Test Results for Honeywell Strobonar 360 Flash Unit (Project # 99-083)

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1 Introduction

Mr. Gordon Smith of Victoria, BC wanted the Technology Centre of British Columbia Institute of Technology (BCIT) to test the output of a strobe light. The main purpose of this test is to verify some experimental results that were obtained a couple of decades ago. For the original instructions supplied by Mr. Smith, please refer to the Appendix.

The following tests were performed by myself, Kam Fung, project leader at the Technology Centre. I can be reached at (604) 451-7056, or *kfung@bcit.ca*. This document describes the test results.

2 Problems Encountered and Their Solutions

When the strobe light was delivered to BCIT, it had not been used for more than a decade. The rechargable batteries inside the unit would not take a charge any more. I took apart the unit and disconnect the batteries. Instead of the batteries, I used a regulated power supply to charge the unit. Output of the supply was set to 2.5 V, with a current limit of $\sim 2\ A$.

At initial charge-up, the strobe light was charged at 2 A. As it approached fully-charged state, current slowly decreased to $< 1\ A$. Maximum voltage resulted across the flash tube was about 367 V, well above the minimum of 225 V indicated in the manual. Therefore, it is reasonable to believe that the capacitor and charging unit were still in good working order.

Another problem was encountered in the measurement of duration of output energy. The original instructions asked for measurements of voltage and current across the flash tube. The hope was that these parameters would enable us to calculated the duration of the light output. These were measured, but it turned out they don't give a good indication of actual light output. A fast light sensor would give a much better picture. The only suitable light sensor that I could find in the relative short time was the TSL252 Light-to-Voltage Optical Sensor by Texas Instruments. Rise time and fall time of this sensor are in the neighbourhood of 7 μsec.

3 Test Results

3.1 Connections

Basic setup of the experiments is shown in figure 1. The strobe unit was powered by a power supply, as described previously. Voltage across the flash tube, measured by a Fluke 29 DVM, was higher than 350 Vdc for each test performed.

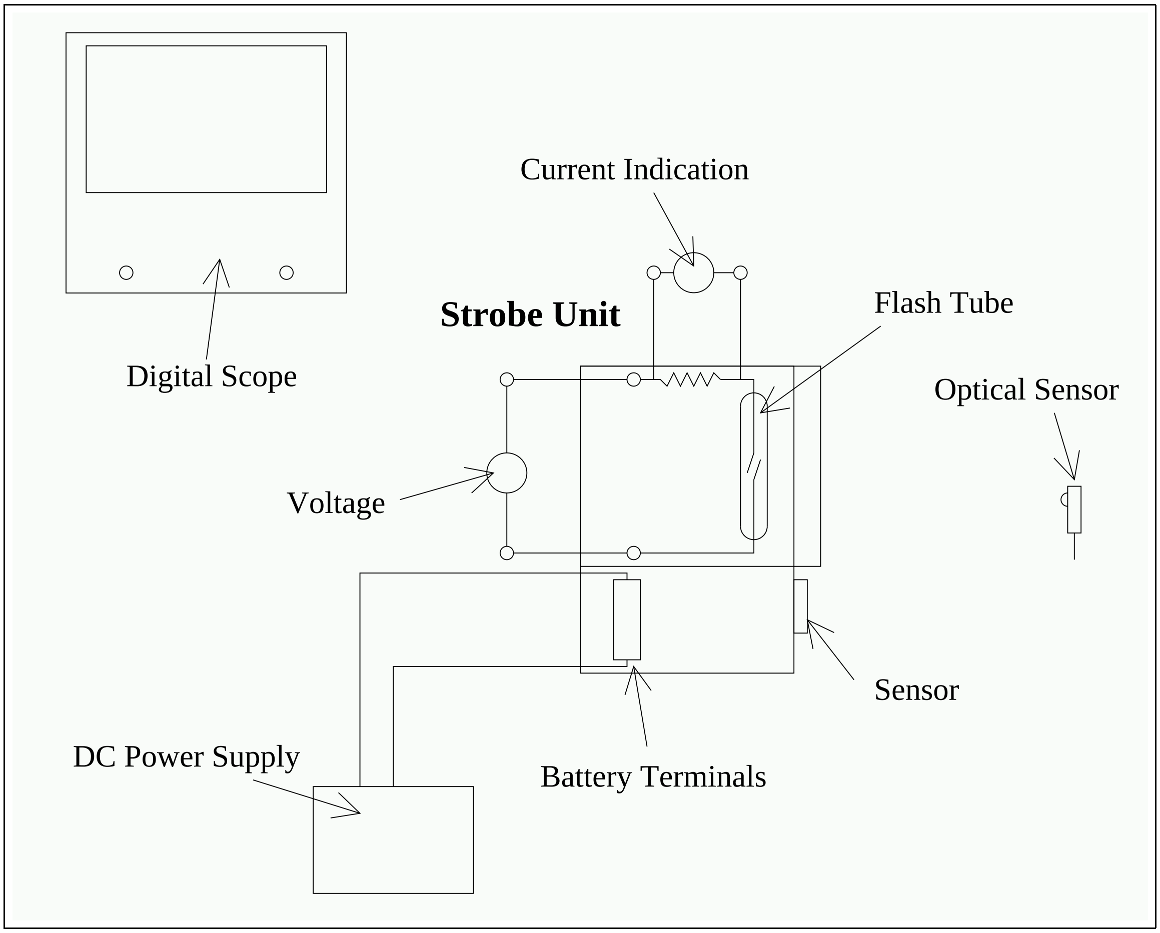


Figure 1: Setup of the experiments performed.

3.2 Types of Measurements

Two sets of outputs were measured. The first set showed the current (I) through, and voltage (V) across the flash tube during the shortest and longest pulse durations. The second set showed I and light output (L) measured by the light sensor.

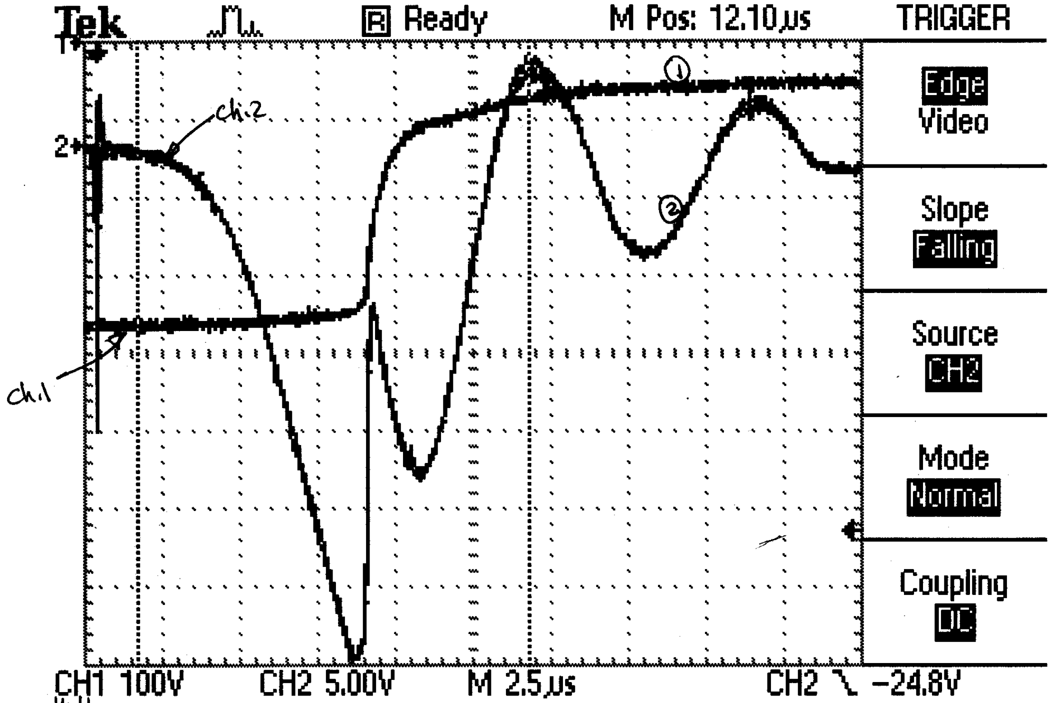
The shortest pulse (*Setup 1*) was effected by placing a reflective surface in front of the flash tube and sensor on the strobe. This caused the sensor to quench output of the flash tube as quickly as possible. The longest pulse (*Setup 2*), on the other hand, was generated by covering up the sensor on the strobe. Without seeing any light produced by the flash, the sensor would just ask the flash to produce as much light as possible, thus the longest pulse.

Measurement of Current (I) through the flash tube was measured by a resistor, connected in series with the tube. Using the 4-wire method, resistance of this resistor was determined to be $0.0974\ \Omega$. Therefore, actual current can be obtained by dividing the voltage measured across this resistance, by this resistance.

3.3 Measurement of Voltage and Current

Results of these experiments are shown in figure 2 and 3. The shortest pulse is shown in figure 2. Voltage is measured by *CH 1*, while current is by *CH 2*.

The Current measurement shows a double peak. It is not clear, however, whether this relates directly to the light output. A fast light sensor would give a much better indication of the actual light output.



CH1 100V
CH2 5.00V
M 2.5µs
CH2 ╲ -24.8V

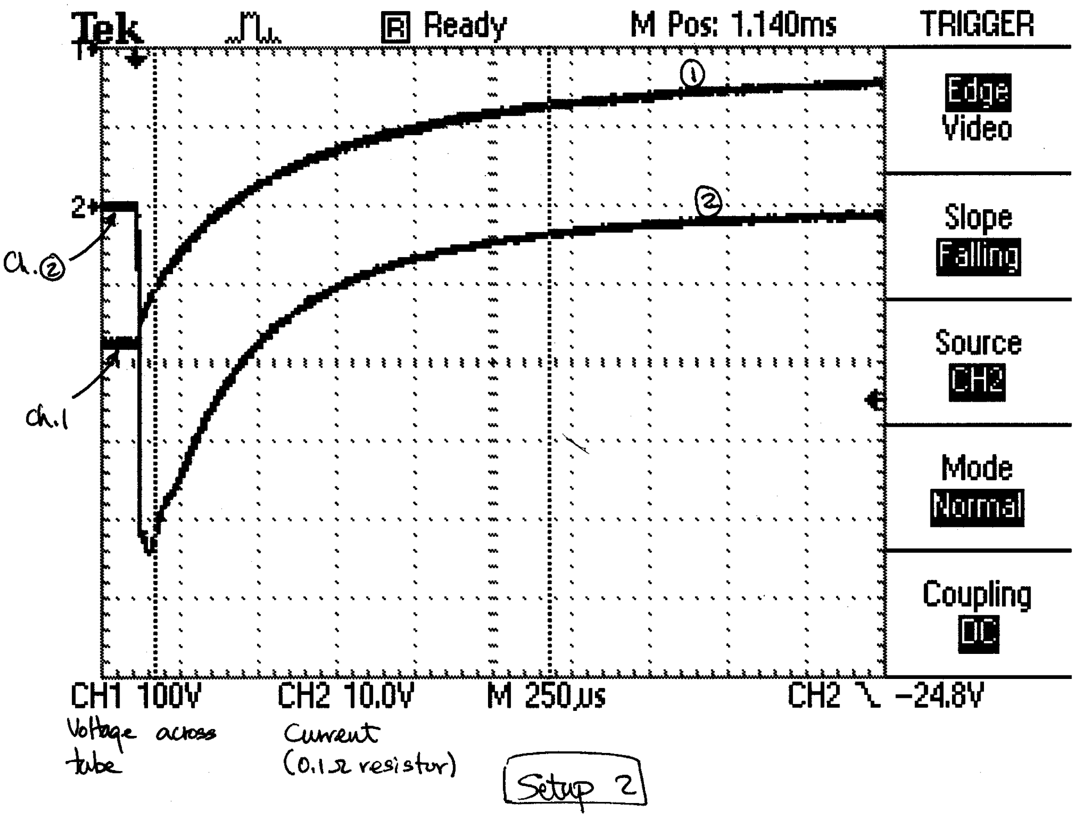
Voltage across tube

Current through tube (across a 0.1Ω resistor)

Setup 1

Dec. 17th/99 by KF

Figure 2: Measurement of Voltage and Current; setup 1; shortest pulse.



Dec. 17th/99 by Kam Fung.

Figure 3: Measurement of Voltage and Current; setup 2; longest pulse.

3.4 Measurement of Light and Current

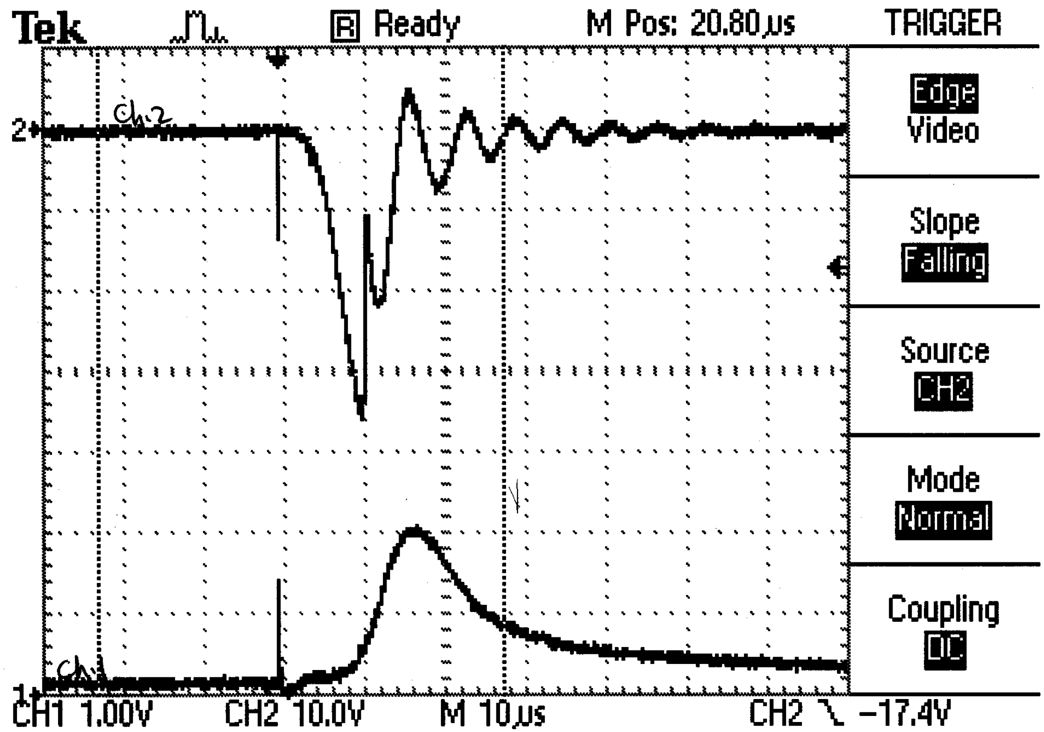
The light sensor used for the following measurements was a TL252 from Texas Instrument. Output voltage of this sensor is directly monitored in these measurements. This voltage, when not saturated, is proportional to the irradiance energy shone on the sensor. Data sheet for this sensor can be found at the TI web site (http://www.ti.com, perform a Quick Search for TSL252).

Because the level of light output of the strobe light was very high, the sensor would be saturated if exposed directly to this light. Shields and blocks were put in front of the sensor, so that the output voltage of the sensor was in the appropriate operating range. There is a slight chance, however, that reflection and refraction could cause changes in the shape of light pulse recorded. This would require a more elaborate setup to investigate.

With the strobe set to give out the shortest pulse, typical results are shown in figure 4 and figure 5. The former graph shows the light output gradually decaying. If this light is used to illuminate an object during a photographic shot, the film will register the image when the light intensity is above a certain level. This level depends on a few factors, including the film used and f-stop of the camera.

The light output does *not* show the double-peak exhibited in the current measurement. There are two explanations for this. One is the actual light generated does not follow the current profile. Second is the light sensor is too slow for this measurement. According to the specifications of this sensor, it takes about 7 μsec for its output voltage to rise from minimum to maximum. Therefore what we see on the graph could just be the response of the sensor. A sensor with faster response time will certainly give a more accurate measurement.

We can use the half-power point, as a rough guess, to determine the effective pulse width of the light pulse. From figure 5, maximum amplitude of the light pulse (Ch. 1) is about 2.6 V. If we use 1.3 V as the cutoff voltage, then the pulse width of this pulse is about $2.8 \times 5 = 14$ μsec. This corresponds to about one $70,000th$ of a second. Again, depending on the film used, f-stop of the camera, distance of the object from the flash, etc. The image registered on the film may correspond to a shorter or longer time than this.



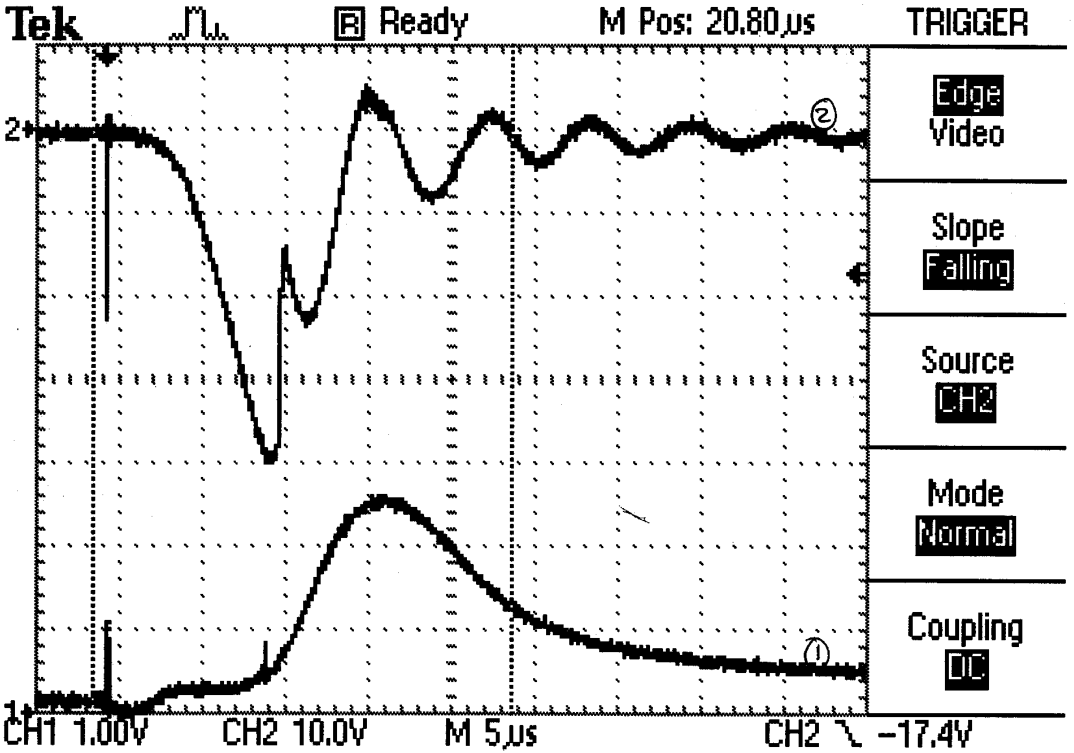
Light output

Current (across 0.1Ω)

Setup ①

Dec. 17/99 by Kam Fung.

Figure 4: Measurement of Current and Light; zoom in view; setup 1; shortest pulse.



Ready M Pos: 20.80µs

TRIGGER

Edge Video

Slope Falling

Source CH2

Mode Normal

Coupling DC

CH1 1.00V CH2 10.0V M 5µs CH2 ↘ -17.4V

Light output

Current
(across 0.1Ω)

Setup 1

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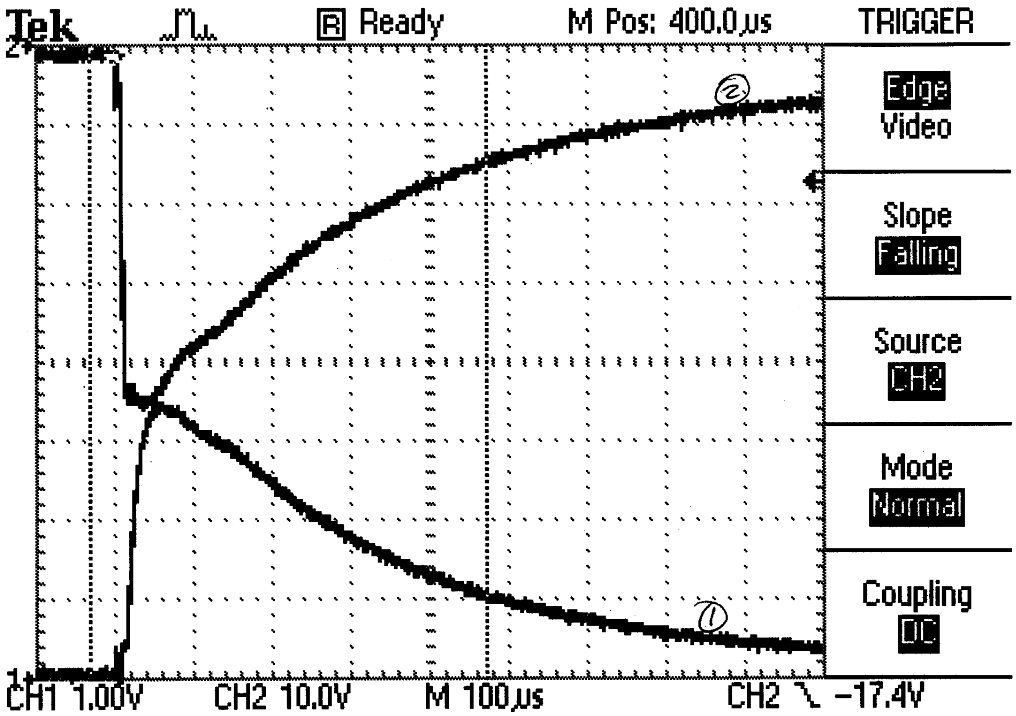
Figure 5: Measurement of Current and Light; zoom out view; setup 1; shortest pulse.



Light Output

Current
(across 0.1Ω)

Setup 2

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Figure 6: Measurement of Current and Light; setup 2; longest pulse.

Figure 6 shows the typical light output of the strobe when it is set to give out the longest pulse (ie. with the sensor on the unit covered). Here, *CH2* current going through the tube is shown in *CH 2*, whereas light output is shown in *CH 1*. For current, negative voltage denotes a positive current.

The long pulse has a similar shape as the short pulse. We can again use the half-power point to estimate the pulse width. Maximum light output is about 3.4 V. Using 1.7 V as the cutoff voltage, the pulse width of this pulse is about $2.9 \times 100 = 290$ μsec. This corresponds to about one 3500th of a second. The same cautions for the shortest pulse apply to this longest pulse.

4 A Few Thoughts

The original Test Instructions ask for the measurements of voltage across and current through the flash tube when it's triggered. This turns out to be inadequate for a reliable estimation of the pulse width for the light output. With the Optical-to-Voltage sensor, a better estimation is possible. However, due to the somewhat limited performance of the sensor used, the measured light output described in this document could still be not accurate enough. However, it gives a good first indication of what happens when the strobe unit is triggered under different circumstances.

This strobe light has an internal quench circuit, which controls the light output to allow for a *correct* exposure level on film. This level, however, is suitable for filming still objects, but may give different effect when used to film high-speed objects. The type of film used certainly plays a role in how the images are recorded.

5 Appendix

Revised Instructions (November 29, 1999) (by Gordon Smith)

5.1 TEST PARAMETERS for Flash Duration settings 1/70000 and manual mode. Test subject: Honeywell Auto/Strobonar 360 System

Two tests, similar in procedure to the method described below, except for the settings of the flash duration times (1/70000 sec and manual setting) of the Strobonar 360 flash system, are requested. It should first be determined that the triggering method described by our documentation of the original experiments is consistent with the method used to trigger the flash tube in the flash tube calibration tests to be performed below:

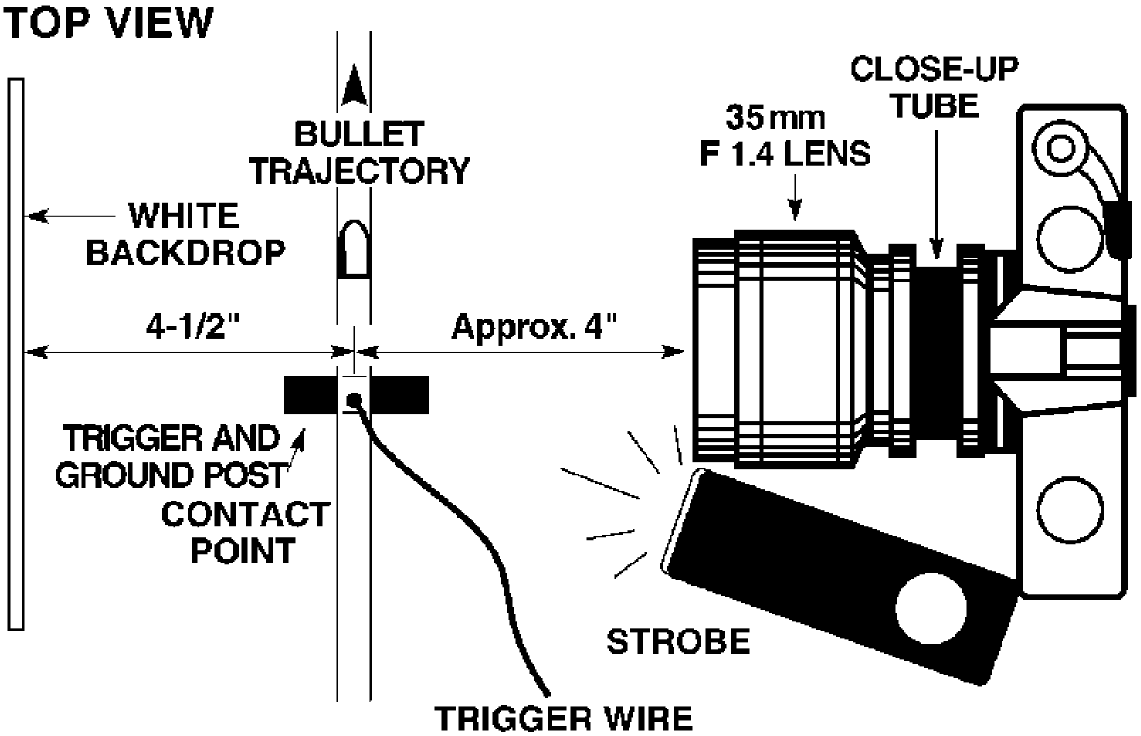

Figure 7: Setup of original experiment (1).

A 1 ohm or fraction of 1 ohm carbon composite resistor (not wirewound) placed between the flash tube ground terminal and the actual flash tube ground, with the voltage across the resistor monitored by one channel of the scope as the tube fires, while at the same time monitoring the the voltage across the + (plus) terminal of the flash tube with the second channel of the scope.

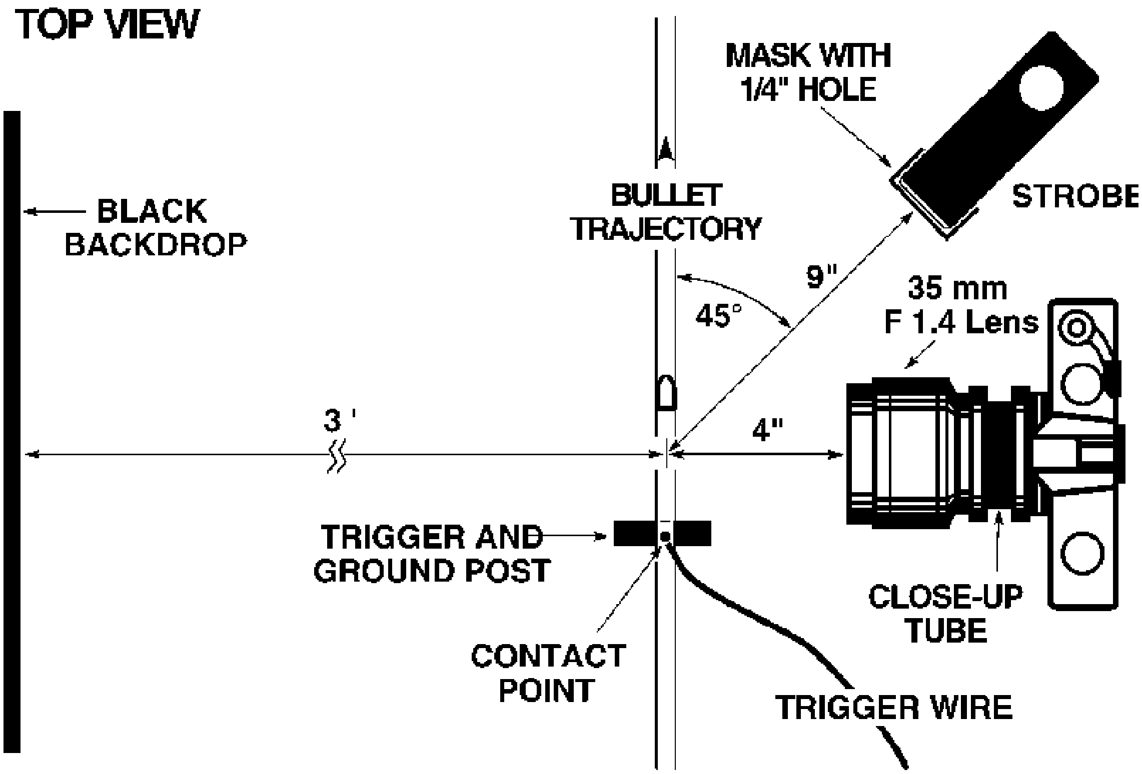

Figure 8: Setup of original experiment (2).

Selection of the actual resistor value should be made by the technician, depending on the lower sensitivity ranges of the oscilloscope being used for the test. The actual value of the resistor in ohms should be recorded, and the resistor itself saved for future examination and Preference.

The oscilloscope should be triggered in a manner consistent with capturing the first instants of the rise time. The scope should have a delayed sweep, or pre-trigger feature, capable of recording events (if any) occurring just previous to trigger times. The oscilloscope time/division setting should be set so that the resulting oscillographs depict the rise, sustain and fall times of the waveforms spanning a maximum number of time divisions consistent with obtaining both of the waveforms in their entirety.

The documentation of the test should include a word description of the procedure performed to obtain the resulting oscillographs, signed and dated by the technician performing the test, and the oscillographs (hardcopy) outputs. This word description should include the make and model numbers of the oscilloscope, and ohmmeter used to declare the ohms value of the resistor.

Included should be the (printed) name of the technician doing the test, as

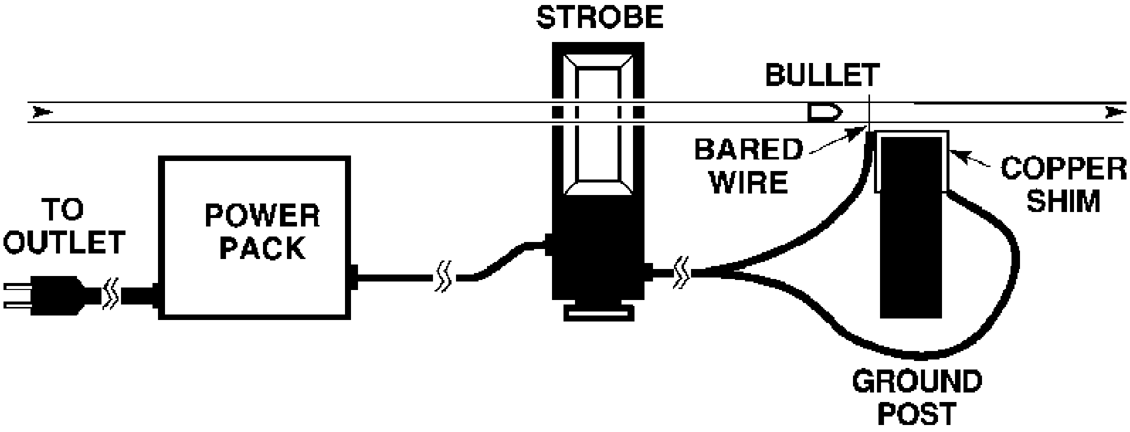

Figure 9: Setup of original experiment (triggering).

well as the company name, street address, phone numbers and email address of the technician or his/her supervisor.

Test results and documentation may be published over the internet along with the original experiments they relate to. The resistor used in these calibration tests should be provided with the resulting documentation.

The original Honeywell Auto/Strobonar 360 Repair Manual will be provided along with the original equipment.

Please refer to diagrams of trigger setups provided in previous emails.