RISHIKESH
STROBOSCOPE PVT.LTD.

INSTRUCTION MANUAL

MOVISTROB® Series 600

High-power Stroboscope
Type 600.00

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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 600.00 offers several advantages:

Extremely high light intensity for observation of large areas
-Long term time and temperature stability of the generated flash frequency.
-High accuracy and high time resolution
-Easy to handle due to colour signal push buttons
-Low maintenance costs
-Compact design
Easy operation is therefore ensured, even after extended periods of non - use.

MOVISTROB® model 600.00 is an IC/CMOS-controlled, multi-functional high-power precision instrument.
The MS 600.00 high-output stroboscope consists of 2 components:

1. Control Unit — containing the AC and generator sections as well as all operating controls.
2. Flahlamp — equipped with an easy-to-replace, linear, high-output Xenon flash tube, ON/OFF snap switch for the flash, swivel yoke.

Because of the extremely high light output of the quartz lamp, the unit is especially suited for illuminating oversized objects such as printing presses, rolling mills, looms, large blowers and fans, and other machines used in aircraft construction, shipbuilding, textiles, ect.
The unit can also be effectively used as a light source for high-speed photography, allowing fast non-periodic motion, such as crash and drop tests, to be captured on film.
In addition to adjusting the flash frequency with the 10-stage helical potentiometer on the control box (internal) after preselection of the flahfrequency, you can also control the flash frequency externally. You can activate external triggering with a contact switch, current impulse or light impulse from a compatible source. During external triggering, an absolutely stopped image of the object results even when the frequency of the periodic motion fluctuates. This mode of operation also provides digital readout of the controlled flash frequency. A phase-shift control knob allows a timed-pulse delay of up to 330°, by which motion can also be observed during external triggering in any desired motion phase.

If you desire to study line-synchronous cycles, such as slip measurements, you can control the unit directly through the line frequency by pressing the „LINE“ button switch. You can also use the phase-shift control knob to change the phase position in this mode.

The flash rate is continuously adjustable from 120 to 19200 flashes/minute, equivalent to 2 to 320 Hz.
The average flash duration is about 15 ∝σ.
The unit offers a wide variety of features in a very compact light metal housing (247 x 140 x 231 mm).
The swivelling handle with 30° click-stop positions serves as a stand allowing suitable positioning for viewing and control.

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

Control Unit 600.00

3.1 OUTPUT SOCKET for Flashlamp GS / KS (1)

The flashlamp with the appropriate cable must be connected with the output socket. Lock the plug in place by screwing the collar on the plug to the thread of the output socket.
Note:
The flashlamp must be connected to the control unit before switch-on.
When disconnecting the flashlamp the power pushbutton (7) must be reset in initial position "OFF" (black colour signal).

3.2 DISPLAY WINDOW

Within the frame of the display window inserted in the control panel, the 5/16 (10 mm) high 7-segment LED numerals are easily readable. When readout in flashes per second = Hz is selected a red decimal point appears automatically. Readout in Hz is carried out to 2 decimal places

3.3 SELECTOR SWITCH for RPM or FL/SEC (Hz) READOUT (3)

The measuring time is 1 second in a measuring sequence of 2 seconds. The measuring accuracy is based on quartz time and amounts to ± 1 revolution on the RPM readout. The range of error on the "FL/SEC" readout (Hz) is only 1/100 ± digit.

3.4 ADJUSTMENT KNOB for INTERNAL FLASH FREQUENCY "GENERATOR" (4)

for continuous adjustment of the internal flash frequency which is infinitely variable within the frequency range preselected with the range selector pushbuttons (8). If you turn the adjustment knob (10-stage helical potentiometer) clockwise, as shown by the curve symbol, the flash frequency rises, when you turn it counterclockwise, it drops.

3.5 PHASE SHIFTER (5)

Using the phase-shift control knob the flash phase position can be moved infinitely up to 330° counter to the control impulses in external triggering or line-synchronous operation, allowing observation of the test object in its various motion segments.
Change the phase position by turning the control knob in the direction of the curved symbol.

3.6 CONNECTOR SOCKET for AC CABLE (6)
This socket connects the control unit to AC power with the 2-meter (7 ft. approx.) cable.

3.7 SIGNAL LINE POWER PUSHBUTTON "POWER" (7)
switches on the stroboscope by depressing the pushbutton.
When depressed (red signal), the instrument is ready to work.

3.8 SIGNAL FLASH FREQUENCY RANGE SELECTOR PUSHBUTTONS "RANGE" (8)
for selection of desired flash rate range:

PUSH BUTTON	FLASHES/MIN = RPM	FLASHES/SEC = HZ
8.1 - low range	120 - 1200	2 - 20
8.2 - medium range	480 - 4800	8 - 80
8.3 - max. range	1920 - 19200	32 - 320

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

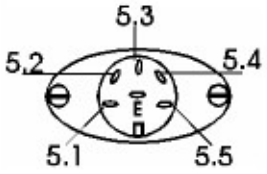
3.9 SIGNAL PUSHBUTTON for EXTERNAL CONTROL "EXT TRIG." (9)
serves to select the desired mode of synchronization.
When the flash frequency is to be controlled by an external source via "Trigger Input" (11) the round signal pustbutton has to be depressed (signal indication: red).
The flash rate can be adjusted by means of the Adjustment Knob (4) within the preselected range (8) when the pushbutton is not pressed (signal indication: black).
Switching over to other operating modes the round pushbutton will automatically be released.

3.10 SIGNAL PUSHBUTTON for LINE SYNCHRONIZATION (10)
If the flash rate is to be controlled by the line frequency this button must be pushed down (signal indication: red). The line frequency is automatically fed in; this is usually 50 or 60 Hz.
In this mode of operation you can observe all line-synchronous motion cycles. Slip measurements on asynchronous motors can be easily carried out and phase fluctuations determined on synchronous motors. To avoid overloading the flash tube (even with the automatic overload protector) the mid-range pushbutton switch (8.....80 Hz) should be switched on in this mode of operation since the control frequency is also in this range.

3.11 INPUT for EXTERNAL CONTROL "Trigger Input" (11)
A 5-pin diode input for connection of an external signal source (pulse generator, sensor, pickup ect.) in order to control the flash rate provided. (270° input socket). In this mode of operation the pushbutton for external control "EXT.TRIG." (9) must be depressed (signal colour indicates red).

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." (signal colour red).
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 of 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" (8) 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.

3.12 Flashlamp 600 GS/KS (see page 10)
The flash tube (below) is mounted within the lamp which also has a separate "ON/OFF" switch (14) to control power to the flash tube.

3.13 XENON QUARTZ HIGH-OUTPUT TUBE (13)
The extreme high-intensity flash tube is held in place by spring contacts on both sides.
If replacement is required, simply release the pressure and then remove the tube.
If the flash tube should ever be overloaded because of incorrect range selection in external triggering or arc-through of the tube, a safety cutoff will be triggered.
After the tube has cooled it will fire again.

3.14 "ON/OFF" SWITCH for Flashlamp GS/KS (14) (see Page 10)
Use this switch to turn the lamp on and off.

4. General Instructions

First, connect the flashlamp with the appropriate cable to the output socket in the control unit.
Lock the plug in place by screwing the collar on the plug to the thread of the output socket (1).
Then connect the control unit to the AC mains with the shockproof plug and socket.
Press the „POWER“ pushbutton (7) and the unit is ready for use.

4.1 Operation with Internal Control
The most common mode of operation is to control the flash rate by the internal flash frequency generator. When the unit is ready for use you can select the frequency range with one of the 3 range pushbutton switches (8). You should select the range in which the motion of the object to be observed lies, if it is known.
When another range is selected the previously-pressed pushbutton is automatically released.
The range pushbutton switch gloss yellow when pressed.
The working frequency can be seen on the screen as a 5-position digital readout (2) in red numerals
Continuous fine adjustment of the flash frequency within the selected frequency range is made with the adjustment knob for the internal flash frequency "GENERATOR" (4). The 10-stage helical potentiometer allows smooth, precise adjustment. The working frequency can be seen in the display window as a 5-position digital readout (2) in red numerals that contrast well in daylight.
Readout can be chosen in RPM or FL/SEC (flashes per second) = Hz.
The desired readout mode can be determined with the changeover switch (3).

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 pressed 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" (11).
Select the proper frequency range (pushbuttons „8“) in which the external synchronizing frequency presumably takes place.
If the control impulse frequency exceeds the selected range, the next higher range should be chosen as a working range. However, in order to avoid an overloading of the flash bulb we recommend you initially select the highest range (32 Hz to 320 Hz) in such cases.
The maximum permissible permanent flash rate of 19200 RPM should not be exceeded.

CAUTION!!
Never press two or even three range pushbutton switches at the same time or leave locked-down, otherwise the unit can be damaged.

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:

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

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

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

(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 or Fuses

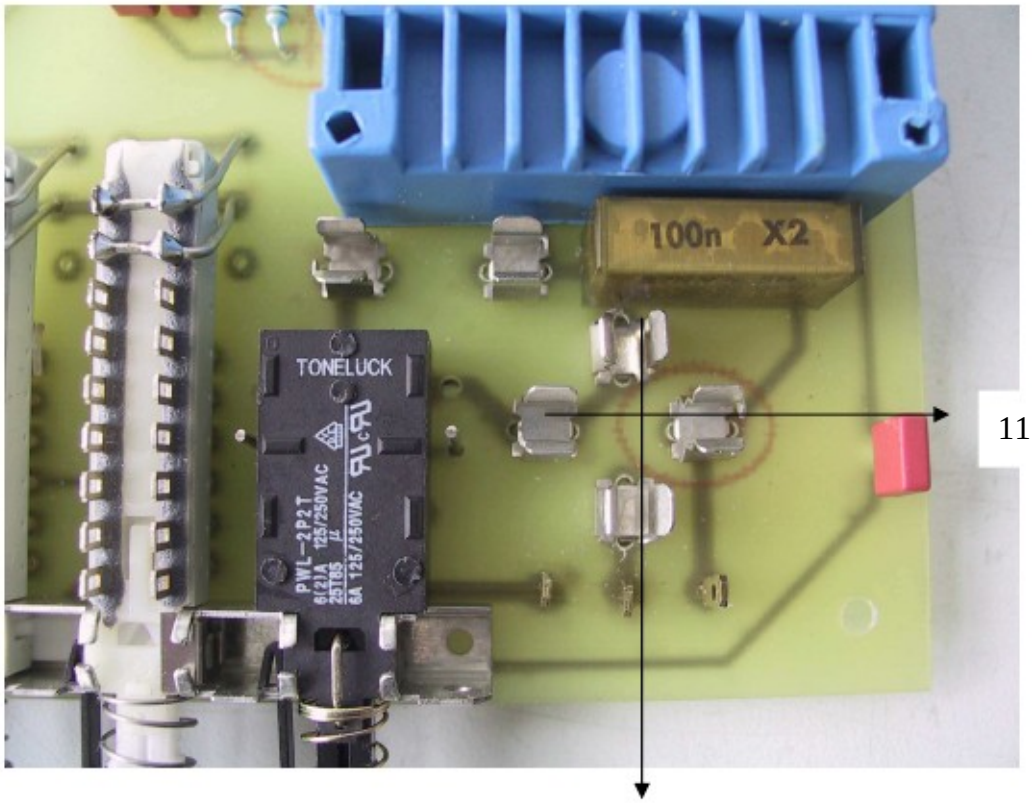
CAUTION:Always disconnect the unit from the power source before servicing.
While the built-in condensers are self-discharging, you should wait at least 3-5 minutes after disconnecting, then check for residual charge in the condensers with an insulated screwdriver before attempting to work inside the unit.

If single flashes are noticeably missing („stuttering“) or if the lamp should completely fail to operate, the tube should be replaced because of age or mechanical damage.
Release the screw to remove the protective lens and frame from the lamp. Next, release the firing antenna from the clamp beside the pressure spring on the side of the larger reflector opening by pressing on the insulation.
The defective tube can then be removed for replacement by counter-pressure on the spring contacts which hold the flash tube in place.
A black coating on the inner wall of the glass in new flash tubes is normal since flash tubes are artificially aged before installation to guarantee trouble-free performance.

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.

Two fuse-holders are located in the control unit at 90° to each other; these are marked with the appropriate operating current. For 230V WE operation a 2.5A T fuse is installed; for 115V WE, a 4A T fuse. The unit is always delivered set up for either 230V/50-60 Hz operating current or 115V AC operating current as ordered. A complete set of spare fuses can be found in a plastic bag inside the unit. Simply by releasing the retaining screws the housing shells can be easily removed to allow adequate access to all built-in components and circuits.

Power supply changing from 230V AC to 115V AC



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.

8. Available Accessoires:

Part Number	Description:
600.10	Carrying case
600.12	Tripod base plate
950.00	Telescopic Tripod

for more information see our home page in internet under accessories

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 600.00
Power supply:	230 / 115 V AC 50-60 Hz
Power consumption:	approx. 135 VA
Flash Tube:	high energy, socket mounted Xenon quarz rod shapped flash bulb
Light intensity:	depending of frequency range Range I5000 Lux Range II4000 Lux Range III2500 Lux at a distance of 0.5 m from light source.
Flash duration:	depending on frequency range I 20µsII 15µs III 10µs
Frequency range:	2 - 320 Hz / 120 - 19.200 rpm,
Range subdivision:	subdivided into 3 overlapping ranges I=2 - 20 Hz = 120 - 1200 rpm II = 8 - 80 Hz = 480 - 4800 rpm III = 32 - 320 Hz = 1920 - 19200 rpm
Digital readout:	selector switch for Hz (FL/SEC) or RPM 5 place, 7-Segment LED, red, 10mm high
Accuracy:	readout in RPM ± 2 rpm readout in Hz (FL/SEC) 1/100±1 digit
Time base / Measuring cycle:	1s - every 2s
Control of flash frequency:	internal oscillator or external triggering selected by signal push button
Internal control:	by 10-stage helical potentiometer
External control:	by contact or pulse signal
Line synchronisation:	built-in, selected by signal push button
Phase shifter:	built-in, continuously adjustable from 1 to 330°
Connection box for flashlamp:	special socket (screwing type connection)
Flashlamp 600 GS/KS:	aluminium die-cast housing , hammer blow effect reflector swivel yoke , "ON/OFF"-switch for flash bulb, length of connection cable: 3 m
Mechanical data of flashlamp:	see page 10
Control unit:	softline housing of light metal, adjusting stand (every 30° snap in action)
Mechanical data for control unit:	width: 247 mm, height: 140 mm depth: 231 mm, weight: 7,500 kg

Special models of serie 600.00 at request

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Flashlamps:

Flashlamp Type GS

Flashlamp Type KS

Dimensions:	270 x 220 x 160 (GS) 180 x 160 x 130 (KS) wxhxd
Weight:	2,00 kg (GS) 1,40 kg (KS) 3,50 m standard
length of connection cable:	up to 10,0 m at request
13:	Linear, high-output Xenon flash bulb B11038 (GS) or B11058 (KS)
14:	“ ON – OFF “ - switch

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