MONARCH INSTRUMENT

Instruction Manual

Nova-Strobe BBL

Basic Battery LED Stroboscope

CE BC

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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 no touch the target.
7. 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.
8. 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.
9. 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.
10. Nova-Strobe LED units contains 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.
11. This instrument is not user serviceable. For technical assistance, contact the sales organization from which you purchased the product or Monarch Instrument directly.

In order to comply with EU Directive 2012/19/EU 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.

TABLE OF CONTENTS

1.0 OVERVIEW

The Nova-Strobe Basic BBL LED (Light Emitting Diode) is a rugged industrial stroboscope that provides extremely bright, uniform light output for performing stop motion diagnostic inspection and RPM measurement. The unit has a pistol grip with lockable trigger switch and wrist strap for comfortable handheld operation or it may be mounted on a tripod using the integral ¼ -20 UNC thread at the base of the handle.

Figure 1 LED Strobe Control Panel

1.1 LED Strobe Control Panel

The Basic LED Strobe has a two-line alphanumeric 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 are not used.

2.0 GETTING STARTED

The BBL is battery powered and has internal rechargeable batteries. The unit should be charged before use (see section 6.0). 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: The 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.

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.

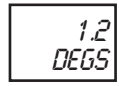
3.1.1 Multiply or Divide By 2

The strobe flash rate can be instantly doubled (x2) or halved (÷2) by pressing the **x2** and **÷2** buttons (shown right). This is useful in determining actual rotational speed. Refer to section 4.0 on speed measurement for more information. 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)

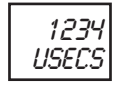
The flash duration (the width of the LED flash) can be adjusted by the user to be a preset number of degrees of rotation (DEGS) or a fixed number with in microseconds (uSEC). The result is a more or less bright image at the expense of less or more image blur. Read section 4.0 on Brightness for more detail.

3.2.1 Flash Duration - Degrees



To view or adjust the flash duration, press the **BRIGHT** button (shown 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.

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**lay button (shown right). The display units will toggle at each press (RPM < > RPS).

4.0 BRIGHTNESS

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 an 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.

4.1 Calculating Blur

Blur can be calculated. For example, 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:

(flash duration/time per rotation) x 360°, which is (.0001/.01) x 360 = 3.6°

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.

4.2 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 target is more blurred. 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*.

4.3 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*.

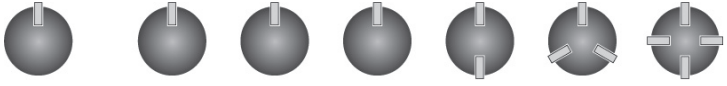
***Note:** There are two limits maintained by the strobe – the pulse can never be greater than 3000 µs nor can it exceed 14° of rotation. The strobe automatically adjusts these values as the flash rate is increased or decreased to maintain these limits at all times. For example - at a flash rate of 600 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).

5.0 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, keyway or imperfection to use as a reference point. If the object being 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 **÷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 keyway you will see one stationary image of the keyway at the actual speed and at 1/2, 1/3, 1/4, etc, of the actual speed. You will see 2 images of the keyway at 2 times the actual speed, 3 images 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 keyway.



Example: Object rating @ 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. Be aware that you will encounter multiple images. Note the flash rate of the first SINGLE image you encounter and call this speed "A". Continue decreasing the flash rate until you encounter a second SINGLE image and 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:

$$RPM = AB/(A-B)$$

For a three-point calculation:

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

$$X = (A-B) \text{ and } Y = (B-C)$$

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.

6.0 BATTERIES

Nova-Strobe LEDs are 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, meaning 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.

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).**

6.1 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 means 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.

6.2 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 V ac).

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).

When charging, the strobe will indicate CHRGE 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.

6.3 Stroboscope Disposal

Prior to disposing of the battery-powered strobe, the user must remove the nickel metal hydride batteries. To do this, first remove the LED assembly. 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.

7.0 SPECIFICATIONS

Specifications*	BBL Basic Battery LED Stroboscope
Flash Range	30-500,000 (FPM), 0.5 to 8333.33 Hz
Flash Rate Accuracy	0.01% of setting or ± 1 last digit
Flash Rate Resolution	0.01 to 1 FPM, 0.1 FPM resolution above 9,999.99 FPM, 1 FPM resolution above 99,999.9
Display Update Rate	Instantaneous
Light Source	12 LED array
Light Output	Average: 3000 lumens @ 6000 FPM 12 in. from lens
Flash Duration	Adjustable 0.5 to 3000 µs or 0.2 to 14 degrees of rotation (auto adjust with flash rate)
Display	LCD with 6 numeric 0.506 in. [12.85 mm] high digits and 5 alphanumeric 0.282 in. [7.17 mm] high digits
Indicators	Battery level
Knob Adjustment	Digital rotary switch with 36 detents per revolution; velocity sensitive
Time Base	Ultra-stable crystal oscillator
Power Supply	Internal NiMH rechargeable batteries with 115/230 V ac 50/60 Hz recharger
Run Time	12 hours typical @ 6000 FPM and 2.8° pulse width with fully charged batteries
Charge Time	4-5 hours typical with supplied recharger
Weight	1.9 lbs. (860 g)

Dimensions (LxWxH)	Body: 9 in. x 3.66 in. x 3.56 in. [229 mm x 93 mm x 90 mm]; Reflector Housing: 4.8 in. [122 mm] dia.; Handle: 4.254 in. [108 mm long]
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)
Compliance	CE compliant. Low Voltage Directive (LVD) 2014/35/EU Electromagnetic Compatibility Directive (EMC) 2014/30/EU Restriction of Hazardous Substances (RoHS) Directive 2011/65/EU
Energy Efficiency BC	Nova-Strobe BBL units with Firmware Revision 0.95 and higher are compliant with the U.S. Department of Energy's energy conservation standards specified in the Code of Federal Regulations 10 CFR 430.32(z) and are registered in the DoE CCMS database.

***Specifications are subject to change without notice.**

8.0 ACCESSORIES

For a complete list of accessories, see webpage.

Carrying Case CC-7	PN: 6280-038	Latching carrying case with provisions for accessories (included in BBL Kit)
Rubber Boot	PN: 6280-048	Protective boot covering reflector housing
Splash-Proof Cover	PN: 6280-041	Protective cover for all Nova-Strobe models

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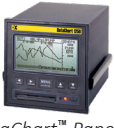

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