Flicker Fusion
User Instructions
Description

The Lafayette Instrument Model 12021A Flicker Fusion provides the user with a variety of versatile controls to perform accurate and timely measurements of CFF. Digital circuitry is used to provide extremely accurate frequency generation from 1.0 Hz to 100.0 Hz in 0.1 Hz steps. The LCD display allows for exact and repeatable frequency settings, while the serial port computer interface provides a means for test result storage or computer control of the device. The user options include five modes of operation to cover virtually any test requirement: Ascending Auto Frequency, Descending Auto Frequency, Continuous, Discrete, and Analog Control Mode. The software program also provides three automatic protocols: Automatic Method, Adaptive Method, and Self-Control Method.

The Lafayette Instrument viewing chamber has two lights, one for the left eye and one for the right eye. The light compartments are completely separated, allowing for four stimulus combinations to occur: left eye only, right eye only, left and right simultaneously, or left and right alternately.

The viewing chamber is constructed to control extraneous factors, which might distort CFF values. The white Electroluminescent lamps produce even illumination over a ½” diameter viewing area. The stimuli are separated by 2 ¾” center to center with a stimulus to eye distance of 15” and a viewing angle of 1.9°. The inside of the viewing chamber is a dull black to minimize reflection.

The Model 12021A Flicker Fusion is a significant improvement over the previous Model 12023A Flicker Fusion. The improved features include: frequency generation with only 0.05% error, defined sweep rate settings, 4 control push buttons and menu-driven LCD display for smaller packaging, RS-232C interface for computer control and test result storage, and hypo-allergenic silicone viewing chamber mask for a comfortable fit on the test subject’s face.
Overview
The Model 12021A Flicker Fusion is designed to test for the critical flicker fusion threshold (CFF). CFF can be used as an index of the temporal resolving power of the human visual system. The threshold of the flicker fusion is determined in the following manner: a light beam is interrupted intermittently by electronic means at a slow rate, causing it to flash or flicker. If the rate of the flicker exceeds a certain rate, the light will appear steady. The rate at which flicker ceases and the light appears steady is the threshold of fusion. The rate of flicker is then decreased from steady to the point at which the light changes from steady to flicker, the threshold flicker. The average of the threshold of fusion and the threshold of flicker is called the critical flicker fusion threshold (CFF).

CFF is sensitive to a number of presentation and observer variables. Presentation variables include stimulus frequency, luminance of the stimulus, stimulus size, light/dark ration, stimulus color, and contrast. Observer variables reported to affect results include body temperature, practice, general physiological state, age, sex, and genetic variables.

Specifications
Power Supply: 10 VDC @ 1.5A, 2.1mm center positive DC plug
Fuse: 0.5A 5 x 20mm fast blow
Frequency: 1.0 to 100.0 Hz in 0.1 Hz increments with an error of 0.05%
Slide Holder: 2” x 2” 35mm holder for optional 12100 neutral density filters with 0.1% to 50% light transmission
Auto Mode Ramp Rates: options of 0.5, 1, 2, and 4 Hz per second
Analog Input: 3.5mm mono phone plug with voltage range from 0.1 to 10V for 1.0 to 100.0 Hz flicker rate; ABSOLUTE MAXIMUM INPUT = 14V
External Initiate: SPST normally open hand-held switch with RCA input
External Response: SPST normally open hand-held switch with 3.5mm stereo plug
RS-232C Port Settings: 9600 baud, no parity, 8 data bits, 1 stop bit
Typical Maximum Luminance: 58 Cd/m²
Viewing Angle: 1.9°
Light/Dark Ratio: 1:1
Stimulus Color: White
Viewing Chamber Mask: hypo-allergenic black silicone; mask may be cleaned with an alcohol wipe
Control Size: 8 5/8”W x 6.5”L x 3 3/4”H; Weight 1.8 lbs
Viewing Chamber Size: 7”W x 19”L x 16”H; Weight 7.4 lbs

Parts Included
- 1 – Control Unit
- 1 – Viewing Chamber
- 1 – 10 VDC wall mount AC adapter
- 1 – DB9 Female to Female cable
- 1 – DB15 Male to Female cable
- 1 – Single hand-held push button
- 1 – Dual hand-held push button
Operating Instructions

1. With all power off, connect the DB15 cable from the CONTROL connector on the rear of the viewing chamber to the VIEWING CHAMBER connector on the rear of the control chassis.
2. Connect the black hand-held subject response box to the external response connector on the rear of the viewing chamber.
3. If external stimulus initiation is desired, connect the silver hand-held push button to the EXTERNAL INITIATE connector on the rear of the control chassis.
4. If computer control is desired, connect the serial cable from the COMM.PORT connector on the rear of the control chassis to communication ports 1 or 2 of the computer.
5. Once the above connections are completed, plug the wall mount AC adapter plug into the DC POWER jack on the rear of the control chassis.
6. Familiarize yourself with the following menu driven controls
7. In each mode the subject may respond by pressing either side of the black subject response key.

A. Luminance Adjust (Figure 1)

This adjustment is only available upon powering up of the device. The stimulus luminance may be adjusted using push button #1 to increase and push button #2 to decrease. Push button #3 will continue to the mode selection. The luminance percentage represents the percent of the maximum stimulus luminance available. Even though the stimulus lamps have been pre-aged to minimize decay, as the lamps age some decay in luminance will be present, however the left and right stimulus lamps will decay at the same rate.

![Figure 1: Luminance Adjust](image)

B. Mode Selections (Figure 2)

1. **Ascending Auto Frequency (>AUTOFREQ)**

   After selecting luminance or reset, select his mode with push button #1. Once the mode is selected, select the desired stimulus for activation using push buttons #1 to #4 in Figure 3. Once the stimulus is selected, select the desired sweep rate for the test using push buttons #1 to #4 in Figure 4. Once the sweep rate is selected, the display will show the mode that has been selected and the lower limit frequency, Figure 5. Push buttons #1 to #4 will now perform the functions labeled below the buttons. To increase the frequency setting use #1, to decrease the frequency setting use #2, to initiate the test use #3, and to reset back to the mode selection screen use #4. Once initiated, the selected stimulus will activate and flicker at the lower limit. The flicker frequency will increase at the selected sweep rate until a response or reset occurs. When a response is made the frequency is halted and the stimulus is deactivated. Press #3 to reset for the next test. Press #3 again to reset back to the mode selection window. If the upper limit frequency of 100.0 Hz is reached or the reset button is pushed, the stimulus is deactivated and the frequency is reset to the starting lower limit.
1. **Descending Auto Frequency (<AUTOFREQ)**

After selecting luminance or reset, select this mode with push button #2. Once the mode is selected, select the desired stimulus for activation using push buttons #1 to #4 in Figure 3. Once the stimulus is selected, select the desired sweep rate for the test using push buttons #1 to #4 in Figure 4. Once the sweep rate is selected, the display will show the mode that has been selected and the upper limit frequency, Figure 5. Push buttons #1 to #4 will now perform the functions labeled below the buttons. To increase the frequency setting use #1, to decrease the frequency setting use #2, to initiate the test use #3, and to reset back to the mode selection screen use #4. To increase the frequency setting use #1, to decrease the frequency setting use #2, to initiate the test use #3, and to reset back to the mode selection screen use #4. Once initiated, the selected stimulus will activate and flicker at the upper limit. The flicker frequency will decrease at the selected sweep rate until a response or reset occurs. When a response is made the frequency is halted and the stimulus is deactivated. Press #3 to reset for next test. Press #3 again to reset back to the mode selection window. If the lower limit frequency of 1.0 Hz is reached or the reset button is pushed, the stimulus is deactivated and the frequency is reset to the starting upper limit.

2. **Continuous (CONTIN)**

After selecting luminance or reset, select this mode with push button #3. Once the mode is selected, select the desired stimulus for activation using push buttons #1 to #4 in Figure 3. Once the stimulus is selected, the display will show the mode that has been selected and the current frequency, Figure 5. Push buttons #1 to #4 will now perform the functions labeled below the buttons. To increase the frequency setting use #1, to decrease the frequency setting use #2, and to reset back to the mode selection screen use #4. The stimulus is on continuously in this mode, therefore the initiate push button is not used.

3. **Discrete (DISCRT)**

After selecting luminance or reset, select this mode with push button #4. Once the mode is selected, select the desired stimulus for activation using push buttons #1 to #4 in Figure 3. Once the stimulus is selected, the display will show the mode that has been selected and the current frequency, Figure 5. Push buttons #1 to #4 will now perform the functions labeled below the buttons. To increase the frequency setting use #1, to decrease the frequency setting use #2, to initiate the test use #3, and to reset back to the mode selection screen use #4. Once initiated, the selected stimulus will activate and flicker at the current frequency. The flicker frequency will remain constant until a response or reset occurs. When a response or reset occurs the stimulus is deactivated.

4. **Analog**

This mode is not selectable through the control push buttons. Analog frequency control is only available in Continuous Mode. Connect the analog input through the 3.5mm mono ANALOG INPUT connector on the rear of the control chassis, using the center pin for the positive voltage. The control will automatically detect when an analog voltage between 0.1 and 10V is present, with $0.1V = 1.0 \text{ Hz}$ and $10V = 100.0 \text{ Hz}$. The frequency will adjust in 1.0 Hz steps as the voltage is changed. Analog voltages below 0.1V will set the frequency at 1.0 Hz and analog voltages above 10V will set the frequency at 100.0 Hz. To exit the Analog Mode, push the reset push button. This will return to the mode selection window, Figure 2. **WARNING:** The maximum allowable analog input voltage without damaging the control unit is 14V.

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**Figure 2: Mode Selection**

![Mode Selection Diagram](image-url)
Figure 3: Stimulus Selection

Figure 4: Sweep Rate Selection

Figure 5: Operate Window

C. Stimulus Selection

1. Left - Only left stimulus flickers.
2. Right - Only right stimulus flickers.
3. Coincident - Both stimuli flicker at the same time.

D. Sweep Rate Selection

The rate at which the frequency changes in either automatic mode.

1. 0.5 Hz per second
2. 1 Hz per second
3. 2 Hz per second
4. 4 Hz per second

Software Program Description

The Model 12021A Flicker Fusion may be controlled using the communication port of the computer. The program allows for control of the hardware in each of the modes, except for Analog Mode. The program controls the operation by simulating the activation of the four push buttons on the control, and also has three built in protocols that may be used to administer tests and save the test results in a text file. All three protocols allow
the user to enter the test subject's name and enter the file name to use in storing the test results. The three protocols include: Automatic Method, Adaptive Method, and Self-Control Method.

For proper operation, connect the provided DB9 serial cable from the COMM.PORT connector on the rear of the control chassis to the communication port of the computer. Power up the Model 12021A control before starting the software.

At start-up, the program allows the user to select the correct communication port to use, Figure 6. The user may then select their desired percent of luminance, Figure 7. After the desired luminance is selected, the mode selection window will allow the user to select one of the four standard modes or an automatic protocol, Figure 8. If one of the four standard modes are selected, the user may then select the desired stimulus, Figure 9. If appropriate, the program will then prompt the user to select the desired sweep rate, Figure 10. The program will then enter the main window for the selected standard mode, Figure 11. This window allows the user to control the frequency adjust, initializing and resetting of tests, and storage of test results.

If in the mode selection window, Figure 8, the user had selected automatic protocol. The program will allow the user to select one of the three automatic protocols, Figure 12.

In Automatic Method, Figure 12, the program automatically runs a test using the Ascending Auto Frequency Mode to determine the fusion frequency and the Descending Auto Frequency Mode to determine the flicker frequency. The results of these two tests are averaged and displayed as the CFF value. The Automatic Method allows the operator to select the stimulus, sweep rate, pre-test delay from 0 to 5 seconds, and a between test delay from 0 to 20 seconds.

In Adaptive Method, Figure 14, the program uses the Discrete Mode to display fixed frequencies and allows the user to respond to the frequencies as “flicker” or “fusion”. Depending on the response, the next frequency displayed will be at a higher or lower frequency. This method uses the test subject’s response to “zero in” on the CFF value. The frequency steps are limited between 10.0 and 0.1 Hz. The test is complete when the test subject can not discern whether the frequency is at flicker or fusion. This method allows the operator to select the stimulus to use and whether the starting frequency should be at fusion or at flicker. The fusion starting frequency is 80.0 Hz and the flicker starting frequency is at 10.0 Hz. Please notice the symbols on the black hand-held subject response box. The half-moon shape with dotted lines extending out symbolizes a response of “flicker”. The half-moon shape with solid lines extending out symbolizes a response of “fusion”.

In Self-Control Method, Figure 15, the program uses the Continuous Mode to display a starting frequency and allows the test subject to select whether to increase or decrease the frequency. The test is complete when the test subject can not discern whether the frequency is a flicker or a constant. This method allows the operator to select the stimulus to use the starting frequency of 50.0 Hz or 10.0 Hz. Please notice the symbols on the black hand-held subject response box. The “+” symbolizes a response to increase the frequency by 0.1 Hz. The “-” symbolizes a response to decrease the frequency by 0.1 Hz.

In all other modes or protocols the subject may respond by pressing either side of the black subject response key.
Lafayette Instrument Flicker Fusion

Figure 7: Luminance Adjust

![Luminance Adjust](image)

Luminance = 100%

Inc  Dec  Continue

Figure 8: Mode Selection

![Mode Selection](image)

Make a selection.

Automatic Protocol

> Auto Freq  < Auto Freq  Continuous  Discrete

Figure 9: Stimulus Selection

![Stimulus Selection](image)

Auto Frequency Increment

Make a selection.

Left  Right  Coincident  Alternate
Figure 10: Sweep Rate Selection

Figure 11: Operate Window

Figure 12: Protocol Selection
Figure 13: Automatic Method

Figure 14: Adaptive Method

Figure 15: Self-Control Method
Photosensitivity Warning

A small percentage of people may experience symptoms of photosensitivity when exposed to flashing lights. These symptoms include feelings of nausea, dizziness, migraines, visual distortions, or photosensitivity induced seizures characterized by one or more of the following: lightheadedness, altered vision, eye or face twitching, jerking or shaking of arms or legs, disorientation, confusion, loss of consciousness or convulsions that can lead to injury from falling or collision. Symptoms can occur in individuals with no history of seizures or epilepsy. Immediately stop using the Flicker Fusion if you experience any of the above symptoms. Consult a physician before using the Flicker Fusion if you or a relative have a history of seizures or epilepsy.
Lafayette Instrument Company and a completed Return Form. When you
Instrumentation may not be returned without prior authorization by
Repairs
not be accepted. Returned products must be in saleable condition, and credit
receipt of the item and in the original shipping carton. Collect shipments will not
be accepted. Returned products must be in saleable condition, and credit is
not be obliged, however, to replace or repair any piece of equipment,
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insurance policy to the manufacturer. This includes Lafayette Instrument
Warranty period for repairs or used instrumentation purchased from Lafayette
Instrument is 90 days. Lafayette Instrument Company agrees either to
repair or replace, at its sole option and free of part charges to the customer,
instrumentation which, under proper and normal conditions of use, proves to be
defective within the warranty period. Warranty for any parts of such equipment
or replaced instrumentation shall be covered under the same limited warranty
and shall have a warranty period of 90 days from the date of shipment or the
remainder of the original warranty period whichever is greater. This warranty
remedy are given expressly and in lieu of all other warranties, expressed or
implied, of merchantability or fitness for a particular purpose and constitutes
the only warranty made by Lafayette Instrument Company.

Lafayette Instrument Company neither assumes nor authorizes any person to
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whatsoever for special, consequential, or punitive damages of any kind from any
cause arising out of the sale, installation, service or use of its instrumentation.
All products manufactured by Lafayette Instrument Company are tested and
inspected prior to shipment. Upon prompt notification by the Customer,
Lafayette Instrument Company will correct any defect in warranted equipment
of its manufacture either, at its option, by return of the item to the factory, or
shipment of a repaired or replacement part. Lafayette Instrument Company
will not be obliged, however, to replace or repair any piece of equipment,
which has been abused, improperly installed, altered, damaged, or repaired by
others. Defects in equipment do not include decomposition, wear, or damage by
chemical action or corrosion, or damage incurred during shipping.

Limited Obligations Covered by this Warranty
1. In the case of instruments not of Lafayette Instrument Company
manufacture, the original manufacturer's warranty applies.
2. Shipping charges under warranty are covered only in one direction. The
customer is responsible for shipping charges to the factory if return of the
part is required.
3. This warranty does not cover damage to components due to improper
installation by the customer.
4. Consumable and or expendable items, including but not limited to
electrodes, lights, batteries, fuses, O-rings, gaskets, and tubing, are
excluded from warranty.
5. Failure by the customer to perform normal and reasonable maintenance
on instruments will void warranty claims.
6. If the original invoice for the instrument is issued to a company that
is not the company of the end user, and not an authorized Lafayette
Instrument Company distributor, then all requests for warranty repair must
be processed through the company that sold the product to the end
user, and not directly to Lafayette Instrument Company.

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Member Countries. It is against U.S. law to ship a Polycr system to any other country
without an export license. If the ultimate destination is not one of the above listed countries, contact us for the required
license application forms.