

7.0 OPTIONS AND ACCESSORIES

- PSC-2U** Universal Recharger, 115/230 Vac with USA, U.K., AUS, Euro Adapter Plugs for battery operated Nova-Strobes
- CC-7** Latching carrying case for Strobe with provision for accessories (included with BBL Kit)
- CC-12** Deluxe water-tight latching carrying case for Strobe with provision for accessories
- SPC-1** Splash proof Protective vinyl Cover for Battery Powered Strobes ONLY
- CAL-N.I.S.T** N.I.S.T. Traceable Certificate of Calibration / Re-calibration
- Protective Rubber Cover** Rubber cover that fits over reflector housing to protect strobe

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MONARCH INSTRUMENT

Instruction Manual



Nova-Strobe BBL Basic Battery LED Stroboscope



205 Westwood Ave
Long Branch, NJ 07740
1-877-742-TEST (8378)
Fax: (732) 222-7088
salesteam@Equipment.NET



Safeguards and Precautions



1. Read and follow all instructions in this manual carefully, and retain this manual for future reference.
2. Do not use this instrument in any manner inconsistent with these operating instructions or under any conditions that exceed the environmental specifications stated.
3. Certain strobe frequencies can trigger epileptic seizures in those prone to that type of attack.
4. Users should not stare directly at the light source.
5. Prolonged exposure to the light can cause headaches in some people.
6. Objects viewed with this product may appear to be stationary when in fact they are moving at high speeds. Always keep a safe distance from moving machinery and do not touch the target.
7. There are no user serviceable parts in this instrument. Refer service to a qualified technician.
8. Do not allow liquids or metallic objects to enter the ventilation holes on the stroboscope as this may cause permanent damage and void the warranty.
9. Do not allow cables extending from unit to come into contact with rotating machinery, as serious damage to the equipment, or severe personal injury or death may occur as a result.
10. This instrument may not be safe for use in certain hazardous environments, and serious personal injury or death could occur as a result of improper use. Please refer to your facility's safety program for proper precautions.

Display

LCD display with 6 numeric 0.506 inch [12.85 mm] high digits and 5 alphanumeric 0.282 inch [7.17 mm] high digits

Indicators

Battery level

Knob Adjustment

Digital Rotary switch with 36 detents per revolution; velocity sensitive

Input Power

Battery powered: Internal Rechargeable Batteries 6 Vdc

Light Output

Average: 3000 Lumens @6000 FPM 12" from lens
Adjustable 0.5 to 3000 microseconds or 0.2 to 14 degrees of rotation (auto adjust with flash rate)

Flash Duration

12 hours typical at 6000 FPM, and 2.8° pulse width with fully charged batteries

Run Time

4-5 hours typical with supplied recharger

Charge Time

1.875 lbs [0.8505 kg] including batteries

Weight

Safety

This product is designed to be safe for indoor use under the following conditions (per IEC61010-1).

Operating Temperature

32-104 °F [0-40 °C]
Humidity
Maximum relative humidity 80% for temperature up to 88 °F [31 °C] decreasing linearly to 50% relative humidity at 104 °F [40 °C]

This product is CE certified and ROHS compatible.
Manufactured in an ISO9001 facility.

For troubleshooting information and technical support visit
www.monarchinstrument.com.

When charging, the strobe will indicate *CHARGE* in the bottom of the display. The recharger will fast charge the batteries for about 4-5 hours and then trickle charge the batteries.

Allow the recharger to charge the batteries until the display shows *DONE* for peak battery life performance. If the batteries are not charged to 100% regularly, the batteries will lose capacity.

5.3 Stroboscope Disposal



Prior to disposing of the battery-powered strobe, the user must remove the Nickel-Metal Hydride batteries. To do this, remove the LED assembly first. This will expose four (4) screws that must be removed so the reflector housing can be dismantled. There are four (4) additional screws in the case half opposite the input and output jacks that must be removed. The case halves can now be separated, exposing the batteries. Remove the cables from the batteries and place tape over the battery terminals to prevent them from shorting. The batteries should be sent to a recycling center or returned to the factory. The rest of the parts may now be disposed of.

6.0 SPECIFICATIONS

Flash Range	30 - 500,000 FPM (Flashes Per Minute), 0.5 to 8333.33 Hz
Flash Rate Accuracy	0.004% of setting or $\pm$ last digit
Flash Rate Resolution	0.01 to 1 FPM (menu selectable), 0.1 FPM resolution above 9,999.99 FPM, 1 FPM resolution above 99,999.9
Display Update Rate	Instantaneous
Time Base	Ultra Stable Crystal Oscillator

11. Nova-Strobe LED units contain Nickel Metal Hydride batteries which must be disposed of in accordance with Federal, State, & Local Regulations. Do not incinerate. Batteries should be shipped to a reclamation facility for recovery of the metal and plastic components as the proper method of waste management. Contact distributor for appropriate product return procedures.



In order to comply with EU Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE): This product may contain material which could be hazardous to human health and the environment. DO NOT DISPOSE of this product as unsorted municipal waste. This product needs to be RECYCLED in accordance with local regulations, contact your local authorities for more information. This product may be returnable to your distributor for recycling - contact the distributor for details.

Monarch Instrument's Limited Warranty applies. See www.monarchinstrument.com for details.

Warranty Registration and Extended Warranty coverage available online at www.monarchinstrument.com.

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The enclosure contains control electronics to properly and safely charge the batteries. Never remove the batteries from the enclosure and attempt to charge externally. **Always use the recharger supplied (PSC-2U).**

5.1 Low Battery Indication

When the batteries are charged, there will be no battery icon indication. When the batteries are low, the Low Battery icon will blink in the display. The strobe may still be used for a short time.

Low Battery Icon =  Outline blinking (very little time left)

The strobe has a protection feature that prevents the strobe from operating if the battery voltage is too low. **This condition is indicated by no flash and the display shows “LO BAT”.** At this time the batteries must be recharged. Remember to release the trigger switch.

5.2 Charging the Batteries

The unit may be recharged at any time. You do not need to wait until the low battery condition is indicated.

To charge the strobe with the recharger:

1. Release the trigger so the strobe is off.
2. Plug the recharger cable into the recharger socket (located below the display panel behind the handle).
3. Plug the recharger into an AC mains wall outlet (115/230 Vac).

CAUTION: Use of rechargers other than the one supplied (PSC-2U) will damage the stroboscope and void the warranty.

When the recharger plug is inserted into the recharger jack, the strobe will go into the Charging Mode. Make sure the trigger switch is not depressed. The BBL strobe will not do anything else when charging (e.g. it will not flash and the buttons have no function).

image you encounter, call this speed “A”. Continue decreasing the flash rate until you encounter a second SINGLE image. Note this speed as “B”. Continue decreasing the speed until you reach a third SINGLE image at speed “C”.

For a two point calculation the actual speed is given by:

$$\text{RPM} = AB/(A-B)$$

For a three point calculation:

$$\text{RPM} = 2XY(X+Y)/(X-Y)^2 \text{ where} \\ X = (A-B) \text{ and } Y = (B-C)$$

In instances when you can shut down the device and install a piece of reflective tape, then an optical tachometer is easier to use for RPM measurement. **Stroboscopes must be used when you can't shut down the device.** The human eye is not easily tricked into seeing a stopped image by a stroboscope when the flash rate is slower than 300 FPM. Therefore, stroboscopes are just about impossible to use below 300 FPM for inspection or to measure RPM.

5.0 BATTERIES

The Nova-Strobe LED is fitted with rechargeable NiMH (Nickel Metal Hydride) batteries. These batteries contain fewer toxic metals than NiCd (Nickel Cadmium) and are currently classified “environmentally friendly”. They also have 30% more capacity than NiCd batteries of the same size.

Like NiCds, NiMH **batteries are prone to self-discharge** - 10 to 15% of charge is lost in the first 24 hours then continues at a rate of 0.5 to 1% per day. For maximum performance, charge the batteries just prior to use.

When not in use, the batteries should be charged at least every three months, otherwise the battery capacity will be reduced or the batteries may become unusable.

Charge the batteries before use and allow 3-5 cycles of charging and discharging for batteries to reach full capacity.

1.0 OVERVIEW

The Nova-Strobe Basic BBL LED (Light Emitting Diode) is a rugged portable battery powered LED Stroboscopes used for inspection and to stop motion to determine the speed of rotating objects. The unit has a pistol grip with lockable trigger switch and wrist strap for comfortable hand held operation or it may be mounted on a tripod using the integral ¼ -20 UNC thread at the base of the handle.

The Basic LED Strobe has a two line backlit alpha-numeric liquid crystal display (LCD) and a 4 key keypad that enables the user to control the operation of the unit. Most of the icons in the LCD display are not used.



Figure 1 LED Strobe Control Panel

1.1 Brightness

GLOSSARY:

LED – Light Emitting Diode

msec – millisecond = 1/1,000 of a second

µsec – microsecond = 1/1,000,000 of a second

° = degree. One rotation = 360°

The strobe's brightness depends on how wide the LED flash pulse is; the wider the pulse, the brighter the visual output from the LEDs. Since the strobe is primarily used on reciprocating or rotating targets there is a downside to the wider flashes. All strobes work by giving short bursts of light (the pulse width) at a rapid repetition rate (the flash rate).

Strobes rely on the persistence of the human eye (the ability to remember and image) and its response to bright light to give an apparent stop motion image. Imagine a shaft rotating at 6000 RPM or one rotation every 1/100 of a second (10 msec). If the strobe flashes once every 10 msec for a brief moment, the user sees the flash at the same spot in the rotation of the shaft and the persistence of the eye remembers this until the next flash making the shaft appeared to be stopped. As the target is rotating there is some movement evident during the strobe flash. The longer the flash duration, the more obvious the rotation is and this increases the blur.

This blur can be calculated – if the shaft takes 10 msec to complete one revolution and the strobe flash duration is 100 µsec (1/100 of a millisecond), the shaft will turn:

$(\text{flash duration/time per rotation}) \times 360^\circ$, which is $(.0001/.01) \times 360 = 3.6^\circ$.

So you will see the shaft move 3.6° . As the flash pulse widens you will see greater degrees of rotation which results in more blur and a brighter perceived illumination (the LEDs are on longer so the average light the eyes see is greater). The trade-off is blur versus brightness. One also has to take into account tangential velocity (rotational speed) – the further away the rotating point is from the center axis the faster the tangential velocity and the worse the blur appears to be – it is always the same number of degrees of rotation but the physical length of the blur gets bigger as the point moves faster. The strobe adjusts the width of the pulse automatically to keep the degree of rotation visible constant.

There are two methods of adjusting the flash pulse width and hence the brightness and consequently the blur.

viewed is perfectly symmetrical, then the user needs to mark the object with a piece of tape or paint in a single location to be used as a reference point. Look only at the reference point.

If the speed of rotation is within the range of the stroboscope, start at a higher flash rate and adjust the flash rate down. At some point you will stop the motion with only a single reference point of the object in view. Note that at a flash rate twice the actual speed of the image you will see two images (reference points). As you approach the correct speed you may see three, four or more images at harmonics of the actual speed. The first SINGLE image you see is the true speed. To confirm the true speed, note the reading and adjust the stroboscope to exactly half this reading, or just press the $\div 2$ button. You should again see a single image (which may be phase shifted with respect to the first image seen).

For example, when viewing a shaft with a single key way you will see one stationary image of the key way at the actual speed and at 1/2, 1/3, 1/4, etc, of the actual speed. You will see 2 images of the key way at 2 times the actual speed, 3 key way at 3 times, etc. The FPM equals the shafts Revolutions Per Minute (RPM) at the highest flash rate that gives only one stationary image of the key way.

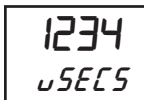


Example: Object rotating at 3000 RPM

If the speed is outside the full scale range of the stroboscope (500,000 FPM), it can be measured using the method of harmonics and multipoint calculation. Start at the highest flash rate and adjust the flash rate down. You will encounter multiple images so be aware of these. Note the flash rate of the first SINGLE

3.2.2 Flash Duration - Microseconds

To view or adjust the flash duration in microseconds press the **BRIGHT** button again after viewing degrees or press the **BRIGHT** button twice from normal operation. The display will show the current flash duration in microseconds (uSECS) – this may be calculated from phase degrees set above. Use the knob to increase or decrease the flash duration in microseconds. Adjusting the microseconds will cause this to be the controlling parameter for pulse width. As the flash rate increases or decreases the strobe will keep the flash duration at the preset width in microseconds provided this does not exceed the strobe specifications. Press the **BRIGHT** button to exit the flash duration adjustment.



3.3 Display Units

The display can show the flash rate in revolutions per minute (RPM) or per second (RPS or Hertz). To switch between display modes press the **DISP** button shown right. The display units will toggle at each press (RPM < > RPS).



4.0 USING THE STROBOSCOPE TO MEASURE RPM

The primary use for a stroboscope is to stop motion for diagnostic inspection purposes. However the stroboscope can be used to measure speed (in RPM / RPS). In order to do this several factors need to be considered. First, the object being measured should be visible for all 360° of rotation (e.g. The end of a shaft). Second, the object should have some unique part on it, like a bolt, key way or imperfection to use as a reference point. If the object being

1.1.1 Degree of Rotation Adjustment

The first method is to adjust the flash pulse width for degree of rotation visible (blur). The user can set this from 0.2 to 14 degrees out of 360. The higher the setting the brighter the strobe appears to be but the more blurred the target is. Optimal setting to stop motion is 1.8 to 3.6°. The number of degrees is a proportional amount and remains constant as the flash rate increases or decreases. The strobe automatically calculates how wide the pulse width should be at different flash rates to keep the blur constant – the faster the flash rate the narrower the pulse width. The pulse width equals: (setting in degrees/360) x (1/flash rate in Hz).

Thus the blur remains constant no matter what the flash rate*.

1.1.2 Pulse Duration Adjustment

The second method is to adjust the flash pulse width to a fixed number of microseconds. Here the user sets the flash pulse width in microseconds not degrees. As the flash rate increases the pulse width stays the same and the image will get brighter and more blurred as the flash width remains constant*. The degree of rotation visible changes to keep the pulse width of the flash constant*.

***Note:** There are two limits maintained by the strobe – the pulse can never be greater than 3000 µs nor can it exceed 14° of rotation. The strobe automatically adjusts these values as the flash rate is increased or decreased to maintain these limits at all times. For example - at a flash rate of 600 flashes per minute 14° of blur represents a flash pulse width of 3800 µsec. The Strobe will limit this value to 3000 µsec or 10.8° of rotation (blur).

2.0 PREPARATION FOR USE

The Stroboscope may be hand held or mounted on a tripod or other user supplied bracket using the ¼-20 UNC bushing at the base of the handle.

The LED Strobe is battery powered and has internal rechargeable batteries. The unit should be charged before use (see section 5.0). The actual operating time of the stroboscope depends on the flash pulse width. Narrower flash widths increase the operating time. Note that the BBL strobe will not operate from the recharger supplied with the unit.

To turn on the stroboscope, depress and hold the trigger. The trigger may be locked in position using the side locking button. To lock the stroboscope on, depress the trigger as far as it will go and then press the locking button. Once the locking button is set you may release the trigger and the trigger will be held in place. To unlock the stroboscope, simply depress the trigger and then release.

NOTE: Unit must power down completely (OFF will be displayed and then disappear) before unit will power on again. This is normal operation. Wait 2 seconds before turning the unit back on again.

3.0 LED STROBE OPERATION

3.1 Adjusting the Flash Rate - RPM

The flash rate can be adjusted by turning the knob on the side of the unit – counter clockwise to increase the flash rate and clockwise to decrease the flash rate. The knob is rate sensitive, the faster you turn the knob the greater the change in flash rate. The smallest adjustment is to add or subtract one from the least significant (right most) digit on the display.



3.1.1 Multiply or Divide By 2

The strobe flash rate can be instantly doubled (x2) or halved ($\div 2$) by pressing the **x2** and **$\div 2$** buttons shown right. This is useful in determining actual rotational speed. Refer to the section on speed measurement – Section 4.0. Note that if doubling or halving the flash rate will cause the strobe to exceed its capability, the display will show OVER or UNDER respectively and the flash rate will remain at the current flash value.

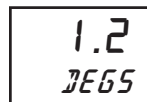


3.2 Adjusting the Flash Duration (Brightness)

The flash duration, the width of the LED flash, can be adjusted by the user to be a preset number of degrees of rotation (DEGS) or a fixed with in microseconds (uSEC). The result is a more or less bright image at the expense of less or more image blur. Read the section on Brightness - Section 1.1.

3.2.1 Flash Duration - Degrees

To view or adjust the flash duration press the **BRIGHT** button shown on the right. The display will show the current flash duration in degrees of rotation – note that there are 360° in a complete rotation. The degrees shown is the amount of rotation visible during the flash. The higher the degrees the brighter the image and the more apparent the blur. Use the knob to increase or decrease the flash duration in degrees of rotation.



Adjusting the degrees will cause this to be the controlling parameter for pulse width. As the flash rate increases or decreases the strobe will adjust the flash duration to keep it at the preset number of degrees provided this does not exceed the strobe specifications. Press any key other than **BRIGHT** to exit or press **BRIGHT** again to go to MICROSECOND adjustment.