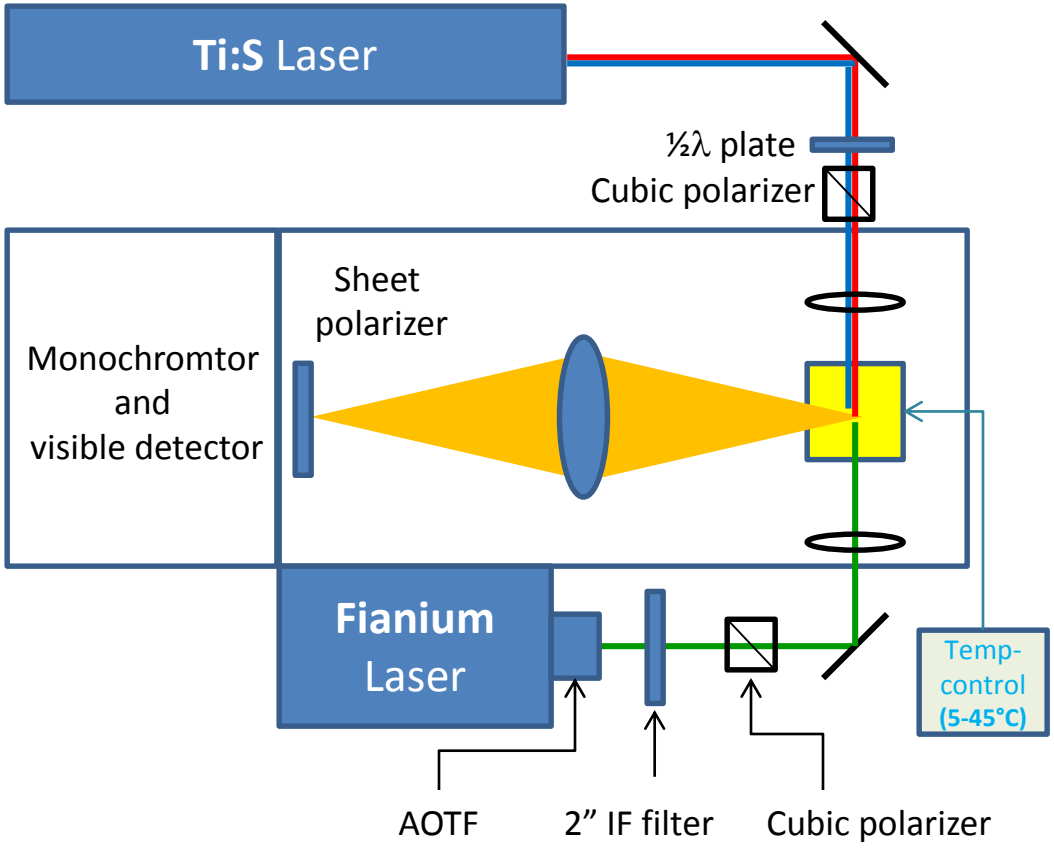
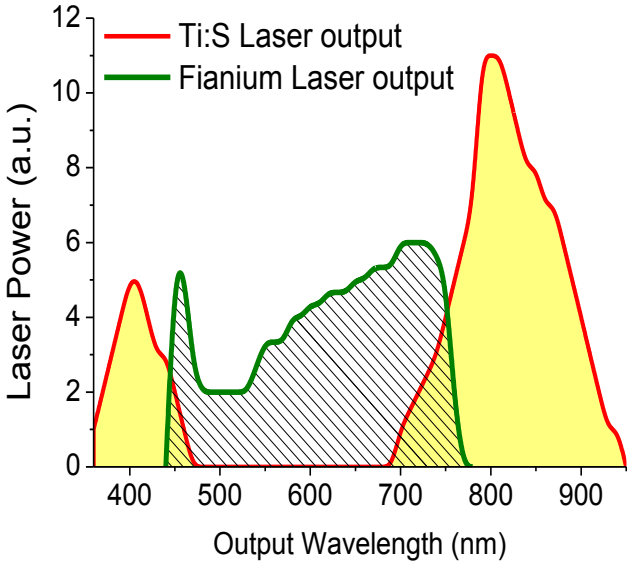
TCSPC Setup User Instruction

R:\Facility\ASU Setups\1_Setup-TCSPC\!Instructions for TCSPC\ Instruction for SPC Operation (2012-10).pptx

TCSPC system consists of 2 lasers for excitation and 2 detectors for fluorescence detection



System layout (only visible detector is shown)



Laser output power as a function of wavelength for the Ti:S (red) and the Fianium (green) lasers

TCSPC System ON/OFF Procedures

Sign-in

Sign in SPC(Ti:S) from the laptop computer

Laser

Using Fianium Excitation

1. **Turn on** the Fianium power strip on the optical table behind the desk, wait for laser to warm up (~ 10 minutes).
2. **Launch** 'Fianium controller' program and **set the desired repetition rate**, while the 'Laser Enable' key is at the '0' position (Laser OFF).
3. **Turn** the 'Laser Enable' key to the '1' position (ON). The 2 green LEDs should light up.
4. **Increase the power** to desired % (0 – 100%) by go in increments of 20% each time.
5. **Launch** 'Fianium AOTF Controller' program, clicking on the dark green box of desired excitation wavelength. Keep the % value ≤30%.

Using Ti:S Excitation:

1. Chiller on and make sure it has sufficient water.
2. Turn on Millennia laser using the 'LoginMillennia' program. Operation details are in file: 'Ti:S Laser Excitation'.

Detector

1. Turn on the power strip labeled "SPC experiment". It is at the edge of the optics table near the PMT.
2. Switch on the power supply for the Hamamatsu PMT using the silver toggle switch. The AC power is always left on. **(For IR PMT, see next Page)**
3. **Slowly** increase the voltage on the PMT power supply to –3000 mV.
4. **Change sync signal** connection on the left side of the BNC rack according to the laser source used ('Fianium', 'Ti:S fast diode', or "Ti:S electronic').

Program

1. Launch '**SPC Control Panel**' program, wait until the wavelength indicator shows '399.9', press 'Launch Becker-Hickl' to run data acquisition program.
2. Make sure that the SYNC count rate is the same as the laser rep rate. If it's different, you'll need to adjust the fast photodiode (for Ti:S) or check the connection (for both lasers).

Sample and Optics

1. Check if laser beam passes through sample preperly
2. Check polarizer setting for both excitation & detection
3. While monitoring the signal on screen, fine adjust the micrometer to translate the camera lens horizontally to maximize the signal.
4. Use 'Coherent' chiller to control the sample temperature if desired

System Shutdown

- Slowly decrease the PMT voltage to 0V, then flip the toggle switch to the left
- Close data collection and SPC Control Panel programs, **turn off the data acquisition PC**.
- Turn off power strip labeled "SPC experiment".
- For **Ti:S Laser**: use the Millennia program to turn off the laser, then turn the chiller off.
- For **Fianium Laser**: use the Fianium Controller program to decrease the power to 0%, 20% at a time. Then both programs off. Switch key to '0' position. Power strip off.
- **Log off from the laptop computer.**

TCSPC System ON/OFF Procedures for Using IR PMT Detector (EM > 850 nm)

Sign-in

Same procedures as for VIS Detector

Laser

Same procedures as for VIS Detector

Detector

For IR PMT, it should be on at least 2 – 3 hours prior to the measurement to avoid high dark counts

1. switch on the chiller which cools the IR PMT housing. It is labeled 'IR MCP/PMT, T=20C, P=84P'.
2. Turn on the IR detector cooler on the instrument rack ('Product for Research'): flip the switch DOWN. The switch is right above the label 'MAX COOL'. Check: DC amp meter should indicate '8', DEG C setting should be '-30C'.
3. **Slowly** increase the voltage on the Hamamatsu IR PMT power supply to –2850 mV.
4. Connect the detector cable to IR Detector.
5. Turn on the power strip labeled "SPC experiment".
6. Turn on the power supply for the IR shutter.
7. **Change sync signal** connection on the left side of the BNC rack according to the laser source used ('Fianium', 'Ti:S fast diode', or "Ti:S electronic').

Program

1. Open the **SPC Control Panel** program, wait to see the response from the monochromator (wavelength indicator shows '399.9), then press "Launch Becker-Hickl. This opens the data collection program.
2. Make sure that the SYNC count rate is the same as the laser rep rate. If it's different, you'll need to adjust the fast photodiode (for Ti:S) or check the connection (for both lasers).
3. When using the IR detector, both the shutter and the monochromator are controlled manually, NOT from the "SPC Control Panel'.

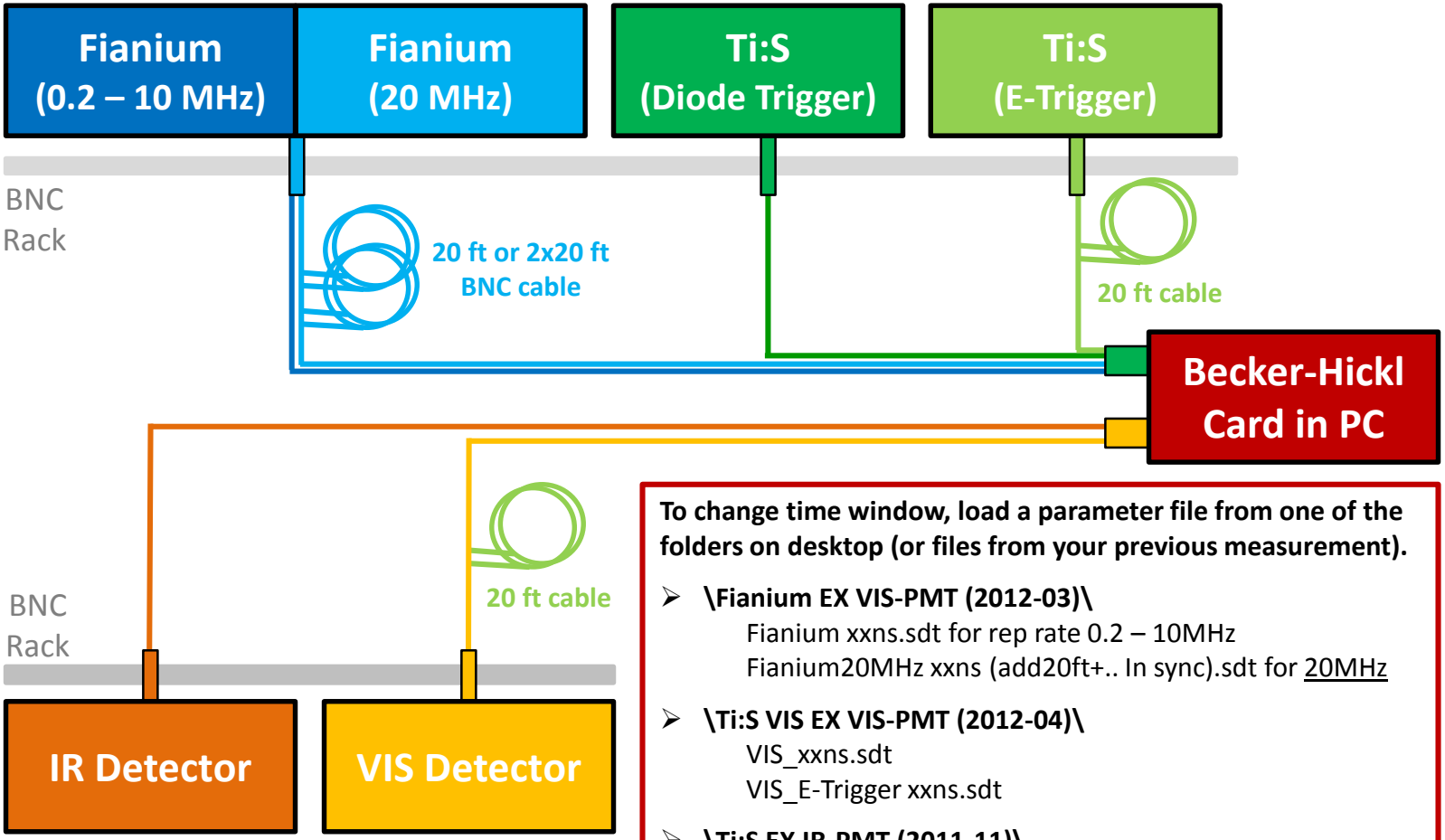
Sample and Optics

Same procedures as for the VIS Detector

System Shutdown

Slowly decrease the PMT voltage to 0V, then flip the toggle switch to the left.
Switch off the PMT cooler and the chiller.
The rest are the same procedures as for VIS Detector

Cable Connections for Excitation Sync Sources



To change time window, load a parameter file from one of the folders on desktop (or files from your previous measurement).

- **\Fianium EX VIS-PMT (2012-03)**
  Fianium xxns.sdt for rep rate 0.2 – 10MHz
  Fianium20MHz xxns (add20ft+.. In sync).sdt for 20MHz
- **\Ti:S VIS EX VIS-PMT (2012-04)**
  VIS_xxns.sdt
  VIS_E-Trigger xxns.sdt
- **\Ti:S EX IR-PMT (2011-11)**
  IR_xxns.sdt

Trouble Shooting List

Fianium no output

1. Confirm the problem by placing a white card at the laser output port, if a weak purplish-white spot is not seen when Fianium power is > 30%

2. Check Fianium Power Supply: key is turned to 'ON' position, no 'xxx alarm' warning appeared on screen

3. Check NREL control software: connection to the laser, power is not set to zero

For #2 &#3, restart Fianium and the control program. If problem persists, contact Su Lin at **727-0391 or slin@asu.edu**

AOTF no output

If a weak purplish-white spot is seen but no laser output at the selected wavelength (assuming the Fianium power is 'high enough'), the problem is likely due to the mismatching of the wavelength calibration file. The calibration file needs to be reloaded.

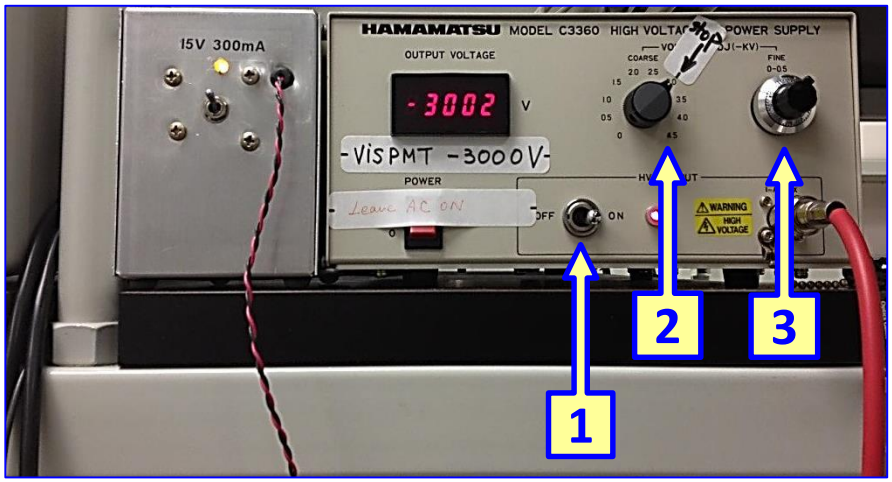
1. Copy the text file '**Tuning Visible 111469 WO 41837**' from C:\ to Desktop
2. In AOTF program, select Tools → Calibration → Import … (select the above file) → Apply → Apply → Quit.

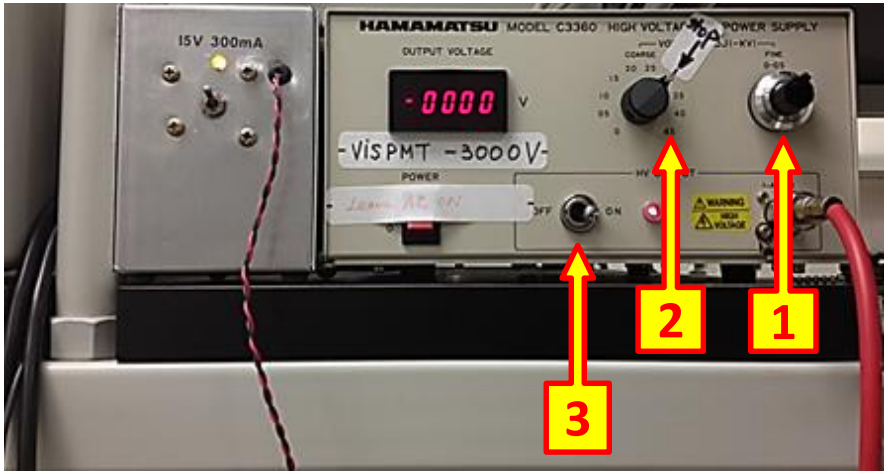
Double-peak or slow rise of IRF

Usually caused by optical misalignment. Use a card to reflect excitation beam, it should be close to the center of the shutter. If not, check the following in the order listed below.

1. Excitation beam at 14 cm height and passes roughly the center of the two openings of the sample chamber wall
2. Check both the cuvette and the camera lens positions, should be 5" away from the left wall of the chamber
3. Camera lens should be at 14 cm in height.

High Voltage for PMT





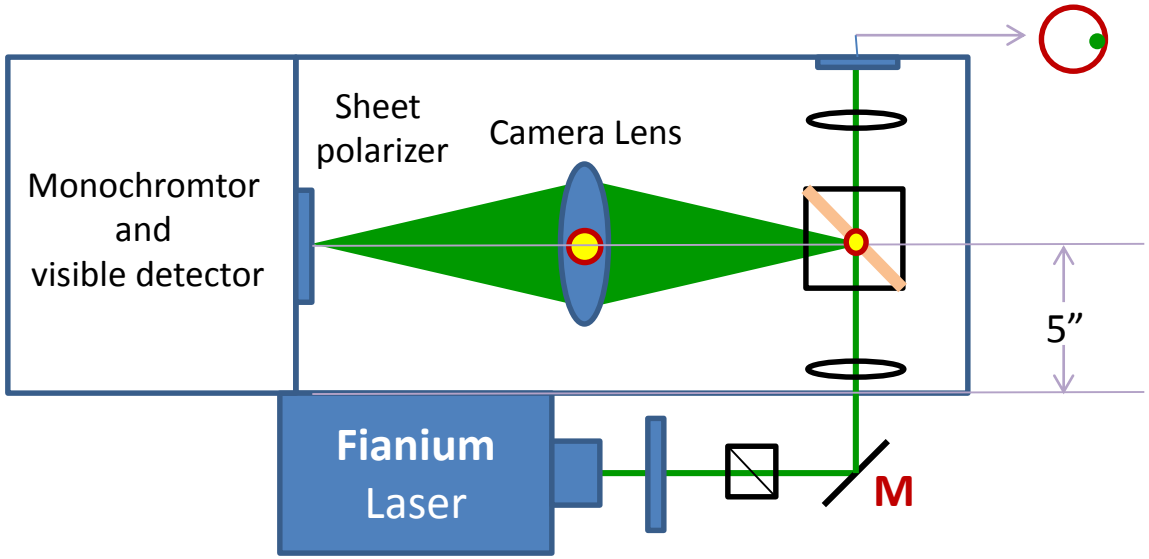
ON (<u>set the output voltage to **-3000V**</u>**)**

1. Flip the switch to 'ON' position
2. Slowly increase the 'COASER' gain to the marked **stop** position
3. Increase the 'FINE' gain till the 'OUTPUT VOLTAGE' is **-3000**

OFF (<u>set the output voltage to **0V**</u>**)**

1. Decrease 'FINE' gain counterclockwise all the way to the minimum
2. Slowly decrease the 'COASER' gain to '0' position
3. Flip the switch to 'OFF' position

Troubleshooting for abnormal IRF or slow rise of signal

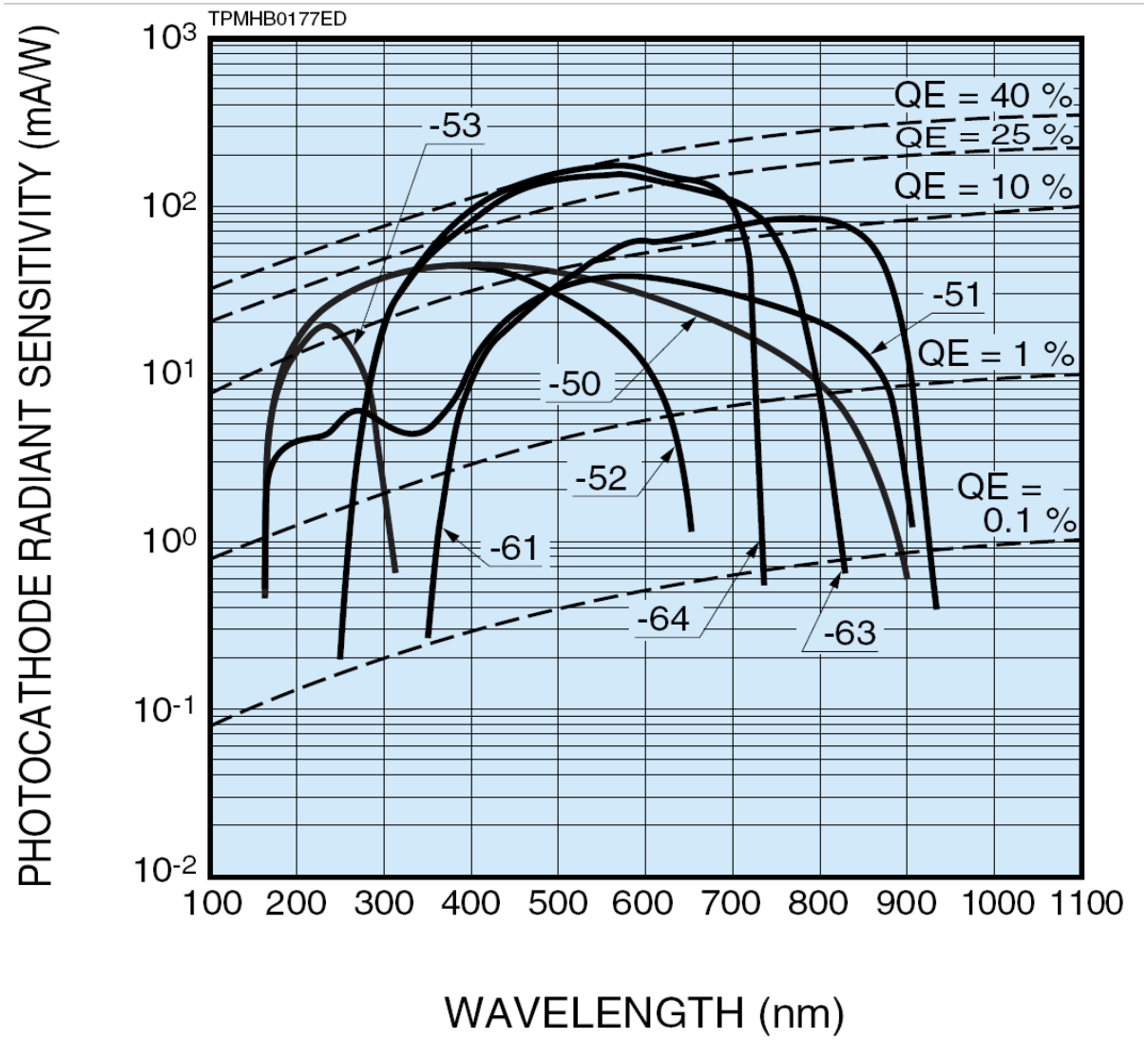


There are 2 reasons which likely cause the IRF > 40 -50 ps, or a long risetime (> 200 ps) in signal:

1. **<u>The SYNC cable</u>**: when there is a bad connection between cables, the profile of the IRF curve will vary when even wiggle the cable. Replace the bad cables if necessary.

2. **<u>Optical alignment</u>**: check if the optical alignment is off
   - Place a cuvette with a card in the sample hold, check to see if the scattered light from the excitation beam is centered on the shutter entrance (keep the shutter closed for this procedure)
   - If not, check if the excitation beam is aligned properly (i.e. goes through the center of both lenses and hits the exit on the opposite side as illustrated in the red circle. Align the beam using ‘M’ control.
   - If still can’t center the beam on the shutter, move the sample holder and the camera lens horizontally. The distance from the center of the cuvette and the center of the camera lens holder should be 5” away from the sample chamber panel to which the Fianium laser is mounted.

MCP-PMT Sensitivity (Current TCSPC Setup with R3809U-50)



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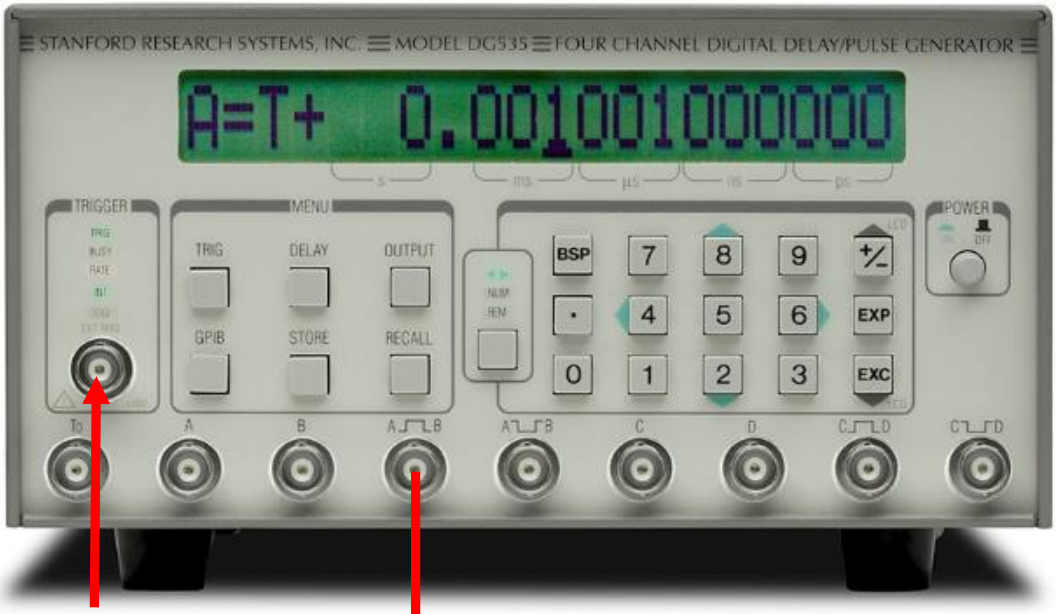
Delay Generator Cable Connections



Connect sync cable from SRS 445 amplifier to Trigger input.

Pulse Inverter

Sync input on Becker-Hickl Card

Use the digital delay generator for measurements in the 1-2 µs range. Max sync rate is 1/(1µs + longest delay).

Updated 2016-02-29

Parameter Settings

Measurement Range: 1.0 us

DG535

- Delay
  - A = T + 1000 ns
  - B = A + 10 ns
- Trigger
  - Threshold: -0.13V
  - Slope: –
  - Source: Ext
  - Term: 50 Ohm
- Output
  - Amplitude: 1.00V
  - AB
  - 50 Ohm
  - Var

BECKER-HICKL SPC830

- Offset: 20

Measurement Range: 1.5 us

DG535

- Delay
  - A = T + 1600 ns
  - B = A + 10 ns
- Trigger
  - Threshold: -0.13V
  - Slope: –
  - Source: Ext
  - Term: 50 Ohm
- Output
  - Amplitude: 1.00V
  - AB
  - 50 Ohm
  - Var

BECKER-HICKL SPC830

- Offset: 21

Measurement Range: 2 us

DG535

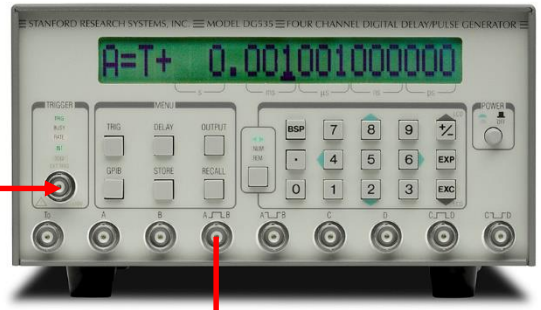
- Delay
  - A = T + 1607 ns
  - B = A + 10 ns
- Trigger
  - Threshold: -0.13V
  - Slope: –
  - Source: Ext
  - Term: 50 Ohm
- Output
  - Amplitude: 1.00V
  - AB
  - 50 Ohm
  - Var

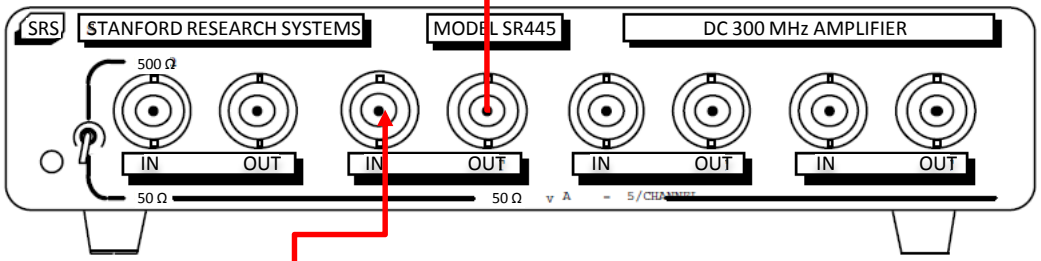
BECKER-HICKL SPC830

- Offset: 0.00

Cable connections for long time scales.
(500 ns – 2 µs)

Stanford Research DG 535 Delay Generator



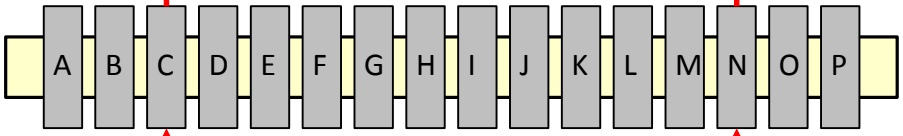


PC

CFD

SYNC

Becker-Hickl
SPC830

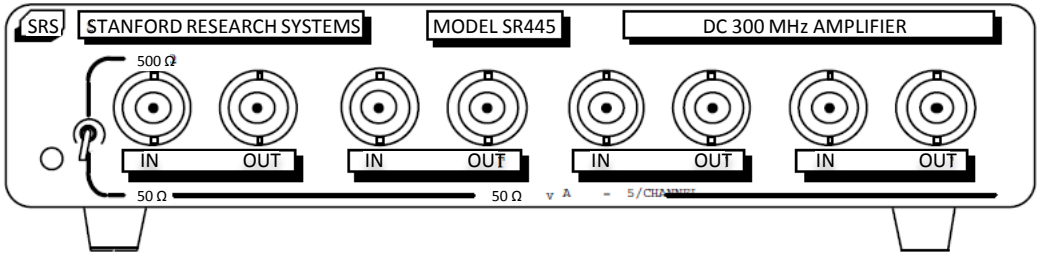


BNC Panel Pass Thru

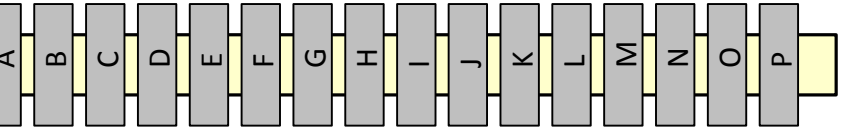
PQ Trigger Diode
(TDA200)

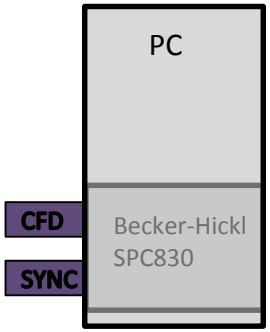
BH APPI
Pulse Inverter

Cable connections for long time scales. (500 ns – 2 µs)

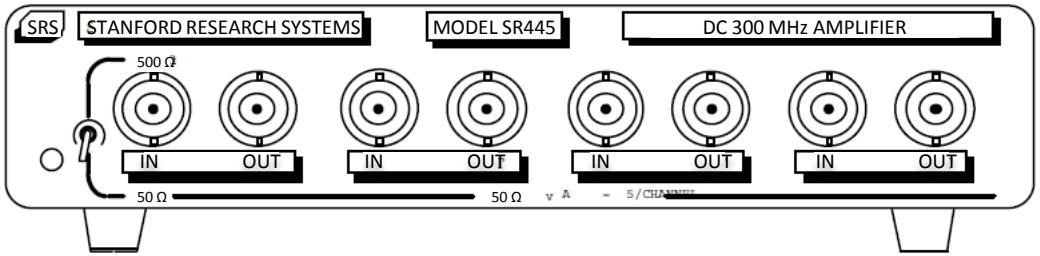


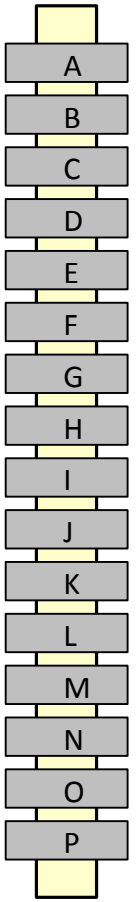
PQ Trigger Diode
(TDA200)

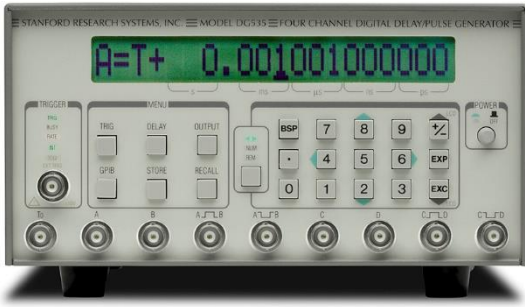


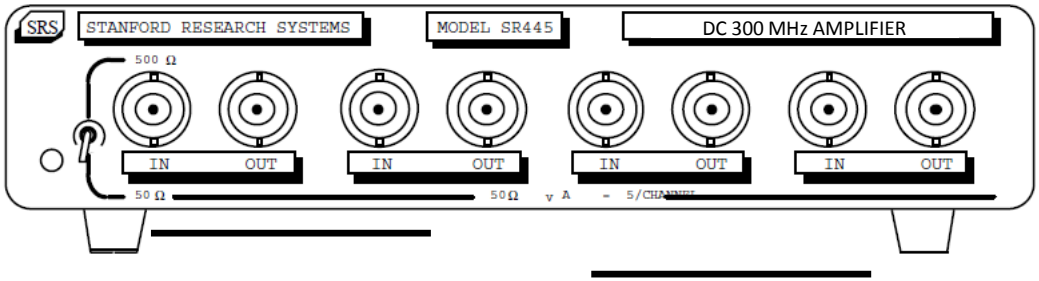


Cable connections for long time scales. (500 ns – 2 µs)



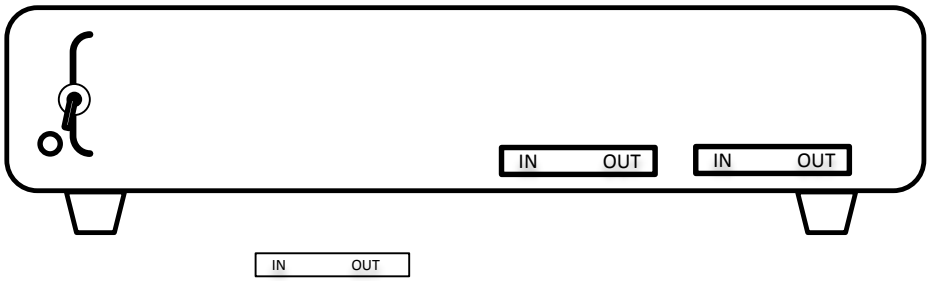






STANFORD RESEARCH SYSTEMS

MODEL SR445



MODEL SR445

IN OUT

IN OUT

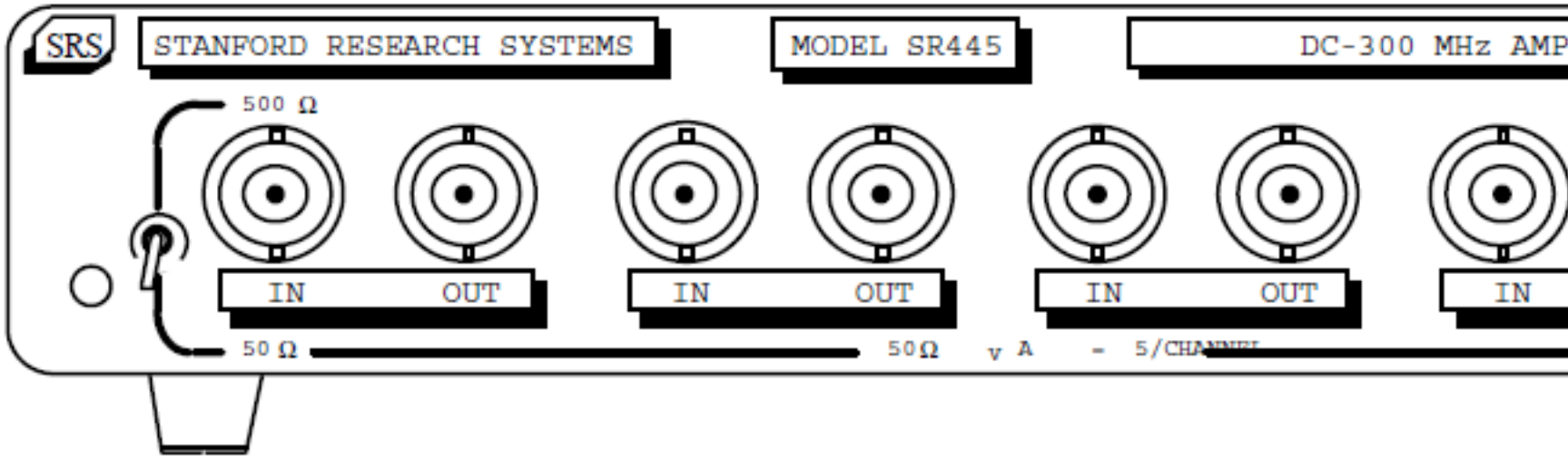
50 Ω

500 Ω

50 Ω

50 Ω

SRS


SRS
STANFORD RESEARCH SYSTEMS
MODEL SR445
DC-300 MHz AMP
500 Ω
IN
OUT
IN
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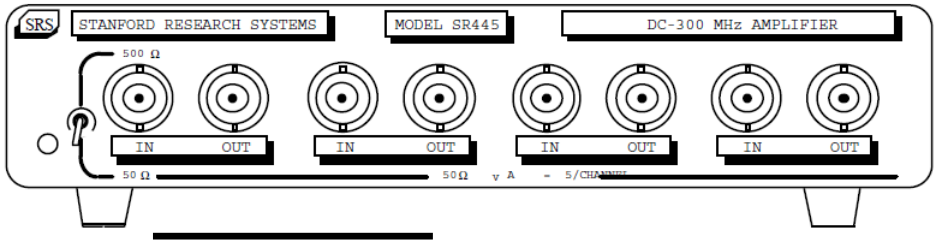
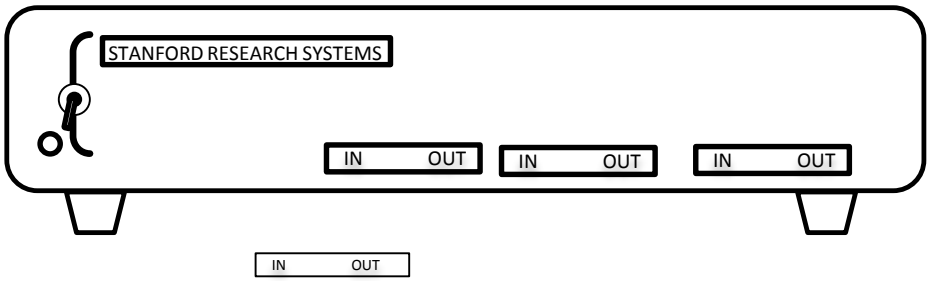
50 Ω





IN OUT

MODEL SR445

50 Ω

500 Ω

50 Ω

SRS

DC 300 MHz AMPLIFIER