4913
4915

Instruction Manual

Digital Stroboscope Type 4913
Fibre-Optic Source Type 4915

Type 4913 is a combined Stroboscope/-Tachometer for visual investigation and accurate measurement of rapid, repetitive motion, mechanical resonances, vibration etc. It includes a hand-held Lamp Unit US 0008 and may be triggered from an int. generator, power line or ext. tachometer signal to provide a stationary or slow moving image of objects with motion frequency from 5 Hz to 10 kHz (0,3 to 600 k r/min). Separate modes with adjustable time and phase delay permit observation at any required point in the motion cycle. In addition a built-in 4-digit display facilitates direct reading of motion frequency or speed, time or phase delay.

As extra Type 4913 can be coupled with the Fibre-Optic Source Type 4915. This has a resilient 1,8 m long fibre-optic cable AE 6000 and outputs a convenient point source of illumination that is ideal for stroboscopic examination of small components, intricate mechanisms and microscope specimens. For internal inspection of engines and other machinery, an Endoscope Probe can be connected.

Brüel & Kjær

1–033 0689-1A
BE-0689

DIGITAL STROBOSCOPE TYPE 4913
AND
FIBRE-OPTIC STROBOSCOPE SOURCE TYPE 4915

From serial no. 968661 and 1021484 respectively

June 1982

SAFETY CONSIDERATIONS

Types 4913 and 4915 have been designed and tested according to Class II of IEC Publication 348, Safety Requirements for Electronic Measuring Apparatus, and have been supplied in safe condition. The present Instruction Manual contains information and warnings which should be followed by the user to ensure safe operation and to retain the instruments in safe condition. Special note should be made of the following:

APPLICATION OF POWER

Before each use of Stroboscope Type 4913, check that it is set to match the available mains voltage and that the correct fuse is installed.

SAFETY SYMBOLS

The apparatus will be marked with this symbol when it is important that the user refer to the associated warning statements given in the Instruction Manual.

 Chassis terminal  Earth or ground terminal  Hazardous voltage

WARNINGS

Keep Types 4913 and 4915 well away from volatile liquids and gasses and operate only in well ventilated environments.

Whenever it is likely that the correct function or operating safety of one or other of the instruments has been impaired, they must be made inoperative and be secured against unintended operation.

Any internal adjustment, maintenance or repair of the instruments must be avoided as far as possible and, if unavoidable, must be carried out only by trained service personnel.

CONTENTS

Digital Stroboscope and Fibre-Optic Source

USES:

- *Investigation of repetitive, high-speed motion with engines and machines etc.*
- *Mechanical design, development and trouble shooting aid*
- *Resonance search and vibration mode study tests*
- *Stroboscopic photography with time or phase delay*
- *Internal inspection of machinery plus examination of microscope specimens*

FEATURES:

- *Combined motion analyzer/tachometer*
- *Slow motion frequency plus phase and time delay adjustments*
- *Synchronization with internal generator, line or external trigger source*
- *Automatic tracking of motion frequency plus remote control*
- *4-digit display of motion frequency/speed, phase-/time delay, slow motion frequency/speed*

The Brüel & Kjær Type 4913 is a versatile instrument with the combined function of stroboscopic motion analyzer and tachometer. Using its high intensity flash source a stationary or slow moving stroboscopic image of all kinds of rapid, repetitive motion can be obtained, making it extremely easy to observe the precise action and motion eccentricities of vibration test components, engines, machines etc.

The flash rate may be synchronized with motion frequencies from 5 Hz to 10 kHz (0,3 to 600 k r/min) and can be triggered from an internal generator, power line or external tachometer signal such as from a Photoelectric Probe MM 0012 or Magnetic Probe MM 0002. Separate modes with adjustable time and phase delay facilitate measurement and observation at any required point in the motion cycle and a "Slow Motion" mode permits subjects to be viewed with an apparent motion frequency of 0,05 to 5 Hz.

Using the built-in 4-digit display an accurate indication of motion frequency or speed, time or phase delay can be obtained which is useful for both measurements and setting-up of the instrument. Additional features are choice of local or remote control, plus single flash operation for photograhic purposes.

As an optional light source Type 4913 can be coupled with the Fibre-Optic Stroboscope Source Type 4915. Light transmission is via a resilient 1,8 m long fibre-optic cable AE 6000 which outputs a convenient point source of illumination that is ideal for stroboscopic examination of small mechanical components, intricate mechanisms and microscope specimens etc.

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BP 0013

Furthermore by coupling the light output of AE 6000 with a matching Endoscope Probe as shown overleaf, inspection of internal surfaces, bearings and working mechanisms actually hidden inside engines and machines is possible. A wide range of suitable probes are available from the West German Companies Richard Wolf GmbH and Karl Storz GmbH. For fitting the 4915 with other fibre-optic systems, a blank coupler is included.

Specifications 4913

LIGHT SOURCE:
Hand-held Lamp Unit US 0008 with 40 Watt Xenon-filled flash tube included. Provides tightly collimated, cold-light flash beam and has integral 3 m long cable plus 3/8″ UNC tripod fastening thread
Flash Duration: ~3 µs at half peak intensity
Average Illuminance: ~17 k lux at 250 mm (10 in) from lamp, 7 k lux at 500 mm (20 in) and 2 k lux at 1 m (40 in)
Min. Lamp Life: 75 million single flashes, or 200 hours at maximum flash rate of 100 Hz for 50% reduction in light output

FREQUENCY RANGES:
Int. Generator: 5 to 105 Hz (300 to 6300 r/min)
Ext. Trigger: 0 to 10 kHz (0 to 600 k r/min)

OPERATING MODES:
Light Off: Flash ignition disconnected, but display operates for use as tachometer
Phase Delay: 0° to 360° adjustment, phase locked to Int., Ext. or Line source
Time Delay: 0 to 3,6 s adjustment, synchronized with Int., Ext. or Line source
Slow Motion: Apparent motion frequency adjustable from 0,05 to 5 Hz (3 to 300 r/min), synchronized with Int., Ext. or Line source
Double Flash: Similar to phase Delay, but providing double image at complementary points in motion cycle. At trigger frequencies above 50 Hz, repetitive single flash is obtained

DISPLAY AND INDICATING MODES:
4-digit LED display, 7-segment numerals 18 mm (0,7 in) high
Trigger Freq: 5 to 9999 Hz or 300 r/min to 600 k r/min to within ±0,3 % +1 digit
Delay: 0 to 360° phase delay to nearest degree, 0 to 3,6 s time delay to nearest 0,2 ms or better
Slow Motion Freq: 0,05 to 5 Hz or 3 to 300 r/min to within ±1 digit

EXT. TRIGGER INPUT:
BNT coaxial socket for triggering via tachometer probe or external source providing periodic electrical signal
Input Voltage: 100 mV to 30 V Pk-Pk
Input Impedance: ~50 kΩ
DC Output: +8 V (50 mA max) DC for powering an external tachometer probe

SINGLE FLASH INPUT:
BNT coaxial socket for remote activation of single flash via camera or electrical pulse. Single flash synchronized with Ext. or Line source and including phase or time delay set on instrument is also possible
Input Pulse: +15 V Pk. Minimum width 2 µs
Minimum Delay: 5 µs
Input Impedance: ~100 kΩ

SIGNAL OUTPUT:
6-pin DIN socket providing flash trigger and ignition reference pulses for use of Fibre-Optic Stroboscope Source Type 4915 or Portable Stroboscope Type 4912 as an auxiliary light source
Output Pulses: +15 V, ~2 ms.
Max. Load: 100 Ω

REMOTE CONTROL:
Remote selection of Light Off, Slow Motion or Phase Delay mode, plus adjustment of Phase Delay via 6-pin DIN socket

ELECTROMAGNETIC COMPATIBILITY:
Complies with Class B computing device of American FCC (Federal Communication Commission) Rules

ENVIRONMENT:
Temperature Range: -10 to 55°C (+14 to 131°F)
Humidity: 0 to 90% RH non-condensing

POWER REQUIREMENTS:
100;115;127;200;220;240 V (50 to 60 Hz) ±10% AC; 45 VA. Complies with Safety Class II of IEC 348

DIMENSIONS:
Control Unit, excluding knobs and feet
Height: 132,6 mm (5,2 in)
Width: 209,5 mm (8,3 in)
Depth: 200 mm (7,9 in)
(B & K modular cabinet KK 0025, 6/12 of 19″ rack module)

WEIGHT:
Control Unit: 5,2 kg (11,5 lbs)
Lamp Unit: 0,8 kg (1,8 lbs)

ACCESSORIES INCLUDED:

1 × Lamp Unit	US 0008
1 × 3/8″-1/4″ UNC Tripod Bush	DB 2164
1 × BNC Plug	JP 0035
2 × BNT Plug	JP 0315
2 × 6-pin Plug	JP 0601
1 × Camera Flash Contact Cable	AQ 0375
1 × Power Cable	AN 0020

ACCESSORIES AVAILABLE:

Photoelectric Probe	MM 0012
Magnetic Probe	MM 0002

Specifications 4915

LIGHT SOURCE:
Modular unit containing 40 Watt Xenon-filled flash tube. Includes 1,8 m flexible Fibre-Optic Cable AE 6000 and transmits a 4,5 mm diameter cold-light flash beam with radiation angle of approximately 60°
Flash Duration:
Normal: ~3 µs
Photo: ~150 µs
(half peak intensity):
Average Illuminance:
Normal: ~12 k lux at 25 mm (1 in) and 1,4 k lux at 100 mm (4 in) from cable output
Photo: ~50 times peak intensity of normal mode
Lamp Life:
Normal: ~75 million single flashes, or 200 hours at maximum flash rate of 100 Hz
Photo: ~1 thousand single flashes for 50% reduction in light output

OPERATING MODES:
Normal: as with Type 4913
Photo: manual or remote activation high intensity single flash via camera flash contacts or electrical pulse. Reset time ~30 s

ELECTROMAGNETIC COMPATIBILITY:
Complies with Class B computing device of American FCC (Federal Communication Commission) Rules

ENVIRONMENT:
Temperature Range: -10 to 55°C (+14 to 131°F)
Humidity: 0 to 90% RH non-condensing

POWER REQUIREMENTS: via Stroboscope Type 4913

DIMENSIONS:
Metal cabinet, excluding knobs and feet
Height: 132,6 mm (5,2 in)
Width: 139,5 mm (5,5 in)
Depth: 200 mm (7,9 in)
(B & K modular cabinet KK 0024, 4/12 of 19″ rack module)

WEIGHT: 2,5 kg (5,5 lbs)

ACCESSORIES INCLUDED:

1 x Fibre-Optic Cable	AE 6000
1 x Output Coupler (4,5 mm Dia.)	UA 0726
1 x Blank Output Coupler	DB 2484

ACCESSORIES AVAILABLE:
Endoscope Probes are available from Richard Wolf GmbH and Karl Storz GmbH of West Germany. For details on your nearest Wolf or Storz agent, consult your local B & K representative

2. CONTROLS

2.1. DIGITAL STROBOSCOPE TYPE 4913

2.1.1. Front Panel

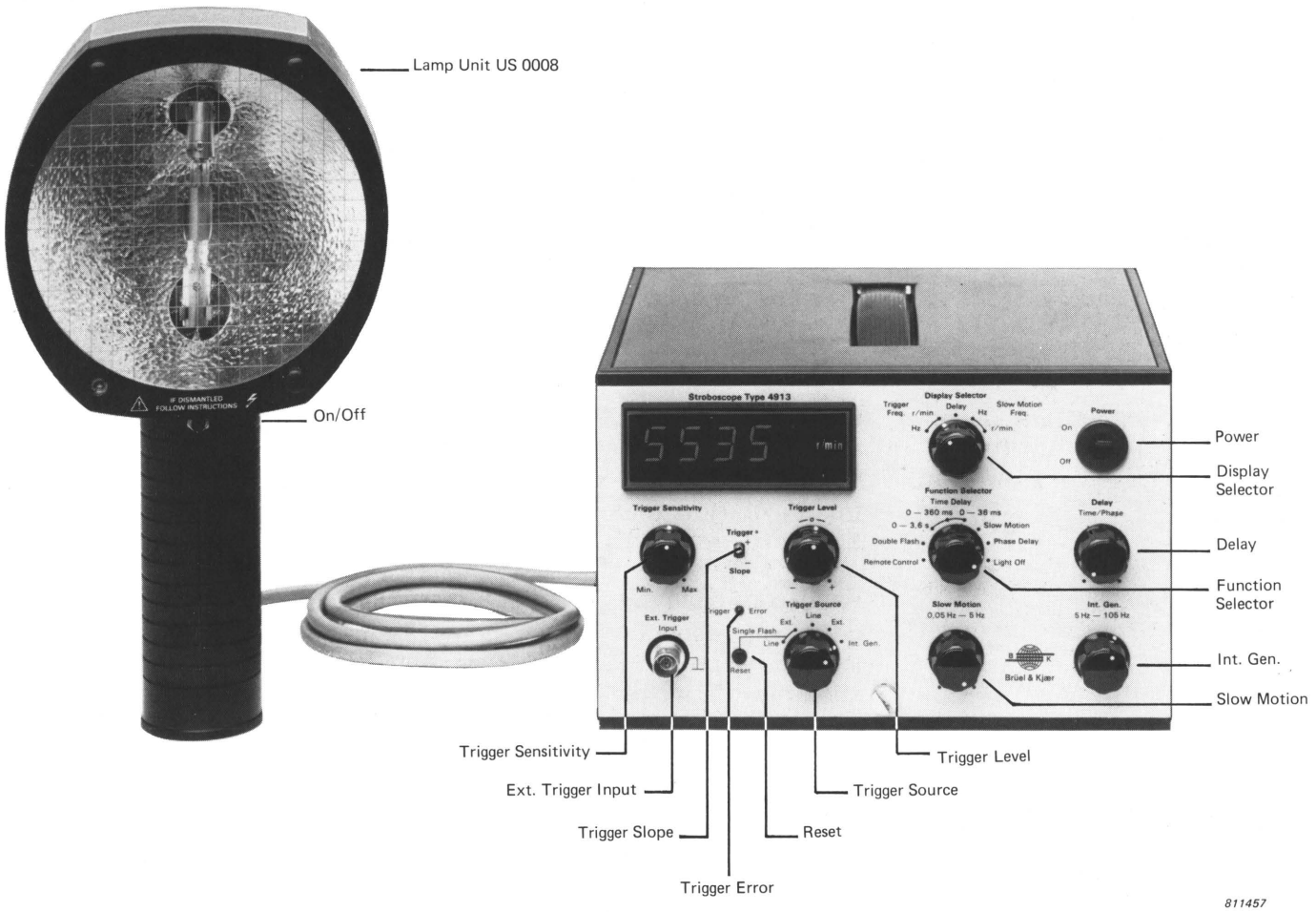

Fig. 2.1. Front panel of Stroboscope Type 4913 and Lamp Unit US 0008

LAMP UNIT US 0008:

Hand-held flash unit with integral 3 m (10 ft) long drive cable for connection to the LAMP OUTPUT socket on the rear panel of the Stroboscope Type 4913. At the top of the hand grip is an "On"/"Off" button for internal connection or disconnection of the lamp drive, whilst in the base is a 3/8″ UNC threaded hole for fastening the unit on a Portable Tripod UA 0587 or other similar support. To help safeguard the Xenon flash tube, the lamp housing has a reinforced polycarbonate window.

SHOCK HAZARD: Before each use of the 4913 make sure that the lamp drive cable is properly secured so that it does not become entangled with operating machinery which may sever the high voltage drive lines of the cable. Also avoid dismantling the lamp unit without first referring to Chapter 5 of this Manual, or the separate Service Manual provided.

POWER:

"On"/"Off" switch for mains power. When it is set to "On", the 4-digit LED (Light Emitting Diode) DISPLAY of the 4913 should light.

DISPLAY SELECTOR:

5-position switch for selecting the following indicating modes with the 4-digit LED DISPLAY.

"Trigger Freq.". Two positions for display of internal generator or external trigger frequency in "Hz" or equivalent operating speed in "r/min". With the internal generator selected as the trigger source, the display range is from 5 to 105 Hz or 300 to 6300 r/min respectively, whilst with an external trigger source it is from 5 to 10 kHz or 300 to 600 k r/min respectively.

"Delay". Single position for display of phase or time delay of the flash ignition with respect to trigger signal. Display range 0 to 360° and 0 to 3,6 s.

"Slow Motion". Two positions indicating the apparent frequency "Hz" or speed "r/min" of the perceived image obtained with the "Slow Motion" FUNCTION SELECTOR mode. Display range is from 0,05 to 5 Hz and 3 to 300 r/min respectively.

FUNCTION SELECTOR:

8-position switch for selecting the following operating modes.

"Light Off". Stand by - lamp off mode with display of phase delay, trigger or slow motion frequency readout chosen with the DISPLAY SELECTOR.

"Phase Delay". Selects flash ignition with adjustable 0 to 360° phase delay with respect to trigger signal. Permits stationary image of rotating and reciprocating machinery to be obtained, which using the DELAY knob may be moved through one complete motion cycle. See section 3.2.2.

"Slow Motion". Selects flash ignition synchronized with the fundamental (or sub-multiple) of the trigger signal minus the frequency set with the "Slow Motion" knob. Permits slow moving image of rotating and reciprocating machinery to be obtained, whose apparent frequency (or speed) may be adjusted from approximately 0,05 to 5 Hz (3 to 300 r/min) regardless of the motion frequency or operating speed of the machinery. See section 3.2.4.

"Time Delay". Selects flash ignition with adjustable "0-36 ms", "0-360 ms" or "0-3,6 s" time delay with respect to trigger signal. Permits stationary image of rotating and reciprocating machinery to be obtained, which may be moved through part or one or more motion cycles using the DELAY knob. The "Time Delay" setting, may also be used in photographing of single events. See sections 3.2.3 and 3.6 respectively.

"Double Flash". Selects double flash ignition synchronized with the "Line" or "Ext." TRIGGER SOURCE modes. It permits a stationary double image of rotating and reciprocating machine parts to be obtained at two complementary points (ie., 180° apart) in the motion cycle which may be moved through one complete motion cycle using the DELAY knob. When "Int. Gen." is selected or the frequency of the external trigger source exceeds aproximately 50 Hz, operation is as with the "Phase Delay" setting. See section 3.5.

"Remote Control". Permits remote selection of "Light Off", "Phase Delay" or "Slow Motion" mode plus remote adjustment of the phase delay via the REMOTE CONTROL INPUT socket on the rear panel of the 4913. See section 3.8.

DELAY:

Single-turn control for adjustment of the phase or time delay of the flash ignition with respect to the trigger signal. The range of adjustment is from 0 to 360° and 0 to 3,6 s respectively. For operation without phase or time delay, the DELAY knob should be set to its extreme anticlockwise position.

SLOW MOTION:

Single-turn control for adjustment of the perceived slow motion frequency from 0,05 to 5 Hz or speed from 3 to 300 r/min.

INT. GEN:

10-turn control for adjusting the internal generator frequency from 5 to 105 Hz (ie., 300 to 6300 r/min).

TRIGGER SOURCE:

5-position switch for selection of the following trigger modes.

"Single Flash - Line". Selects single flash ignition synchronized with the AC mains source used to power the 4913, but triggered manually via the RESET button on the front panel, or remotely via SINGLE FLASH INPUT on the rear panel. Is intended for photographic purposes. See section 3.6.

"Single Flash - Ext.". Selects single flash ignition synchronized with the EXT. TRIGGER INPUT signal, but triggered manually via the RESET button on the front panel, or remotely via the SINGLE FLASH INPUT on the rear panel. Is intended for photographic purposes. See Section 3.6.

"Line". Selects operation as stroboscope with flash ignition triggered by the AC mains source used to power the 4913. The lamp flashes at the line frequency of the mains source. See section 3.4.

"Ext.". Selects operation as stroboscope and/or tachometer, with flash ignition triggered by the EXT. TRIGGER INPUT signal. The lamp flashes in synchronism with the trigger signal at frequencies up to approximately 110 Hz. If the trigger frequency exceeds 110 Hz, the lamp will flash in synchronism with the highest sub-multiple of the trigger frequency below 110 Hz. With no external signal present at the EXT. TRIGGER INPUT, the lamp will normally be kept extinguished except when the slow motion mode is employed. See section 3.3.

"Int. Gen.". Selects operation as free running stroboscope, with flash ignition triggered by the internal generator of the 4913. The frequency at which the lamp flashes may be adjusted from 5 to 105 Hz and is set by the INT. GEN. knob. See section 3.2.

RESET: Push button for manual trigger of single flash ignition when the "Single Flash - Line" or "Single Flash - Ext." TRIGGER SOURCE mode is selected.

TRIGGER ERROR: A LED indicator which when lit warns that EXT. TRIGGER INPUT signal is absent, trigger signal is not periodic or TRIGGER LEVEL knob is incorrectly set.

EXT. TRIGGER INPUT: 3-pole coaxial socket accepting the standard BNT plug JP 0315 or BNC plug JP 0035 supplied. The centre pin of the socket is for application of an external signal to trigger the flash ignition and/or use of the 4913 as a tachometer. The middle contact (see Fig. 2.2) outputs +8 V (50 mA max.) DC for powering an active tachometer probe such as the B & K MM 0012, whilst the outer screen is ground and is internally connected to chassis. The trigger input has an input impedance of 50 kΩ in series with 680 nF and is triggered by signals between 100 mV and 30 V Peak-Peak with repetition frequency up to 10 kHz (6000 kr/min) and minimum pulse width of 5 μs. See section 3.3.

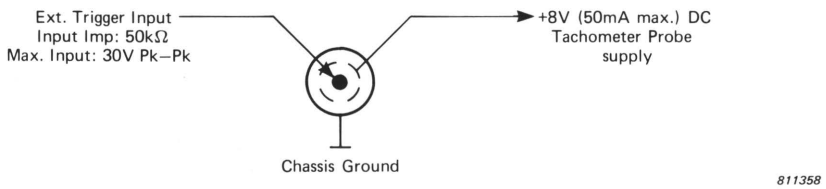

Fig. 2.2. EXT. TRIGGER INPUT (external view)

TRIGGER SLOPE: 2-position switch for selecting triggering on positive or negative going slope of external trigger signal waveform.

TRIGGER SENSITIVITY: Single-turn control enabling EXT. TRIGGER INPUT signal levels from approximately 100 mV to 30 V Peak-Peak to be accommodated when set for max. and min. input sensitivity respectively

TRIGGER LEVEL: Single-turn control for adjusting voltage at which the 4913 is triggered by the EXT. TRIGGER INPUT signal. The approximate range of adjustment is -0,4 V to +0,4 V with TRIGGER SENSITIVITY set to "Max." and -30 V to +30 V with TRIGGER SENSITIVITY set to "Min."

2.1.2. Rear Panel

LAMP OUTPUT: 4-pin insulated socket carrying high voltage drive and ignition lines for connection to the drive cable plug of the Lamp Unit US 0008 or the LAMP INPUT plug of the Fibre-Optic Stroboscope Source Type 4915.

⚠ **WARNING!** The Lamp Unit US 0006 supplied with earlier types of B & K stroboscope is not designed for operation with the 4913 and will damage the 4913 if connected to the LAMP OUTPUT socket

SIGNAL OUTPUT: 6-pin socket supplying flash trigger and flash ignition reference pulses for synchronization of an auxilliary light source, such as the Portable Stroboscope Type 4912 or the Fibre-Optic Stroboscope Source Type 4915. It accepts a DIN plug such as the B & K plug JP 0600 with screw lock provided. For connections see section 3.7 and Chapter 5 respectively.

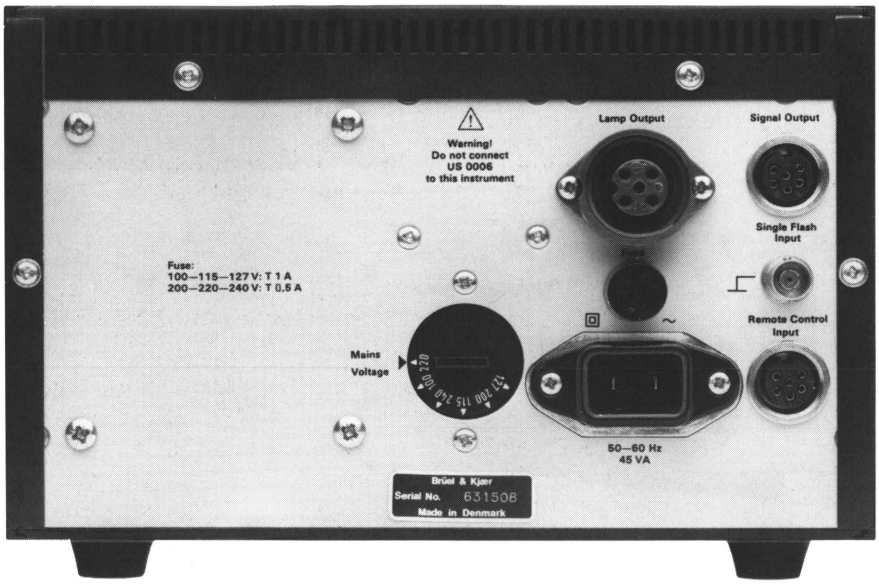

Fig. 2.3. Rear panel of the Stroboscope Type 4913

SINGLE FLASH INPUT:

3-pole coaxial socket accepting the standard BNT plug JP 0315, BNC plug JP 0035 or Camera Flash Contact Cable AQ 0375 provided. Is used for remote trigger of single flash ignition using an electrical pulse or the flash contacts of a camera as described in section 3.6. The identities of its centre contact and double screen are indicated in Fig. 2.4.

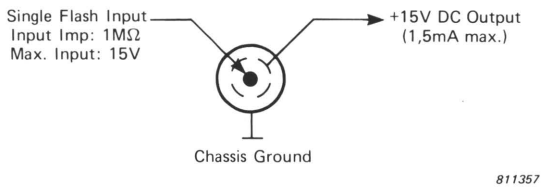

Fig. 2.4. SINGLE FLASH INPUT socket (external view)

REMOTE CONTROL INPUT:

6-pin socket with control lines for remote adjustment of phase delay and selection of either "Slow Motion" or "Light Off" modes. It is operative when the FUNCTION SELECTOR is set to "Remote Control" and accepts a DIN plug such as the B & K plug JP 0600 with screw lock provided. For connections, see section 3.8.

MAINS VOLTAGE:

6-position switch for selection of the correct mains voltage setting as described in section 3.1.3.

FUSE:

Fuse holder, accepting a 1 A slow blow fuse (B & K no. VF 0013) for 100 to 127 V mains operation or a 0,5 A slow blow fuse (B & K no. VF 0023) for 200 to 240 V mains operation. To check and fit the appropriate fuse, see section 3.1.3.

AC MAINS INPUT:

2-pin socket accepting the Power Cable AN 0020 provided for connection of a 100; 115; 127; 200; 220 or 240 V ±10% (50 to 60 Hz) single phase AC mains supply. Before connecting a supply, the mains voltage setting and fuse checks given in section 3.1.3 should be carried out to ensure safe operation of the instrument.

2.2. FIBRE–OPTIC STROBOSCOPE SOURCE TYPE 4915

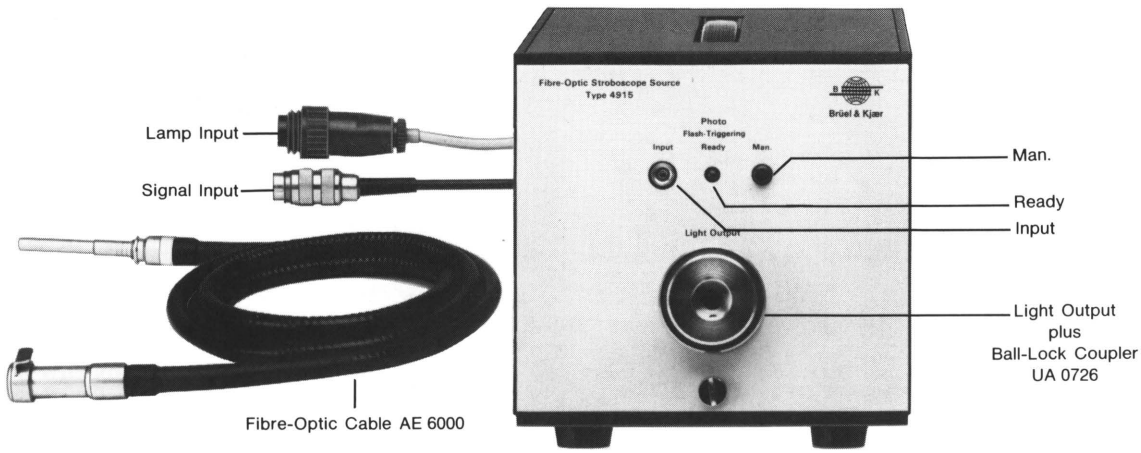

Fig. 2.5. The Fibre-Optic Stroboscope Source Type 4915

LAMP INPUT: Integral cable plus 4-pin plug with screw-lock for direct connection with the high voltage lamp drive and ignition lines of the LAMP OUTPUT socket on the 4913.

SIGNAL INPUT: Integral cable plus 6-pin plug with screw-lock for direct connection with the flash trigger lines of the SIGNAL OUTPUT socket on the 4913

PHOTO FLASH TRIGGERING:

MAN: Push button for manual trigger of single "Photo" flash ignition, synchronized with the "Int. Generator", "Ext." or "Line" TRIGGER SOURCE mode of the 4913. For use with the "Single Flash - Ext." and "Single Flash - Line" TRIGGER SOURCE modes of the 4913, first press the RESET and MAN. buttons of the 4913 and 4915 when the READY LED is lit and then press the RESET button once again to trigger flash ignition. See section 4.3.

READY: A LED indicator which when lit indicates that the 4915 is charged and ready for local or remote trigger of single "Photo" flash ignition

INPUT: 3-pole coaxial socket accepting the Flash Contact Cable AQ 0375 provided with the 4913. Is used for remote trigger of single "Photo" flash ignition via the flash contacts of a camera when the "Int. Generator", "Ext." or "Line" TRIGGER SOURCE mode of the 4913 is selected. See section 4.3.

LIGHT OUTPUT: 24 mm diameter, 1 mm pitch screw flange plus Ball-Lock Coupler UA 0726 for transmission of the light output of the 4915 via the flexible Fibre-Optic Cable AE 6000 supplied. For use with other types of fibre-optic cable, a Blank Coupler DB 2484 is provided. See section 4.1.3.

FIBRE–OPTIC CABLE AE 6000: 1,8 m long, 4,5 mm diameter flexible light guide. The input face of the cable (narrow tapered end) push fits the Ball-Lock Coupler UA 0726 of LIGHT OUTPUT exit of the 4915. For clip fastening of an Endoscope Probe, the output face has a metal collar with release catch attached. Do not sharply bend or twist the cable as this can damage it.

3. OPERATION WITH LAMP UNIT US 0008

3.1. PRELIMINARY

3.1.1. Environment and Handling

The Stroboscope Type 4913 plus its associated Lamp Unit US 0008 are designed to be operated in environments with ambient temperature from -10 to +55°C (+14 to 131°F) and humidities up to 90% RH (non-condensing). For safe operation avoid use in environments containing volatile gasses and liquids. Also verify that the 4913 is set to match the available supply voltage and that the correct fuse is installed before each use of the instrument.

3.1.2. Mounting

To facilitate easy adjustment of its controls, the 4913 is generally best employed close to the subject to be investigated. For this purpose a flat, vibration free surface should be chosen where it may be used free-standing without risk of it falling into operating machinery or of its lamp cable becoming entangled with machine parts. To aid viewing of the instrument, its front may be raised by folding down the metal stand attached to its front feet.

Fig. 3.1. The Lamp Unit US 0008, plus Stroboscope Type 4913 with front raised using the metal stand on the base of the instrument

Regarding use of the Lamp Unit US 0008 with the 4913, this may be held by hand or mounted on a tripod or similar support. A 3/8″ UNC camera tripod mounting thread is provided in the base of the lamp's hand-grip. The Lamp Unit provides a narrow concentrated light beam and may be used at a distance of up to 3 metres away from the subject even in fairly bright ambient lighting conditions. The typical light output characteristics of the lamp as a function of lamp - subject distance and angle of incidence from optical centre are indicated in Table 3.1 and Fig 3.2 respectively.

Lamp - Subject Distance	0,125	0,25	0,5	0,75	1,0	m
Average Flash illuminance	25	17	7	4	2	k lux

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Table 3.1. Average flash illuminance of US 0008 as a function of lamp - subject distance at flash rates greater than 50 Hz

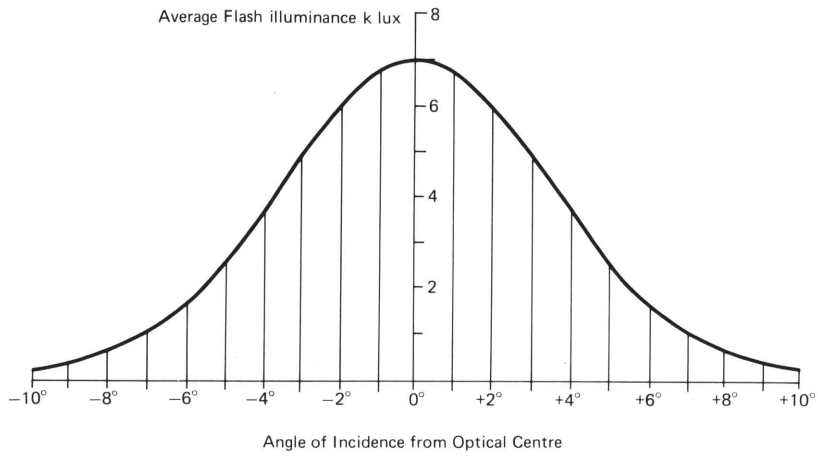

Fig. 3.2. Average flash illuminance of US 0008 as function of angle of incidence from optical centre with lamp - subject distance of 0,5m

Optional types of mounting for use with the 4913 are the Carrying Case KA 2004 for protection of the instrument during transport and the Metal Frame KK 0014 for mounting it in a standard 19 inch instrumentation rack. Both can accommodate two modular instruments the same size as the 4913, however, for installation in the Metal Frame the four feet of the 4913 must first be unscrewed. For further information on rack mounting of B & K instruments, the B & K Short Form Catalogue should be consulted.

3.1.3. Connection of Mains Supply

Before connecting a mains supply, the following mains voltage setting and fuse checks should be carried out to ensure safe operation of the instrument.

Mains Voltage Setting

The 4913 may be powered from 100, 115, 127, 200, 220 and 240 V ±10% (50 to 60 Hz) single phase AC mains lines. To select the correct mains voltage setting, use a small coin or wide-blade screwdriver to turn the MAINS VOLTAGE selector on the rear panel so that the appropriate voltage setting on the selector lines up with the black arrow printed on the panel.

Fuse Rating

The mains fuse is contained in the fuse holder immediately above the MAINS INPUT on the rear panel and may be released using a screwdriver to turn the centre of the holder. For operation from 100 to 127 V supplies the fuse should be a 1 A slow blow (B & K no. VF 0013), whilst for 200 to 240 V supplies it should be an 0,5 A slow blow (B & K no. VF 0023). Make sure that only fuses of the required rated current and of specified type are used for replacement. The use of mended fuses or short circuiting of the fuse holder is prohibited.

Supply Connections

Once the mains voltage setting and fuse have been checked, the mains supply may be connected to the MAINS INPUT of the 4913 using the Power Cable AN 0020 supplied. The 4913 has a high standard of safety insulation in accordance with safety class II of IEC 348 and therefore its chassis need not be connected to mains ground.

3.2. OPERATION AS A "FREE RUNNING" STROBOSCOPE

For use of the 4913 as a "free-running" stroboscope, its internal generator is employed. This type of operation is well suited for quick investigation, fault detection and measurements on rotating and reciprocating machines operating at a relatively constant frequency.

3.2.1. Determination of Motion Frequency or Speed

For obtaining a stationary stroboscopic image of a rotating or reciprocating machine, plus determination of its motion frequency, the basic operating procedure is as follows:

1. Carry out the preliminary checks and adjustments necessary (see section 3.1) and connect the drive cable plug of the Lamp Unit to the LAMP OUTPUT socket of the 4913.

2. Set the front panel controls of the 4913 as follows:

DISPLAY SELECTOR:	Trigger Freq. "Hz" or "r/min"
TRIGGER SOURCE:	"Int. Gen."
FUNCTION SELECTOR:	"Phase Delay"
DELAY:	extreme anticlockwise position
SLOW MOTION:	extreme anticlockwise position

INT. GEN: extreme clockwise setting

POWER: "On"

The Lamp Unit should start to flash at the frequency indicated on the DISPLAY of the 4913. If not, press the "On"/"Off" switch on the hand-grip of the Lamp Unit.

3. Keeping at a safe distance which will allow close-up observation, aim the light source at the moving object to be investigated.

4. Slowly turn the INT. GEN. knob anticlockwise, whilst observing the moving object. This will initially result in multiple images being observed as the flash rate is decreased and passes through synchronism with the multiples or sub-multiples of the motion frequency of the object.

5. Ignoring the multiple images, continue to turn the INT. GEN. knob anticlockwise and stop the moment the first stationary single image is obtained. When this occurs the flash rate will coincide with the fundamental or one of the sub-multiples of the motion frequency of the object.

6. If it is difficult to see whether the image obtained is a single or multiple one, then stop the machine and using chalk or reflective tape make a contrasting mark on the surface of the object to be examined. When the machine is restarted, commence turning the INT. GEN. knob from its extreme clockwise position until a stationary image with only one contrasting mark is visible.

   If it is not possible to obtain a stationary image, then the 4913 should be triggered from an external signal source as described in section 3.3. The 4913 will then function as a tachometer, enabling a direct indication of the motion frequency up to 10 kHz (ie 600 k r/min) to be obtained.

7. Having obtained a stationary image, note the frequency indication given by the 4913. To check whether the indicated frequency corresponds with the true motion frequency and not a sub-multiple, set the DISPLAY SELECTOR to "Delay" and the DELAY knob to its extreme anticlockwise position. Slowly turn the DELAY knob to move the image through exactly half or one or more whole motion cycles and note the phase indication on the 4913. The true motion frequency may then be calculated using the relation:

$$f_m = n\, f_1 \frac{360°}{P_1}$$

where
f_m is the true motion frequency in Hz or r/min
n is the number of motion cycles
f_1 is the frequency indication in Hz or r/min
P_1 is the phase delay indication in degrees for n motion cycles

Example:
Frequency indication $f_1 = 75$ Hz
Number of motion cycles $n = 5$
Phase indication $P_1 = 18°$

$$\text{True motion frequency } f_m = 5 \times 75 \times \frac{360°}{18}$$

$$f_m = 7500 \text{ Hz or } 450 \text{ k r/min}$$

An alternative method of establishing the true motion frequency which may be employed if difficulty is experienced in obtaining a reliable motion cycle count, is to continue turning the INT. GENERATOR knob anticlockwise until a second stationary single image is obtained. The true motion frequency may then be calculated using the relation:

$$f_m = \frac{f_1 f_2}{(f_1 - f_2)}$$

where f_1 is the frequency indication obtained with the first stationary single image and f_2 is that obtained with the second stationary single image.

Example:
First frequency indication f_1 = 75 Hz
Second frequency indication f_2 = 50 Hz

$$\text{True motion frequency } f_m = \frac{75 \times 50}{75 - 50}$$

$$f_m = 150 \text{ Hz or } 9 \text{ k r/min}$$

3.2.2. Detemination of Phase Delay

For examination of a moving object at any point in its motion cycle, the "Phase Delay" function of the 4913 may be employed. In addition the phase relation of two or more reciprocating or rotating machine parts which have the same motion frequency may be determined.

1. Carry out items 1 to 7 of section 3.2.1 to obtain a stationary single image of one of the synchronously moving parts to be examined and determine its true motion frequency.

2. Using the DELAY knob move the observed image of the synchronously moving part to a convenient reference point in its motion cycle and note the phase indication given by the 4913.

3. Looking at the second moving part, adjust the DELAY knob to move the observed image so that it has the same relative position as the first and note the phase indication on the 4913.

4. Provided that the motion frequency of the two moving parts investigated is identical and not greater than 100 Hz, then the phase delay of the second part with respect to the first may be determined by subtracting the first phase reading from the second. If the motion frequency is greater than 100 Hz, then the phase delay must be calculated using the relation:

$$P_d = \frac{(P_2 - P_1) f_i}{f_m}$$

where
P_d is the true phase delay in degrees
P_1 is the first phase indication in degrees, noted in item 2
P_2 is the second phase indication in degrees, noted in item 3
f_i is the frequency indicated on the 4913 in Hz or r/min
f_m is the true motion frequency in Hz or r/min

3.2.3. Timing of Motion Sequences and Events

Using the "Time Delay" mode of the 4913, motion sequences and events such as the opening and closing of cam operated switch contacts, valves etc., may be accurately timed. The operating procedure for this purpose, is as follows:

1. Set the FUNCTION SELECTOR to "0 - 36 ms Time Delay" and the DISPLAY SELECTOR to "Delay".

2. Keeping the control settings specified in item 1, carry out items 1 to 6 of section 3.2.1 to obtain a stationary single image of the moving part or event to be timed.

3. Check that the DELAY knob is set to its extreme anticlockwise position and note the relative position of the end of the motion sequence or event to be timed.

4. Slowly turn the DELAY knob clockwise to move the observed image so that the start of the motion sequence or event takes up the same position as in item 3. If this is not possible, set the FUNCTION SELECTOR to "0 - 360 ms" or "0 - 3,6" time delay and repeat adjustment with the DELAY knob.

5. Note the time delay indication given by the 4913. This will correspond to the period of the motion sequence or event, whatever the motion frequency of the moving part.

3.2.4. Slow Motion Observation

For determining the direction of motion as well as investigation of the behavior of rotating or reciprocating machine parts, use can be made of the "Slow Motion"mode of the 4913. The operating procedure for this purpose, is as follows:

1. Carry out items 1 to 6 of section 3.2.1 to obtain a stationary single image of the moving part to be investigated.

2. Set the FUNCTION SELECTOR to "Slow Motion" and depending on whether the apparent slow motion frequency or speed is to be monitored, set the DISPLAY selector to "Hz" or "r/min".

3. The observed image should now slowly rotate or move back and forth at the apparent frequency or speed displayed on the 4913. The actual direction of rotation is the same as that of the observed image.

4. To alter the apparent slow motion frequency or speed, adjust the SLOW MOTION knob.

Other uses of the "Slow Motion" mode are in determination of slip with induction motors and friction coupled motor driven parts (see section 3.4), plus in swept frequency vibration testing for initial and final resonance search with mechanical test objects. For performing the latter, the 4913 should be set for a slow motion frequency of approximately 5 Hz and its "Ext." TRIGGER SOURCE mode selected for triggering on the output of the frequency generator employed in the vibration test set-up (see section 3.3.1). When the vibration test frequency is swept, a sudden increase in the displacement of the stroboscopic image will be observed each time the test object passes through resonance. Where initial investigations indicate that more detailed examination is merited, it is recommended that the vibration generator be set for manual sweep and that the "Phase Delay" mode of the 4913 be employed.

3.3. OPERATION FROM EXTERNAL TRIGGER SOURCE

In the "Ext." (not "Single Trigger - Ext.") TRIGGER SOURCE mode, the 4913 will operate only when a sequental or repetitive signal is applied via the EXT. TRIGGER INPUT on the front panel. Provided that the signal is a derivative of the motion to be studied and that this is periodic, then the Stroboscope's lamp will provide a stationary image of the moving object even if its motion frequency is only approximately stable or varies owing to alteration of the operating speed. Furthermore, the LED DISPLAY of the Stroboscope is capable of providing a direct indication of the external trigger signal frequency from 5 Hz up to 9999 Hz (ie., 600 r/min up to 600 k r/min), thus enabling it to be used a tachometer.

To permit operation from external trigger frequencies up to 9999 Hz, the Stroboscope is designed to operate in synchronism with the external signal. At trigger frequencies up to approximately 110 Hz, the flash ignition is synchronized with the fundamental of the trigger signal, whilst at higher frequencies it is synchronized with the highest frequency sub-multiple of the trigger signal below 110 Hz. As a result correct synchronism is maintained with high frequency trigger signals, even though the actual flash rate of the lamp never exceeds approximately 110 flashes per second.

The minimum input signal level required for triggering is approximately 100 mV Pk-Pk. However, if required input levels up to 30 V Pk-Pk can be accommodated without overload of the instrument. To prevent false triggering by noise and other unwanted components which may be present with the trigger signal, it is recommended that the TRIGGER LEVEL knob be set approximately one quarter of a half turn to the left or right of its centre zero mark "0". The TRIGGER SENSITIVITY knob should then be adjusted by turning it clockwise from its "min." position and stopping the moment the TRIGGER ERROR LED on the front panel is extinguished and a stable trigger frequency indication is obtained with the LED DISPLAY. To check that triggering is correct, select the "Phase Delay" mode and turn the PHASE DELAY knob from one end of its range to the other. The observed image should move through one complete motion cycle. If not, the TRIGGER LEVEL knob should be adjusted a further distance away from its centre zero mark "0" and the TRIGGER SENSITIVITY knob readjusted until correct triggering is obtained.

Specific considerations concerning external triggering by other instruments, as well as by photoelectric and magnetic probes, are dealt with in the following sections.

3.3.1. External Instruments

As discussed above any electrical signal which is a derivative of the motion to be investigated may be used to trigger the 4913. With the aid of an accelerometer and Vibration Meter, for example, the vibration of a stationary member used to support the moving object to be studied may be monitored and the AC output of the Vibration Meter used for triggering the Stroboscope. A suitable output may also be obtained using a Tracking Filter in the monitoring set-up or where a Vibration Exciter is employed for swept-frequency vibration testing of mechanical components and structures etc., the constant level output of the Frequency Generator used to drive the exciter can be employed.

For these and similar applications, the trigger signal should be applied between the centre contact and outer screen of the EXT. TRIGGER INPUT using a single screened coaxial cable with BNC plug fitted at one end. The EXT. TRIGGER INPUT has an input impedance of 50 kΩ in series with 680 nF and maximum input voltage rating of 30 V Peak-Peak.

3.3.2. Photoelectric Tachometer Probe MM 0012

The Photoelectric Tachometer Probe MM 0012 is a combined infra-red source and pickup device. It is designed for contact-free sensing of reflective objects, contrasting marks etc., and together with the 4913 may be used as an external trigger source. For connecting MM 0012 to the EXT. TRIGGER INPUT of the 4913 it is supplied with a 3 m long, double-screened BNT Cable AQ 0158, which is used to carry the trigger signal as well as the necessary supply voltage for powering the Probe.

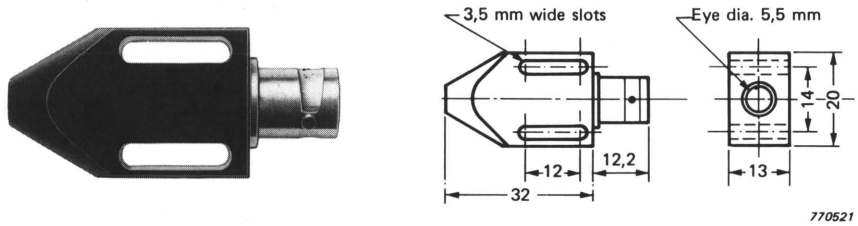

Fig. 3.3. Photoelectric Tachometer Probe MM 0012 plus associated dimensions

To trigger with the probe make a contrasting mark approximately 5 mm wide on the side of the object to be examined and mount the Probe at a distance of 1 to 10 mm away from the mark (see Fig. 3.4). With shiny objects use matt black adhesive tape or a black marking pen for making a contrasting mark, while with non-reflective objects reflective tape should be used. On each pass of the mark, the Probe will trigger the Stroboscope in synchronism with the fundamental or sub-multiple of the motion frequency of the object.

If correct triggering cannot be obtained and the TRIGGER ERROR LED of the 4913 remains lit even when the TRIGGER LEVEL knob is set for maximum input sensitivity, the Probe should be moved closer to the object. Alternatively, the effective output of the Probe may be increased using a battery powered torch to illuminate the contrasting mark. To prevent the Lamp Unit interfering with operation, avoid aiming its light beam directly at the Probe, and/or screen the front of the Probe using a piece of black tape.

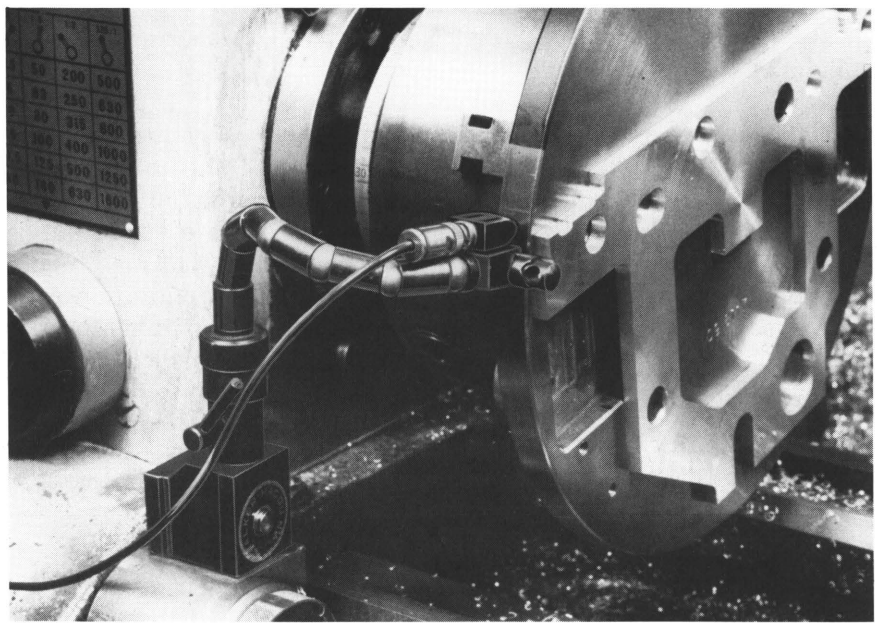

Fig. 3.4. The Photoelectric Tachometer Probe MM 0012 in use

For further information on the MM 0012 Photoelectric Tachometer Probe, a separate Product Data sheet is available.

3.3.3. Magnetic Transducer MM 0002

This is shown in Fig. 3.5 and is a variable reluctance type magnetic transducer which may be used as a contact-free, velocity-sensitive pickup for triggering the 4913. It is ideal for use in dirty environments, where triggering by optical means using the Photoelectric Probe MM 0012 is likely to be restricted by oil and grease etc.

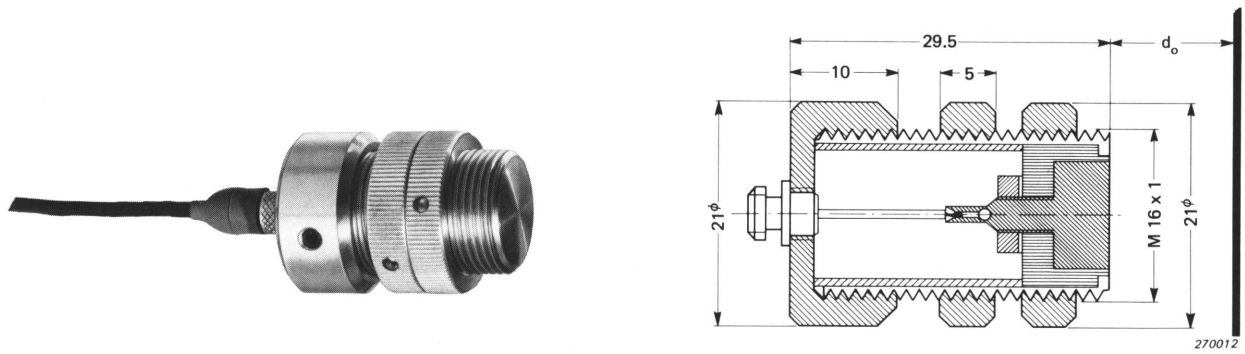

Fig.3.5. The Magnetic Transducer MM 0002 plus associated dimensions

For optimal sensitivity the Magnetic Transducer should be mounted at a distance 1 to 2 mm away from the moving object to be investigated. If the object is neither ferromagnetic nor electrically conductive, then one of the high-μ discs supplied with the Transducer or a thin strip of copper should be cemented to the object or attached by means of adhesive tape. Also supplied is a 1,2 m miniature coaxial cable with screw lock connectors which may be used to connect the Transducer to the EXT. TRIGGER INPUT of the Stroboscope when this is fitted with a 10-32 UNF to BNC Input Adaptor JP 0145. The MM 0002 is a passive device and therefore does not require a power source.

For further information on the MM 0002 Magnetic Transducer, a separate Product Data sheet is available.

3.4. USE WITH LINE TRIGGER SOURCE

With the "Line" TRIGGER SOURCE mode, the flash rate is automatically synchronized with the line frequency of the mains supply used to power the 4913. This is of benefit for investigations on electric motors and other mains powered equipment. Provided that the motion frequency of the equipment is an exact integer multiple (eg., 1, 2, 3 etc.) or sub-multiple of the supply frequency, then it will provide a stationary image of the equipment without the need for manual adjustment to the 4913 or having to use a separate external trigger source. For determining the exact motion frequency of the equipment, use can be made of the "Phase Delay" mode as described in item 7 of section 3.2.1.

Where induction motors or friction coupled machine parts which are subject to slip are examined, the motion frequency will not be an exact integer multiple or sub-multiple of the supply frequency. Provided that the slip frequency is less than 5 Hz (ie., 300 r/min), then a stationary image can be obtained utilizing the "Slow Motion" mode with the "Line" mode. If the coupling ratio K_r and synchronous frequency f_s of the motor are known (see manufacturer's specifications), then the percentage slip S_l can be determined using the relation:

$$S_l = 100\ K_r \frac{f_{sm}}{f_s}$$

where f_{sm} is the slow motion frequency indication given by the 4913 when the SLOW MOTION knob is adjusted to give a stationary image.

3.5. USE WITH DOUBLE FLASH IGNITION

The "Double Flash" mode available with the FUNCTION SELECTOR is intended for use with the "Line" or "Ext." TRIGGER SOURCE modes only. Provided that the motion frequency of the particular object to be investigated does not exceed approximately 50 Hz (3 k r/min), then "Double Flash" mode may be used for simultaneous observation of any two points in a motion cycle which are spaced 180° apart. In addition the observed double image may be moved through one complete motion cycle with aid of the DELAY knob. This is useful for spotting unbalance with rotating objects, observing the extremities of travel with reciprocating objects, and in optical measurement of the maximum peak to peak displacement of mechanical resonances.

With external trigger frequencies greater than 50 Hz or with the "Int. Gen." TRIGGER SOURCE mode selected, the function of the "Double Flash" mode is the same as that of the "Phase Delay" mode. Similarly with the "Single Flash-Line" or "Single Flash-Ext." mode, only a single flash will obtained with the "Double Flash" mode.

3.6. USE WITH SINGLE FLASH IGNITION

3.6.1. Local and Remote Activation

Using the "Single Flash" TRIGGER SOURCE modes, a single flash can be obtained by pressing the RESET button on the front panel of the 4913. Alternatively, one can be obtained by applying a +15 V pulse with minimum width of 2 μs between the centre contact and outer screen of the SINGLE FLASH INPUT on the rear panel or by momentarily shorting the centre contact to the inner screen of this socket using a camera for which a Flash Contact Cable AQ 0375 is supplied. Depending on whether the "Ext" or "Line" single flash mode is selected, the flash ignition will be synchronized with the external trigger source connected via the EXT. TRIGGER INPUT or with the mains source used to power the Stroboscope and will include the preset phase or time delay set with the DELAY knob of the instrument.

Another means of obtaining a single flash is available using the "Ext." (not "Single Flash - Ext.") TRIGGER SOURCE mode and shorting the centre contact of the SINGLE FLASH INPUT to its outer screen, whilst leaving the EXT. TRIGGER INPUT open circuit. In this case, a single flash with preset time delay (not phase delay) referred to the instant of shorting the SINGLE FLASH INPUT will be produced, which can be used in photographing linear motion. For photographing of reciprocating or rotational motion, use of the single flash modes discussed at the start of this section are to be preferred.

3.6.2. Flash Photography

For synchronization of single flash with a camera, the "X" flash contacts of the camera should be used to trigger the 4913 as described in section 3.6.1. Camera shutter and aperture settings recommended for exposure of different types of photographic film with the Lamp Unit stationed 0,5 and 1 m away from the subject to be photographed are given in Table 3.2. As indicated the correct shutter speed setting depends on the frequency of the external trigger source used and/or time delay set using the DELAY knob of the

Min. Ext. Trigger Source Frequency	Hz	⩾5	⩾5	⩾5	⩾5	⩾8	⩾15	⩾30	⩾60	⩾100
	r/min	⩾300	⩾300	⩾300	⩾300	⩾480	⩾900	⩾1,8k	⩾3,6k	⩾6k
Maximum Delay	Phase	360°	360°	360°	360°	360°	360°	360°	360°	360°
	Time	3,6 s	900 ms	450 ms	225 ms	110 ms	60 ms	30 ms	15 ms	9 ms
Camera Shutter Setting		"B"	1 s	1/2 s	1/4 s	1/8 s	1/15 s	1/30 s	1/60 s	1/100 s
Film B & W	Kodak Tri-X 27 DIN (400 ASA)	f 5,6 / 0,5 m (1,6 ft) – f 2,8 / 1 m (3,2 ft)								
	Polaroid 36 DIN (3000 ASA)	f 22 / 0,5m (1,6 ft) – f 11 / 1m (3,2 ft)								
Film Colour	Ektrachrome 24 DIN (200 ASA)	f 5,6/ 0,5 m (1,6 ft) – f 2,8 / 1 m (3,2 ft)								
	Polaroid 20 DIN (75 ASA)	f 4 / 0,5 m (1,6 ft) – f 2 / 1 m (3,2 ft)								
		Camera Aperature Setting f / Flash-Subject Distance m(ft)								

811338

Table 3.2. Exposure guide for synchronized single flash activated by "X" flash contacts of a camera

Stroboscope. The maximum shutter speed setting for reliable "X" contact triggering, depends on the particular camera employed and is usually limited to 1/30 s, 1/60 s or 1/100 s. If in doubt, consult the camera's instructions concerning use with electronic flash.

To obtain sharp, accurately exposed photographs of the subject, the camera should be mounted on a suitable tripod and the Lamp Unit aimed directly at the subject either from immediately behind or slightly to one side of the camera. Also all background illumination should be reduced as much as possible so that the light of the Lamp Unit dominates. When using a shutter speed setting longer than 1/30 s, this will usually necessitate working in very dim or dark surroundings.

The exposure guide given in Table 3.2 may also be used to provide reliable results with other types of black and white film provided that these have the same film speed rating as the Kodak and Polaroid film indicated. However, reliance should not be placed in their application to colour film other than the particular types specified. This is because different types colour film respond differently to the illumination from very short duration flash sources, despite of the the fact that they have the same film speed rating. It is therefore recommended that the user experiment with several different exposure combinations to determine which is most suitable.

3.7. USE WITH AUXILIARY LIGHT SOURCE

A convenient auxiliary light source for use with the 4913, is the B & K Portable Stroboscope Type 4912. This is shown in Fig. 3.6 and is a completely self-contained, hand-held unit which can be operated either from its own built-in rechargeable batteries or from an external DC source. For operation at flash rates of 25 Hz or more, it is capable of producing an average light output greater than 1 and 2,5 k lux at a range up to 500 and 250mm respectively.

For combined use of the two Stroboscopes, the FUNCTION SELECTOR of the 4912 should be set to "Ext. Trig." and the centre contact and outer screen of its EXT. TRIGGER INPUT connected to the SIGNAL OUTPUT of the 4913 using the BNT plug (B & K no JP 0315) and 6-pin plug (B & K no. JP 0600) supplied. With the 4912 connected to the "Flash Ignition" SIGNAL OUTPUT line (see Fig 3.7), it will flash in direct synchronism with the Lamp Unit US 0008, whilst when connected to the "Flash Trigger Ref" the flash ignition of US 0008 with respect to that of the 4912 will be delayed in accordance with the particular phase or time delay set on the 4913. If required more than one 4912 may be connected without having an adverse influence on the 4913.

Fig. 3.6. Portable Stroboscope Type 4912

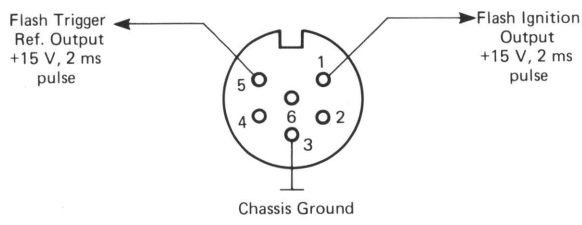

Fig. 3.7. SIGNAL OUTPUT socket connections for external triggering of the Portable Stroboscope Type 4912

Note: When an external trigger source with frequency greater than 110 Hz is employed with the 4913, the flash rate as well as repetition frequency of the "Flash Trigger Ref." and "Flash Ignition" outputs of the instrument, will be a sub-multiple of the external trigger frequency (see section 3.3). Also the actual phase delay of the "Flash Ignition" output with respect to the "Flash Trigger Ref." output may include one or more periods of the external trigger signal. However, with regard to strobosopic observation of moving objects, the apparent phase delay will be the same as that set on the 4913.

For further information on the Portable Stoboscope Type 4912, its Instruction Manual should be consulted.

3.8. REMOTE CONTROL

Remote operation can be obtained using the 4913 together with the Control Pedal WB 0030/WH 1165 shown in Fig.3.8. This is available on special order to the B & K Systems Development Group and for coupling it to the REMOTE CONTROL socket on the rear panel of the 4913 is supplied with a 3 m (~10 ft) connection cable. If a longer connection cable is required, then this should be specified when ordering WB 0030/WH 1165.

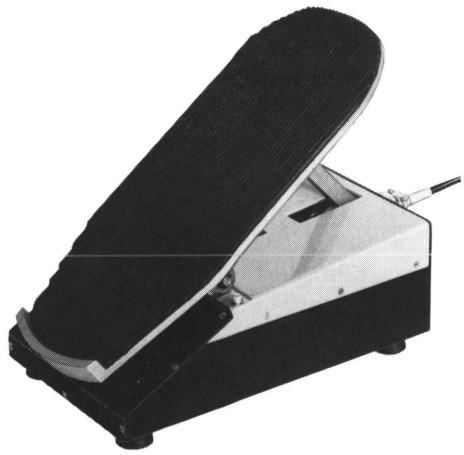

Fig. 3.8. Control Pedal WB 0030/WH1165

For use of the Control Pedal, the FUNCTION SELECTOR of the 4913 should be set to its "Remote Control" mode. With light toe pressure on the pedal it will remotely select the "Phase Delay" mode permitting the flash rate to be adjusted either via the INT. GENERATOR knob of the 4913 or via an external trigger source which may be connected. Once a stationary image has been obtained, the phase delay may be continuously adjusted from 0 through to 360° by gradually depressing the pedal. When fully depressed the "Slow Motion" mode with the slow motion frequency set on the 4913 will be selected. For readout of the phase delay or slow motion frequency, the DISPLAY SELECTOR of the 4913 must be set accordingly.

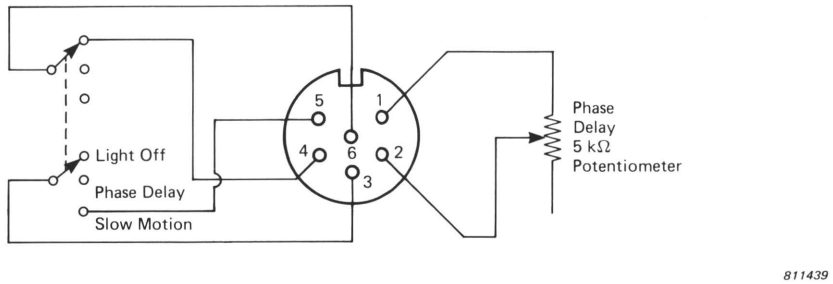

Fig. 3.9. External connections to REMOTE CONTROL socket for remote operation of the "Phase Delay" and "Slow Motion" modes of the 4913

An alternative means of obtaining the above remote control functions is with the aid of an external switch and 5 kΩ potentiometer. The appropriate connections for this purpose are given in Fig. 3.9 and can be made using the 6-pin plug (B & K no. JP 0600) supplied for the REMOTE CONTROL socket of the 4913.

4. OPERATION WITH FIBRE–OPTIC SOURCE TYPE 4915

4.1. PRELIMINARY

4.1.1. Environment and Handling

Like the Stroboscope Type 4913, the Fibre-Optic Source Type 4915 is designed to be operated in environments with ambient temperature from -10 to +55°C (+14 to 131°F) and humidities up to 90% RH (non-condensing). Provided that the metal cabinet of the 4915 is kept perfectly dry, its Fibre–Optic Cable AE 6000 may be used in wet environments and liquids without impairing the operating safety of the instrument. On no account, however, should it be used in the presence of volatile gasses and liquids.

4.1.2. Connections and Mounting

For operation of the 4915 together with the 4913, disconnect the Lamp Unit US 0008 from the 4913 and connect its LAMP OUTPUT and SIGNAL OUTPUT sockets with the LAMP INPUT and SIGNAL INPUT plugs of the 4915. The 4915 can be used either free-standing on its four plastic feet or, for better viewing, its front may be raised by folding down the metal stand attached to its front feet.

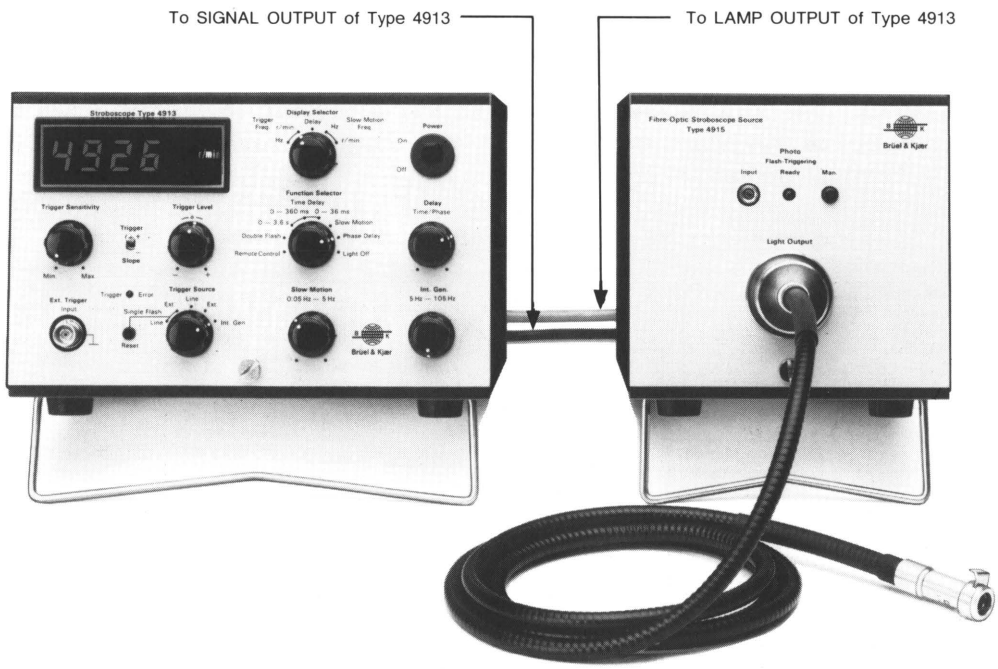

Fig. 4.1. Use of the Fibre-Optic Stroboscope Source Type 4915 together with Digital Stroboscope Type 4913

Optional types of mounting are the Metal Frame KK 0014 for fitting the 4913 plus 4915 in a 19 inch instrumentation rack and the Carrying Case KA 2004. To facilitate installation in the Metal Frame, the plastic feet of the 4913 and 4915 should be unscrewed. For further details on these types of mounting the B & K Short Form Catalogue should be consulted.

4.1.3. Use and Care of Fibre-Optic Cable AE 6000

For fitting the 4915 with its 1,8 m long flexible Fibre–Optic Cable AE 6000, a Ball-lock Coupler UA 0726 is supplied. This screws fast to the LAMP OUTPUT flange on the front of the 4915 and is equipped with centre hole for push-fit fastening the tapered metal sheath at the input end of the cable (see Fig. 4.2). Besides facilitating easy attachment of the cable, the coupler ensures that the input face of the cable is accurately aligned with the light output of the 4915. When properly inserted the cable will be gripped by the ball-lock catch in the coupler.

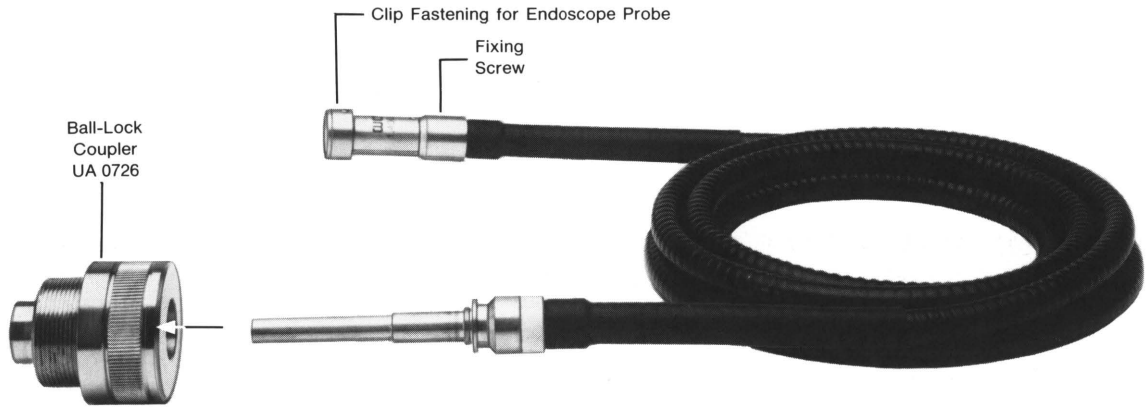

Fig. 4.2. Connection of Fibre-Optic Cable AE 6000 using the Ball-Lock Coupler UA 0726

At the output of the cable there is a metal collar with spring clip for attaching an Endoscope Probe. If required this collar may be unscrewed after loosening the fixing screw indicated in Fig. 4.2. The output face has a diameter of 4,5 mm and transmits a cold-light conical flash beam with radiation angle of approximately 60°. Besides providing a convenient source of illumination for stroboscopic investigation of small test objects and intricate mechanisms at a range up to 300 mm, it is also well suited for illuminating microscope specimens. For operation at flash frequencies greater than 50 Hz, the average illuminance obtained is as indicated in Table 4.1.

Flash Source to Subject Distance	2,5	5	7,5	10	12,5	cm
Average Flash illuminance	12	5	2	1,4	1	k lux

820040

Table 4.1. Average illuminance provided by the Fibre-Optic Source Type 4915 plus Fibre-Optic Cable AE 6000 at flash frequencies greater than 50 Hz

For use of other types of fibre-optic cable a Blank Coupler DB 2484 is provided. This has the dimensions shown in Fig.4.3 and when drilled with appropriate sized centre hole can accommodate cables between 4,5 and 17,5 mm in diameter. For optimal light output it is important that the input face of the cable protrudes 23 mm from the rear of the Coupler. See Fig. 4.3.

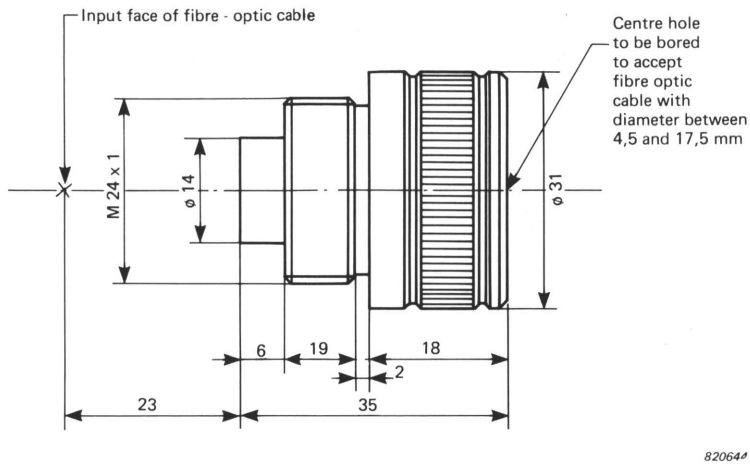

Fig. 4.3. Dimensions (in mm) of the Blank Coupler DB 2484 for correct fitting and alignment of Fibre-Optic Cables

To prevent damage to Fibre–optic Cables, avoid bending or twisting them sharply. Also take care not to scrape their input or output face against metal objects and for unplugging them from the 4915 always grip them by their metal sheath. For cleaning cables, lightly rub their input and output face with the end of a double ended cotton swab (ie., ear cleaning aid) which has been moistened in water containing a few drops of mild soap solution. On no account use detergents or other strong cleaning agents.

4.2. NORMAL SINGLE AND REPETITIVE FLASH OPERATION

For normal single and repetitive flash use of the 4915, operation is similar to that described in Chapter 3 except that the 4915 is employed together with the 4913 in place of the Lamp Unit US 0008. Connection of the two instruments is as shown in Fig. 4.1. No attention need be paid to the READY LED, INPUT socket or MAN. button on the front of the 4915, as these are for single flash "Photo" operation only. See section 4.3.

4.3. SINGLE "PHOTO" FLASH OPERATION

4.3.1. Triggering

Activation of single "Photo" flash depends on the particular signal source employed for triggering the 4913. With the 4913 connected to the 4915 as in Fig. 4.1 and its "Int. Gen.", "Ext." or "Line" TRIGGER SOURCE mode chosen for normal repetitive flash operation, "Photo" flash may be activated simply by pressing the MAN. button on the 4915 when the READY LED is lit. Alternatively, remote activation is possible via the flash contact of a camera when this is coupled to the INPUT socket on the front of the 4915 using the Flash Contact Cable AQ 0375 provided with the 4913.

For operation with the 'Single Flash - Ext" and "Single Flash - Line" TRIGGER SOURCE modes, the 4913 must first be enabled by pressing its RESET button plus the MAN. button on the 4915 when the READY LED is lit. "Photo" flash can then be activated via either the RESET button or the SINGLE FLASH INPUT socket (see section 3.6.1) of the 4913. For each subsequent "Photo" flash the 4913 must once again be enabled by pressing the RESET and MAN. buttons.

Once "Photo" flash is activated, flash ignition will be synchronized with the particular internal or external trigger source selected with the 4913 and will include the phase or time delay set with the DELAY knob of the instrument. The minimum cycling time between flashes is 30 seconds.

4.3.2. Flash Photography

Camera settings for close-up photography of subjects illuminated via the Fibre–Optic Cable AE 6000 are given in Table 4.2. These apply for single flash "Photo" operation of the 4915 when activated by the "X" flash contacts of a camera as described in section 4.3.1.

To facilitate close-up work the use of a 35 mm single-lens reflex camera with standard 50 to 55 mm lens plus extension rings is recommended. The camera aperture setting for correct exposure is determined by the film speed rating, the flash intensity of the 4915 and the distance between the output face of the Fibre-Optic Cable and the subject (see Table 4.2). For optimum results it is usually best that the light output of the Fibre-Optic Cable be aimed at a slight angle to the surface of the subject in order to avoid reflections.

Min. Ext. Trigger Source Frequency	Hz	⩾5	⩾5	⩾5	⩾5	⩾8	⩾15	⩾30	⩾60	⩾100
	r/min	⩾300	⩾300	⩾300	⩾300	⩾480	⩾900	⩾1,8k	⩾3,6k	⩾6k
Maximum Delay	Phase	360°	360°	360°	360°	360°	360°	360°	360°	360°
	Time	3,6 s	900 ms	450 ms	225 ms	110 ms	60 ms	30 ms	15 ms	9 ms
Camera Shutter Setting		"B"	1 s	1/2 s	1/4 s	1/8 s	1/15 s	1/30 s	1/60 s	1/100 s
B + W Film	Kodak Plus–X 22 DIN (125 ASA)	f 5,6/400 mm (16 in)			f 11/200 mm (8 in)			f 22/100 mm (4 in)		
	Kodak Tri–X 27 DIN (400 ASA)	f 4/1600 mm (64 in)			f 8/800 mm (32 in)			f 16/400 mm (16 in)		
Colour	Kodak Ektachrome 19 DIN (64 ASA)	f 4/400 mm (16 in)			f 8/200 mm (8 in)			f 16/100 mm (4 in)		
	Kodak Ektachrome 24 DIN (200 ASA)	f 4/800 mm (32 in)			f 8/400 mm (8 in)			f 16/200 mm (16 in)		

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Table 4.2. Exposure guide for synchronized "Photo" flash photography of subjects illuminated by the Fibre-Optic Source Type 4915 with Fibre-Optic Cable AE 6000 attached

The choice of correct shutter speed depends on the frequency of the internal or external trigger source employed with the 4913 plus the time delay set on the instrument. Also the maximum shutter speed setting for reliable X-contact synchronization must be taken into account. This is usually limited to 1/30, 1/60 or 1/100 s and depends on the particular camera employed. See camera's operating instructions for flash photography.

5. SERVICE AND REPAIR

5.1. GENERAL

The 4913 is designed and constructed to provide the user with many years of reliable operation. However, like other light sources, the operating life of the Lamp Unit US 0008 and Fibre-Optic Source Type 4915 is not indefinite. With normal single and repetitive flash operation, their flash tube (VS 1007 and VS 1006 respectively) is capable of providing approximately 75 million single flashes, which with a flash rate of 100 flashes per second is equivalent to just over 200 hours of continuous operation. Similarly with single flash "Photo" operation of the 4915, a tube life of approximately 1000 flashes can be expected. It is therefore recommended that a spare flash tube be kept for replacement.

⚠ **WARNING:** Both US 0008 and the 4915 contain a number of high voltage storage capacitors which can remain charged even when US 0008 and the 4915 are disconnected from the 4913 and are left unused for several days or more. For replacement of the flash tube assembly without risk of personal injury it is necessary that the appropriate instructions given in sections 5.1 and 5.2 be carefully observed.

Should the 4913 fail to operate correctly even after having replaced the flash tube of US 0008 or of the 4915, then it should be immediately disconnected from the mains supply and be secured against unintended operation. For repair consult the separate Service Manuals available for the 4913 and 4915 or contact your local B & K service representative. Under no circumstances should repair be attempted by persons not qualified in the service of electronic instrumentation.

5.2 REPLACEMENT OF FLASH TUBE

5.2.1. Hand-Held Lamp Unit US 0008

With Lamp Unit US 0008 the Flash Tube Assembly VS 1007 is employed. To replace this assembly, proceed as follows:

1. Disconnect the Lamp Unit drive cable from the LAMP OUTPUT socket of the 4913.

2. Ease off the four black plastic lugs at the front of Lamp Unit and using a suitable screwdriver remove the four screws fastening the lamp window and protection grill. See Fig. 5.1.

3. Taking care not to touch the metal terminals of the flash tube, lift off the lamp window and protection grill.

4. Holding the insulated portion of a short piece of cable, interconnect the terminals at either end of the flash tube. This will discharge the high voltage storage capacitor contained in the handle of the Lamp Unit, enabling the flash tube to be safely removed without risk of electric shock.

Fig. 5.1. Replacement of Flash Tube Assembly VS 1007 with Lamp Unit US 0008

5. Wearing safety glasses, use a screwdriver to gently ease the flash tube terminal out of the spring clip nearest the lamp handle.

6. Gripping the free end of the flash tube carefully pull it out of the spring clip at the top of the parabolic reflector.

7. Remove the new Flash Tube VS 1007 from its packing and use the packing to store the original tube. Avoid touching the glass surface of the tube, as finger prints can reduce its light output.

8. Holding the flash tube terminal fitted with a metal screen, push the other terminal up into the spring clip at the top of the parabolic reflector and twist the flash tube so that the metal screen faces forward.

9. Press the bottom flash tube terminal into the spring clip near the handle and check that its internal electrodes are in line with the optical centre of the parabolic reflector.

10. Replace the protection grill plus window of the Lamp Unit. Under no circumstances operate it without its protection grill and window fitted.

5.2.2. Fibre-Optic Source Type 4915

To replace the Flash Tube VS 1006 of the Fibre-Optic Source Type 4915, proceed as follows:

1. Disconnect the 4915 from the LAMP OUTPUT and SIGNAL OUTPUT sockets of the 4913.

2. Release the bottom and two side panels of the 4915 and slide them off towards the rear of the instrument. The bottom panel is held by the screw-headed catch on the front of the 4915, whilst the slide panels are each fastened by a single screw on the rear panel.

3. Remove the lid of the screened compartment inside the 4915. This is fastened by a total of six screws, two near the bottom of the rear panel and two on each slide panel of the compartment. See Fig. 5.2.

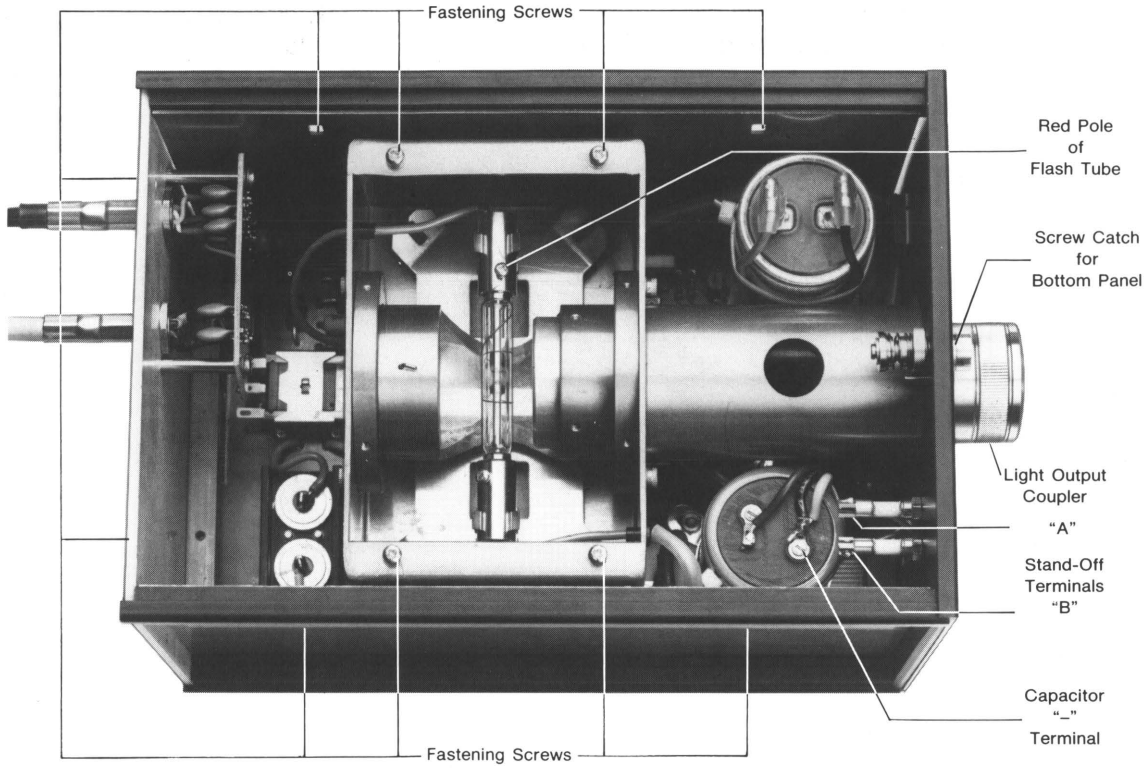


Fig. 5.2. Replacement of Flash Tube Assembly VS 1006 with the Fibre-Optic Source Type 4915

4. Carefully holding the insulated handle of a screwdriver with plain metal shaft, interconnect the gold-plated stand-off terminal "A" to the negative terminal of the capacitor shown in Fig. 5.2 for approximately 5 seconds and then repeat with the stand-off terminal "B". This will discharge both storage capacitors of the 4915, making the flash tube safe to remove without risk of electric shock.

5. Partially loosen the four screws on top of the lamp enclosure and take off its lid.

6. Wearing safety glasses, gently ease the flash tube out of the spring clips in the lamp enclosure and unscrew the metal terminals at either end of the tube.

7. Remove a new Flash Tube VS 1006 from its packing and use the packing to store the original tube. Avoid touching the glass surface of the tube, as finger prints can reduce its light output.

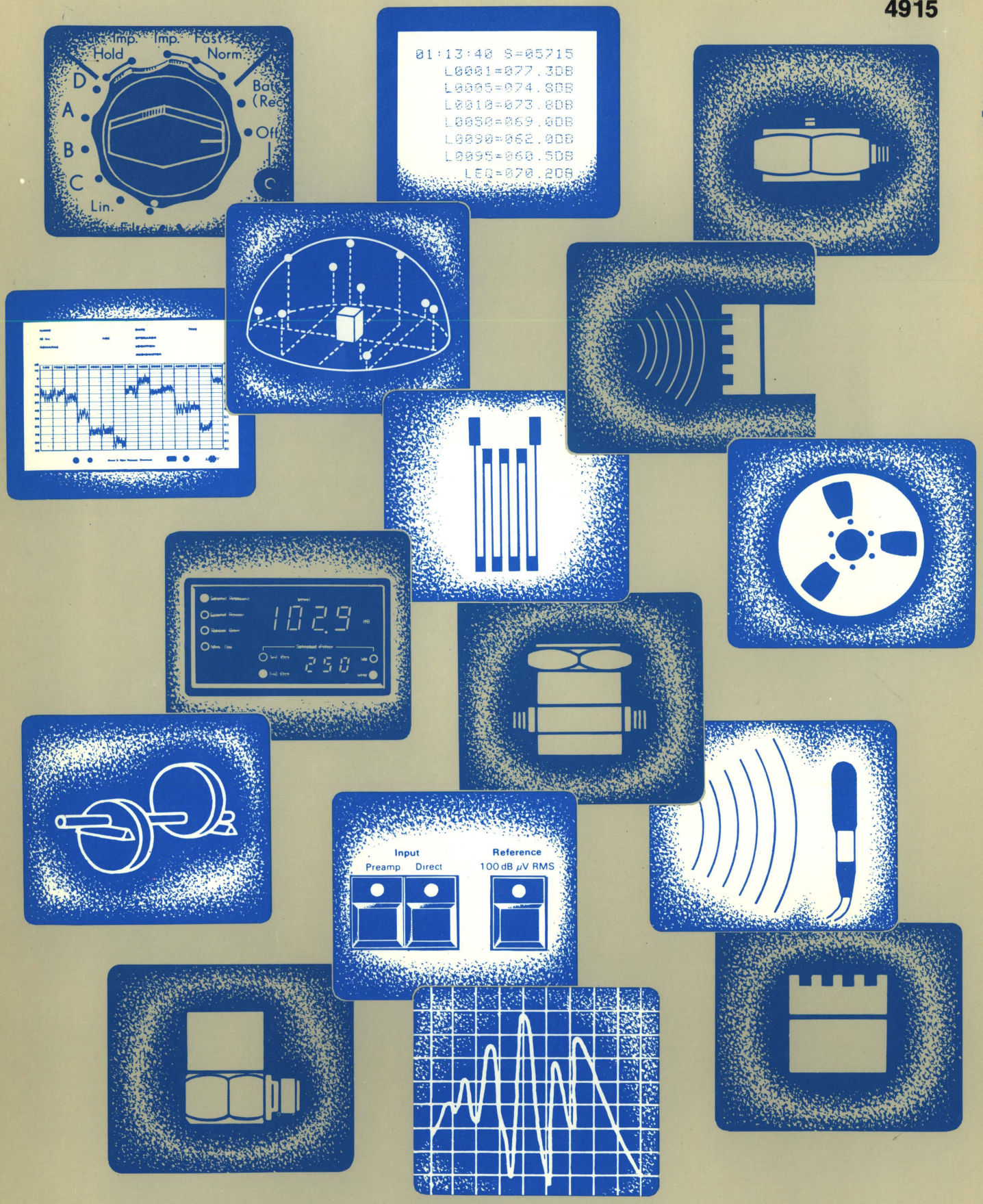
8. Fit the new flash tube with the terminals removed in item 6, noting which end of the tube includes a red mark. Before tightening the screws for the terminals, wind the loose end of the tubes wire wrapping around the screw at the red end of the tube. Clip off the surplus wire and check that the wire wrapping overlaps both electrodes inside the tube.

9. Install the flash tube in the lamp enclosure of the 4915. For correct operation it is important that the terminal at the red end of the tube be fitted to the spring clip in the enclosure which has a red lead attached.

10. Carefully align the flash tube so that the gap between its electrodes is centered with the spherical reflector at the rear of the lamp enclosure. For checking the alignment, illuminate the lamp enclosure with an external light source and peer into the enclosure via the coupler on the front of the 4915.

11. Reassemble the 4915 making it ready for use. Under no circumstances operate it without its screened lid and panels fitted.

4913
4915



Brüel & Kjær DK-2850 NÆRUM, DENMARK · Telephone: + 452800500 · Telex: 37316 bruka dk

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