



LS-3-LED

STROBOSCOPE



Operating Manual



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IMPORTANT: This device is used for inspecting the movement of rotating and vibrating objects. It may only be used in accordance with these instructions. The device must not be opened. Modifications to the device are not permitted. The manufacturer shall not be liable for damage resulting from incorrect use or use contrary to the intended use. Warranty claims will also be invalidated in this event.

1.0 INTRODUCTION

The Check-Line LS-3-LED is a hand-held, battery-powered stroboscope featuring extremely bright LEDs for the highest light output in its class. Designed for machinery observation, visual inspection and motion analysis, its robust design is suitable for use in the toughest industrial environments.

1.1 Scope of Delivery

Check that you have received all of the following:

- Stroboscope: LS-3-LED design (40 LEDs)
- Operating instructions
- Calibration certificate
- Trigger plug
- Universal AC-DC converter

A handle and a foam-fitted, plastic carrying case are available as option.

Note: This device is suitable for use in residential, commercial and industrial area.

1.2 Precautions when using



Risk of Injury! Flashing lights can cause retina damage: The stroboscope LS-3-LED and versions are fitted with 40/118 LEDs respectively. These produce potentially dangerous optical radiation, which can cause retina damage. Do not stare directly at the light and never direct it at people or animals.



Risk of injury! Moving objects appear still or in slow motion in stroboscopic light. Do not touch such objects under any circumstance.



Risk of injury! The device may not be used in potentially explosive areas.



Risk of injury! Stroboscopic light can trigger epileptic seizures in persons at risk.

2.0 OVERVIEW

2.1 Connections, controls and settings (LS-3-LED)

- (A) POWER = DC-POWER IN
- (B) INPUT = input for external trigger /24 V power supply for sensors
- (C) Display
- (D) Rotary/push knob
- (E) Selector switch: OFF, FREQUENCY, BRIGHT, MENU, LASER

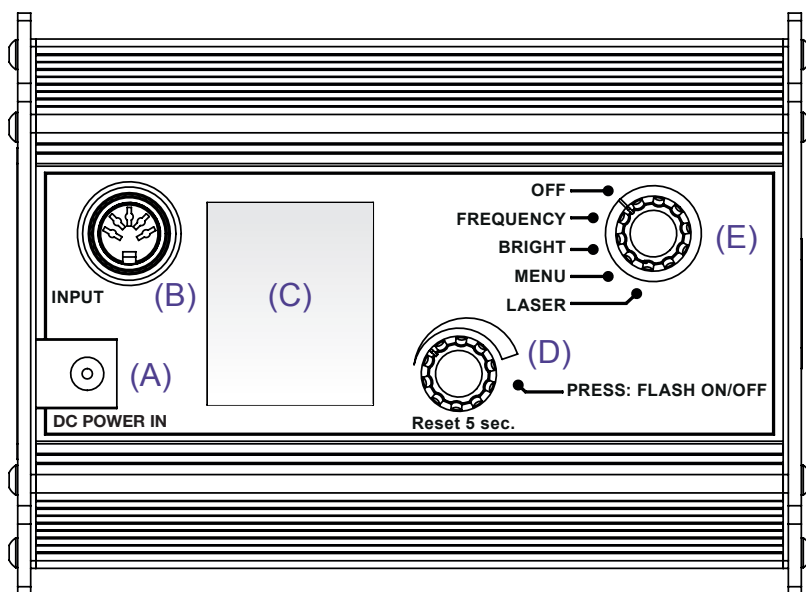


Fig.1 - Stroboscope LS-3-LED

2.2 Display

- (1) Brightness in μ s and/or degrees (BRIGHT)
- (2) Delay in ms and/or degrees (DELAY)
- (3) Phase shift (PHASE)
- (4) Unit of frequency in rpm, Hz and/or FPM
- (5) Value
- (6) Multiplier (MULT.)
- (7) Trigger divider (DIV.)
- (8) Slow motion (SLOW)
- (9) Trigger signal edge (TRIG.)
- (10) Internal/external trigger (INT / EXT)
- (11) Store / read parameters (MEMORY IN / MEMORY OUT)
- (12) Pro mode (P)

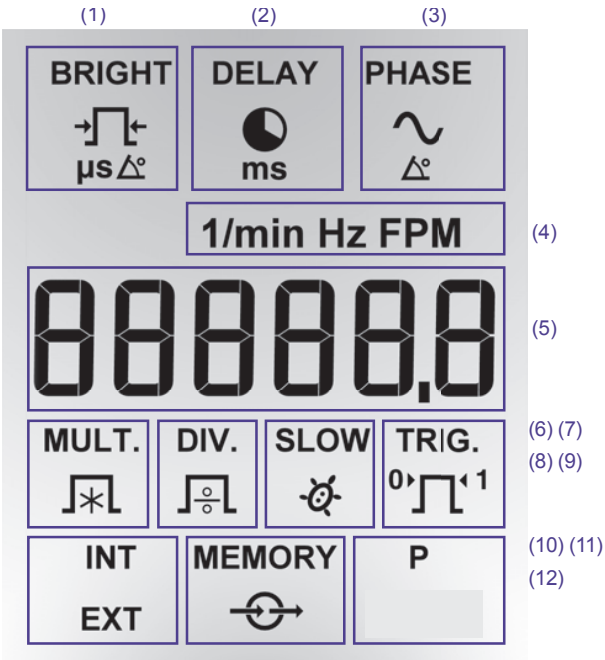


Fig. 2 - Display

3.0 SETUP

3.1 Connectors (see Fig. 1)

No.	Marking	Term	Description
(A)	DC POWER IN	External Power	AC-Adapter Connection Jack
(B)	INPUT	Input socket	Input for external tripper/24 V power supply

3.2 Set-up steps

Please follow the steps below when setting up the device:

1. Plug in External AC-DC Power to (A) DC POWER IN on rear of device (see Fig 1).
2. Direct the device at a moving object and switch it on. Turn the selector switch (E) one notch to the left to **“FREQUENCY.”**



The device will start to flash immediately. For this reason, do not direct it at people or animals.

NOTE: The device will flash at the frequency that was set most recently. The display shows the selected flash frequency in the unit that was set most recently (rpm, Hz or FPM). If the flash frequency coincides with the frequency of the motion, a static image appears.

3.3 Connect the trigger

The device has the option of being externally triggered.



DO NOT trigger the device with signals in excess of 300,000 FPM. Material damage may occur.

NOTE: Use only original material from the manufacturer to connect the trigger signal.

The trigger input is isolated and is suitable for PNP and NPN signals. A trigger plug suitable for this input socket is included with the device.

1. Plug the trigger plug into the input socket **INPUT (B)**.
2. Screw in trigger plug.
3. Assign the connection socket as per Fig. 3.

NOTE: The device must be manually switched between external and internal trigger signals (see How select an internal/external trigger, page 9).

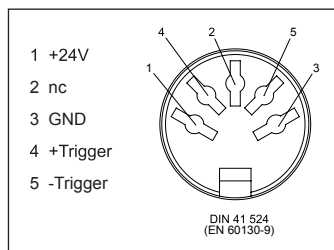


Fig. 3 - Assignment of the connection socket.

4.0 OPERATION

The LS-3-LED is available in Standard and Pro modes (see section 4.3, Standard mode and section 4.4, Pro mode).

4.1 Controls

No.	Term	Description
(D)	Rotary/Push Knob	<ul style="list-style-type: none"> • Turn the knob to select the value and push to confirm. The adjustment increment depends upon the rotational speed. • Turning the knob while simultaneously pushing it, effects the adjustment increment in steps of 100. • The flash can be turned off by pushing the knob once and turned on again by pushing the knob once again.
(E)	Selector Switch	Choose between OFF , FREQUENCY , BRIGHT and MENU by turning the switch to the desired position


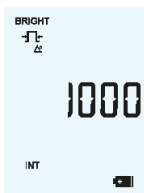
4.2 Display

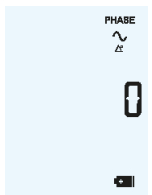
Note: Preset values are retained in each mode (Standard or Pro mode)

OVERVIEW OF ADJUSTABLE PARAMETERS					
Position of the selector switch (E)	Display	Available with		Functions of the rotary/push knob (D)	
		Internal trigger	External trigger	Set value	Select parameter
OFF	—				
FREQUENCY	FPM				
BRIGHT	BRIGHT deg			•	
MENU	PHASE deg	•	•	•	
	INT/EXT	•	•	•	•
	Following functions are only available in the PRO mode				
	1/min/Hz/FPM	•	•		•
	MULT.	•		•	
	BRIGHT deg/μs	•	•		•
	DELAY ms	•	•	•	
	DIV		•	•	
	SLOW		•	•	
	TRIG.		•		•
	MEM IN	•	•	•	
	MEM OUT	•	•	•	

4.3 Standard Mode

NOTE: Not all of the setting shown in Fig 2 are available in Standard Mode.

No.	Position of the Selector Switch (E)	Adjustable Parameters	Description	
(4)	OFF	—	Device is switched off	
(4)	FREQUENCY	FPM	Frequency selection; FPM: flashes per minute - Turning the knob while pushing it simultaneously, the adjustment increment is effected in steps of 100. - The flash can be turned off by pushing the knob once and turned on again by pushing the knob once again.	
How to select FREQUENCY 1. Turn the selector switch (E) to the FREQUENCY position. All settings, will appear in the display for a few seconds, followed by S 2. Select the desired frequency by turning the rotary/push knob (D).				
(1)	BRIGHT	BRIGHT deg	Selection of brightness (in 1/1,000 degrees)	
Brightness (BRIGHT in deg) Flash duration: This function allows the flash duration to be adjusted, which influences the brightness and focus of the object being viewed. In the Standard mode, this setting can only be made in relative form (degrees), whereas the Pro mode also features the additional setting of measuring brightness in absolute form (microseconds).				

No.	Position of the Selector Switch (E)	Adjustable Parameters	Description	Display
(3)	MENU	PHASE deg: 0...359	Delay setting between the trigger signal and flash (in degrees relative to the frequency)	

Phase shift (PHASE in deg)

Phase shift setting (in degrees, relative to the frequency) between the trigger signal and flash. This value allows a fixed angle to be set between the trigger signal and flash.

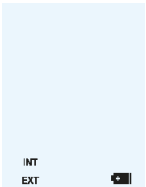
- Example without external connection: The viewing position can be extremely precisely adjusted without changing the flash frequency. You can shift the viewing position within a movement cycle.
- Example with external connection: The external trigger signal is triggered before the desired observation point (= flash position of the stroboscope). This would mean that the connected stroboscope would regularly flash too early. The PHASE deg setting adjusts the delay, altering the flash position of the stroboscope by a set angle. This setting is not affected by the current rotational speed, which means that the stroboscope will flash at the desired position even during rotational speed fluctuations or during the start-up period.

How to select in the MENU

1. Turn the selector switch (E) to the MENU position.
2. Select which parameter (e.g. PHASE deg) you want to change by **turning** the rotary/push knob (D).
3. **Push** the rotary/push knob (D) to confirm a parameter selection. The number shown in the display will begin to flash.
4. Select the desired value **by turning** the rotary/push knob (D.)
5. Confirm and exit selection by **pushing** the rotary/push knob (D).

The setting is now active.

NOTE: The display and adjustable value can be changed by **turning** the rotary/push knob (D).

No.	Position of the Selector Switch (E)	Adjustable Parameters	Description	Display
(10)	MENU	INT /EXT	Internal /external trigger	

How to select an internal / external trigger



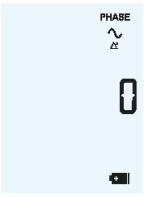
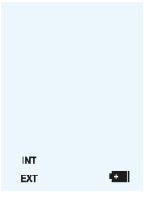
1. Turn the selector switch (E) to the MENU position.
 2. Select the INT / EXT parameter by **turning** the rotary/push knob (D).
 3. **Push** the rotary/push knob (D) to confirm the parameter selection. The display will now show the selection of INT and EXT parameters, the active setting will begin flashing.
 4. Select the desired parameter by **turning** the rotary/push knob (D).
 5. Confirm and exit selection by **pushing** the rotary/push knob (D).
- The setting is now active.

4.4 Pro Mode

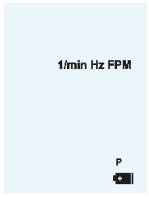

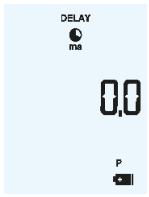
Follow the steps below to access the pro mode:


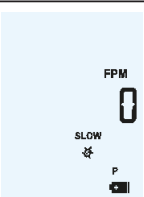


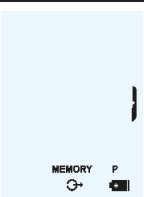
1. Turn the selector switch (E) from OFF to the required position while simultaneously **holding** the rotary/push knob (D) until the **PRO** notification appears in the display.
2. When the Pro mode is activated, a **P** appears in the bottom right area of the display

NOTE: If you have selected settings in **Pro Mode** and then switch the device off, these settings will **ONLY** be active when the device is switch back on if pro mode is activated. Otherwise, only the standard mode settings will be active.

No.	Position of the Selector Switch (E)	Adjustable Parameters	Description	Display
(4)	FREQUENCY	FPM	Description: Frequency selection; FPM: flashes per minute - Turning the knob while pushing it simultaneously, the adjustment increment is effected in steps of 100. - The flash can be turned off by pushing the knob once and turned on again by pushing the knob once again.	
(1)	BRIGHT	BRIGHT deg	Selection of brightness (in 1/1,000 degrees)	
(3)	MENU	PHASE deg: 0...359	Delay setting between the trigger signal and flash (in degrees relative to the frequency)	
(10)	MENU	INT /EXT	Internal /external trigger	

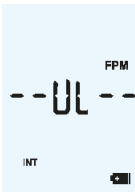
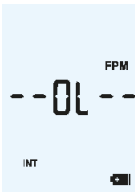
NOTE: See also section 4.3 Standard Mode for examples and explanation regarding the above mentioned display messages.

No.	Position of the Selector Switch (E)	Adjustable Parameters	Description	Display
(4)	MENU	rpm / Hz / FPM	Unit of frequency selection: - rpm: unit for measuring rotational speed - Hz: flash frequency per second - FPM: flashes per minute	
(6)	MENU	MULT: x1, x2, x3.../ +1, +2, +3, ... respectively. The selected flash frequency is immediately multiplied/divided by 1, 2, 3 ...	Multiplier: This function is only possible when the internal trigger is selected	
Multiplier (MULT) At this function the adjusted frequency can be divided or multiplied with integer values to check the harmonic multiple images (see section XX Determining the actual rotational speed of an object).				
(1)	MENU	BRIGHT: PULSE deg PULSE μ s	Selection of brightness unit (in degrees or micro-seconds)	
Brightness (BRIGHT in deg / BRIGHT in μs) At this function the adjusted frequency can be divided or multiplied with integer values to check the harmonic multiple images (see section 5.0, Determining the actual rotational speed of an object).				
(2)	MENU	DELAY ms: 0.0...2.000	Delay time setting (in milliseconds) between the trigger signal and flash.	

No.	Position of the Selector Switch (E)	Adjustable Parameters	Description	Display
(7)	MENU	DIV: 1...2550	Pulse divider, max value 255. This function is only possible when the external trigger is selected	
Pulse divider (DIV) The pulse divider can be used to set a value x, by which the external trigger signal is then divided. Example: when scanning a cog wheel, an external trigger (e.g. rotational speed sensor) sends our a signal for each cog scanned. With a DIV value of 10, it will only flash once every 10 signals.				
(8)	MENU	SLOW: 0...600	The flash frequency exceeds the trigger frequency by the value selected. This function is only possible when the external trigger is selected	
SLOW (slow motion) The SLOW function allows the viewer to view movement in slow motion. The speed of the slow motion depends on the flash frequency and corresponds to the value selected.				
(10)	MENU	TRIG: 0 / 1	Selection of trigger signal edge (increasing 0, decreasing 1). This function is only possible when the external trigger is selected	
(11)	MENU	MEM IN: 1 ... 5	Selected settings can be backed up in five separate storage locations.	
(11)	MENU	MEM OUT: 1 ... 5	It is possible to read backed-up settings.	

4.5 Operating Modes

The following operating modes may be displayed:

No.	Position of the Selector Switch (E)	Adjustable Parameters	Description	Display
	LASER / EXT / SLOW		The trigger frequency is below the measurement range	
	LASER / EXT / SLOW		The trigger frequency is above the measurement range	

NOTE: The symbol of a parameter that differs from the factory settings will flash during operation. The stroboscope will be automatically switched off after 15 minutes of running on battery power.

5.0 DETERMINING THE ROTATIONAL SPEED OF OBJECTS

The stroboscope can be used as a digital revolution indicator to determine an object’s actual rotational speed and/or the frequency of cyclical movements. The stroboscope does this by visually “freezing” the object’s movement and then taking a reading of the rotational speed or frequency from the LCD display. As is the case with all stroboscopes, it is vital to ensure that this “frozen” image is not a harmonic of the object’s actual rotational speed.

Useful information:

- It’s helpful to have a rough idea of the object’s rotational speed beforehand.
- Regular shaped objects, e.g. a fan with several vanes or a motor shaft, must be affixed with an identification marking (using color or a reflective strip etc.) in order to be able to differentiate its orientation of movement.
- A still image always appears exactly at integer division of the speed of the object’s actual rotational speed!

Example 1 (marking required)



The example shows the importance of using identification markings. Say you want to determine the actual rotational speed of this ventilator.

The only thing you know is that its rotational speed is less than 3,500 rpm. The following “frozen” images will appear if you reduce the flashing rate based on 3,500 FPM (flashes per minute):

Image No.	1	2	3	4
Flashing rate	3,300	2,200	1,650	1,320

Image No.	5	6	7	8
Flashing rate	1,100	825	733.3	550

What is the actual rotational speed of the fan? Images 1, 3, 5, 6 and 8 correspond to the original one, which means the rotational speed could be 3300, 1650, 1100, 825 or 550 rpm.

Which is correct?



To determine the fan's actual rotational speed, one of the ventilator vanes is attached with a marking and the test is repeated.

Image No.	1	2	3	4
Flashing rate	3,300	2,200	1,650	1,320

Image No.	5	6	7	8
Flashing rate	1,100	825	733.3	550

The orientation marking confirms that the images at 3,300, 1,650 and 825 rpm are harmonic multiple images. Three identification marks appear in each of these images.

Still images appear at 1,100 rpm and again 550 rpm, each displaying just one mark. Remember that a still image always appears exactly at integer division of the speed of the actual rotational speed of an object. 550 is half of 1,100. This means that the rotational speed of the ventilator must be 1,100 rpm

Example 2 (no marking required)

This example shows how the actual rotational speed of an object can be determined without using an orientation marking. This is only possible for suitably shaped objects.



Let's assume the only thing we know about this cam is that it rotates at less than 7,000 rpm. Its clear shape eliminates the need for an orientation marking. The following "frozen" images will appear if the flashing rate of 7,000 is reduced:

Image No.	1	2	3	4
Flashing rate	6.000	4.000	3.000	1.500

The images showing 6,000 and 4,000 rpm are double or multiple images rather than single images. Still images appear at 3,000 and again at 1,500 rpm. 1,500 is half of 3,000. This means that the actual rotational speed is 3,000 rpm.

6.0 TECHNICAL DATA

General Parameters	
Number of LEDs	40
Frequency Range	30–300,000 flashed per minute
Display	LCD, multiline
Accuracy	±0.02% (±1 digit/±0.025 µs)
Resolution	± 0.1 (30.0 ... 999.9 FPM) ± 1 (1,000 ... 9,999 FPM) ± 10 (10,000 ... 300,000 FPM)
External Trigger Input	3 - 30 V / max. 5 mA (isolated optocoupler) DIN 41524 5-pin standard connector U _{out} = 24 VDC, 60 mA
Certifications	EMV / EMC 2004/108/EG; 2006/95 EG; DIN EN 61010-1:2011; DIN EN 62471:2009; CE;
Flash Parameters	
Light Duration	Adjustable
Light intensity	approx.. 1,750 Lux @ 1°
Flash Color	approx. 5,000 – 8,000 K
Power Supply	
Power Supply	AC-Operation via supplied Universal AC-DC converter
Continuous Use Time	approx. 7:00 h @ 0.500° (~875 Lux) approx. 2:30 h @ 0.500° (~4,000 Lux) approx. 4:00 h @ 2,000 Lux (1.140°) approx. 5:00 h @ 2,000 Lux (0.250°)
Housing	
Material	Aluminum
Dimensions	6.0 x 5.1 x 4.4 in. (150 x 130 x 112 mm)
Weight	approx 1,050 g
Ambient Conditions	
Temperature	32 – 104 °F (0 – 40 °C)
Type of Protection	IP30

NOTE: Warranty void! The device may only be repaired by the manufacturer or the supplier.

NOTE: Correct disposal! The electronic components in the device contain environmentally harmful substances. They must be disposed of in accordance with the environmental regulations in the country of use.



7.0 FACTORY RESET

To reset the factory settings, **press and hold** the rotary/push knob (D) for at least 5 seconds

8.0 WARRANTY

ELECTROMATIC Equipment Co., Inc. (ELECTROMATIC) warrants to the original purchaser that this product is of merchantable quality and confirms in kind and quality with the descriptions and specifications thereof. Product failure or malfunction arising out of any defect in workmanship or material in the product existing at the time of delivery thereof which manifests itself within one year from the sale of such product, shall be remedied by repair or replacement of such product, at ELECTROMATIC's option, except where unauthorized repair, disassembly, tampering, abuse or misapplication has taken place, as determined by ELECTROMATIC. All returns for warranty or non-warranty repairs and/or replacement must be authorized by ELECTROMATIC, in advance, with all repacking and shipping expenses to the address below to be borne by the purchaser.

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Some State jurisdictions or States do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation may not apply to you. The duration of any implied warranty, including, without limitation, fitness for any particular purpose and merchantability with respect to this product, is limited to the duration of the foregoing warranty. Some states do not allow limitations on how long an implied warranty lasts but, notwithstanding, this warranty, in the absence of such limitations, shall extend for one year from the date of invoice.

