



# MONARCH INSTRUMENT

*Instruction Manual*



## **Nova-Strobe vbx** **Vibration Battery x Strobe**

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Printed in the U.S.A.

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**1071-4220-111R**



## 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 not 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. 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.
9. This product 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.

## CE 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:

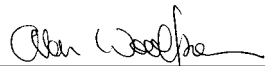
**Name:** Nova-Strobe X Series  
**Models:** bbx, dbx, pbx, vbx

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

**EN61326:1997 EMC /A1:1998/A2:2001/A3:2003 Class A**  
Specifically CISPR 16-1:2003/CISPR 16-2:2003  
**EN55011:1998/A1:1999/A2:2002 EN61000-4-2 EN61000-4-3**  
**EN61010-1:2001-2 Safety Regulation**

and therefore conforms with the requirements of Council Directive 89/336/EEC relating to electromagnetic compatibility and 73/23/EEC relating to the low voltage directive with amendments, when operated in accordance with the user guide. EMC testing of this product was performed by Retlif Testing Laboratories, NH, in February of 2007 (File R-4702N-5).

14<sup>th</sup> February, 2007  
Manufacturer (Amherst,NH)

  
Alan Woolfson, VP Engineering (Authorized Signature)

## 10.0 OPTIONS AND ACCESSORIES

<b>C-4027</b>	Set of mating 1/8 inch (3.5mm) stereo phone plugs (to provide TTL signal and sensor power)
<b>CA-4044-6</b>	6 foot (1.8M) input / output cable, 1/8 inch (3.5mm) male phone plug to male BNC connector
<b>CA-4045-6</b>	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
<b>CA-4046-6</b>	6 foot (1.8M) Accelerometer input cable, 1/8 inch (3.5mm) male phone plug to BNC with BNC union connector
<b>CC-7</b>	Latching carrying case for Strobe with provision for accessories
<b>L-1903</b>	Digital Stroboscope replacement lamp
<b>SPC-1</b>	Splash proof Protective Cover for battery model Stroboscopes ONLY
<b>ROS-P</b>	Remote Optical Sensor with 8 foot (2.5 m) cable for triggering strobe
<b>T-5</b>	Reflective tape. 5 foot (1.5 m) roll, 0.5 inch wide
<b>MT-190P</b>	Magnetic Sensor/Amplifier with 8 foot (2.5 m) cable for triggering strobe
<b>IRS-P</b>	Infrared Sensor for use without reflective target at 0.5 inch (12 mm) gap with 8 foot (2.5 m) cable for triggering strobe
<b>Accelerometer</b>	100 mV/g with 6 foot coiled cable, 1/4" x 28 Tapped Hole

10. This instrument is not user serviceable. For technical assistance, contact the sales organization from which you purchased the product.



**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](http://www.monarchinstrument.com) for details.**  
**Warranty Registration and Extended Warranty coverage available online at [www.monarchinstrument.com](http://www.monarchinstrument.com).**

### TABLE OF CONTENTS

<b>1.0 OVERVIEW .....</b>	<b>1</b>
<b>1.1 Display Panel / Definition of Buttons .....</b>	<b>2</b>
<b>2.0 PREPARATION FOR USE .....</b>	<b>4</b>
<b>2.1 Power .....</b>	<b>4</b>
<b>2.2 Input / Output Connections .....</b>	<b>4</b>
<b>3.0 MENU .....</b>	<b>6</b>
<b>4.0 OPERATION .....</b>	<b>7</b>
<b>4.1 Internal Mode - Standard Strobe Operation .....</b>	<b>8</b>
<b>4.2 Internal Mode - TACH Frequency Generator .....</b>	<b>10</b>
<b>4.3 External Input Mode .....</b>	<b>11</b>

4.4	Tachometer Mode - External Input Required .....	11
4.5	External Delay Modes (Phase Shifting) .....	12
4.6	Lock Modes - Accelerometer Input Required .....	12
4.7	Power Up Features .....	14
5.0	APPLICATIONS .....	15
5.1	Using the Stroboscope to Measure RPM .....	15
5.2	Balancing and Phase Measurement .....	17
5.3	Phase Analysis .....	19
5.4	Motion Studies .....	21
6.0	LIMITATIONS OF REMOTE OPTICAL SENSORS .....	22
7.0	LAMP AND FUSE REPLACEMENT .....	23
7.1	Lamp Replacement .....	23
7.2	Fuse .....	25
8.0	BATTERY AND POWER SUPPLY SPECIFICS .....	25
8.1	Low Battery Indication .....	26
8.2	Charging the Batteries .....	26
8.3	External Power Supply/Recharger .....	27
8.4	Battery Disposal .....	27
9.0	SPECIFICATIONS .....	28
10.0	OPTIONS AND ACCESSORIES .....	30

<b>General:</b>	
<b>Time Base</b>	Ultra Stable Crystal Oscillator
<b>Display</b>	LCD display with 6 numeric 0.506 inch [12.85 mm] high digits and 5 alphanumeric 0.282 inch [7.17 mm] high digits
<b>Indicators</b>	Battery level, On Target, TIME, AUTO, ALT, TACH, LOCK, and EXT icons
<b>Knob Adjustment</b>	Digital Rotary switch with 36 detents per revolution; velocity sensitive
<b>Memory</b>	Last setting before power down is remembered and restored on next power up. 9 user settable flash rates.
<b>Output Pulse</b>	40 $\mu$ sec positive/negative pulse (menu selectable), 3.3 Vdc typical
<b>Input Power</b>	Internal Rechargeable Batteries 6 Vdc, External AC recharger (115 Vac to 230 Vac)
<b>Light Output</b>	<b>Average:</b> 11 Watts at 3000 FPM, >13 Watts above 3450 FPM <b>Instantaneous</b> (per flash): 230 mJoule typical to 3450 FPM
<b>Flash Duration</b>	10-25 microseconds (auto adjust with flash rate)
<b>Flash Tube (Lamp) Life</b>	100 million flashes
<b>Run Time</b>	2 hours typical at 1800 FPM, and over 1 hour at 6000 FPM with fully charged batteries
<b>Charge Time</b>	4-5 hours typical with PSC-pbxU
<b>Weight</b>	1.875 lbs [0.8505 kg] including batteries

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]

**NOTE: Safety thermal feature will set unit into TACH Mode (stops flashing) in the event of internal overheating.**

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

## 9.0 SPECIFICATIONS

### Internal Mode:

<b>Flash Range</b>	30 - 50,000 FPM (Flashes Per Minute)
<b>Flash Rate Accuracy</b>	0.004% of setting or $\pm$ last digit
<b>Flash Rate Resolution</b>	0.01 to 1 FPM (menu selectable), 0.1 FPM max resolution above 9,999.99 FPM
<b>Display Update Rate</b>	Instantaneous

### External Modes:

<b>Flash Range and Display</b>	same as internal mode - External flash rates to 0 are acceptable
<b>Tachometer Measurements</b>	5 to 250,000 RPM Accuracy: $\pm 0.001\%$ of reading or $\pm$ last digit
<b>Display Update Rate</b>	0.5 second typical
<b>Trigger to Flash Delay</b>	5 $\mu$ sec typical
<b>Phase Delay</b>	<b>Phase:</b> 0.1 to 359.9 degrees, <b>Time:</b> 0.01 to 1000 milliseconds, <b>Auto:</b> 0 to 200 VRPM
<b>External Input</b>	TTL Compatible (24V pk max), 500 nanosec min pulse width, Positive or Negative edge triggered (menu selectable)

### Tracking (Accelerometer) Mode:

<b>Flash Range</b>	100 - 50,000 FPM (Flashes Per Minute)
<b>Tachometer Measurements</b>	100 to 50,000 RPM Accuracy: $\pm 1$ RPM
<b>Display Update Rate</b>	0.5 second typical
<b>Trigger to Flash Delay</b>	5 $\mu$ sec typical
<b>Phase Delay</b>	<b>Phase:</b> 0.1 to 359.9 degrees, <b>Time:</b> 0.01 to 1000 milliseconds, <b>Auto:</b> 0 to 200 VRPM
<b>Tracking Filter</b>	Selectable Wide and Narrow Bandwidths. The filter may not lock below 100 FPM
<b>External Input</b>	10 or 100 mV/g accelerometer sensitivity (menu selectable) Positive or Negative edge triggered (menu selectable)
<b>Accelerometer Power</b>	18 Vdc $\pm 10\%$ @ 2mA (menu selectable: on=yes, off=no)

## 1.0 OVERVIEW

The **Nova-Strobe vbx** is a truly portable, battery-operated stroboscope that is suited for a wide range of industrial, institutional, and educational applications, and is able to interface with several of the Vibration Data Collectors that are currently available. Several interface cables are available. Sturdy and compact, the strobe can be operated anywhere in the plant or field to permit visual inspection (freeze motion), phase shift studies, and digital measurement of rotary, reciprocating, or linear motions of various equipment while it is in operation.

The **Nova-Strobe vbx** has a special “tuning” circuit that allows it to track vibration transducer (accelerometer) signals. This capability makes it different from general-purpose strobe lights. It also has a Narrow and Wide Bandwidth filter selection to discriminate fundamentals from harmonics. The Narrow Bandwidth filter limits the influence of harmonics around the selected frequency, providing a more stable phase reading.

The **Nova-Strobe vbx** requires an input signal to synchronize the flash rate with an external source, typically a vibration transducer in the tracking mode or optical pickup in the external mode. This signal is applied, using a special cable, to the Input ( $\blacktriangle$  pointing into socket) jack connector on the side of the strobe light. The **Nova-Strobe vbx** generates a tachometer signal that is on the Output ( $\blacktriangledown$  pointing away from socket) jack. Information about the use of these signals is given in other sections of this manual. Special adapter cables are available to suit several commercially available Vibration Analyzers.

The **Nova-Strobe vbx** is ideally suited for:

1. Balancing
2. Inspection of High Speed Rotating Parts
3. Motion Analyses, or Phase Shift Measurement
4. Over speed Trip Tests
5. Online coupling Inspections
6. RPM/RPS Measurements

- All applications suited to a general purpose, phase shifting stroboscope (**Nova-Strobe pbx**)

The **Nova-Strobe vbx** can also be used as a highly accurate, remote electronic digital tachometer for direct measurement of RPM/RPS (speed) without special reflective tape or markings. RPM results are updated and displayed approximately every ½ second on the LCD display.

### 1.1 Display Panel / Definition of Buttons

The display panel consists of a backlighted liquid crystal display with six numeric digits on top and five alphanumeric digits on the bottom, which indicate modes, flash rates, etc. (see Figure 1).

Additional information displayed include:

<b>PHASE</b>	Indicates Phase Delay Mode is active
<b>TIME</b>	Indicates Time Delay Mode is active
<b>AUTO</b>	Indicates Auto Phase Shifting Mode (virtual RPM) is active
<b>ALT.</b>	Indicates alternate function of each button (lower section) and knob will be used
<b>TACH</b>	Tachometer Mode active (strobe won't flash)
<b>LOCK</b>	Lock onto the accelerometer signal for input
<b>EXT</b>	External Input Mode active

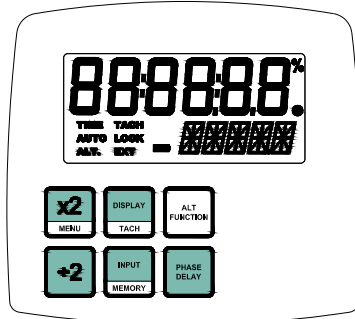


Figure 1 Display Panel

When charging, the strobe will indicate *CHARGE* in the bottom right 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.

### 8.3 External Power Supply/Recharger

The external power supply/recharger (PSC-pbxU) can also be used to run the stroboscope continuously from the AC mains (115/230 Vac).

**To power the strobe with the external power supply/recharger (PSC-pbxU):**

- Plug the power supply/recharger cable into the recharger socket (located below the display panel behind the handle).
- Plug the power supply/recharger into an AC mains wall outlet.
- Press (and lock) the trigger switch to operate. If the trigger switch is not pressed, the unit will start charging.


### 8.4 Battery Disposal

Prior to disposing of the **Nova-Strobe vbx**, the user must remove the Nickel-Metal Hydride batteries. To do this, remove the lens, reflector and lamp as detailed in the Lamp Replacement section. 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.

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

## 8.1 Low Battery Indication

When the batteries are charged, there will be no battery 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 (section 8.2 Charging the Batteries) or powered by the power supply/charger (section 8.3 External Power Supply/Charger). Remember to release the trigger switch.

## 8.2 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 Nova-Strobe vbx with the power supply/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-pbxU) will damage the stroboscope and void the warranty.**



On Target Indicator for Tachometer Mode and Remote Sensor in External Mode



Indicates input frequency exceeds the limit of the stroboscope



Battery charge indication, not shown if fully charged (see section 8.1)

Below the display are six membrane buttons which control the operation of the Stroboscope. They are:



Multiplies flash rate by 2 times  
ALT Function - Starts Menu (See section 3.0)  
Hold when powering up to show all segments, then Rev # and display test



Divides flash rate by 2  
Hold when powering up to reset factory defaults



In Internal/External Mode - Toggles display between RPM and RPS. In External Phase or Time Delay Mode - Cycles display through RPM, RPS, Phase and Time. In Auto Mode - Cycles display through RPM, RPS, VRPM and VRPS.  
ALT Function - Toggles Tach Mode (flashing) on/off



Manually cycle through Internal, External, Wide Lock, and Narrow Lock Modes  
ALT Function - Memory - Reads and Stores 9 preset flash rates



Activates Alternate Function for buttons (lower section) and knob



In Internal Mode, toggles between normal flash rate adjust and “phase” delay adjust

In External and Lock Modes, cycles through External only (no delay), Phase, Time and Auto (VRPM)

ALT Function – In Lock Mode, toggles Filter tracking

The **ALT FUNCTION** button toggles **ALT.** in the display. When **ALT.** is displayed, the buttons will perform their secondary function listed in the lower section of each button. It also changes how the tuning knob works.

## 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 **Nova-Strobe vbx** has internal rechargeable batteries and may also be powered by an external AC power supply (PSC-pbxU). If using the internal batteries, the unit should be charged before use (see section 8.2 Charging the Batteries). The actual operating time of the stroboscope will depend on the flash rate and duty cycle of operation. The strobe can also be run continuously from the AC mains with the power supply supplied (PSC-pbxU, see section 8.3 External Power Supply/Charger).

### 2.2 Input / Output Connections

The **Nova-Strobe vbx** has input and output jacks on the left side of the stroboscope. 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).

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

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 4). Push the tabs on the front rim outward and press the lens into place.

### 7.2 Fuse

Under normal operating conditions, the fuse within the stroboscope should never blow. Examples of abnormal operating conditions would be foreign materials entering the strobe, such as water, pulp, ink, etc.

The Nova-Strobe vbx has a resettable fuse, which will reset once conditions are normal again.

## 8.0 BATTERY AND POWER SUPPLY SPECIFICS

The **Nova-Strobe vbx** 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 charge capacity.**



### To change the lamp:

1. Push apart the two tabs on the side of the reflector housing and remove the 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 it is not necessary to remove the reflector.
2. 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 straight out.

**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 while pushing it into place (see Figure 4). Make sure the lamp is in straight and centered in the reflector hole.

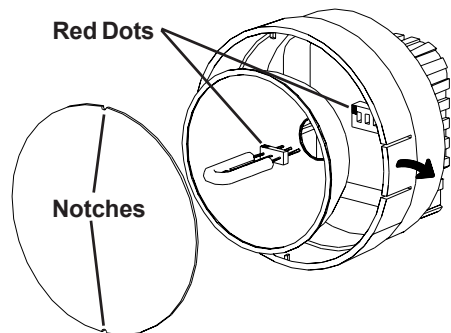


Figure 4 Lamp Replacement

The input and output are TTL compatible. See Figures 2 and 3 for connector connection detail.

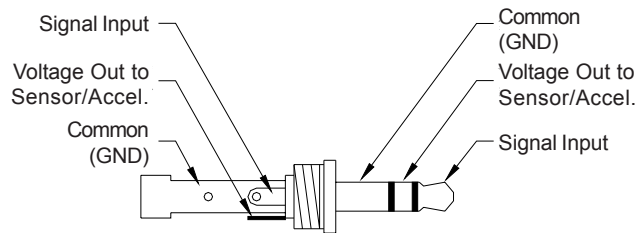


Figure 2 Input Connector Detail (Stereo plug)

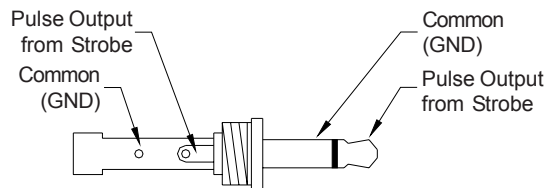


Figure 3 Output Connector Detail (Mono plug)

The optional Accelerometer, ROS-P (Remote Optical Sensor), MT-190P (Magnetic), or IRS-P (Infrared) sensors may also be used to trigger the unit.

In the External Input Mode, the Signal from the tip is used and +6V power is applied to the ring. In the Lock modes, the accelerometer signal is on the ring and the tip is unused. The accelerometer can be powered externally (**ANALZ = YES**) or by the strobe (**ANALZ = NO**). See **ANALZ** menu for details.

**NOTE:** When using external sensors that are powered by the **Nova-Strobe vbx**, e.g. Remote Optical Sensor (ROS-P), the sensor must be plugged in **before the stroboscope is turned on**, or the remote sensor may not be powered up.

The input jack (▲ pointing into socket) enables an external signal to trigger the strobe. The strobe must be placed in the External Input Mode by pressing the **INPUT** button on the display panel. When in External Input Mode, **EXT** will be shown on the display. The polarity of the input pulse can be set in the MENU options.

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 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. The polarity of the output pulse can be set in the MENU options.

### 3.0 MENU

The strobe has a Menu, which allows the user to select settings such as number of decimal places, backlight on or off, positive or negative edge for input and output signal, and input blanking on or off.

#### To enter the MENU:

1. Press the **ALT FUNCTION** button and then the **MENU** button.
2. *SETUP* and the menu option will be displayed.
3. Turn the tuning knob to cycle through the main menu selections.
4. Once the desired menu option is displayed, press the **MENU** button again to select/save it. Press any other button to cancel selection.

when using a delayed flash mode. The **Nova-Strobe vbx** has an "Input Blanking" feature to allow it to ignore this false trigger.

Even with the Input Blanking, large delays cannot be obtained using an ROS if the strobe's flash is triggering the ROS. The duration of the ROS pulse in response to the strobe's flash is about 0.5 milliseconds to 1.1 milliseconds depending on the flash rate. This limits the largest delay possible because the flash swamps the signal from the ROS, and consequently it will not provide the pulse from the reflective marker. If large delays are desired, reposition the ROS so it is away from the strobe's direct flash or use a magnetic sensor. Moving the ROS 6 to 12 inches will help.

The Input Blanking feature itself limits the maximum delay, which is detrimental to non-optical sensors. It is possible to disable (or enable) the blanking in the **Nova-Strobe vbx**. (see section 3.0 MENU).

## 7.0 LAMP AND FUSE REPLACEMENT

### 7.1 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 5 minutes.

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.**

For these tests the strobe light should be set on a tripod. A long cable will be needed for the sensor. The sensor should be mounted on a magnetic base.

Follow the same 5 steps outlined in the previous section for General Preparation for phase analysis, and then follow these steps:

1. Mark the piping system off in given intervals and note the location of supports or hangers. For example, use 6-foot intervals. Draw a simple diagram on paper.
2. Start at the machine end, adjust the strobe light to running speed, and note the phase reading using the clock face method. (For reference, adjust the phase marker to the 12:00 o'clock). Move the vibration transducer to each location, noting the phase reading at each.

**NOTE:** Do not move the strobe, just the vibration sensor. Do not change the Phase Angle control knob after the initial reference has been set.

3. The phase markings should “walk” around the clock face as the sensor is moved to each location. Each time the marking is at or near 12:00 o'clock, the motion is at or near maximum and is in phase with the reference point. Each time the marking is at or near 6:00 o'clock, the motion is at or near maximum in the opposite direction and is out of phase with the reference point.

## 6.0 LIMITATIONS OF REMOTE OPTICAL SENSORS

Remote Optical Sensors have a slight limitation when used with the **Nova-Strobe vbx** because they sense not only the reflective marker but the strobe flash as well. If the ROS is positioned near the strobe, the light from the strobe may cause the ROS to trigger the stroboscope at the wrong time, especially

5. Turn the black tuning knob to edit the menu option.
6. Press the **MENU** button to save your changes. Press any other button to cancel.
7. Press any button other than **MENU** to exit the Main Menu.
8. *DONE* will be displayed.

Below is a list of the menu items:

**DECP T**- Decimal Point (none, 1 or 2)

**BLITE**- Backlight (Yes=On or No=Off)

**INPUT**- Positive (pos) or Negative (neg) Edge for Input Signal

**OUTPUT**- Positive (pos) or Negative (neg) Edge for Output Signal

**BLANK**- Input Blanking (Yes=On or No=Off), see section 6.0

**ACCEL**- Select 10mV/g or 100mV/g for the accelerometer sensitivity

**ANALZ**- Select YES if an analyzer is being used to power the accelerometer or NO if the strobe to power the accelerometer.

## 4.0 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 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.

There are five operating modes for the **Nova-Strobe vbx**. These are Internal, External Input, External Phase Delay, External Time Delay, and Auto (Virtual RPM). All but the Internal Mode require an **external input signal**.

In the **Internal Mode** the knob adjusts the flash rate. In the **External Input Mode** an external signal is used to trigger the flash and the knob has no effect. The **External Delay Modes (Phase, Time and Auto)** enable the

user to vary the stopped motion image at any point in the cycle without having to move the trigger source location. The **Lock** modes use the signal from an accelerometer/input source.

#### 4.1 Internal Mode - Standard Strobe Operation

In the **Internal Mode** the stroboscope generates it's own signals and functions like a tunable stroboscope. The strobe is in the Internal Mode when nothing is plugged into the input jack or when manually set using the INPUT button.

##### To change the flash rate:

With the power on, turn the knob counter clockwise to increase the flash rate and clockwise to decrease it. The knob is velocity sensitive. Turn the knob slowly to have each "click" is equal to 0.01 FPM. Turning the knob more quickly will adjust the FPM by larger steps. When adjusting flash rate, quickly turn the knob (or use the **x2** or **÷2** buttons) to coarsely change the FPM. Then slowly turn the knob for fine adjustments.

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

##### To multiply or divide the current flash rate by 2:

In addition to the knob, there are two buttons on the display panel marked **x2** and **÷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.

to an area above any split line, to the bearing cap. Note the phase angle at each of these locations.

2. The reference mark should stay at the 12:00 o'clock position for each of these measurements. If phase changes/shifts (probably to 6:00 o'clock) at any of these measurement points, there is looseness at the mechanical joint.

##### Checking for unbalance:

1. If the vibration transducer is moved from the vertical position on the bearing to another radial position, the reference mark will move to the new position if there is a significant amount of unbalance. The reference mark will follow the vibration transducer around the clock only if the once per turn vibration is caused by unbalance.

##### Checking for alignment:

1. Alignment checks can be made by moving the vibration transducer to each end of the machines in a train. The vibration transducer is positioned axially at these locations for these measurements. Keep track of the phase for each measurement location.
2. As the vibration transducer is moved to each location, it's direction keeps changing from North to South, for example. When it changes direction, phase will shift from 12:00 o'clock to 6:00 o'clock.
3. If you move across a coupling and phase does not change as expected, a misalignment condition can be the cause.

#### 5.4 Motion Studies

The **Nova-Strobe vbx** can be a useful tool to determine how a mechanical support or a piping system is moving. It allows the user to find points of maximum motion as well as minimum motion. This is important if a new pipe hanger is to be installed or if a brace is going to be added to dampen a vibration condition.

This section outlines the preparations and use of the strobe light in order to be assured the measurements you are making are correct.

**NOTE:** A data collector or vibration analyzer is not needed in order to do phase analysis. You do need a method of powering the vibration transducer, you can use a self-generating velocity transducer to “drive” the strobe light, or you can set *AMALZ* to NO in the menu and the strobe will power the vibration transducer (accelerometer).

### General preparation for phase analysis is as follows:

1. It is important to use a magnetic mounting base on the vibration transducer.
2. Use a transducer cable that is long enough to allow you to get some distance away from the strobe light.
3. Mount the strobe on a tripod so it can be fixed in one location.
4. Connect the vibration transducer to the strobe light (using a power source or a data collector).
5. Start all measurements with the vibration transducer mounted on a bearing housing in the vertical direction. (This is a good habit to get into). Aim the strobe light at the selected reference mark and turn it on. Adjust the flash rate to running speed and then set it to the LOCK mode. Using the Phase adjust, position the reference mark to the 12:00 o’clock position.

**NOTE: Do not move the strobe location between measurements.**

### Checking for looseness:

1. Keeping the vibration transducer in the vertical direction, move the vibration transducer from the foundation, to the base plate, to a foot,

### Alternate Knob Function (multiple by 2, 3, 4, 5, etc.)

The tuning knob functions differently when **ALT.** is displayed. The current flash rate is used as an adder. The knob will add (counter clockwise) or subtract (clockwise) that 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. This 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: A 3 bladed fan is spinning at 3600 RPM. The strobe is flashing at 3600 FPM. Press the ALT FUNCTION button to display **ALT.** Then turn the knob counter clockwise 2 clicks. The strobe will now flash at 10,800 FPM (effectively 3600 times 3). The fans blades will be all superimposed on each other. One can now see if the blades are out of alignment, bent, etc. by viewing the blades from the front or viewing from the side edge of the blades.

### To select a flash rate from a Preset (memory) location:

1. Press the ALT FUNCTION button and then the MEMORY button.
2. *READ* will be displayed.
3. Turn the tuning knob to cycle through the preset flash rates.
4. Once the desired flash rate is displayed, press the MEMORY button to select it. Press any other button to cancel.
5. *DONE* will be displayed.

### To store the current flash rate in a Preset (memory) location:

1. Press the ALT FUNCTION button and then the MEMORY button.
2. *READ* will be displayed.
3. Do NOT turn the knob and press the MEMORY button again.
4. *STORE* will be displayed.
5. Turn the tuning knob to cycle through the memory locations.

6. Once the desired memory location is displayed, press the MEMORY button to store the current flash rate in that location. Press any other button to cancel.
7. *DONE* will be displayed.

### Internal “Phase” Delay / Jog

Once the flash rate has been adjusted to give a stopped motion image, the PHASE DELAY button may be used with the knob to increase or decrease the phase of the reference mark location. Use the PHASE DELAY button and knob to bring a reference mark, such as a key way, into your line of sight.

#### To adjust the “Phase” Delay:

1. Press the PHASE DELAY button.
2. *PHASE* will be displayed on the bottom line and the current flash rate will be displayed on the top line.
3. Turn the tuning knob to adjust the phase of the reference mark.
4. Press the PHASE DELAY button again to turn the “Phase” Delay mode off.

## 4.2 Internal Mode - TACH Frequency Generator

In the Internal Mode, the strobe can be used as a frequency generator (outputting TTL pulses) without having the strobe flash. The pulse output will still occur at the flash rate; the strobe is just not flashing.

#### To stop flashing:

Press the ALT FUNCTION button and then the TACH button. The TACH icon will be displayed.

#### To start flashing again:

Press the ALT FUNCTION button and then the TACH button. The TACH icon will go away and the strobe will start flashing again.

allow it to be placed at a reference location. It may also be noted that slight adjustment of the Phase Angle control knob may be required before each measurement, to assure that the reference location is repeated.

If the data collector you are using does not respond to the phase reference signal supplied to it by the strobe, it is possible that the Trigger Set-up in the vibration data collector may be reversed. If so, change the set-up from “positive” trigger slope to “negative”, or vice versa, and try again.

When the strobe is tuned in the Internal (INT) mode, and then switched to LOCK mode, the filter in the strobe will track slight changes in speed. If the speed changes too much or too fast, the strobe will lose LOCK/TRACK and stop flashing. It will be necessary to switch back to Internal (INT) mode and repeat the adjustments. Also, try switching between the Narrow and Wide Bandwidth LOCK to optimize results. Generally, the Wide Bandwidth will give best tracking results but the Narrow Bandwidth will give better stabilization.

**NOTE:** When it is necessary to have repeatable phase measurements, it is necessary to write down the transducer locations used. Also, the transducer mounting method should be written down. Stud mounting or magnetic base mounting is preferred since data taken with hand-held transducers may lead to significant phase differences.

## 5.3 Phase Analysis

The **Nova-Strobe vbx** can be used to measure movement of parts of a machine, couplings and machine cases in a machine train. The direction of movement (Phase) reveals important information about looseness, unbalance and alignment.

This section is not intended to be a comprehensive review of these measurements. Refer to one of the many training notes and application notes written over the years on these techniques.

Connect the proper interface cable between the strobe and the data collector or analyzer. See wiring diagram to build the cable. The Input (Up Arrow) and Output (Down Arrow) jacks are located on the left side of the strobe. Connect the vibration transducer (this may be a separate cable or an integral cable) to the strobe cable.

**NOTE:** The vibration transducer provides the signal the strobe uses as a phase trigger source and therefore is the input to the strobe. The vibration transducer also provides the vibration signal to the data collector or analyzer. The interface cable provides a “TEE” connection to both. The strobe provides the phase referenced tachometer signal (output), which is used as a TTL input to the data collector or analyzer for triggering.

Now you are ready to go to work!

Follow the operating instructions outlined at the beginning of this section for tuning the strobe to 1X running speed. After the reference mark has been “frozen” (as nearly as possible, but slight rotation is acceptable). Press the **Input/Memory** button until the **LOCK** icon is on. The flash rate is now derived from the vibration transducer. **Phase information is only valid when operating in the LOCK mode.**

Press the **Phase Delay** button until *PHASE* is shown on the display. Using the control knob, position the reference mark to a “convenient reference location”. The data collector can now be employed to receive and process the phase information as supplied to it by the strobe and the transducer. After the information is received, simply release the trigger on the strobe, proceed to the next point, and then repeat the process.

**NOTE:** The trigger must stay depressed until the data collector or analyzer is through processing the data.

For certain data collectors that do not provide constant power out to transducers that so require, it may be necessary to command the analyzer to begin taking the data before the phase image becomes stable enough to

### 4.3 External Input Mode

In the External Input Mode the user can't make any flash rate adjustments. 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.

To put the strobe into the External Input Mode, connect a signal to the external input and press the **INPUT** button on the display panel until **EXT** is displayed.

### 4.4 Tachometer Mode - External Input Required

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

**To enter the Tachometer-External Mode:**

1. Press the **INPUT** button until **EXT** is displayed.
2. Press the **ALT FUNCTION** button and then the **TACH** button. The **TACH** icon will be displayed.

**NOTE:** If the external input signal exceeds the maximum flash rate, the strobe will go into the Tachometer Mode automatically.

**To exit the Tachometer-External Mode:**

1. Press the **ALT FUNCTION** button and then the **TACH** button. The **TACH** icon will go away.
2. The unit will remain in the External Input Mode unless the **INPUT** button is pressed to change the mode.

## 4.5 External Delay Modes (Phase Shifting)

There are three **External Delay Modes**: **Phase Delay**, **Time Delay**, and **Auto (Virtual RPM)**. In the **External Phase Delay Mode** the flash is triggered 0.1 to 359.9 degrees after each external signal pulse. The knob sets the amount of delay in degrees. In the **External Time Delay Mode** the flash is triggered 0.01 to 1000 milliseconds after each external signal pulse. The knob sets the amount of delay in milliseconds. In the **Auto (Virtual RPM) Mode** the flash is triggered by increasing amounts after the external trigger pulse so that the image will appear to rotate at a given (virtual) RPM or RPS. The knob sets this virtual RPM or RPS.

### To enter one of the External Delay Modes:

1. Ensure there is an external input plugged into the unit and press the **INPUT** button on the display panel until **EXT** is displayed.
2. Press the **Phase Delay** button to cycle to the desired mode.
3. Use knob to adjust delay/angle (phase, time or virtual RPM).

### To exit the External Delay Mode:

1. Press the **PHASE DELAY** button to cycle back to External only.
2. The word *PHASE* or the *TIME* or *AUTO* icon will go away.

## 4.6 Lock Modes – Accelerometer Input Required

In the **LOCK Modes** the vibration transducer (accelerometer) controls the flash rate. Prior to setting the **LOCK Mode**, the strobe **MUST** be operated in the **Internal Mode**. The accelerometer must be properly connected and powered, usually by the external **Vibration Analyzer**, and must be mounted in place. Special cable assemblies are available for several commercially available **Vibration Analyzers**, or you may “steal” the accelerometer signal and feed it into the strobe input as detailed above.

## 5.2 Balancing and Phase Measurement

The **Nova-Strobe vbx** contains an internally tuned filter that is incorporated in a phase shifting network, which allows the shaft reference mark to be directed at any convenient location on the machine while balancing or performing motion studies (phase measurement) along a machine’s casing or along a machine train. Examples of a convenient location are the machine’s horizontal split line, top or bottom dead center, or the plane of the reference transducer.

**NOTE:** It is advisable to “LOG” this reference location, so that it may be utilized in future studies or balancing procedures.

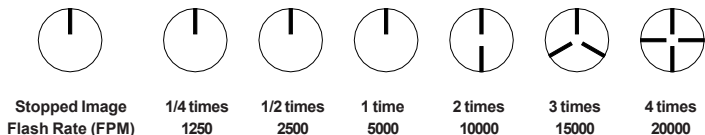
To set-up for balancing or phase measurement, a data collector or vibration analyzer must be used that is capable of interfacing with the **Nova-Strobe vbx**. The instrument must then be set up to obtain and record the phase information supplied to it from the strobe and the reference transducer.

As a general set-up guideline for the data collector or analyzer, in order to be triggered properly and to read phase properly, check the following:

1. Set the instrument to accept an external tachometer trigger signal. The strobe light will provide this signal.
2. Set the frequency range for order analysis (10 orders full scale works best). This insures the 1X frequency will be centered in the 1X (first order) filter which is a must for repeatable phase measurements.
3. Set the vibration instrument to display averaged spectrum and phase data (4 or 8 averages).
4. Set transducer power to On.

**NOTE:** Application Notes are available for some data collectors that describe their particular set-up configurations. Check the Owners Manual for your data collector for proper setup configurations.





### Example: Object Rotating at 5000 RPM

If the speed is outside the full scale range of the stroboscope (50,000 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 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:  $\text{RPM} = 2XY(X+Y)/(X-Y)^2$  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 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.

Once set up, you have to tune the strobe to set the center frequency of the filters to work with the accelerometer. Using the Internal Mode, adjust the flash rate of the strobe to stop motion of the target of interest. Press the **Input/Memory** button until the **LOCK** icon is on. The strobe will now use the signal from the accelerometer to control the flash rate using the wide band filter lock. Press the **Input/Memory** button again to go into the narrow band filter lock. The **LOCK** icon will blink.

The Narrow and Wide Bandwidth filters can be used to optimize its ability to lock onto the vibration signal at any speed. The Wide bandwidth will allow the strobe to track the signal over a fairly wide range of speed change and should be used when tracking the fundamental frequency (in simple systems).

On machines such as a gear drives, reciprocating engines, or any drive with multiple fundamental frequency excitation, the strobe could encounter difficulty tracking the designated signal, due to the tracking filter's normal bandwidth. If substantial levels of multiple fundamental frequencies, or fundamentals with harmonics occur within a selected bandwidth, the shaft reference may appear to oscillate, or drift substantially, when viewed with the **Nova-Strobe vbx**. Also, if the accelerometer cannot be positioned on the primary point of interest, a fundamental frequency of something other than that of the primary point of interest may be predominant. In these cases, use the Internal (INT) Mode and flash rate adjust to stop the motion of the primary point of interest, then use the Narrow Bandwidth LOCK Mode. The filter is far more sensitive and will better be able to discriminate the required signal. However, it will not be able to track over widely varying speed changes, which will require retuning in the Internal (INT) Mode.

After the image has been locked and the Narrow or Wide Bandwidth has been optimized for the speed and/or background noise on the sensor signal, the Phase knob can be used to adjust the phase of the output pulse (and image) - refer to the Phase Analysis section later in this manual for adjusting the Phase Angle control.

After you have the unit in either the wide or narrow lock mode and you have a steady RPM, you can turn on tracking.

#### **To turn on Filter Tracking:**

Press the **ALT FUNCTION** button and then the **PHASE DELAY** button. The strobe will display “**TRACK**” for a moment. Now the Wide or Narrow bandpass filter will automatically attempt to track input RPM. This is useful if you want to see how the vibration changes over a wide RPM range. It will track as long as the RPM doesn't change too quickly. As RPMs change, the phase of the image is likely to change as the filter tracks.

#### **To turn off Filter Tracking:**

Press the **ALT FUNCTION** button and then the **PHASE DELAY** button. The strobe will display “**NOTR**” for a moment.

## **4.7 Power Up Features**

When the strobe is powered up it will remember the last settings.

Press and hold the **x2/MENU** button, then turn on the strobe by depressing the trigger switch. This will turn on all the display segments for two seconds or until you release the button. It will then show the software revision, “REV x.x” and then go through a display diagnostic.

Press and hold the **÷2** button, then turn on the strobe by depressing the trigger switch. This will restore the factory programmed presets.

## **5.0 APPLICATIONS**

### **5.1 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 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 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 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 Flashes Per Minute (FPM) equals the shaft's Revolutions Per Minute (RPM) at the highest flash rate that gives only one stationary image of the key way.**