RISHIKESH
STROBOSCOPE PVT.LTD.

INSTRUCTION MANUAL

MOVISTROB® Series 500

Type 500.00

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1. Introduction

Each MOVISTROB® product has to pass through various controls during its production phases and must also undergo very strict and conscientious function and quality tests before leaving the factory for delivery to our clients.
We can assure you that the MOVISTROB® product you received is in strict conformity with our high quality standards and it fully meets all safety and performance requirements.
All relevant data on this instrument are electronically stored and can be recalled at any time.
Upon delivery, the instrument complies with the required safety regulations.
To maintain this condition and to ensure safe operation, it is absolutely essential to follow the instructions below.

Advice

We therefore highly recommend to study the following Operating Instructions very thoroughly prior to first use of the stroboscope. Besides technical informations the instructions contain also important hints for use and application as well as special cautions against damage or injury.
Please note that we feel not responsible for any kind of damages or defects caused to the instrument by inapprobiate handling or operation nor in case of unauthorized electronical or mechanical actions or any kind of alterations to the unit.

2. General Description

A stroboscope is used for studying rapid periodic motions. For this purpose, it generates short flashes of light with a frequency corresponding to that of the motion of the viewed object.
In this way, the motion can be made to appear to slow down or stop and therefore visible.
This is possible, because the human eye is unable to distinguish the timing of interval images above a certain frequency.
It is similarly possible to photograph linear motions viewed by the light of the stroboscope.
A further and important application in addition to this stroboscopic retarded action is the measurement of speed. It is possible to measure the speed of small motors without loading them mechanically, as it would be the case with measurement using a tachometer for example.
Our MOVISTROB® model 500.00 offers several advantages:

High flash frequency up to 1000 Hz

-Long term time and temperature stability of the generated flash frequency.
-High accuracy and high time resolution
-Easy to handle
-Low maintenance costs
-Compact design

Easy operation is therefore ensured, even after extended periods of non - use.
MOVISTROB® model 500.00 is an IC/CMOS-controlled, multi-functional high-power precision instrument.
It is equipped with a glass tube protected high-efficiency Xenon longlife flash bulb, sources of intermittent white light with high flash frequency and luminance.
The flash rate is continuously adjustable from 150 to 60000 flashes/minute, equivalent to 2.5 to 1000 Hz.
The average flash duration is about 6 $\propto\sigma$.
The unit offers a wide variety of features in a very compact sheet metal housing (200 x 125 x 155 mm). with carrying handle.
Owing to its solid design and the neat arrangement of its controls, the unit can be easily handled and conveniently operated, especially unter though conditions. It is provided with a 2.50 m 3-core power cord with ground for connection to any standard 230 Volt (or 110 V) AC power source.

CAUTION!

Persons with limited physical, sensorial or mental abilities are not allowed to use the unit, unless they are supervised for their safety by a qualified person or are briefed by the responsible person how to use the unit.
Use of this product may induce an epileptic seizure in those 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 and do not touch the target.

There are high voltages present inside this product. Refer to the section on lamp replacement 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.
The instrument may be operated by trained personnel only.
Maintenance and repairs may also be carried out by qualified personnel or by the manufacturers only.

3. Controls and Indicators

3.1 SIGNAL MAINS PUSHBUTTON "ON" (1)

switches on the stroboscope by depressing the pushbutton.
When depressed (red signal), the instrument is ready to work.

3.2 SIGNAL FLASH FREQUENCY RANGE SELECTOR PUSHBUTTONS (3)

for selection of desired flash rate range:

PUSH BUTTON	FLASHES/MIN = RPM	FLASHES/SEC = HZ
8.1 - low range	150 - 4000	2.5 -66.67
8.2 - medium range	3700 - 18000	61.67 - 300
8.3 - max. range	18000 - 60000	300- 1000

When changing over from one range into the next the previously pressed button will automatically be released. The range selector pushbutton shows colour green when depressed.
CAUTION!
Never press two buttons (nor three) at the same time or leave locked-down, otherwise the unit can be badly demaged.

3.3 CONTROL KNOB with DIAL (8)

for continuous adjustment of flash rate within the range.selected by the range buttons (3).
The transparent dial provides three linear scales with double graduation.
The outer graduation of each scale gives the number of flashes per minute (RPM).
The inner (red scale) indicates the number of flashes per second (Hz).
An index line on the front panel serves as a reading mark.

3.4 FLASH BULBE with TRANSPARENT FIBREGLASS REFLECTOR COVER (2)

The high-efficiency Xenon gas discharge tube is mounted within a refector (⏐ 80 mm) and is protected by a transparent fibreglass cover. Within the selected frequency range the shape of the light pulses is virtually independent of the frequency. However, when changing from a higher to a lower range, the pulse amplitude and duration are increased to a certain extent.
Since the average pulse duration is only about 6 ∝σ, the object will appear well defined even at high speeds.

3.5 INPUT for EXTERNAL CONTROL "Trigger Input" (10)

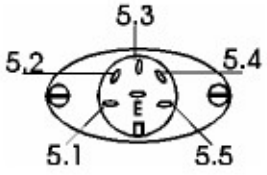
A 5-contact receptacle for connection of an external source (pulse generator, sensor, pickup ect.) in order to control the flash rate is provided. (270° input socket).

Contacts of Trigger Input

POLE 5.1/5.2 provide an AC Voltage of 5V/0.6A (line frequency) (from 03.2004 - 12VDC)

POLE 5.3/5.4 for connection of a closing contact
Flash will be released on closing.

POLE 5.4/5.5 for connection of an electrical pulse generator within a range from 2 to 100V.
5.4 = Plus (+) Trigger / 5.5 = Minus (-) Trigger
Pole "E" = Plus (Vdd) IR or Inductiv Sensor / Pole 5.5 = Minus (Vss) Sensor



Make sure that "External Control Push Button" (9) is depressed on Position "Ext.Trig" if flash frequency is to be controlled by an external source.
When triggering via closing contacts, control circuit resistance should not exceed 100 Kohm when contacts are closed. Back-to-back operation is permissible. The short-circuit current is under 20 µA, i.e. below the 100 µA allowable limit current. The power circuit may not contain

an external current source. When triggered by external current the flash is triggered along the positively-directed edge of an impulse. The impulse current (maximum) should not exceed 100 V. The response cycle lies at 2,5 V (TTL).
Caution:
Always press the proper "Frequency Range Selector Button" (3) for the flash frequency range in which the external synchronization frequency lies. In any case if the control impulse frequency exceeds the preselected low range the next higher range should be selected as a working range However, we recommend you initally select the highest range (80 to 300 Hz) in such cases.

3.6 SIGNAL PUSHBUTTON for EXTERNAL CONTROL "Ext Trig." (9)
serves to select the desired mode of synchronization.
When the flash frequency is to be controlled by an external source via "Trigger Input" (10) the round signal pustbutton has to be depressed (signal indication: red).
The flash rate can be adjusted by means of the Control Knob with Dial (8) within the preselected range (3) when the pushbutton is not pressed (signal indication: grey).
Switching over to other operating mode the round pushbutton will automatically be released

3.7 SIGNAL PUSHBUTTON for LINE SYNCHRONIZATION (11)
If the flash rate is to be controlled by the line frequency this button must be pushed (signal indication: red).
The flash frequency will be automatically synchronized with the frequency of the line.
This mode may be used for slip measurement or control of in line synchronous motors.

3.8 SIGNAL PUSHBUTTON for INTERNAL CONTROL of FLASH FREQUENCY "Int. Trig" (7)
If the flash rate is to be controlled by the built-in flash frequency generator the "Int.Trig" button must be depressed (signal indication: red). Before the fine adjustment of the flash frequency can be activated via Control Knob with Dial (8), the desired flash rate range has to be selected by the Flash Range Frequence Selector Button (3).

3.9 BNC-OUTLET for CONNECTION of DIGITAL COUNTERS ETC (6)
The BNC-outlet supplies a voltage between 5 to 10 V making an average of 7 V.
The impedance does not exceed 10 K

3.10 PHASE SHIFTER (12)
This control knob allows the operator to see stroboscopically any point in the cycle being observed.
The adjustable time delay between the triggering pulse from any pickup or line synchronization ranges from 0° to max. 650°.
Phase shifting is only possible when the unit is operating on line synchronization or external triggering.

3.11 BC-RECEPTACLE for EXTERNAL LIGHT SOURCE (5)
A separate hand lamp (optional) connected with the unit via BC socket (5), can be actuated by using the pushbutton "Ext.Flash" (4) on the front panel.. The "ON" position is indicated by a yellow signal. When the flash bulb inside the hand lamp is activated the built-in flash bulb will be automatically switched off.
This arrangement facilitates observation of moving objects in places otherwise inaccessible.
Note:
The external light source must be connected to the control unit before switch-on.
When disconnecting the hand lamp the pushbutton (4) must be reset in initial position "OFF" (grey colour signal).

3.12 PUSH BUTTON for OPERATING an EXTERNAL LIGHT SOURCE (4)
When an external light source (hand lamp type 900.05, magnifying strob lamp type 900.06) is connected to the unit it can be switched on by pressing button (signal indication: yellow).
The built-in flash bulb will automatically be switched off.

4. General Instructions

Connect the instrument to the nominal AC line stated on the type plate. Switch on by pressing pushbutton „1“.
The stroboscope is now ready for operation.
To protect the flash tube, it is advisable to switch the instrument off when an interruption occurs for a longer observation period.

4.1 Operation with Internal Control

The most common mode of operation is to control the flash rate by the internal flash frequency generator.
To actuate this program press pushbutton "Int. Trig" (7).
Then set the desired flash rate range by pressing range selector pushbutton „3“, and make the exact adjustment within the preselected range by means of control knob „8“.
When one of the push buttons is pressed, the button previously depressed is automatically released.
Under no circumstances should two or even three range buttons be depressed simultaneously.
The flash tube will beoverloaded and damage will result.

4.2 Operation with External Control

If the flash rate is to be controlled externally by closing a contact, magnetic impulses, light impulses or other pulse signals pustbutton "Ext.Trig." (9) must be pushed in "ON" position (signal indicating red).
Connection of the pulse generator to the control unit is to be effected through a trigger cable which must be connected to the "Trigger Input" (10).
Select the proper frequency range (pushbuttons „3“) in which the external synchronizing frequency presumably takes place.
If the control impulse frequency exceeds the selected range the next higher range should be selected as a working range. However, in order to avoid an overloading of the flash bulb we recommend you initially select the highest range (300 Hz to1000 Hz) in such cases.
The maximum permissible permanent flash rate of 60000 RPM should not be exceeded.
When one of the push buttons is pressed, the button previously depressed is automatically released.
Under no circumstances should two or even three range buttons be depressed simultaneously or kept in depressed position by force.
The flash tube will be overloaded and damage will result.
Do not allow the flash bulb to burn constantly.

5. Stroboscopic Principle

With stroboscopy, high-speed periodic motion which cannot be followed by unassisted eyes can be made accessible for observation and its frequency measured. For this purpose the oscillating or rotating object is illuminated in a periodic series of light impulses (flashes) which are as brief as possible. The object then appears (at the appropriate flash frequency) to be motionless (stopped image) or slowed (slow-motion). The object’s behavior and motion can thus be observed in all their details.
At low frequencies in the flash rate (below about 30 Hz) a certain flickering of the image is unavoidable.
To make the visual perception appear real requires a solid-colored disc with a single eccentric mark.

5.1 Stopped Image of the Object

If the rotating object (or the mark) is to appear to the observer as a stopped image under stroboscopic light, the period T of the flash frequency must be a whole-number multiple n of the rotation period r:

$$T = Tn = nr$$

For the corresponding frequencies $f = 1/T$ and revolutions $v = 1/r$ the relationship is:

$$f = fn = 1\ v \mid n$$

The highest flash frequency ($n = 1$) which produces a stopped image of the object, i.e. the mark equals the revolutions: $f1 = v$ (stopped images in which the mark appears more than once still result from flash frequency $f > f1$).

The observed phase of the rotation in stopped image, i.e. the rotational angle at the moment of the flash, is purely accidental. Through brief changes of the flash frequency however the desired phase position can be adjusted approximately. In the same way, RPM fluctuations can cause a change in phase position. Exact phase stability, i.e. sharply stopped image, can be achieved when the flash frequency is controlled externally by the moving object.

5.2 Measurement of RPM and Frequencies

To measure the RPM v either the highest flash frequency f1 = v which results in a stopped image of the object can be determined, or two neighbouring flash frequencies fn and fn+1 can be determined and from these the rotational frequency computed. For the periods for f and fn+1 in the flash frequency the equation is:

$$r = Tn+1 - Tn$$

From this we derive the frequencies:

$$v = fn \cdot fn+1 \mid fn - fn+1$$

5.3 Slow-Motion Cycle

If the period T of the flash frequency deviates slightly from a whole-number multiple Tn = nr of the rotation time r of the object, i.e.

$$T = (n + e)\, r \text{ with } /e/ < 1$$

then the object no longer appears stopped, but has rotated through the angle 2e between two succeeding flashes. If /e/ is sufficiently small the eye perceives a constant slow-motion cycle. Angular speed w', at which the object appears to rotate, is given by:

$$w' = 2\,v' = 2 \cdot \frac{e}{T(n+e)\,r} = 2 \cdot \frac{e}{nr}$$

If we compare this with the true angular speed of the object, we obtain:

$$w' = (e \mid n) \cdot w$$

For e > 0 (i.e. T > Tn and/or f > fn) w and w' have the same sign, so that true and apparent rotation are in the same direction.

The opposite holds for e < 0. With increasing /e/ the angular speed w' of the apparent rotation rises. Finally the angle 2πe becomes so large that the mark on the rotating disc appears at two different places during two succeeding flashes. Other phenomena (described below) also occur.

5.4 Stopped Images of Phantom Objects

Stopped images of rotating objects results from flash frequency periods Tn = nr, and also at other flash frequencies. However, the latter represent phantom objects, not the real object. Using the example of the rotating disc with an eccentric mark , it is obvious that stopped images also occur when:

$$T=(n \mid k)r \qquad \text{and / or } f = (k \mid n)\, v,$$

whereby n and k are whole relatively-prime numbers. The stopped image shows k marks, which are arranged in the corner of a regular k-angle. Only a very few of the theoretically infinite number of flash frequencies result in observable images, since at each corner of the k-angle there is only one mark for k sequential flashes, but (k - 1) times no marks. As k increases then the images have less and less contrast. The images of the real object (k =1) always appear sharpest.

In addition, the images become more and more faint at a given k with increasing n. The interval in which the mark is illuminated at one corner of the k-angle amounts to n rotation periods. In conclusion , the k mark images must not overlap. Altogether we may expect observable images only with low values of n and k. In objects with a complicated texture the phantom objects mostly disappear in an untextured background.

5.5 Objects with a Finite Rotational Symmetry

In many cases the axis of the rotating object is an m-number symmetrical axis, i.e. the object overlaps itself through a rotation about the angle 2/m. In the example of the disc this is achieved through m equal marks which are arranged in the corners of a regular m-angle. In this case substitute r/n for the period r in the relationships derived above.

Stopped images of the real object therefore result from

$$T = (n + k)\, r \text{ and /or } f = (k + n)\, v,$$

In addition, stopped images of phantom objects also occur for

$$T = (n \mid k) \square (r \mid m) \text{ and / or } \qquad f = (k \mid n)(m \square v)$$

(k, m, n are whole numbers). If k and n are selected relatively-prime, k.m marks appear in the corners of a regular k.m-angle.

6. Replacing Flash Tube and Fuses

If there is repeated flash failure or a complete breakdown, the tube must be replaced. For this purpose the transparent glassfibre cover which protects the reflector must be removed.
Before attempting to remove the flash bulb make sure the stroboscope is turned off and thepower cord removed from the AC outlet. Allow the bulb to cool down; but wait at least 2 minutes before attempting to change the lamp.
The 4-pin tube must be gently pulled out. Insert the new tube (incorrect insertion impossible) and, if necessary, remove fingerprints by means of a soft cloth. In case the flash tube fits in tightly the housing must be opened by unscrewing four screws on the backside of the unit and remove the lid catch.
Then loosen the tube with a screwdriver applied as a lever between tube base and socket and pull the tube out.
Only after the housing has been closed, the instrument may be put into operation again. It may be up to one hour before a new bulb produces an uniterrupted flash sequency.

Remark
Do not use the flash bulb needlessly, as its life is limited to approx. 350 hrs. You will achieve a much longer lifetime, if you switch the instrument off in cases of long intervals in between the measuring or motion control actions.

When the lid catch of the housing is removed, the fuse 0.5 A (in case of 110V AC = 0.63 A) can easily be replaced.

7. Maintenance and Repair

If the instrument is suspected of being unsafe, take it out of operation permanently.
This is usually the case when the unit shows physical demage, no sign of functioning or stress beyond the tolerable limits.
Repair, replacing parts, calibration ect. should be carried out by trained personnel only or preferably return it to the manufacturer for inspection and control.

In correspondence concerning the instrument, please quote the type number and serial number as given on the type plate underneath the bottom of the housing.

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Technical Specifications — Model 500.00

Flash tube:	Xenon high-efficiency white light tube 4-pin plug in type, model MS.500.
Light intensity:	approx. 750 lux
Flash duration:	approx. 2 - 7 $\propto\sigma$
Flash-rate range:	2.5 - 1000 flashes/sec. = Hz equivalent to 150 - 60000 flashes/min = RPM in three overlapping direct-reading ranges
Accuracy:	less than $\pm$ 2 % of dial reading
External triggering:	by mechanical contactor or pulse signals (EM or photoelectric pickups)
Phase shifter:	built-in pulse delay continuously adjustable from 0° to 650°
Line synchronization:	built-in, operated by signal push button
BNC outlet:	built-in for connection of digital counters
External light source:	connection box for separate hand lamp model 900.05 operated by signal push-button allowing either ignition of internal or external flash tube
Housing:	sheet-steel with carrying handle
Weight:	2,8 kg
Dimensions:	200 x 125 x 160 mm
Special accessories: (optional)	special carrying box mod. 500.10, red filter mod. 500.11, hand lamp mod. 900.05, magnifying strob lamp mod. 900.06, infrared sensor mod. 910, electromagnetic induction pickup mod. 915, telescopic tripod mod. 950.00, protective spectacles mod. 950.01

Instruments for other than 230-250V, 50-60c/s power supply (AC) on request.