MONARCH INSTRUMENT

Instruction Manual

Nova-Strobe DBL and Nova-Strobe PBL

Deluxe and Phaser LED Stroboscopes

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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 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.
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 Deluxe DBL and Phaser PBL LED (Light Emitting Diode) are rugged industrial stroboscopes that provide extremely bright, uniform light output for performing stop motion diagnostic inspection and RPM measurement. The units have a pistol grip with lockable trigger switch and wrist strap for comfortable handheld operation or they may be mounted on a tripod using the integral ¼-20 UNC thread at the base of the handle. Although the DBL and PBL are similar, the PBL has the ability to phase shift the image with respect to an external signal and can animate the image in slow-motion rotation for inspection purposes. In addition, the PBL can run continuously from an external power supply.

1.1 LED Strobe Control Panel

The Deluxe and Phaser LED Strobes have a two-line backlit alphanumeric liquid crystal display (LCD) and a 12-key keypad enables the user to enter data and control the operation of the unit. The buttons have dual functions – the primary function is shown in black print on the blue background (the top half) of the button. The secondary function is as a numeric keypad and the numerics are shown against a white background (the bottom half) of the key – 0 to 9, period and ENTER. The LCD has several icons which will be explained later in this manual.

Figure 1 LED Strobe Control Panel

1.2 Modes of Operation

The stroboscope has two basic modes of operation – INTERNAL and EXTERNAL.

1.2.1 Internal Mode

The strobe is in the Internal Mode when nothing is plugged into the input jack or when manually set using the **INPUT** key. In the Internal Mode, the strobe generates its own timing signals and the users can enter the flash rate using several different methods – see Section 3.1.

1.2.2 External Mode

In the External Input Mode, the user can't make any flash rate adjustments with the knob. The flash rate is a function of the input signal. This mode is used to synchronize the flash to an external event (for example, from an optical sensor) to stop or freeze motion. The flash will be triggered on the rising or falling edge (menu selectable) of the external input pulse. The strobe is in the External Input Mode whenever there is a plug in the input jack. When the strobe is in the External Input Mode, **EXT** will be displayed.

When an external input is applied to the unit and the strobe is put in the Tachometer Mode, the unit will read the signal from the external input (sensor) and display the reading on the LCD without flashing the lamp. **The strobe will not flash in the Tach (Tachometer) Mode.**

1.2.3 Charging Mode

The strobe is in Charging Mode when the battery recharger plugged into it. The strobe will continuously display the state of the battery charge while being recharged.

2.0 GETTING STARTED

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

2.1 Power

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 DBL strobe will not operate from the recharger supplied with the unit.** The PBL will run continuously from the supplied AC-powered charger (PSC-pbxU).

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.

2.2 Input/Output Connections

On the left side of the strobe are the input and output jacks. These can be used for external triggering or synchronization (daisy-chaining two or more strobes). These jacks accept 1/8" [3.5 mm] phone plugs (input - stereo, output - mono). The input and output signals are TTL compatible. See Figures 2 and 3 for connector connection detail.

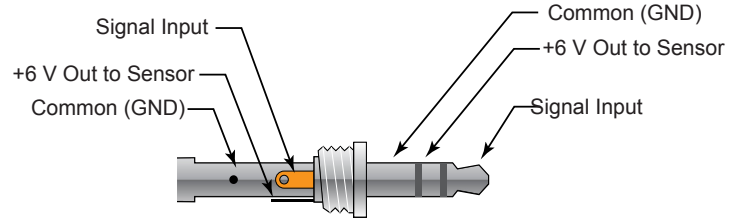


Figure 2 Input Connector Detail (stereo plug)

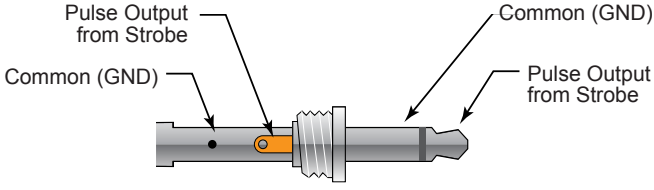


Figure 3 Output Connector Detail (mono plug)

The input jack (▲ pointing into socket) enables an external signal to trigger the strobe. Inserting a plug into the input jack will automatically put the strobe into the External Mode. The INPUT button can be used to toggle between External Input Mode and Internal Mode. When the plug is removed, the strobe will be put back into the Internal Mode. The polarity of the input pulse can be set in the MENU options. In the External Mode, the knob cannot be used to change the flash rate.

With no external input, the output jack (▼ pointing away from socket) provides a TTL-compatible pulse from the strobe's internal oscillator. If an external input is applied, the output pulse is in sync with the input pulse. This output pulse may be used to synchronously trigger a second stroboscope to illuminate larger areas. Many strobes can be "daisy chained". The output jack of one strobe is connected to the input

jack of the next strobe causing all the strobes to flash together and be controlled by the first strobe in the chain. The polarity of the output pulse can be set in the MENU options.

3.0 LED STROBE OPERATION

3.1 Adjusting the Flash Rate - RPM

There are several ways to adjust the flash rate of the strobe:

3.1.1 Using the Knob

The flash rate can be adjusted by turning the knob on the side of the unit – counterclockwise 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.

3.1.2 Using the Keypad

It is possible to enter the required flash rate as a number by entering the value using the keypad as you would a calculator. Press the **NUM**ber key (shown right) followed by the numeric keys representing the flash rate (e.g. 1234), using the secondary key functions – numbers 0 to 9 and the period, then press the **ENTER** button.

Note: The system will round the display to the nearest least significant digit displayed. If the display has no decimal places and you enter 1234.6, the display will show 1235 and the strobe will flash at 1234.6 flashes per minute.

3.1.3 Decade Adjustment

The flash rate can be adjusted in decade steps (e.g. 1, 10, 100 etc.) by pressing the ▶ button (shown right). This will start a digit on the display blinking. If the knob is turned, this digit will increment or decrement with rollover and roll under features.

Each time the ▶ button is pressed, the blinking digit moves one position to the right and the decade decreases by 10 until the digits stop blinking. Pressing the ▶ button again will cause the left most digit to start blinking.

To exit the decade adjustment mode while a digit is blinking, press any key other than the ▶ button.

3.1.4 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 the Section 4.0 on speed measurement. 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.

3.1.5 Fixed Increment N Adjustment

The strobe flash rate can be incremented or decremented in fixed increments. To do this, adjust the flash rate to the required adjustment value, say 300, which we will refer to as N. Then press the **±N** button (shown right). (Note: – N is the displayed value at the time the button is pressed). The display will show **ALT** in the bottom left-hand corner which indicates the knob is in the ALTernate function mode. Turning the knob counterclockwise will increase the flash rate by N (300 in this example) for each click

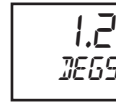
or turning it clockwise will decrease the flash rate by N. It is not possible to decrement the flash rate below 30 FPM.

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 5.0.

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).

3.4 Tachometer Mode

The stroboscope can be used as a programmable pulse generator or as a tachometer by pressing the **TACH** button (shown right). When an external input is supplied to the unit and the strobe is put in Tachometer Mode, the unit will read the signal from the external input (sensor) and display the reading on the LCD without flashing the lamp. The TACH icon will show on the display. There is also an ON-TARGET INDICATOR which illuminates when a valid external signal is received.

If there is no external input and the **TACH** button is pressed, the strobe will stop flashing but will still output a pulse at the rate indicated on the display. This rate may be adjusted as described in Section 3.1.

To exit the Tachometer Mode, press the **TACH** button again.

3.5 Mode Selection

The **INPUT** button (shown right) toggles between the Internal and External Modes as described in Section 1.2. When in the External Mode, the display will show EXT and the stroboscope will only flash with an external input. Plugging in an external source will cause the unit to automatically switch to the External Mode. Removing an external source while in the External Mode will cause the unit to switch to the Internal Mode.

3.6 Memory

The Stroboscope has the ability to save and recall up to 5 values. This is done by pressing the **MEM**ory button (shown right). The first time the button is pressed, the display will show READ; if pressed again, it will show SAVE. If the knob is turned while READ or SAVE is displayed, the display will cycle through memory locations 1 to 5, indicated as RM1 to RM5 where RM is Recall Memory or SM1 to SM5 where SM is Save Memory. To actually SAVE or READ the selected memory location, press the **MEM** button again. The ENTER button works as well. The display will show DONE. Note that the value saved will be the current flash rate prior to pressing the **MEM** button the first time.

3.7 Phase Delay

The **DELAY** button adjusts the phase shift of the flash with respect to time. There are two modes: Internal and External (PBL model only).

3.7.1 Internal Phase Delay

This is also referred to as jog. Once the flash rate has been adjusted to give a stop motion image, the PHASE **DELAY** button may be used to increase or decrease the phase of the image with respect

to its original position. Use the PHASE **DELAY** button to bring a reference mark, such as a keyway, into your line of sight.

To adjust the phase or jog the image, press the **DELAY** button. PHASE will be displayed on the bottom line of the LCD and the current flash rate will be displayed on the top line. Turning the knob adjusts the phase of the "stopped" image. It is a relative adjustment. Press the **DELAY** button again to exit this mode.

3.7.2 External Delay (PBL Model ONLY)

The **DELAY** button has no function in External Mode on the DBL stroboscope.

On the PBL, there are three **External Delay Modes**: **Phase Delay**, **Time Delay**, and **Auto (Virtual RPM)**. These modes are only active if an external trigger source is plugged into the unit. The **EXT**ernal icon must appear on the display.

Pressing the **DELAY** button cycles through the following modes:

In the **External Phase Delay** mode, the flash is delayed 0.1 to 359.9 degrees after each external trigger pulse. The display will show the delay in degrees on the top line and will indicate PHASE on the lower line. The knob adjusts the amount of delay in degrees, counterclockwise to increase and clockwise to decrease.

In the **External Time Delay** mode, the flash is delayed 0.01 to 1000 msec after each external trigger pulse. The display will show the **TIME** icon; the delay in milliseconds on the top line and will indicate MSECS on the lower line. The knob adjusts the amount of delay in milliseconds, counterclockwise to increase and clockwise to decrease.

In the **Auto (Virtual RPM)** mode, the flash is automatically delayed in increasing amounts after the external trigger pulse so that the image appears to rotate at a slow (virtual) speed, RPM. The display will show the **AUTO** icon; the virtual speed in RPM on the top line and will indicate V'RPM (Virtual RPM) on the lower line. The knob adjusts the virtual speed in RPM, counterclockwise to increase and clockwise to decrease.

4.0 MENU

The **MENU** button allows settings of basic setup options – displayed decimal places, backlight on or off, positive or negative edge for input and output signal and blanking. The menu is entered by pressing the **MENU** button and using the knob to scroll through the menu options as described below. The top display line shows SEtUP. To select a menu option, press the **MENU** button again.

4.1 Decimal Places

This option allows the user to set the number of decimal places shown on the display for numeric. After pressing the **MENU** button rotate the knob until the display bottom line shows DECPT and press the **MENU** button again. The top line of the display will show the number of decimal places (2, 1, none) selected by rotating the knob. Press the **MENU** button to select, then any other key to exit. The display will show DONE and return to the normal readout.

4.2 Backlight

This options enables the display backlight to be turned on or off. After pressing the **MENU** button, rotate the knob until the display bottom line shows BL ITE and press the **MENU** button again. The top line of the display will show YES or no selected by rotating the knob counterclockwise (yes) or clockwise (no). The backlight will turn on and off accordingly. Press the **MENU** button to select, then any other key to exit. The display will show DONE and return to the normal readout.

4.3 Input Pulse Edge

This option sets the input pulse edge that triggers the stroboscope. After pressing the **MENU** button, rotate the knob until the display bottom line shows INPUT and press the **MENU** button again. The top line of the display will show the PoS (for positive edge triggered) or nEG (for negative edge triggered) selected by rotating the knob counterclockwise (PoS) or clockwise (nEg). Press the **MENU** button to select, then any other key to exit. The display will show DONE and return to the normal readout.

4.4 Output Pulse Polarity

This option sets the polarity of the output pulse. After pressing the **MENU** button, rotate the knob until the display bottom line shows OUTPT (Output) and press the **MENU** button again. The top line of the display will show the PoS (for positive edge triggered) or nEG (for negative edge triggered) selected by rotating the knob counterclockwise (PoS) or clockwise (nEg). Press the **MENU** button to select, then any other key to exit. The display will show DONE and return to the normal readout.

4.5 Blanking

The blanking option is used to reject the strobe's own flash when using an external optical sensor and prevent double triggering. After pressing the **MENU** button, rotate the knob until the display bottom line shows BLANK and press the **MENU** button again. The top line of the display will show YES or no selected by rotating the knob counterclockwise (yes) or clockwise (no); yes enables blanking, no disables it. Press the **MENU** button to select, then any other key to exit. The display will show DONE and return to the normal readout.

5.0 STROBE 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 and this increases the blur.

5.1 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.

5.2 Brightness in Degrees of Rotation

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*.

5.3 Brightness in Pulse Duration

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*.

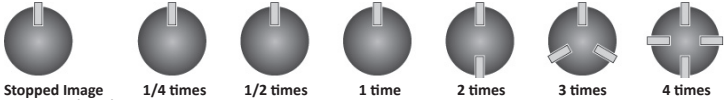
***Note:** There are two limits maintained by the strobe – the pulse can never be greater than 3000 µs nor can it exceed 14° of rotation. The strobe automatically adjusts these values as the flash rate is increased or decreased to maintain these limits at all times. For example, at a flash rate of 600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

6.0 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, such as 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 keyway at 3 times, etc. **The FPM equals the shaft's revolutions per minute (RPM) at the highest flash rate that gives only one stationary image of the keyway.**



Stopped Image Flash Rate (FPM)	1/4 times 1000	1/2 times 1500	1 time 3000 Actual RPM	2 times 6000	3 times 9000	4 times 12000

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. 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:

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

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

If a Remote Optical Sensor or Magnetic Sensor is used to sense one pulse per revolution (External Mode), the readout will display directly in RPM (FPM) without any adjustment required.

In instances when you can shut down the device and install a piece of reflective tape, 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.

7.0 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 for the DBL and PSC-pbxU for the PBL).**

7.1 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.

7.2 Charging the Batteries

The unit may be recharged at any time. There is no 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 ones supplied (PSC-2U for DBL and PSC-pbxU for PBL) 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 DBL 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 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.

7.3 External Power Supply/Charger (PBL only)

The PBL will run continuously from the external power supply/charger (PSC-pbxU) powered by the AC mains (115 – 230 V ac).

To run the PBL from the external power supply/charger (PSC-pbxU):

1. Plug the recharger cable into the recharger socket)located below the display panel, behind the handle).

2. Plug the recharger into an AC mains wall outlet (115/230 V ac).
3. Press the trigger switch to operate as normal. If the trigger switch is not pressed, the strobe will start charging. The batteries ARE NOT charged while the strobe is operational and running off the power supply/charger.

7.4 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.

8.0 SPECIFICATIONS

Specifications*	DBL Deluxe	PBL Phaser
Internal Mode:		
Flash Range	30-500,000 (FPM), 0.5 to 8333.33 Hz	
Flash Rate Accuracy	0.004% of setting or ± 1 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	
Internal Phase Delay	Yes	Yes
External Mode:		
Flash Range	0 - 500,000 FPM, 0.5 to 8333.33 Hz	
Tachometer Mode	5 to 500,000 RPM Accuracy: ±0.001% of reading or ± last digit	
Display Update Rate	0.5 second typical	
Trigger to Flash Display	< 5 µsec	
External Input	TTL Compatible (24 V pk max), 500 nanosec min pulse width, positive or negative edge triggered (menu selectable)	
Phase Delay (degrees)	N/A	0.1 to 359.9
Time Delay (milliseconds)	N/A	0.01 to 1000
Virtual RPM - Slow Motion	N/A	0-200 VRPM

Specifications*	DBL Deluxe	PBL Phaser
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) **Note:** Flash duration is limited to 10 degrees when running PBL continuously from the external power supply/charger (PSC-pbxU) powered by the AC mains (115 - 230 V ac).	
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, On-Target, ALT, TACH, and EXT icons	
Knob Adjustment	Digital rotary switch with 36 detents per revolution; velocity sensitive	
Time Base	Ultra-stable crystal oscillator	
Memory	Last setting before power down is remembered and restored on next power up	
Output Pulse	5 V pulse – positive or negative (menu selectable) one pulse per flash	
Power Supply	Internal NiMH rechargeable batteries with 115/230 V ac 50/60 Hz recharger	Internal NiMH rechargeable batteries with 115/230 V ac 50/60 Hz recharger or continuous using 115/230 V ac 50/60 Hz power supply/ recharger
Run Time	8-10 hours typical @ 1800 FPM	8-10 hours typical @ 1800 FPM w/ batteries or continuous w/ power supply

Specifications*	DBL Deluxe	PBL Phaser
Charge Time	4-5 hours typical with supplied recharger or continuous with power supply	
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)	

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

8.1 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

8.2 Energy Efficiency

BC Nova-Strobe DBL/PBL 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.

9.0 SENSORS, ACCESSORIES, AND REPLACEMENT PARTS

Sensors

RLS-P	PN: 6180-081	Rugged Laser Sensor with removable 3 m cable, M12 connector to 1/8" phone plug connector
ROLS-P	PN: 6180-029	Remote Optical Laser Sensor with 8 ft. [2.5 m] cable
ROS-P	PN: 6180-057	Remote Optical Sensor with 8 ft. [2.5 m] cable
ROS-P-25	PN: 6180-057-25	Remote Optical Sensor with 25 ft. [7.6 m] cable
IRS-P	PN: 6180-020	Infrared Sensor with 8 foot [2.5 m] cable for use without reflective target at 0.5 inch [12 mm] gap
MT-190P	PN: 6180-036	Magnetic Trigger Sensor/Amplifier with 8 ft. [2.5 m] cable

RLS-P
Rugged Laser Sensor
PN: 6180-081

ROLS-P
Remote Optical Laser Sensor
PN: 6180-029

ROS-P
Remote Optical Sensor
PN: 6180-057

IRS-P
Infrared Sensor
PN: 6180-020

MT-190P
Magnetic Sensor with Amplifier
PN: 6180-036

Accessories

Splash-Proof Cover	PN: 6280-041	Splash-proof protective vinyl cover for battery-powered strobes ONLY
Case CC-7	PN: 6280-040	Latching carrying case for strobe with provisions for accessories (included with DBL Kit)
Case CC-12	PN: 6280-049	Deluxe watertight latching carry case for strobe with provisions for accessories (included with PBL Kit)
Input/Output Cable CA-4044-6	PN: 6280-037	6 ft. [1.8 m] input/output cable, 1/8 inch [3.5 mm] male phone plug to male BNC connector
Input/Output Cable CA-4045-6	PN: 6280-038	6 ft. [1.8 m] input/output cable, 1/8 inch [3.5 mm] male phone plug to 1/8 inch [3.5 mm] male phone plug for daisy-chaining strobes together
Rubber Boot	PN: 6280-048	Protective Rubber Boot for all Nova-Strobe X series stroboscopes
T-5 Tape	PN: 6180-070	Reflective Tape 5 ft. [1.5 m] roll, 0.5 in. [12.7 mm] wide

Splash-Proof Cover
PN: 6280-041

Case CC-7
PN: 6280-040

Case CC-12
PN: 6280-049

Input/Output CA-4044-6
PN: 6280-037

Input/Output CA-4045-6
PN: 6280-038

Rubber Boot
PN: 6280-048

T-5 Reflective Tape
PN: 6180-070

Replacement Parts

PSC-2U Universal Recharger	PN: 6280-022	Universal Recharger, 115/230 V ac with USA, UK, AUS, Euro Adapter Plugs for battery operated Nova-Strobes (included with DBL)
PSC-pbxU Supply/ Recharger	PN: 6280-024	Universal Power Supply/Charger, 115/230 V ac with USA, UK, AUSand Euro Adapter Plugs (included with PBL)
Internal NiMH Battery Pack	PN: 6280-046	Rechargeable NiMH battery pack for all Nova Strobe models: BBX, DBX, PBX, VBX, BBL, DBL, and PBL models

Universal Recharger
Model PSC-2U
PN: 6280-022

Power Supply/Recharger
PSC-pbxU 115/230 V ac
PN: 6280-024

Internal Battery Pack
for all Nova-Strobe models
PN: 6280-046

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