Centroid [mm]	2.726, 3.979
Peak Intensity [Signal]	1.898, 1.955
Diameter [mm]	1.818, 1.795
Radiuses of Fit [x]	7.7, 10.4
Peak 1 to Avg	2.105
Aperature Uniformity	
Min. Mean, Max [Signal]	10.0, 71.0, 182.0
Signal, Peak [Signal]	51.1, 87.6
% Error to Ape. [x]	91.0
Image Uniformity	
Min. Mean, Max [Signal]	10.0, 24.5, 115.0

SFT@2 SimuA15 saved | Show [13.0, 20.8] 22.3 [umol] | In: 175.0 [Signal] | At: Full Pixel Count [80] | Pass: WARN | 1

FF @ 266nm





Peak PLYR ± [μrad]	[-437.385, 1691.963] 1747.582
Centroid PLYR ± [μrad]	[-513.952, 1380.336] 1472.879
Peak % Resp. [%]	76.1
Total Rel. Energy [mJ]	19.738
Eff. Area [mm²]	1.876
Eff. Diameter 86.5% [mm]	1.694
Apert. Diameter 86.5% [mm]	3.850
d4 Sigma Diam [mm]	3.570
Divergence 86.5% [mrad]	3.650
Knife Edge 84.0% [mm]	2.252, 2.152
Ellipticity	
Major, Minor 86.5% [mm]	1.704, 1.637
Angle [degrees]	54.181
Circularity	0.961
Gaussian Fit 86.5%	
Coefficient	0.000, 0.852
Centroid [mm]	0.000, 3.077
Peak Intensity [digital]	0.0, 190.9
Diameter [mm]	0.000, 1.820
Roughness of Fit [%]	34.5, 25.3
Peak To Avg	1.513
Aperture Uniformity	
Min, Mean, Max [digital]	0.0, 1.0, 4.0
Sigma, RMS [digital]	0.9, 1.9
% Energy in Apert. [%]	0.9
Image Uniformity	
Min, Mean, Max [digital]	0.0, 102, 194.0

APC Version: 2.4.4

Xbar [-46.7, 163.0] 169.5 [pixel] Int: 3.0 [digital] x1 Full Pulse Cont BG Pass WARN 1

NF @ 266 nm

PLEASE CHECK LIST: To be checked by the Sales Dept

SHIPPING CHECKLIST: To be filled out by the Shipping Dept. in case of packaging

Checked by: *Zm*

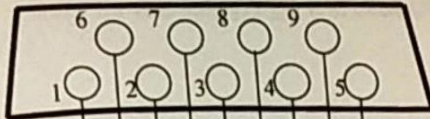
Date: *2003-07-07*



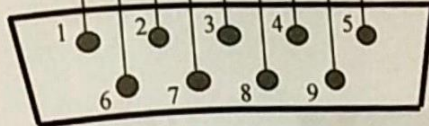
**Motorized Variable Attenuator:**  
BSLT PN#17001570/19001570

Cable wiring scheme of RS 232 interface

To computer :  
9-pin female  
connector

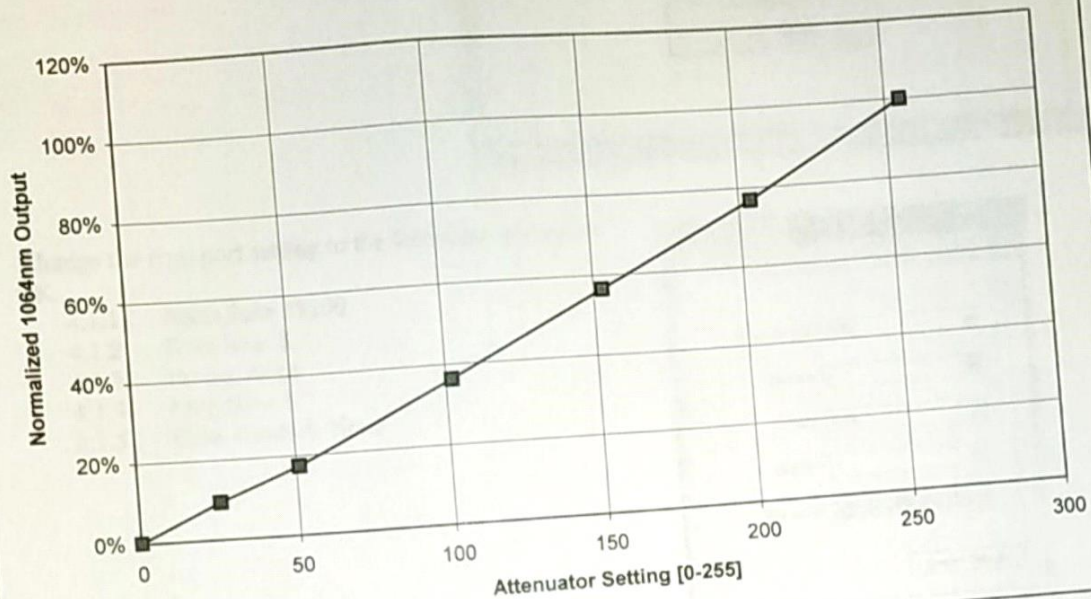


To laser :  
9-pin male  
connector



Computer Pin	Signal Name
1	DCD (not used)
2	RX (Receive data)
3	TX (Transmit data)
4	DTR (not used)
5	GND
6	DSR (not used)
7	RTS (not used)
8	CTS (not used)
9	RI (not used)

**MVAT Transmission**





# CHAPTER 8

## SPECIFICATIONS

### Integrated Cooler and Electronics Specifications

#### Mechanical Specifications:

Laser Head Weight	2.5 lbs.
Standard ICE Chassis Dimensions	7.5"W x 14"H x 14"D (nominal)
Standard ICE Weight	32 lbs. (with coolant)
19" Rack ICE Chassis Dimensions	19"W x 18"H x 5.25"D (nominal)
19" Rack ICE Weight	32 lbs. (without coolant)

#### Input Electrical Specifications:

Prime Power	115 VAC $\pm$ 10%, 50/60 Hz
	230 VAC $\pm$ 10%, 50/60 Hz
	400 Watts maximum

#### Environmental Specifications:

Storage Temperature	5° to +50°C (Distilled Water)
Operating Temperature	10° to 40°C (Distilled Water)

#### ICE Electrical Interface

- Connector Name: RS-232  
Connector Type: D-Sub, DE-9S

PIN	SIGNAL NAME	DESCRIPTION
1	DCD	Data Carrier Detect. Not Used.
6	DSR	Data Set Ready. Not Used.
2	RX	Receive Data.
7	RTS	Request to Send. Not Used.
3	TX	Transmit Data.
8	CTS	Clear to Send. Not Used.
4	DTR	Data Terminal Ready. Not Used.
9	RI	Ring Indicator. Not Used.
5	Gnd	Signal Ground.

NOTE: A pin-to-pin (straight-through) cable should be used to connect to the RS-232 port. A null modem cable should not be used. If a 9-to-25 pin adapter is used, ensure that it is a straight-through adapter.

- Connector Name: LASER HEAD I/O  
Connector Type: D-Sub, Multi-pin 13W3S (DB-25 Shell Size)

PIN	SIGNAL NAME	DESCRIPTION
1	Laser In/ik (+)	Laser Interlock. Must be tied to Pin 6 to close.
6	Laser In/ik (-)	Laser Interlock. Must be tied to Pin 1 to close.
3	+24 VDC	+24 VDC at 300 mA.
9	+24V Rin	Return for +24V.
7	Q-SW Trg	Q-Switch trigger output. $\sim$ +15V, 100 $\mu$ s pulse into 50 $\Omega$ .
2	Q-SW +15 VDC	+15 VDC at 100 mA.
8	Q-SW +15V Rin	Return for +15V.
5	Simmer Trigger	$\sim$ 250V pulse <sub>new</sub> to ionize laser flashlamp.
10	Sim Trigger Rin	Signal return.
4	Reserved	Reserved for BSLT use.
A3	Lamp (+)	High voltage to laser flashlamp. $\sim$ 120 $\mu$ s pulse, 1000V at 300A.
A2	Lamp (-)	High voltage return.
A1	Safety Gnd	Ground.

- Connector Name: REMOTE RUN  
Connector Type: BNC

PIN	SIGNAL NAME	DESCRIPTION
C	Remote Run	+5 VDC thru 10K pull-up resistor. Short to Run, Open to Stop.
SH	Remote Run Rin	Signal return.

- Connector Name: REMOTE INTLK  
Connector Type: BNC

PIN	SIGNAL NAME	DESCRIPTION
C	Remote In/ik (+)	+15 VDC thru 10K pull-up resistor. Short to Shield to Close.
SH	Remote In/ik (-)	Signal return.

- Connector Name: EXT Q-SW  
Connector Type: BNC

PIN	SIGNAL NAME	DESCRIPTION
C	External Q-Switch In	External Q-Switch trigger input. +5 VDC, 100 $\mu$ s, into 50 $\Omega$ .
SH	External Q-Sw Rin	Signal return.



6. Connector Name: EXT TRIG  
Connector Type: BNC

PIN	SIGNAL NAME	DESCRIPTION
C	External Trigger	External lamp trigger input. +5 VDC, 100µs. into 50Ω.
SH	External Trig Rtn	Signal return.

7. Connector Name: HV/100  
Connector Type: BNC

PIN	SIGNAL NAME	DESCRIPTION
C	HV/100	Test point. Provides PFN capacitor sample voltage/100.
SH	HV/100 Rtn	Signal return.

8. Connector Name: Q-SW SYNC  
Connector Type: BNC

PIN	SIGNAL NAME	DESCRIPTION
C	Q-Sw Sync	Test point. +5 VDC sync pulse output. 100µs. 500Ω drive.
SH	Q-Sw Sync Rtn	Signal return.

9. Connector Name: Lamp SYNC  
Connector Type: BNC

PIN	SIGNAL NAME	DESCRIPTION
C	Lamp Sync	Test point. +5 VDC sync pulse output. 100µs. 500Ω drive.
SH	Lamp Sync Rtn	Signal return.

10. Connector Name: Mains AC INPUT  
Connector Type: IEC 320

PIN	SIGNAL NAME	DESCRIPTION
1	AC L1	115/230 VAC, 50/60 Hz.
2	AC L2/N	115/230 VAC, 50/60 Hz.
3	Safety Gnd	Safety ground.

**Laser Head Interface**

1. Connector Name: LASER I/O  
Connector Type: Fischer, DEE104A092

PIN	SIGNAL NAME	DESCRIPTION
1	Laser In/ik (+)	Laser Interlock. Tied to Pin 2.
2	Laser In/ik (-)	Laser Interlock. Tied to Pin 1.
11	Reserved	No connection.
3	Reserved	No connection.
14	+24 VDC	+24 VDC at 300 mA for harmonic generator oven.
16	+24V Rtn	Return for +24V.
15	Reserved	No connection.
6	Temp FB #1	Temperature feedback from harmonic generator. Test point.
17	Temp FB Rtn	Temperature feedback signal return.
7	Reserved	No connection.
19	Q-Sw +15 VDC	+15 VDC at 100 mA to Q-Switch driver.
8	Q-Sw +15V Rtn	Return for +15V and Q-Switch trigger.
18	Q-SW Trig	Q-Switch trigger input to Q-Switch driver.
9	Simmer Trigger	Flashlamp start pulse to trigger transformer.
10	Sim Trigger Rtn	Signal return.
4	Reserved	No connection.
5	Reserved	No connection.
12	Reserved	No connection.
13	Reserved	No connection.

2. Connector Name: HV INPUT  
Connector Type: Fischer, DEE104A087

PIN	SIGNAL NAME	DESCRIPTION
1	Lamp (+)	High voltage to laser flashlamp. ~120µs pulse. 1000V at 300A.
2	Lamp (-)	High voltage return.
3	PFN In/ik (+)	High voltage interlock. Tied to Pin 4.
4	PFN In/ik (-)	High voltage interlock. Tied to Pin 3.



**Laser Timing:**

Figure 16 shows a typical timing diagram for the Ultra Laser system. The delay from Q-Switch Sync to Laser output is shown for 1064nm at 50 mJ. Decreasing the pump energy or increasing the Q-Switch delay will result in an increase in the delay from Q-Switch Sync to Laser output. This is due to reduced gain in the resonator, resulting in longer pulse buildup time.

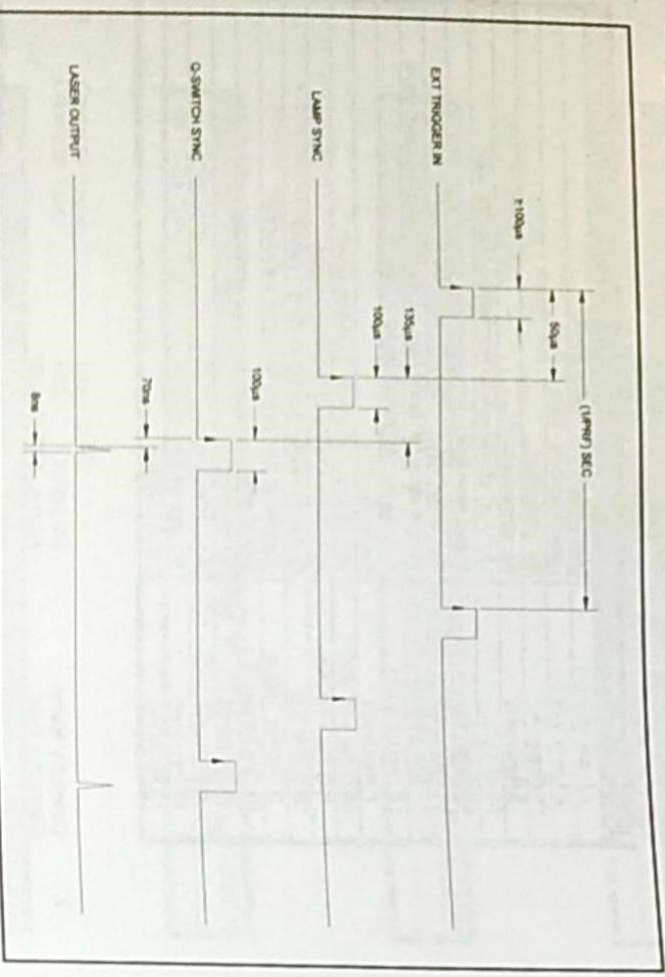
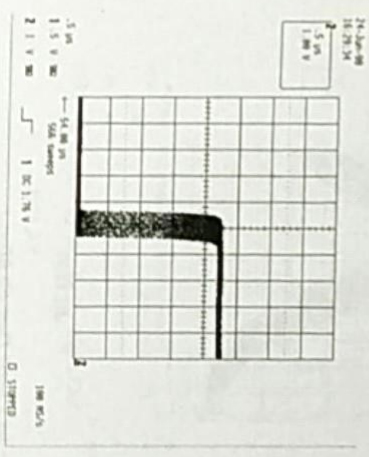


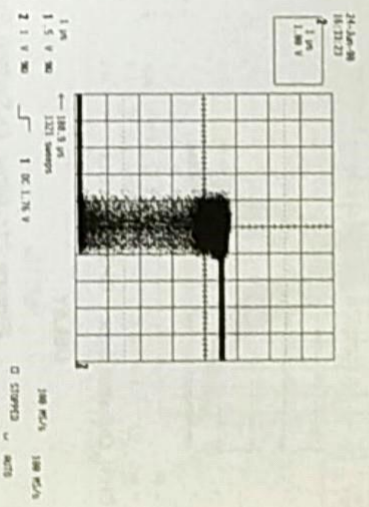
Figure 18: Typical Timing Diagram

**Delay and Jitter Measurements:**

Actual timing and jitter waveforms are shown in the following figures. Unless otherwise specified, all waveforms were recorded at 1064nm, 50 mJ out, 20 Hz. Q-Switch delay was set at 135 µs past Lamp Sync. The energy in Figure 22 was set at 25 mJ by decreasing the lamp pump energy. The energy in Figure 23 was set at 15 mJ by returning the energy adjustment back to 50 mJ and then changing the Q-Switch delay using the E-Max Adjustment from 135 µs to 260 µs.



Lamp Sync Jitter



Q-Switch Sync Jitter

Figure 19: Sync Jitter with respect to External Trigger In

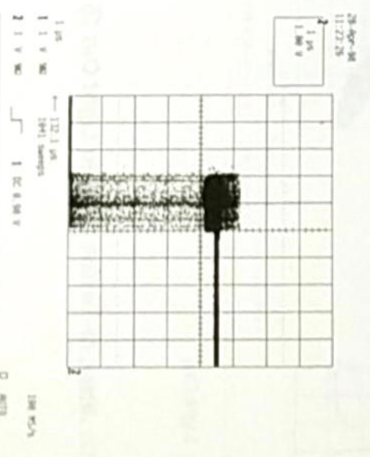


Figure 20: Q-Switch Sync Jitter with respect to Lamp Sync



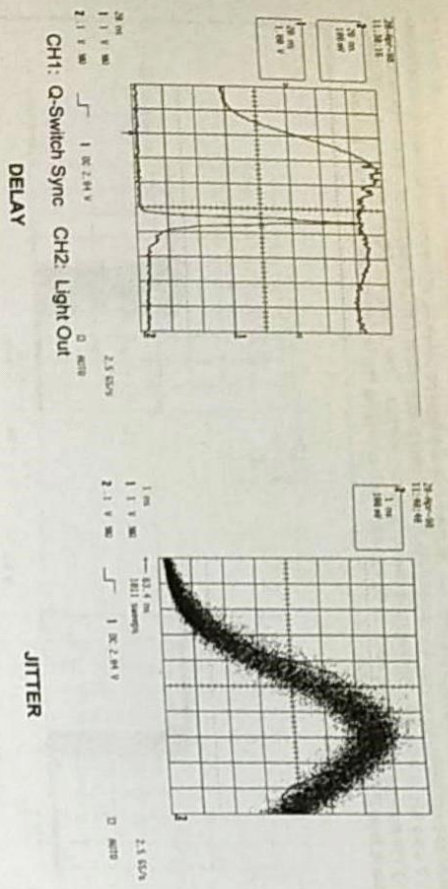


Figure 21: Jitter, Q-Switch Sync to Light Out @ 50mJ

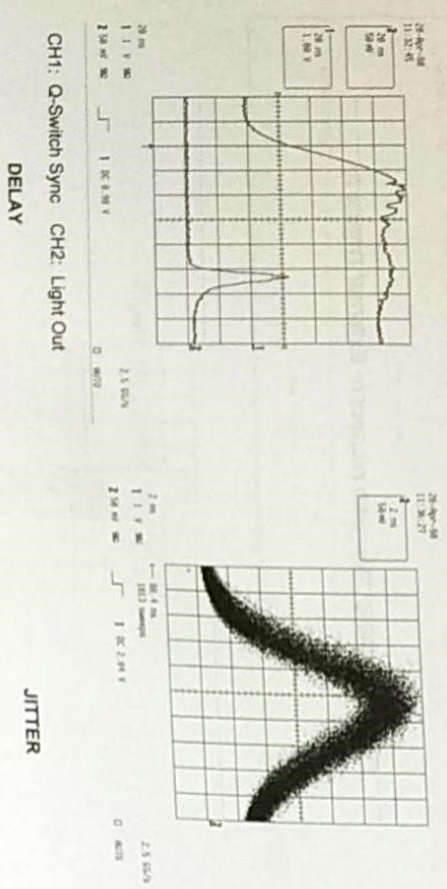


Figure 22: Jitter, Q-Switch Sync to Light Out @ 25 mJ

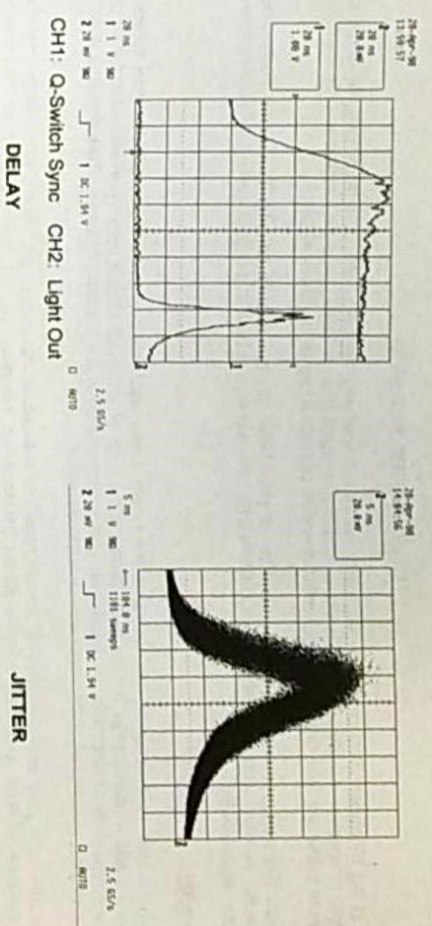


Figure 23: Jitter, Q-Switch Sync to Light Out @ 15 mJ