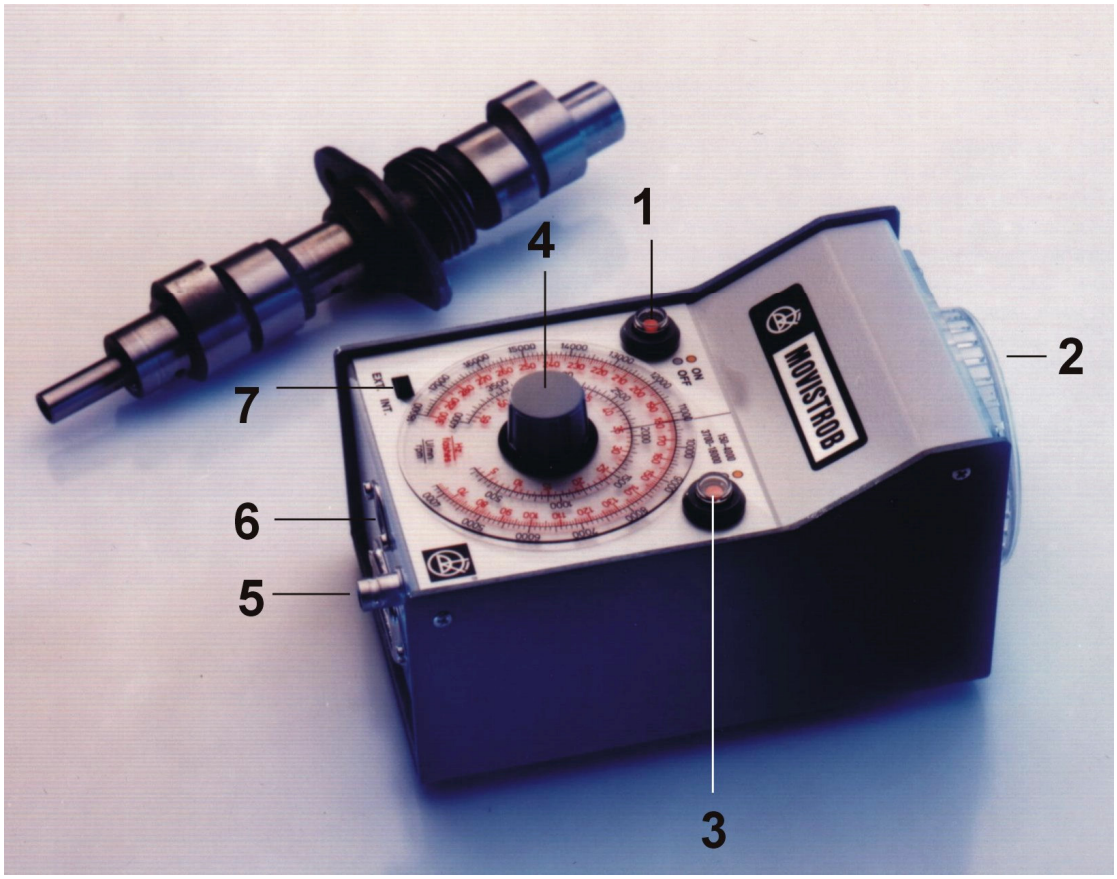
Instruction Manual

MOVISTROB Type 300.00; 350.00; 350.10



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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.
Microprocessor-controlled stroboscopes offer several advantages:

- Long term time stability 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.
All models of MOVISTROB® series 300 are microprocessor-controlled high-precision instruments.
They are equipped with Xenon longlife Flash Tubes, sources of intermittent white light with high luminance.
The flash rate is continuously adjustable from 150 to 18000 flashes/minute, equivalent to 2.5 to 300 Hz.
The average flash duration is about 6 µs.
Model 300.00 can be operated on internal synchronization only, whereas both models 350.00 and 350.10 provide external trigger facilities. In the following, we shall attend to type 350.10 for this unit offers all features of the 300 series models.
The stroboscope is housed in a lightweight steel casing (180 x 105 x 105 mm). Owing to its small weight, its compact and solid design and the neat arrangement of its controls, the unit can be easily carried 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!

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

The instrument carries the following controls and functional components (see fig.):

3.1 SIGNAL MAINS PUSHBUTTON (**1**)
switches on the instrument by depressing the pustbutton.
Red signal appears when ready to work.

3.2 SIGNAL FLASH FREQUENCY RANGE SELECTOR PUSHBOTTON (**3**)
for selection of desired flash range:

Push Button	Flashes/Min = RPM	Flashes/Sec = Hz
Low range (grey signal indicated)	150 - 4000	2.5 - 66.67
High range (red signal indicated)	3700 - 18000 (overlapping ranges)	61.67 - 300.

3.3 CONTROL KNOB with DIAL (**4**)
for continuous adjustment of flash frequency within the range selected by the range switch **(2)**.
The transparent dial provides two 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 BULB with TRANSPARENT FIBREGLASS REFLECTOR COVER(**2**)
The Xenon gas discharge tube is mounted within an 80 mm reflector 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 over from high to low range, the pulse amplitude and duration are increased to a certain extent.
Since the average pulse duration is only about 6 µs, the object will appear sharply defined, even at high speeds.

3.5 INPUT for EXTERNAL CONTROL (**6**) (does not apply for type 300.00)
A 5 contact receptacle is used for connection to an external source for controlling the flash rate (270° input socket).

CONTACTS OF TRIGGER INPUT:

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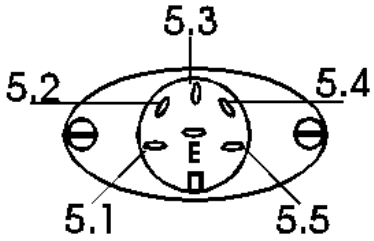

Pole 5.1/5.2 ***provide an DC voltage of 15 V / 0.6A***

Pole 5.3/5.4 ***are for connection of a closing contact.***
flash will be released on closing

Pole 5.4/5.5 ***are for connection of an electrical pulse generator within a range from 2 to 100 V.***

5.4 = Plus (+) Trigger / 5.5 = Minus (-) Trigger
Pole 5.1 = Plus (Vdd) IR or Induktiv Sensor / Pole 5.2 = Minus (Vss) Sensor

Make sure that "Mode Switch **EXT/INT (7)**" is switch on Position **"EXT"** when 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 Selection Button (**3**) for the flash frequency range in which the external synchronization frequency lies. In any case if the control impulse frequency exceeds the selected low range the higher range should be selected as a working range.
However, we recommend you initally select the highest range (61,67 to 300 Hz) in such cases.

3.6 BNC-OUTLET for CONNECTION of DIGITAL COUNTERS ETC **(5)**
(does not apply for models 350.00 and 300.00)
The BNC-Outlet is placed next to the input for external control **(5)**.
The pulse voltage is between 5 to 10 V making an average of 7 V.
The impedance does not exceed 10 KΩ.

3.7 MODE SWITCH **EXT / INT** for SELECTION of INTERNAL or EXTERNAL CONTROL **(7)**
serves to select the desired mode of synchronization.
The switch has to be set on position **"EXT"** when the flash frequency is to be controlled by an external source via "Trigger Input **(6)**".
On position **"INT"** the flash rate can be adjusted by means of Control Knob with Dial **(4)** within the selected range

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. Illuminate the object under test with the stroboscope and set the flash rate so that a stationary or slowly moving object is visible.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 synchronizing unit, the desired flash rate being set by the controls on the control panel. Select the flash rate range by pressing pushbutton **„3",** and make the exact adjustment within the selected range by means of control knob **„4".**

4.2 Operation with External Control
If the flash rate is to be controlled externally, by closing a contact, magnetic impulses or light impulses, the slide switch **„*7*"** must be placed in position ***„EXT".*** 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 ".
Select the frequency range (Pushbutton **„3"**) in which the external synchronizing frequency takes place.
In order to prevent the flash tube from overload be sure the pushbutton is not in the depressed position.
The low range may allow the trigger frequency to exceed the flash rate range.
The maximum permissible permanent flash rate (18000 RPM) may be exceeded for short periods (not more than 1 minute) up to maximum flash rate of 30000 RPM.
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**:

$$\mathbf{T = Tn = nr}$$

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

$$\mathbf{f = fn = 1\ v \div n}$$

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 in 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:

$$\mathbf{r = Tn+1 - Tn}$$

From this we derive the frequencies:

$$\mathbf{v = fn \bullet fn+1 \div fn - fn+1}$$

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.

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

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:

$$\mathbf{w' = 2\ v' = \frac{2\ \pi\ e}{T} = \frac{2\ \pi\ e}{(n+e)\ r} \quad \frac{2\ \pi\ e}{nr}}$$

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

$$\mathbf{w' = (e \div n) \bullet w}$$

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:

$$\mathbf{T = (n \div k)\ r \quad and\ /\ or \quad f = (k \div n)\ v,}$$

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

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

In addition, stopped images of phantom objects also occur for

$$\mathbf{T = (\ n \div k\ ) \bullet (\ r \div m\ )} \quad \text{and / or} \quad \mathbf{f = (\ k \div n\ )\ (\ m \bullet v\ )}$$

(**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 any mains 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 two screws on either side and four more screws on the bottom of the unit. 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 tube produces an uniterrupted flash sequency.
Remark
Do not use the flash bulb needlessly, as ist 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 inset of the housing is removed, the fuse 0.5 A (in case of 110V AC = 0.63) 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.

Technical Specifications

	Model 350.10	**Model 350.00**
Flash tube	Xenon white light tube 4-pin plug-in type	Specifications and technical data are as per model 350.10, but without BNC-Outlet for connection of digital counters.
Peak light intensity	approx. 550 lux	
Flash duration	approx. 2 - 7 µs	
Flashing-rate range	2.5 - 300 flashes/sec (Hz) equivalent to 150 - 18000 flashes/min = RPM in two overlapping ranges.	**Model 300.00** Specifications and technical data are as per model 350.10, but without BNC-Outlet for connetion of digital counters, input for external control and slide switch for external control. .Power cable not pluggable.
Accuracy	less than ± 2 % of dial reading	
External triggering	by mechanical contactor or pulse signals	
Housing	sheet-steel material	
weight	1.7 kg	
dimensions	180 x 105 x 105 mm	