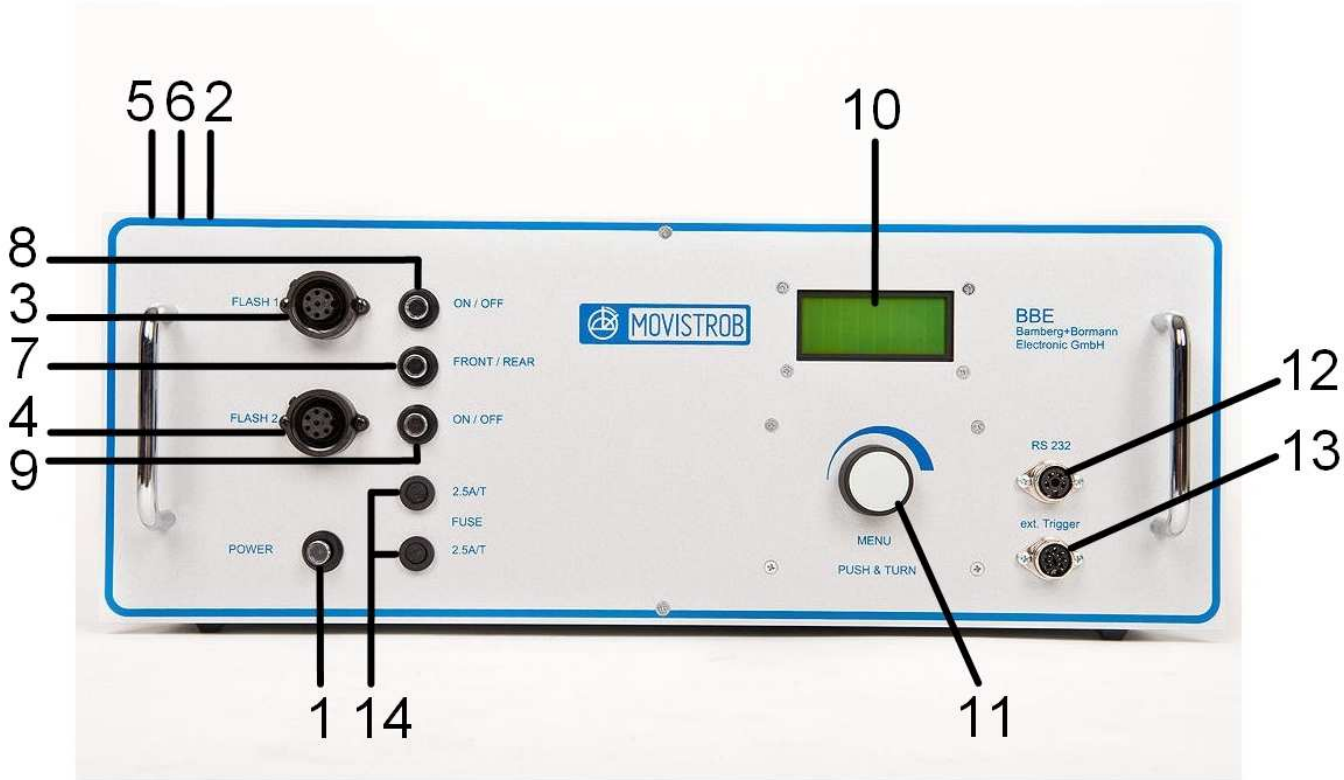
INSTRUCTION MANUAL

MOVISTROB® Series 600

High-power Stroboscope
Type 610.00 - 2GS / 19“



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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 610.00 – 2GS / 19”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 610.00 – 2GS / 19” is a processor-controlled, multi-functional high-power precision instrument. The MS 610.00 – 2GS / 19” high-output stroboscope consists of 2 components:

1. Control Unit containing the AC and generator sections as well as all operating controls.
2. Flashlamps 2 x Type **GS** od 2 x Type **KS** - 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, etc.
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 multi-function control knob **(Mfk)** on the control box (internal), 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 with the control knob allows a timed-pulse delay of up to 355°, 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 switching in one of the „LINE“ modes. Phase-shift is also possible in the “Line Pha” mode.

The flash rate is continuously adjustable from 60 to 19200 flashes/minute, equivalent to 1 to 320 Hz.
The average flash duration is about 3-7µs, depending on the frequency.
The unit offers a wide variety of features in a very compact light metal housing.

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 manufacturer only.

3. Controls and Indicators

Control Unit 610.00 – 2GS / 19”

3.1 OUTPUT SOCKET for Flashlamp GS / KS **(** front: **3** and **4** / back: **5** and **6)**
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 **(1)** must be reset in initial position "OFF" (black colour signal).

3.2 DISPLAY WINDOW (**10**)
Within the frame of the display window inserted in the control panel, the 10 mm high illuminated LC-Display numerals are easily readable.
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 "Hz" (flashes per second) readout is less than 0,02%.

3.3 RPM or FL/SEC (Hz) READOUT
By pushing and turning the **Mfk** (**11**) the the display changes through the different display modes: **Rpm** (= U/min) or **Hz** (= flashes/sec.).

3.4 ADJUSTMENT of the INTERNAL FLASH FREQUENCY
For continuous adjustment of the internal flash frequency which is infinitely variable within the frequency range turn the **Mfk (11)** (multi-function control knob) clockwise, as shown by the curve symbol, the flash frequency rises, when you turn it counterclockwise, it drops.

3.5 PHASE SHIFTER
Using the phase-shift modes „**ExtPhase“** or **„LinePha“** by pushing and turning the **Mfk (11)** the flash phase position can be moved infinitely up to 355° counter to the control impulses in external

triggering or line-synchronous operation, allowing observation of the test object in its various motion segments.

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

3.7 SIGNAL LINE POWER PUSHBUTTON **"POWER" (1)**
Switches on the stroboscope by depressing the pushbutton.
When depressed (red signal), the instrument is ready to work.

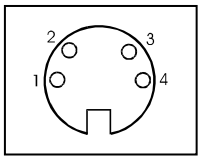
3.8 EXTERNAL CONTROL MODES **"Ext.Phase, Ext.Hz** and **Ext. Rpm"**
Serves to select the desired mode of synchronization.
With a connection of an external sensor / signal generator the flash frequency can be controlled by an external source via **"Trigger Input" (13)**. We recommend our Inductiv Sensor Type 915 or Infrared Sensor Type 910.

3.9 LINE SYNCHRONIZATION MODES **"Line Pha, Line Hz** and **Line Rpm"**
Using the line synchronisation modes by pushing and turning the **Mfk (11)** 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.

3.10 INPUT for EXTERNAL CONTROL **"Trigger Input" (13)**
A 7-pin diode input for connection of an external signal source (pulse generator, sensor, pickup etc.) in order to control the flash rate provided. For this operation the selected menue has to be one of the external control modes (see 3.8).

3.11 INPUT for RS 232 **(12)**
With this connection (5-pole DIN female connector) the stroboscope can be operated by remote control via PC.
Pin connection of data cable for serial interface:

1. Signal ground
2. serial input
3. serial output
4. n.c.



serial data cable (9pin / Sub.D)

Computer		Stroboscope
3	→	2
2	→	3
5	→	1
7-8	→	housing / diode plug
1-4-6		short circuit

3.12 **Flashlamp GS/KS** (see 8. Technical Data)
The flash tube (below) is mounted within the lamp which also has a separate "ON/OFF" switch to control power to the flash tube.

3.13 XENON QUARTZ HIGH-OUTPUT TUBE (see 8. Technical Data)
The extremely 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 SWITCH for front or back pair of flashlamps GS/KS (**7**)

Use this switch for alternating operation of the flash lamps (if 4 flash lamps are connected – 2 in front and 2 in back). It is only possible to run 2 flash lamps at the same time.
The signal push buttom shows „black" for FLASH 1+2 and „red" for FLASH 3+4.
The shown frequency - respectively triggerfrequency - is still readable in the display.

4. Menue:

By pushing (keep pressed) and turning the **Mfk** (**11**) the display changes through the different display modes.

Int. Hz	- internal control - display indication in „Hertz“ (Hz) - see 5.1
Int. Rpm	- internal control - display indication in revolutions per minute (Rpm) - see 5.1
Ext Phase	- external synchronisation - display indication of the phase-shift in degree - see 5.5
Ext HZ	- external synchronisation - display indication in Hertz (Hz) - see 5.2
Ext. Rpm	- external synchronisation - display indication in revolutions per minute (Rpm) - see 5.2
Line Pha	- mains synchronisation - display indication of the phase-shift in degree - see 5.5
Line Hz	- mains synchronisation - display indication in „Hertz“ (Hz) - see 5.4
Line Rpm	- mains synchronisation - display indication in revolutions per minute (Rpm) - see 5.4
Standby	- possible settings are 1 up to 10 minutes (in 1 minute steps) or “disabled” - see 5.6

5. 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 **(3/4)** and/or **(5/6)**.
Then connect the control unit to the AC mains with the shockproof plug and socket **(2)**.
Press the **„POWER“** pushbutton **(1)** and the unit is ready for use (signal pushbutton indicated “red”).
If four flashlamps are connected they can be used alternately by pressing signal pushbutton (**7**). Simultaneous use of all flashlamps is not possible.

5.1 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 adjust the flash frequency and match it with the object motion.
The working frequency can be seen on the screen of the LC Display (digital readout) **(10)**.
Continuous fine adjustment of the flash frequency within the selected frequency range is made with the multifunction knob (MFk) **(11)** for the internal flash frequency.
The working frequency can be seen in the LC display window as digital readout **(10)** in numerals that contrast well in daylight.
Readout can be chosen in RPM or FL/SEC (flashes per second) = Hz by push & turn of the Mfk **(11)**.

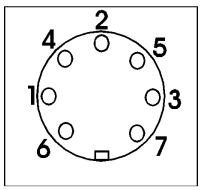
5.2 Operation with External Control

If the flash rate is to be controlled externally by closing a contact, magnetic impulses, light impulses or other pulse signals the mode „**Ext Hz“** for display indication in Hertz (Hz), **„Ext Rpm”** for display indication in revolutions per minute (Rpm) or **„Ext Phase“**for display indication of the phase-shift has to be chosen in the menue (by push & turn of the Mfk **(11)**). The flash phase position can be moved infinitely up to 355° in 1° steps.

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, marked as “EXT. TRIGGER” **(13)**. (see 5.3 – contacts of trigger input).

5.3 Contacts of trigger input **„EXT TRIGGER“ (8)**

Pin 7.1 - 15V+
Pin 7.2 - Ground / Minus – Trigger
Pin 7.3 – not connected
Pin 7.4 - not connected
Pin 7.5 - Ground
Pin 7.6 - Trigger Plus (Umax. 24V TTL)
Pin 7.7 – not connected



Closing contacts (short circuit) – pin 7.2 and 7.5 (Ground), switching contact (+) 7.1 and 7.6
Operation with sensor – Pin 7.2 and 7.5 (Ground), switching contact respective sensor output in input 7.6
Supply voltage – Pin 7.1 (+) and 7.2 (Ground)

When triggering via closing contacts, control circuit resistance should not exceed 100 Ohm when contacts are closed. Back-to-back operation is permissible. The short-circuit current is under 2 mA , i.e. below the 30 mA 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 24 V. The response cycle lies at 10 V (TTL). We recommend our photoelectric (IR) Sensor type 910 as well as our inductiv Sensor type 915. In order to protect the flash bulb against damage an automatic cutoff will be activated as soon as the flash frequency exceeds 320 Hz. However the display will continue indicating the trigger frequency.

5.4 Mains Synchronous Operation

In the mains synchronisation mode **"LINE"** the line frequency is automatically fed in - usually 50 or 60 Hz. Like in operation with external control the triggering can be displayed in **Hz**, **Rpm** and **Phase.** The flash phase position in **"LINE PHA"** can be moved infinitely up to 355° in 1° steps (see 5.5).

5.5 Phase Shift Modes

In mains synchronous mode (**"Line Pha"**) or operation with external control (**"Ext Phase"**) the phase shift allows observation of the test object in its various motion segments.
Using the phase-shift mode the flash phase position can be moved infinitely up to 355° in 1° steps (see 5.5). Change the phase position by turning the multi-function control knob **(11)**. Angelar degrees will be shown on display.

5.6 Standby Time

In menue item **„Standby"** the time is adjustable in the range **1 to 10 minutes** in 1 minute steps or „**disabled**". The Standby time has a **preset of 5 minutes** (factory-adjusted). Turn the **Mfk (11)** until the desired time is displayed.
By pushing and turning the **Mfk (11)** to the left the different display modes are available again.

If setting „**disabled**" is used the timer is unoperative and the stroboscope will operate continuously.
Note: Continous operation will reduce the lifetime of the flashbulb.

After the set time is expired the stroboscope will stop flashing. „**Standby**" is shown in the display.
By pushing or turning the **Mfk (11)** the device starts to run again.

6. Replacing Flash Tube or Fuse

CAUTION: Always disconnect the unit from the power source before servicing.
While the built-in condensers are self-discharging, you should wait at least 8 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 or use the standy function in cases of long intervals in between the measuring or motion control actions.

6.1 Replacing the fuse

The fuse-holders are located on the front side of the control unit **(14)**. For 230V AC operation two 2.5A T fuses are installed; for 115V AC two 4A T fuses.
Release the fuse holder by push and left-turn. Replace the fuse and insert the fuse holder again.

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 damage, no sign of functioning or stress beyond the tolerable limits.
Repair, replacing parts, calibration etc. 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.

8. Technical Data MS 610.00

Power supply:
230 V AC, 50-60 Hz
115 V AC on request

Power consumption:
ca. 185 VA

Flash Tube:
socket mounted Xenon quarz
rod shapped flash bulb

Light intensity:
max. 6000 lux in 50 cm distance from reflector (beam axis)

Flash duration:
depending on frequency range 3 – 7 µs

Frequency range:
1 Hz - 320 Hz = 60 U/min - 19200 U/min

Range switching:
automatically

Digital readout:
2 lines LC Display with 8 charakters
10 mm high, illuminated display

Accuracy:
readout in RPM ± 1 rpm
readout in Hz (FL/SEC) max. 0,02%
(2 digits after decimal point)

Trigger action:
internal oscillator, external triggering or mains synchronous

Phase shifter:
continuously adjustable from 1 to 330°

Connection of light source:
special socketS (screwing type)
max. 4 light sources, alternating operation of the 2 flash lamps at the same time time

Control of flash frequency:
internal oscillator, external triggering or mains synchronous

Input for external triggering:

7-pole DIN female connector with bayonet cap connection by

Seriel Interface:

5-pole DIN female connector with bayonet cap, PC RS 232 interface

Light source:

Light source with swivel yoke and tripod mount, "ON-OFF"-switch for flash bulb, and 3 m connection cable (up to 10 m on request)

Dimensions of Light source:

L x H x D / Weight

365 x 235 x 198 mm / 4,2 Kg **(GS)**

190 x 155 x 130 mm / 1,6 Kg **(KS)**

Control unit:

Light metal system housing, Powder-coated, silver,

Dimensions of control unit:

Width housing: 440 mm, front panel: 482mm,

Height: 182 mm, (incl. rubber foot),

Depth: 493 mm,

Weight: 12,4 kg

Accessories:

Inductive sensor Type 915 , Infrared Sensor Type 910, Protective Spectacles Type 950.01

High Performence Light Source Type 600 GS

Type 600 GS

High Performence Light Source Type 600 KS

Type 600 KS

Dimensions:	**365 x 235 x 198 (GS) 190 x 155 x 130 (KS)**
Weight:	**4,00 kg (GS) 1,60 kg (KS)**
Length of connection cable:	**3,50 m standard up to 10,0 m at request**
15	**Linear, high-output Xenon flash bulb, B11038 (GS)**
16	**Linear, high-output Xenon flash bulb, B11058 (KS)**
17	**“ ON – OFF “ - switch**

March 2013

9. 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 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.