



MONARCH INSTRUMENT

Instruction Manual



CE

**Nova-Strobe DA Plus
and
Nova-Strobe DB Plus**
Portable Stroboscopes

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1071-4810-114

15 Columbia Drive
Amherst, NH 03031-2334 USA
Phone: (603) 883-3390
Fax: (603) 886-3300
E-mail: support@monarchinstrument.com
Website: www.monarchinstrument.com



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. Use of this product may induce an epileptic seizure in persons prone to this type of attack.
4. 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.
5. There are lethal voltages present inside this product. Refer to the section on Lamp Replacement before attempting to open this product.
6. 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.
7. 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.
8. Do not direct strobe flash toward certain data collectors, as it may temporarily interrupt data collector operation, and could result in loss of stored data.
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. This product contains sealed lead acid 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.

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This limited warranty does not extend or apply to consumables (including, but not limited to, lamps and batteries, if applicable) or equipment, instruments or accessories which are warranted separately by the original manufacturer of these items.

DECLARATION OF CONFORMITY

As Manufacturer:
Monarch Instrument
Division of Monarch International Inc.
15 Columbia Drive, Amherst NH 03031 USA

declares under Monarch's sole responsibility that the product:

**Name: NovaStrobe - Stroboscope
Models: DA Plus 115/230, DB Plus 115/230**

to which this declaration relates is in conformity with the following standards:

**EMC: EN50082-1:1997
EN50082-2:1995
EN55011:1991 Group 1 Class A (DA Plus)
EN55011:1991 Group 1 Class B (DB Plus)**

and therefore conforms with the requirements of Council Directive 89/336/EEC relating to electromagnetic compatibility. Curtis-Straus Laboratories performed the testing of this product. (DA Plus Report No R-3514N, DB Plus Report No 980555-1)

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17th August 1998 (DB Plus)

5th November 1999 (DA Plus)

Manufacturer (Amherst, NH)

Alan Woolfson, VP Engineering (Authorized Signature)

1.0 OVERVIEW

All descriptions in this manual apply to both the battery powered strobe and AC mains powered strobe except where noted.

The Nova-Strobe is a sophisticated instrument with many features, yet remains simple to operate. Use only the features required for your application. The Strobe's internal microprocessor and digital encoder knob ensures precise settings and measurement. Each Strobe comes with a NIST Traceable Certificate of Calibration.

The Strobe stores and recalls six user programmable flash rate settings and the last used settings in non-volatile memory so that the Strobe "remembers" all the settings when the power is turned off.

1.1 Direct Digital Synthesis

"Direct Digital Synthesis" is the method by which the Strobe's internal microprocessor generates all the signals required to set internal flash rates. In analog stroboscopes, these values are adjusted using a single or multiple turn potentiometer (knob), which generally lack sensitivity and tend to drift with time. It is very difficult to set absolute values on analog stroboscopes.

The digital strobe synthesizes all signals digitally, in small, very precise steps. These signals are derived from a stable crystal oscillator. There is no user calibration or adjustment required to ensure an accurate reading. In the internal flash mode, these steps are as small as 0.1 flashes per minute. Thus absolute values may be dialed in very easily and accurately. The Strobe's adjustment knob is actually a digital encoder that is connected directly to the microprocessor. This knob has 36 definite steps or clicks per revolution allowing very definite adjustment and can be turned continuously. This is equivalent to having a 100 turn potentiometer in an analog unit. Of course you are not expected to turn this knob that many times to get from the slowest flash rate to the fastest flash rate.

1.2 Display Panel

The display panel consists of a backlit liquid crystal display with six alphanumeric digits which indicate modes, flash rates, etc. (see Figure 1). Below the six digits are five small chevrons (∇) which indicate the present mode or value displayed, and are described below:

EXT.	External Mode active
TACH	Tachometer Mode active (strobe won't flash)
ALT	Indicates second function of each button and knob will be used
FPS/HZ	Flashes Per Second is on the display
FPM/RPM	Flashes Per Minute is on the display

The EXT. chevron is on whenever the strobe is in the external mode which is when the unit has an external signal plugged into the external input jack. The TACH chevron is on whenever the tachometer only (no flashing) mode is

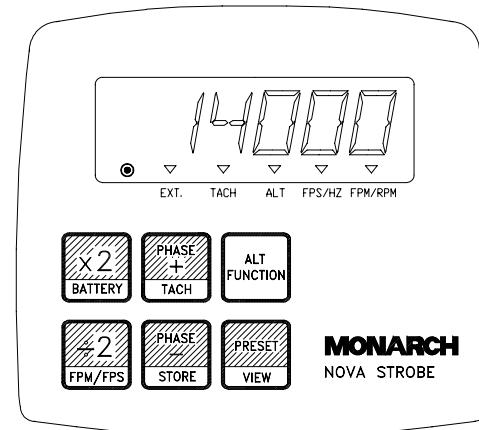


Figure 1 Back Panel

8.0 OPTIONS AND ACCESSORIES

C-4040	Set of mating 1/8 inch (3.5mm) male phone plugs for external input / output
CA-4044-6	6 foot (1.8M) input / output cable, 1/8 inch (3.5mm) male phone plug to male BNC connector
CA-4045-6	6 foot (1.8M) input / output cable, 1/8 inch (3.5mm) male phone plug to 1/8 inch (3.5mm) male phone plug for daisy chaining strobes together
CC-7	Latching carrying case for Strobe with provision for accessories
L-1903	Digital Stroboscope replacement lamp
R-115	Recharger 115 Vac 50/60 Hz (3 hour) for battery operated Nova-Strobes
R-230	Same as above except 230 Vac 50/60 Hz
ROS-5P	Remote Optical Sensor with 8 foot (2.5M) cable for triggering strobe
T-5	Reflective tape. 5 foot (1.5M) roll
MT-190P	Magnetic Sensor with 8 foot (2.5M) cable for triggering strobe
IRS-5P	Infrared Sensor for use without reflective target at 0.5 inch (12mm) gap with 8 foot (2.5M) cable for triggering strobe
SPC-1	Splash proof Protective Cover for Battery Powered Strobe

7.0 SPECIFICATIONS

Internal Mode	30.0 - 14,000.0 FPM (Flashes per Minute) 0.5 - 233.33 FPS (Flashes per Second) ± 0.1 FPM The greater of ± 0.5 FPM or $\pm 0.01\%$ of reading Instantaneous
External Mode	5.0 to 14,000.0 FPM 0.08 to 233.33 FPS External flash rates to 0 are acceptable 1 Second Typical 5.0 to 99999.9 FPM ± 0.1 FPM Resolution 100,000 to 200,000 FPM ± 1 FPM Resolution $\pm 0.01\%$ of reading Accuracy
Time Base	Ultra stable Crystal Oscillator
Light Power	
Average	(Battery Powered) 10W (AC Powered) 15W
Instantaneous (per flash)	220mJoule
Flash Duration	10 - 30 microseconds typical
Memory	6 preset user programmable Flash Rates. 100, 500, 1000, 3600, 7200, 14000 FPM Last settings before power down remembered and restored on next power up.
Knob Adjustment - all ranges and modes	Rotary Switch with 36 detents per rev.
Display	6 digit alphanumeric backlit LCD display. Low Battery Indication (Battery powered only). Individual chevrons for mode display.
Input Power	(Battery powered) Internal Rechargeable Batteries 6VDC. External AC fast charger. (AC powered) 115VAC or 230VAC
Input Pulse Trigger to Flash Delay	20 μ sec min positive pulse, TTL to 24VDC max $< 5 \mu$ sec
Output Pulse	100 μ sec positive pulse, 5VDC typical
Remote Sensor Power Supply	5VDC @50mA
Weight	(Battery powered) 2½ lbs (1.2 kg) including batteries (AC powered) 1½ lbs (0.68 kg)

selected. The ALT chevron toggles whenever the Alt function button is pressed, and when this chevron is on, the buttons will perform their alternate function listed in the white (lower) section of each button. The FPS/HZ chevron is on when the display is displaying Flashes Per Second or Hertz (Hz). The FPM/RPM chevron is on when the display is displaying Flashes Per Minute.

Other icons in the display include the following:

- | | |
|--------|---|
| ◎ | Remote Sensor On Target Indicator |
| ----- | Indicates input frequency exceeds the limit of the stroboscope |
| LO BAT | (Battery Powered Model Only) Flashes on display when the battery is getting low. It is on steady when strobe must be recharged. |

Below the display are six membrane buttons which control the operation of the Stroboscope. The operation of these buttons is explained within section 3.0 Operaton.

2.0 PREPARATION FOR USE

The Strobe 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.

2.1 Power

The AC powered strobe must have its power cord plugged into an AC outlet (115VAC or 230VAC).

The battery powered strobe has internal rechargeable batteries. The unit should be charged before use (see section 6.2). This model can operate continuously in excess of 55 minutes at 6000 flashes per minute from fully charged batteries. The strobe has a protection feature that prevents the strobe from operating if the battery voltage is low. This condition is indicated by no flash and the display shows "LO BAT". At this time the batteries must be recharged. The actual operating time of the stroboscope depends on the flash rate and duty cycle of operation. Slower flash rates increase the operating time.

2.2 Input / Output Connections

The strobe has input and output jacks on the left side of the stroboscope (see Figure 2). These can be used for external triggering or synchronization (daisy chaining two or more strobes). These jacks accept 1/8" (3.5mm) phone plugs (input - stereo, output - mono). The jacks' outer connection (barrel) is common and the inner or center connection is the signal. The input jack also has a middle connection which provides power to an input sensor. The input and output are TTL compatible.

The input jack (▲ pointing into socket) enables an external signal to trigger the strobe. Inserting a plug into the input jack will put the strobe into the External mode. The range for triggering is from 0 flashes per second to 233 flashes

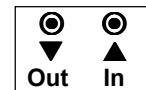


Figure 2 Input/
Output Jacks

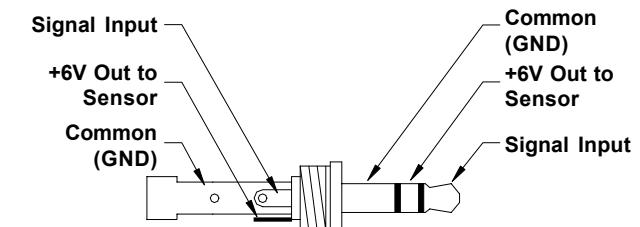


Figure 3 Input Connector Connection Detail

per second (14,000 flashes per minute). The display will only display down to 0.08 FPS (5 FPM). There is typically a 5 μ sec delay from trigger input to flash. The trigger source should provide a pulse with a minimum duration (width) of 20 μ sec.

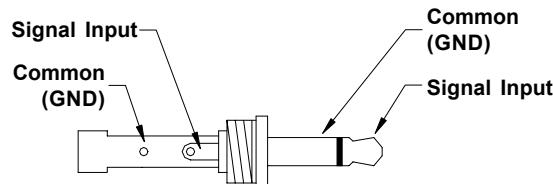


Figure 4 Output Connector Connection Detail

With no external input, the output jack (\blacktriangledown pointing away from socket) provides a TTL compatible pulse from the strobe's internal oscillator. If an external input is applied, the output pulse mimics the input pulse. This output pulse may be used to trigger a second stroboscope synchronously 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.

3.0 OPERATION

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 trigger on, hold the unit in the right hand, depress the trigger as far as it will go, and then use your thumb to press the locking button. You may release the trigger and the trigger will be held in place. To release the trigger lock, simply depress the trigger and then release.

When the strobe is powered up, it will begin flashing immediately. It will remember the last internal flash rate and whether to display in FPM or FPS.

There are three major operating modes for the Strobe. These are Internal, External and Charging (Battery powered model only). In the **Internal Mode**, the knob adjusts the flash rate from 30 to 14,000 Flashes Per Minute (FPM). In the **External Mode**, an external signal from a remote sensor is used to trigger the flash and the knob has no effect. The **Charging Mode** (Battery powered model only) is when the strobe has the battery charger plugged into it. The strobe will continuously display the state of the battery charge while being recharged.

3.1 Internal Mode - Standard Strobe Operation

In the **Internal Mode** the stroboscope generates its own signals and functions like a tunable stroboscope. The strobe is in the Internal Mode when nothing is plugged into the input jack.

With the power on, turn the knob counter clockwise to increase the flash rate and clockwise to decrease the flash rate. The knob is velocity sensitive. Turn the knob slowly to have each "click" equal to 0.1 FPM. Turning the knob more quickly will adjust the FPM by larger steps. When adjusting flash rate, quickly turn the knob (or use the $\times 2$ or $\div 2$ buttons) to coarsely change the FPM. Then slowly turn the knob for fine adjustments. Turn slower still for very fine adjustments.

NOTE: There are maximum and minimum values in each mode, beyond which you cannot adjust. In the Internal Flash mode, the maximum flash rate is 14,000 FPM. If you are adjusting the rate and you reach a value which on the next increment would exceed 14,000 FPM, the display will not increment. The same is true if you try to adjust the flash rate below 30 FPM.

6.0 BATTERY POWERED MODELS ONLY

6.1 Low Battery Indication

When the batteries are low, the display blinks "LO BAT" every second. The strobe may still be used for a short time. When the battery charge is further depleted, the strobe will stop flashing, display "LO BAT" and then completely shut off. When "LO BAT" is displayed the unit needs to be recharged (see below).

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 battery powered 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.

CAUTION: Use of rechargers other than the one supplied (R-115 or R-230) may damage the stroboscope and void the warranty.

The strobe will display the current battery charge percent and the recharger will fast charge the batteries for up to 5 hours (typically 3½ - 4 hours) or until the batteries are about 95% charged.

Once the fast charge is completed, the recharger will trickle charge the batteries (as indicated by all the chevrons on the display coming on), which takes up to 1 hour.

NOTE: The total charge time is typically less than 5½ hours including the fast charge and trickle charge.

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

WARNING: The unit may be left on to charge overnight, but the unit should not be left on charge indefinitely (more than 36 hours) as this will damage the lead acid batteries.

6.3 Battery Disposal

Prior to disposing of the battery powered strobe, the user must remove the sealed lead acid batteries. To do this, remove the lens, reflector and lamp as detailed in the Lamp Replacement section. This will expose 4 screws that must be removed so the reflector housing can be dismantled. There are four 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.

WARNING: Do NOT touch the new lamp with bare fingers.

3. The lamps are polarized and must be put into the socket matching polarity. **Using a lint free cloth, match up the red dot on the plug with the red dot on the socket** and gently rock the lamp back and forth while pushing it into place (see Figure 6). Make sure the lamp is in straight and centered in the reflector hole.

CAUTION: Do NOT allow the reflector to contact the lamp.

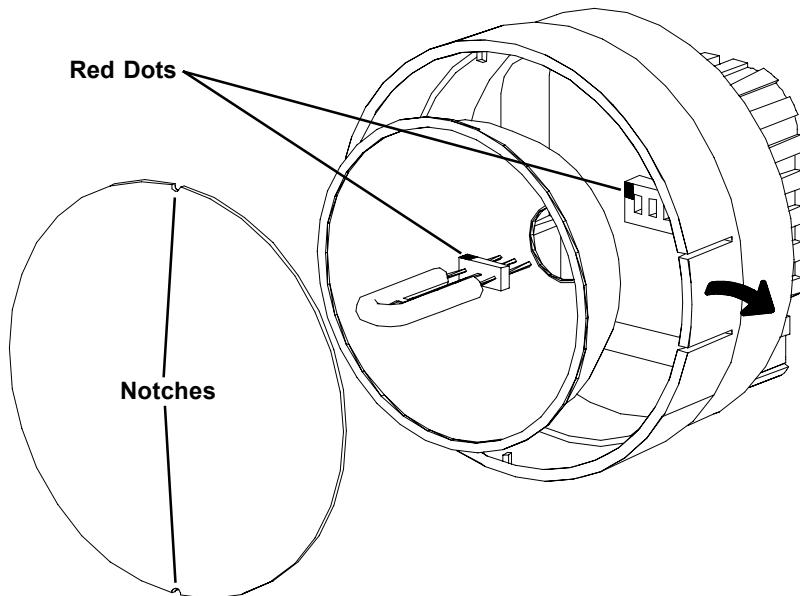


Figure 6 Lamp Replacement

4. Reinstall the reflector and then position the front lens in place matching up the notches on the lens with the two small tabs on the housing to prevent lens rotation (see Figure 6). Push the tabs on the front rim outward and press the lens into place.

5.2 Fuse Replacement

There is a 5 x 20mm fuse inside the unit which may be accessed by removing the lens and reflector (refer to section 5.1). Under normal operating conditions, the fuse should never blow. Examples of abnormal operating conditions would be foreign materials entering the strobe, such as water, ink, etc. If the fuse needs to be replaced, replace only with a fuse of the same type and value:

Battery Powered: Slow Blow - 3.15A fuse (part# 1062-3004-001)

AC Powered: Fast Blow - 750mA fuse (part# 1062-0201-001)

In addition to the knob, there are two buttons on the back panel marked $\times 2$ and $\div 2$. This enables the user to instantly double or halve the reading on the display to the maximum or minimum values allowed. This feature is useful for checking harmonics in the internal flashing mode.

The **Preset** button will cycle through six different preset flash rates. These rates are set at the factory to be: 100, 500, 1000, 3600, 7200 and 14000 FPM. Each time the **Preset** button is pressed, the flash rate and display is changed to the next preset flash rate. The user can change the presets by turning the knob and then pressing the **Store** button. The **Store** button stores the current flash rate into the last preset location the user has viewed.

Once the flash rate has been adjusted to give a stopped motion image, the **Phase +** and **Phase -** buttons may be used to increase or decrease the phase of the image. Press and hold the **Phase +** button to have the image appear to slowing rotate in the direction the object is actually rotating. Press and hold the **Phase -** button to rotate the image in the opposite direction the object is actually rotating. Use the phase buttons to bring a reference mark, such as a key way, into your line of sight. You can then use the **Store** button to store the current flash rate into the last preset location viewed.

3.2 External Mode - External Input Required

The strobe is in the **External Mode** whenever there is a plug in the input jack. The External chevron comes on automatically to indicate this mode.

In the **External Mode** there are no flash rate adjustments the user can make. 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 edge of the external input pulse. The Alt Function mode and chevron is automatically set in this mode, since the primary function of the buttons have no use in this mode.

3.3 Common Features for Both Internal and External Modes

The **Alt Function** button toggles the Alt Function chevron on and off. When the Alt Function chevron is on, the buttons will perform their secondary function listed in the white section of each button. The Alt Function also changes how the tuning knob works.

Below are all the Alternate functions of each button:

The **Battery** button (Battery powered model only) will display the current battery charge level from 0 to 100% for about 2 seconds. When the strobe is not flashing, this number represents the percentage of usable charge left in the batteries. When the strobe is flashing, this number will be lower. It will decrease with increasing flash rates. This gives the user an indication of how much quicker the batteries will be discharged at a given flash rate.

The **Tach** button toggles the Tach chevron on and off. When the chevron is on, the strobe is inhibited from flashing. When using an external sensor or input trigger, the strobe will be in the External Mode. The strobe can be used as a tachometer without having the strobe flash. In the Internal Mode, the strobe can be used as a frequency generator (outputting TTL pulses) without having the strobe flash.

When the **Alt Function** chevron is turned on, the current flash rate is used as an adder. As long as the Alt Function chevron remains on, the knob will add (counter clockwise) or subtract (clockwise) the initial flash rate for each "click" the knob is turned. This in effect allows the

user to multiply the initial flash rate by 2, 3, 4, 5, etc up to the maximum flash rate, which is very helpful on fan blades. Using this feature, one can superimpose the blades on top of each other and check for blade tracking, bent blades, lead and lag tests, etc. For example: with a 3 bladed fan spinning at 3600 RPM and the strobe flashing at 3600 FPM, press the Alt button to turn on the Alt chevron. Now turn the knob clockwise 2 clicks. The strobe is now flashing at 10,800 FPM (effectively 3600 times 3) and the fans blades will be all superimposed on each other. You can now see if the blades are out of alignment, bent, etc. by viewing the blades from the front or from the edge.

The **FPM/FPS** button toggles the display between Flashes Per Minute(FPM) and Flashes Per Second (FPS). The FPM and FPS chevrons on the display indicate how the flash rate is being displayed.

NOTE: The unit automatically converts between FPM and FPS, so you can set the rate in FPM and then view it in FPS by simply pressing the **FPM/FPS** button.

The **Store** button stores the current flash rate into the last preset location the user has viewed.

The **View** button displays the next flash rate preset (one of six). It does **not** change the flash rate. This allows the user to select which preset to write over before storing the current flash rate by pressing the **Store** button.

3.4 Power Up Features

Press and hold one of the buttons listed below, then turn on the strobe by using the trigger switch:

The **Store** button will restore the factory programmed preset flash rates: 100, 500, 1000, 3600, 7200 and 14000 FPM.

The **Alt Function** button will turn on all the display segments for two seconds and then show the software revision, “REV x.x”.

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 also be used to measure speed. 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 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 the highest flash rate and adjust the flash rate down. At some point you will stop the motion with only a single image of the object in view. Note that at a flash rate twice the actual speed of the image you will see two images. 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, 1/4, 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. (see Figure 5). The FPM equals the shaft's Revolutions Per Minute (RPM) at the highest flash rate that gives only one stationary image of the key way.

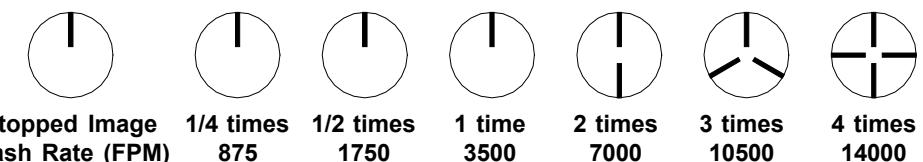


Figure 5 Object Rotating at 3500 RPM

If the speed is outside the full scale range of the stroboscope (14,000 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:

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

For a three point calculation:

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

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

$$Y = (B-C)$$

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, then an optical tachometer is easier to use for RPM measurement. **Stroboscopes should only 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 should not be used below 300 FPM for inspection or to measure RPM.

5.0 LAMP AND FUSE REPLACEMENT

5.1 Lamp Replacement

WARNING: Before attempting to remove the lamp, make sure the stroboscope is turned off and any mains cord is removed from the AC outlet. Allow the lamp to cool waiting at least 1 minute.

The stroboscope is designed to discharge the internal high voltages within 30 seconds. However, caution should be exercised when replacing the lamp.

The lamp can be replaced by using just a pocket screwdriver. **It is not necessary to remove any screws to replace the lamp.** A new spare lamp is supplied with each new DA+ or DB+ Strobe Kit.

To change the lamp:

- Push apart the two tabs on the side of the reflector housing and remove the front lens using a small screwdriver to help pry one tab and lift the lens. Take care not to pry the tab any more than is necessary to free the lens. The reflector is held in place by the front lens and will come loose, but is not necessary to remove the reflector.
- Hold the lamp with a cloth between your forefinger and thumb and rock it back and forth gently while pulling out. **Do not attempt to rotate the lamp.** The lamp is socketed and will come out easily when pulled.