Strobe Light

CMSS6165

Supports the AX, GX, MX and CMVA Series Micrologs

Part No. 32177800
Revision A

⚠ ***WARNING!*** Not certified for use in hazardous locations.
⚠ Read this manual before using this product. Failure to follow the instructions and safety precautions in this manual can result in serious injury. Keep this manual in a safe location for future reference.

User Manual

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Please take a moment to register your product at www.skf.com/cm/register to receive exclusive benefits offered only to our registered customers, including receiving technical support, tracking your proof of ownership, and staying informed about upgrades and special offers. (Please visit our website for more details on these benefits.)

Tell us how we're doing!

It's important that you're satisfied with the quality of our product user manuals. We appreciate your feedback; if you have comments or suggestions for improvement, please tell us how we're doing! (SKF CM User Manual Feedback@skf.com)

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SKF Reliability Systems Limited Warranty

WARRANTY

Subject to the terms and conditions contained herein, SKF warrants to the Buyer that for the warranty period indicated below the products sold by SKF that are listed below (the "Products"), when properly installed, maintained and operated, will be free from defects in material and workmanship and shall be fit for the ordinary purposes for which the Products are designed.

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This limited warranty defines SKF's sole and exclusive liability and Buyer's sole and exclusive remedy for any claim arising out of, or related to, any alleged deficiency in any Product sold by SKF, even if such claim is based on tort (including negligence or strict liability), breach of contract, or any other legal theory.
If the Product does not conform to this limited warranty, Buyer must notify SKF or SKF's authorized service representative within thirty (30) days of discovery of the nonconformity; provided, however, that SKF shall not be liable for any claim for which notice is received by SKF more than thirty (30) days following the expiration of the applicable warranty period for the Product. Upon receipt of timely notification from Buyer, SKF may, at its sole option, modify, repair, replace the Product, or reimburse Buyer for any payment made by Buyer to SKF for the purchase price of the Product, with such reimbursement being pro rated over the warranty period.

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Except as expressly provided below, the warranty period for each Product shall commence on the date the Product is shipped by SKF to Buyer.

90-DAY WARRANTY

Products warranted for ninety (90) days by SKF are as follows: cable assemblies, MARLIN

QuickConnect (MQC), magnetic temperature probes, and all refurbished equipment.

ONE-YEAR WARRANTY

Products warranted for one (1) year by SKF are as follows: all Microlog products and accessories, all MARLIN data managers (MDM), all MARLIN Condition Detectors (MCD), all Wireless Machine Condition Detectors (WMCD), all Multilog Condition Monitoring Units (CMU, TMU), Multilog Local Monitoring Units (LMU), all Wireless Monitoring Systems V/T, all Vibration PenPlus, all transmitters, all SKF software, all Monitor Interface Modules (MIM), all Machine Condition Transmitters (MCT), MicroVibe P and Custom Products with the prefix of CMCP (with the exception of any consumable or expendable items).

TWO-YEAR WARRANTY

Products warranted for two (2) years by SKF are as follows: all standard Eddy Probes, Eddy Probe Drivers, and Eddy Probe Extension Cables, Multilog On-Line Monitoring system (DMx), and all M800A and VM600 Machinery Monitoring Systems.

For all On-Line Systems that have satisfied Criteria 1 and 2 below, the warranty period shall be either thirty (30) months from the date the On-Line System is shipped by SKF to Buyer, two (2) years from the date the On-Line System is installed and commissioned by SKF, or two (2) years from the date on which the installation of the On-Line System has been audited and commissioned by SKF or its authorized service representative, whichever period ends first.

Criteria 1. Devices used with a Multilog Condition Monitoring Unit (CMU), Multilog Local Monitoring Unit (LMU), including, but not limited to, the sensing device, the interconnect cabling, junction boxes, if any, and the communications interface, must consist only of SKF-supplied or SKF-approved devices and/or components. The computer provided by Buyer must meet the requirements stipulated by SKF.

Criteria 2. SKF or its authorized service representative has installed the On-Line System or has audited the installation and commissioned the On-Line System.
"On-Line Systems" are defined as systems consisting of Multilog Condition Monitoring Unit(s) (CMU), Multilog Local Monitoring Unit(s) (LMU), and any sensing or input devices, the interconnect cabling between the sensing or input devices and the Multilog Condition Monitoring Unit(s) (CMU), Multilog Local Monitoring Unit(s) (LMU), and the cabling between the Multilog Condition Monitoring Unit (CMU), Multilog Local Monitoring Unit (LMU) and the proprietary SKF communications interface with the host computer.

FIVE-YEAR WARRANTY

Products warranted for five (5) years by SKF are as follows: all standard seismic sensors (accelerometers and velocity transducers).

OTHER SKF PRODUCTS

Any SKF product supplied hereunder but not covered by this limited warranty shall be either covered by the applicable SKF limited warranty then in place for such product or, if no such warranty exists, shall be covered by the 90-day warranty stated above.

THIRD PARTY PRODUCT WARRANTIES

For any third party products sold to Buyer by SKF, SKF will transfer to Buyer any warranties made by the applicable third party product vendor to the extent such warranties are transferable.
CONDITIONS

As a condition to SKF's warranty obligations hereunder and if requested or authorized in writing by SKF, Buyer shall forward to SKF any Product claimed by Buyer as being defective. Buyer shall prepay all transportation charges to SKF's factory or authorized service center. SKF will bear the cost of shipping any replacement Products to Buyer. Buyer agrees to pay SKF's invoice for the then-current price of any

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SKF shall not be obligated under this limited warranty or otherwise for normal wear and tear or for any Product which, following shipment and any installation by SKF (if required by the contract with the Buyer), has, in SKF's sole judgment, been subjected to accident, abuse, misapplication, improper mounting or remounting, improper lubrication, improper repair or alteration, or maintenance, neglect, excessive operating conditions or for defects caused by or attributable to the Buyer, including without limitation Buyer's failure to comply with any written instructions provided to Buyer by SKF.

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EXCEPT WARRANTY OF TITLE AND FOR THE WARRANTIES EXPRESSLY SET FORTH IN HEREIN, IT IS UNDERSTOOD AND AGREED THAT: (a) SKF MAKES NO OTHER WARRANTY, REPRESENTATION OR INDEMNIFICATION, EITHER EXPRESS OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT; (b) IN NO EVENT SHALL SKF BE LIABLE OR OBLIGATED FOR SPECIAL, EXEMPLARY, PUNITIVE, INCIDENTAL, DIRECT, INDIRECT, GENERAL OR CONSEQUENTIAL DAMAGES (INCLUDING, BY WAY OF EXAMPLE ONLY, LOST PROFITS OR SAVINGS, LOSS OF

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The exclusive remedies provided in this limited warranty shall not be deemed to have failed of their essential purpose so long as SKF is willing and able to perform to the extent and in the manner prescribed in this limited warranty.

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Introduction to the SKF Strobe Light

⚠ Safeguards and Precautions

- Read and follow all instructions in this manual carefully, and retain this manual for future reference.
- Do not use this instrument in any manner inconsistent with these operating instructions or under any conditions that exceed the environmental specifications stated.
- Use of this product may induce an epileptic seizure in persons prone to this type of attack.
- 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.
- Lethal voltages are present inside this product. Refer to the *Lamp Replacement* section before attempting to open this product.
- 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.
- 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.

- 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.
- This product contains Nickel Metal Hydride batteries which must be disposed of in accordance with Federal, State, and 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.
- This instrument is not user serviceable. For technical assistance, contact your SKF representative.

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.

Overview

The Strobe Light is a truly portable, battery-operated stroboscope suited for a wide range of industrial, institutional, and educational applications, and is able to interface with the SKF Microlog. 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 Strobe Light 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 Strobe Light 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 (▲ pointing into socket) jack connector on the side of the strobe light. The Strobe Light generates a tachometer signal that is on the Output (▼ 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 work with your Microlog.

The Strobe Light is ideally suited for:

Balancing
Inspection of High Speed Rotating Parts
Motion Analyses, or Phase Shift Measurement
Over speed Trip Tests
Online coupling Inspections
RPM / RPS Measurements
All applications suited to a general purpose, phase shifting stroboscope

The Strobe Light 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 half second on the LCD display.

Display Panel / Definition of Buttons

Display Panel

The display panel consists of a backlit liquid crystal display with six numeric digits on top and five alphanumeric digits on the bottom, which indicate modes, flash rates, etc.

Figure 1. The Display Panel.

Additional information displayed includes:

PHASE - Indicates Phase Delay Mode is active

TIME - Indicates Time Delay Mode is active

AUTO - Indicates Auto Phase Shifting Mode (virtual RPM) is active

ALT. - Indicates alternate function of each button (lower section) and knob will be used

TACH - Tachometer Mode active (strobe won't flash)

LOCK - Lock onto the accelerometer signal for input

EXT - External Input Mode active

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

Definition of Buttons

Below the display are six buttons which control the operation of the StroboLite. They are as follows:

Multiplies flash rate by 2 times
ALT Function - Starts Menu
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

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.

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

2
Preparation for Use

The Strobe may be hand held or mounted on a tripod or other user supplied bracket using the $\frac{1}{4}$-20 UNC bushing at the base of the handle.

Power

The Strobe Light has internal rechargeable batteries and may also be powered by an external AC power supply. If using the internal batteries, the unit should be charged before use (see *Chapter 8*, *Charging the Batteries*). The actual operating time of the stroboscope depends 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 (see *Chapter 8*, *External Power Supply / Charger*).

Input / Output Connections

The Strobe Light 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" (3.5 mm) phone plugs (input – stereo, output – mono).

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

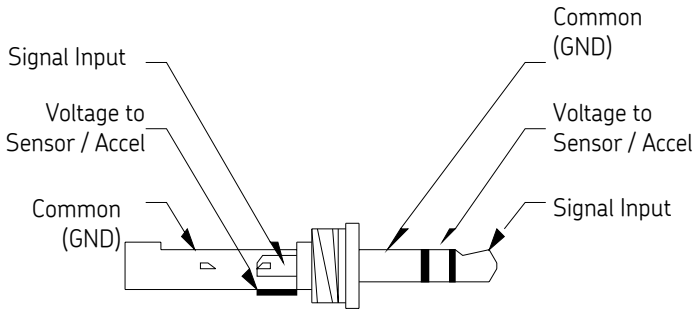


Figure 2. Input Connector Detail (Stereo Plug).

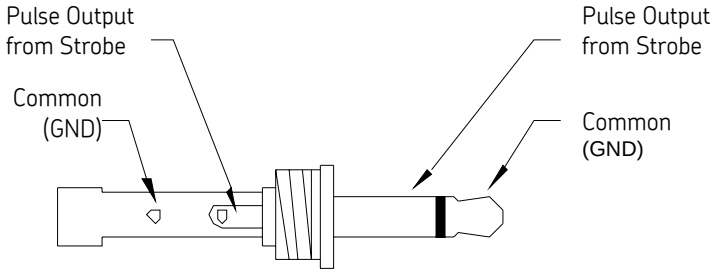


Figure 3. Output Connector Detail (Mono Plug).

An Accelerometer, ROS (Remote Optical Sensor), magnetic, or infrared sensors may also be used to trigger the unit.

In the Ext mode, the Signal from the tip is used and +6 V 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.

- When using external sensors that are powered by the Strobe Light (e.g., Remote Optical Sensor), the sensor must be connected before the stroboscope is powered on, or the

remote sensor may not be powered up.

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 Input Mode. When the plug is removed, the strobe will be put back into the Internal Mode. The Internal Mode can be forced by pressing the INPUT button. 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
Menu

The strobe's menu 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 make selections from the menu:

- Press the **ALT FUNCTION** button and then the **MENU** button.
- **SETUP** and the menu option displays.
- Turn the tuning knob to cycle through the main menu selections.
- Once the desired menu option is displayed, press the **MENU** button again to select it. Press any other button to cancel selection.
- Turn the black tuning knob to edit the menu option.
- Press the **MENU** button to save your changes. Press any other button to cancel.
- Press any button other than **MENU** to exit the main menu. **DONE** displays.

Below is a list of the menu items:

DECPT - Decimal Point (**none**, **1** or **2**)

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

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

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

BLANK - Input Blanking (**Yes**=On or **No**=Off)

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

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

4
How to Operate the Strobe Light

Powering on the Strobe Light

To turn on the stroboscope:

- Depress and hold the trigger.
- Lock the trigger 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.

Operating Modes

The Strobe Light has five operating modes:

Internal - Knob adjusts the flash rate.

External Input - External signal is used to trigger the flash and the knob has no effect.

External Delay (Phase, Time and Auto (Virtual RPM)) - 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.

- All require an external input signal, except Internal mode.

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 connected to 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; each "click" is equal to 0.01 Flashes Per Minute (FPM). Turning the knob faster 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.
    - ➢ 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**. These enable 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.

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 to add / subtract. The knob will add (counter clockwise) or subtract (clockwise) that initial flash rate for each "click" the knob is turned. This allows the user to multiply the initial flash rate by 2, 3, 4, 5, etc., up to the maximum flash rate.

Using this feature on fan blades, 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 fan's blades are 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:

- Press the **ALT FUNCTION** button and then the **MEMORY** button.
- **READ** displays.
- Turn the tuning knob to cycle through the preset flash rates.

- Once the desired flash rate is displayed, press the **MEMORY** button to select it. Press any other button to cancel. **DONE** displays.

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

- Press the **ALT FUNCTION** button and then the **MEMORY** button.
- **READ** displays. Do not turn the knob and press the **MEMORY** button again. **STORE** displays.
- Turn the tuning knob to cycle through the memory locations.
- 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. **DONE** displays.

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:

- Press the **PHASE DELAY** button. **PHASE** displays on the bottom line and the current flash rate displays on the top line.
- Turn the tuning knob to adjust the phase of the reference mark.
- Press the **PHASE DELAY** button again to turn Phase Delay mode off.

Internal Mode - TACH Frequency Generator

In Internal Mode, the strobe can be used as a frequency generator (outputting TTL pulses) without having the strobe flash. The pulse output still occurs 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 displays.

To start flashing again:

- Press the **ALT FUNCTION** button and then the **TACH** button. The **TACH** icon disappears and the strobe starts flashing again.

External Input Mode

The strobe is in External Input Mode whenever there is a plug in the input jack. When the strobe is in the External Input Mode, **EXT** displays.

In the External Input Mode, the user can not 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.

Tachometer Mode - External Input Required

When an external input is supplied to the unit and the strobe is placed in Tachometer Mode, the unit reads the signal from the external input (sensor) and

displays the reading on the LCD display without flashing the lamp. The strobe will not flash in Tachometer Mode.

To enter Tachometer mode:

- Press the **ALT FUNCTION** button and then the **TACH** button. The **TACH** icon displays.
  - ➢ If the external input signal exceeds the maximum flash rate, the strobe will go into Tachometer mode automatically.

To exit Tachometer mode:

- Press the **ALT FUNCTION** button and then the **TACH** button. The **TACH** icon disappears.

External Delay Modes (Phase Shifting)

There are three External Delay modes:

Phase Delay
Time Delay
Auto (Virtual RPM)

External Phase Delay Mode - 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.

External Time Delay Mode - 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.

Auto (Virtual RPM) Mode - 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:

- Ensure there is an external input connected (so the unit is in External Mode).
- Press the **PHASE DELAY** button to cycle to the desired mode.
- Use the knob to adjust delay / angle (phase, time or virtual RPM).

To exit the External Delay mode:

- Press the **PHASE DELAY** button to cycle back to External only. The **PHASE, TIME**, or **AUTO** icon disappears.

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 Internal Mode. The accelerometer must be properly connected and powered, usually by the Microlog, and must be mounted in place.

Once set up, tune the strobe to set the center frequency of the filters to work with the accelerometer.

To tune the strobe:

- Using 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 displays. 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 allows 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 Strobe Light. 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 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 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 the unit is in either the wide or narrow lock mode and a steady RPM is established, tracking may be turned on.

To turn on Filter Tracking:

- Press the **ALT FUNCTION** button and then the **PHASE DELAY** button. The strobe displays **TRACK** for a moment.

The Wide or Narrow bandpass filter automatically attempts 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 does not 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 displays **NO TR** for a moment.

Power Up Features

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

To display segments, software revision, and diagnosis:

- Press and hold the **x2** / **MENU** button, then turn on the strobe by depressing the trigger switch. This turns 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.

To restore factory programmed presets:

- Press and hold the **÷2** button, then turn on the strobe by depressing the trigger switch.

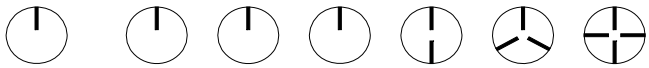
5
Applications

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 RPM / RPS). To do this, several factors must 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 must 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 ways 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.



Stopped Image	1/3 times	1/2 times	1 time	2 times	3 times	4 times
Flash Rate (FPM)	1250	2500	5000	10000	15000	20000

Example: Object Rotating at 5,000 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:

RPM = AB/(A-B)

For a three point calculation:

RPM = 2XY(X+Y)/(X-Y)2 where

X = (A-B) and

Y = (B-C)

If a Remote Optical Sensor or Magnetic Sensor is used to sense one pulse per revolution (External mode), the readout displays 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 not 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.

Balancing and Phase Measurement

The Strobe Light 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.

- 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, the Microlog must be set up to obtain and record the phase information supplied to it from the strobe and the reference transducer.

➢ Reference your Microlog User Manual for details on setting up balance and phase measurement POINTs.

As a general setup guideline, in order to be triggered properly and to read phase properly, check the following:

- Set the Microlog to accept an external tachometer trigger signal. The strobe light will provide this signal.
- Set the frequency range for order analysis (10 orders full scale works best). This ensures the 1X frequency will be centered in the 1X (first order) filter, which is necessary for repeatable phase measurements.
- Set the Microlog to display averaged spectrum and phase data (4 or 8 averages).
- Set transducer power to On.
- Connect the proper interface cable between the strobe and the Microlog. See wiring diagram to build the cable. The Input and Output 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.

  ➢ For the AX Series Microlog, strobe light use requires accessory cables CMAC 5404 (input cable) and CMAC 5406 (output cable). Reference your AX Series Microlog User Manual for connection details.

  ➢ For the GX / MX Series Microlog, you will need to use the SKF Audio

Headphone (CMAC 5078) and Strobe Adapter kit (CMAC 5402). Reference the Audio Headphone and Strobe Adapter User Manual for connection details.

- For CMVA Series Micrologs, you will need to use the included phase adapter (CMSS6135E) and strobe light cable (CMSS50278-CE).

The vibration transducer provides the signal the strobe uses as a phase trigger source and is the input to the strobe. The vibration transducer also provides the vibration signal to the Microlog. 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 Microlog for triggering.

- 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 displays. The flash rate is now derived from the vibration transducer. Phase information is only valid when operating in **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 Microlog 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.

- The trigger must stay depressed until the Microlog is finished processing the data.

If the Microlog does not respond to the phase reference signal supplied to it by the strobe, it is possible that the Trigger Setup in the vibration data collector may be reversed. If so, change the setup from "positive" trigger slope to "negative," or vice versa, and try again.

When the strobe is tuned in Internal mode, and then switched to **LOCK** mode, the filter in the strobe tracks slight changes in speed. If the speed changes too much or too fast, the strobe loses LOCK / TRACK and stops flashing. It will be necessary to switch back to Internal 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, and the Narrow Bandwidth will give better stabilization.

- When it is necessary to have repeatable phase measurements, you must record the transducer locations used. Also, the transducer mounting method should be the recorded. Stud mounting or magnetic base mounting is preferred since data taken with hand-held transducers may lead to significant phase differences.

Phase Analysis

The Strobe Light 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.

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

- The Microlog is not needed 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 **ANALZ** to **YES** in the menu and the strobe will power the vibration transducer (accelerometer).

To prepare preparation for phase analysis:

- It is important to use a magnetic mounting base on the vibration transducer.
- Use a transducer cable that is long enough to allow you to get some distance away from the strobe light.

- Mount the strobe on a tripod so it can be fixed in one location.
- Connect the vibration transducer to the strobe light (using a power source or the Microlog).

- 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 o'clock position.
    - ➢ Do not move the strobe location between measurements.

To check for looseness:

- Keeping the vibration transducer in the vertical direction, move the vibration transducer from the foundation to the base plate, then to a foot, then to an area above any split line, and then to the bearing cap. Note the phase angle at each of these locations.
- The reference mark should stay at the 12 o'clock position for each of these measurements. If phase changes / shifts (probably to 6 o'clock) at any of these measurement points, there is looseness at the mechanical joint.

To check for unbalance:

- 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 when 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.

To check for alignment:

- Move the vibration transducer to each end of the machines in a train.
- Position the vibration transducer axially at these locations for these measurements.
- Keep track of the phase for each measurement location.
    - ➢ As the vibration transducer is moved to each location, its direction keeps changing from North to South, for example. When it changes direction, phase will shift from 12 o'clock to 6 o'clock.

If you move across a coupling and phase does not change as expected, a misalignment condition can be the cause.

Motion Studies

The Strobe Light 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.

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

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

- Mark the piping system in given intervals and note the location of supports or hangers. For

example, use 6-foot intervals. Draw a simple diagram on paper.

- 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 12 o'clock.) Move the vibration transducer to each location, noting the phase reading at each.
  - Do not move the strobe, just the vibration sensor. Do not change the Phase Angle control knob after the initial reference has been set.
- 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 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 o'clock, the motion is at or near maximum in the opposite direction and is out of phase with the reference point.

6
Limitations of Remote Optical Sensors

Remote Optical Sensors (ROS) have a slight limitation when used with the Strobe Light 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 when using a delayed flash mode. The Strobe Light 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 Strobe Light.

- Reference *Chapter 3 – Menu*, for details.

7
Lamp and Fuse Replacement

Lamp Replacement

> ⚠ ***WARNING:***
> ***Before attempting to remove the lamp, make sure the stroboscope is turned off and any mains cords are removed from the AC outlet. Allow at least five minutes for the lamp to cool.***

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.

To change the lamp:

- 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.
- 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.***

- 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.

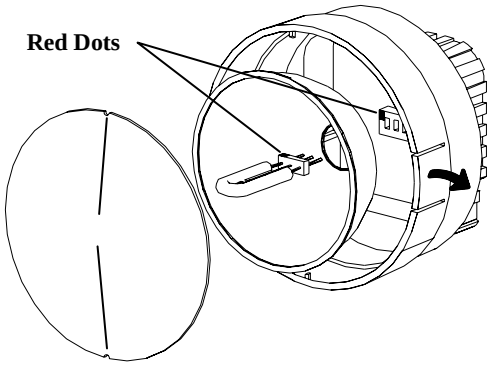


Figure 4. Lamp Replacement

> ⚠ ***CAUTION:***
> ***Do not allow the reflector to contact the lamp.***

- 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.

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 Strobe Light has a resettable fuse, which will reset once conditions are normal again.

8
Battery and Power Supply Specifics

The Strobe Light 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.

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 charger supplied.

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 (see *Charging the Batteries* section below) or powered by the power supply / charger (see *External Power Supply / Charger* section below).

Charging the Batteries

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

To charge the Strobe Light with the power supply / charger:

- Release the trigger so the strobe is off.
- Connect the charging cable into the charging socket (located below the display panel behind the handle).
- Connect the charger into an AC mains wall outlet (115 / 230 Vac).

> ⚠ ***CAUTION:***
> ***Use of chargers other than the one supplied will damage the stroboscope and void the warranty.***

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

Allow the charger 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.

External Power Supply / Charger

The external power supply / charger 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 / charger:

- Connect the power supply / charging cable into the charging socket (located below the display panel behind the handle).
- Connect the power supply / charger 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.

Battery Disposal

Prior to disposing of the Strobe Light, 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 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.

9
Specifications

Internal Mode

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

External Modes

Flash Range and Display	30 - 50,000 FPM External flash rates to 0 are acceptable
Tachometer Measurements	5 to 250,000 RPM Accuracy: ±0.001% of reading or ± last digit
Display Update Rate	0.5 second typical
Trigger to Flash Delay	< 11 µsec
Phase Delay	Phase: 0.1 to 359.9 degrees, Time: 0.01 to 1000 milliseconds, Auto:

	0 to 200 VRPM
External Input	TTL Compatible (24 V pk max), 500 nanosec min pulse width, Positive or Negative edge triggered (menu selectable)

Tracking (Accelerometer) Mode

Flash Range	100 - 50,000 FPM
Tachometer Measurements	100 to 50,000 RPM
	Accuracy: ±1 RPM
Display Update Rate	0.5 second typical
Trigger to Flash Delay	<11 µsec
Phase Delay	Phase: 0.1 to 359.9 degrees, Time: 0.01 to 1000 milliseconds, Auto: 0 to 200 VRPM
Tracking Filter	Selectable Wide and Narrow Bandwidths. The filter may not lock below 100 FPM
External Input	10 or 100 mV / g accelerometer sensitivity (menu selectable)
	Positive or Negative edge triggered (menu selectable)
Accelerometer Power	18 Vdc ±10% at 2 mA (menu selectable:

on=yes, off=no)

General

Time Base	Ultra Stable Crystal Oscillator
Display	LCD display with 6 numeric 0.506 inch (12.85 mm) high digits and 5 alphanumeric 0.282 inch (7.17 mm) high digits
Indicators	Battery level, On Target, TIME, AUTO, ALT, TACH, LOCK, and EXT icons
Knob Adjustment	Digital Rotary switch with 36 detents per revolution; velocity sensitive
Memory	Last setting before power down is remembered and restored on next power up. 9 user settable flash rates.
Output Pulse	40 µsec positive / negative pulse (menu selectable), 3.3 Vdc typical
Input Power	Internal Rechargeable Batteries 6 Vdc, External AC recharger (115 Vac to 230 Vac)
Light Output	Average: 11 Watts at

	3000 FPM, >13 Watts above 3450 FPM
	Instantaneous (per flash): 230 mJoule typical to 3450 FPM
Flash Duration	10-25 microseconds (auto adjust with flash rate)
Flash Tube (Lamp) Life	100 million flashes
Run Time	2 hours typical at 1800 FPM, and over 1 hour at 6000 FPM with fully charged batteries
Charge Time	4 - 5 hours typical
Weight	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° F - 104º F (0° C - 40° C)

- 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)

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