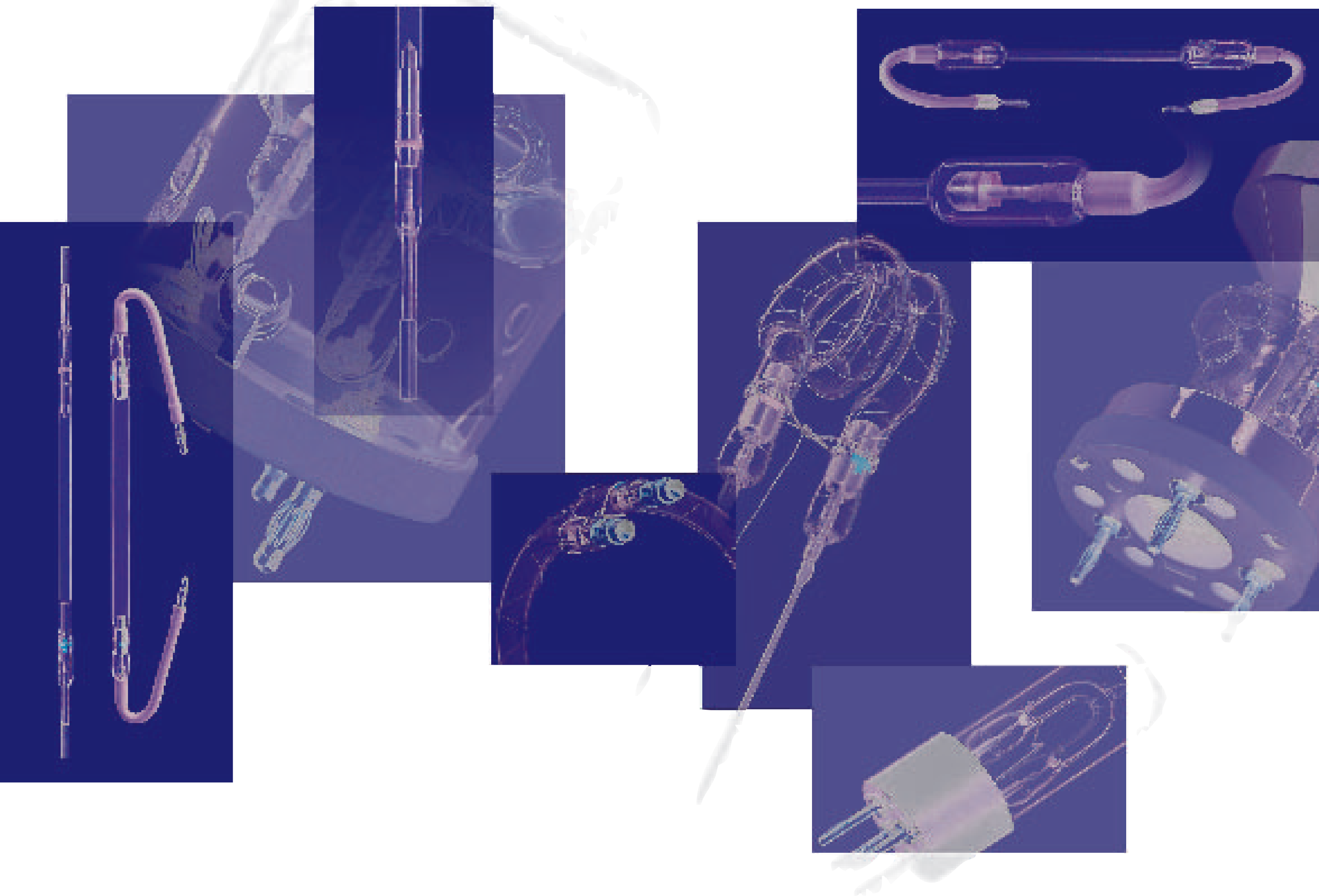
Flashlamps
advanced technology



FLASHLAMPS
Verre & Quartz

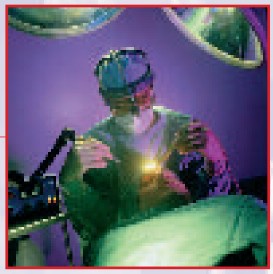
FLASHLAMPS
Verre & Quartz

Flashlamps advanced technology

APPLICATIONS

Scientific research

Lasers, spectroscopy, photochemistry...



Medicine

Lasers or IPL for dermatology, hair removal. Retinography, laser surgery… UV disinfection (mercury-free)

Industry

Lasers for cutting, drilling, welding, marking…
Surface treatments

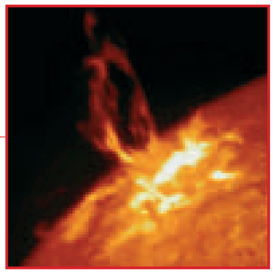
Photography

Flashlight equipments for professional photography

Photography by courtesy of Michel Hans

Stroboscopy

Signal lights, video imaging, illumination effects…



Solar simulation

Photovoltaic cells, material testing

Aerospace industry

Airport runway lighting, anticollision lighting systems. Neon beacons

Printing & reprography

IR applications (printing, reprography…)

FLASHLAMPS
Verre & Quartz

THE "FLASHLAMPS - Verre & Quartz" COMPANY

The "Etablissements Diot Frères" installations were manufacturing silica tubings from crystals of quartz, and specialized in tight silica-to-tungsten seals since 1928. The first flashlamps (Hg) were manufactured in 1936. The establishments changed to the Verre & Quartz Company in 1947. The main activity is to manufacture UV mercury lamps of quartz, and also X-rays lamps : the Company rapidly gets its notoriety in the medical field. High power flashtubes already used in studio photography : many 10 kJ flashtubes were successfully used (1953). In the early 60's, Maiman experimented the first worldwide laser pumped by an helical flashlamp, allowing Verre & Quartz to extend its production of flashlamps, used as new optical sources for solid-state laser pumping. In collaboration with well-known technical institutes and Research Laboratories, Verre & Quartz developed flashlamps which became highly sophisticated products requiring manufacturing techniques more and more reliable. Low power borosilicate flashtubes and low size quartz flashlamps have been appearing in 1963, thanks to a new method of achievement of sealing glass. The first realisation of solid-state lasers (Ruby and Neodymium) took place in 1965. This fabrication is forsaken in favour of the flashtubes. The lamps for studio photography were benefiting the great improvements realized for lamps intended for optical pumping of lasers, particularly the technique of "shrunk electrodes" or the elaboration of new types of emissive dopants as well as their concentration and homogeneity in the tungsten matrix. Thanks to the Eureka project "High power solid-state laser", new technologies allow the lamps to reach very great average powers.

The first well-known customers were Marie Curie, J. Perrin, then A. Kastler and Leprince-Ringuet.

Now, at the start of the 21th Century : Flashlamps Verre & Quartz is glad to present a great variety of flashlamps for each type of applications.

We will be honored by your trustfulness for study and realization of all services and manufacturings meeting your requirements and giving you the benefit of our long experience.

Les "Etablissements Diot Frères" débutent la fabrication de tubes de silice à partir de cristaux de quartz, et se spécialisent dans les soudures silice-métal dès 1928. Les premières lampes à éclairs (Hg) sont produites en 1936. La société change de nom et devient "Verre & Quartz" en 1947. La société produit principalement des lampes UV en quartz ainsi que des lampes aux rayons X : elle bénéficie alors d'une excellente notoriété dans le monde médical. Des lampes flash de grande puissance pour la photographie apparaissent en 1953, et des lampes de 10 kJ sont alors utilisées avec succés. Dès 1960, le premier laser pompé par lampe à éclairs hélicoïdale est mis au point par Maiman : cela permet à Verre & Quartz de diversifier sa production de lampes dans l'intention de les utiliser comme sources de pompage des lasers à solide. En collaboration avec des instituts techniques et Laboratoires de Recherche renommés, Verre & Quartz a développé des lampes flash très élaborées, faisant appel à des techniques de fabrication de plus en plus fiables. Apparition en 1963 de lampes borosilicates de faible puissance, puis de lampes en quartz de moyenne énergie complétant la production générale, grâce à une nouvelle méthode de réalisation des verres de transition pour soudure verre/métal. La société produit aussi des lasers rubis et Néodyme-verre en 1965. Cette activité est néanmoins rapidement abandonnée au profit de la production des lampes à éclairs. Les lampes pour la photographie professionnelle ont profité des progrès importants dont les lampes laser ont bénéficié, en particulier la technique des électrodes pincées ou bien l'élaboration de nouveaux types de composés émissifs contenus dans la matrice tungstène, leur concentration et leur homogénéité. Grâce au projet Eureka "Laser à solide de forte puissance", les nouvelles technologies permettent maintenant aux lampes d'atteindre de très hautes densités de puissance moyenne.

Les premiers clients prestigieux se nomment Marie Curie, J. Perrin, puis A. Kastler et Leprince-Ringuet.

Maintenant nous abordons le 21ème siècle : la société Flashlamps Verre & Quartz est fière de vous présenter sa large gamme de lampes à éclairs pour tous types d'applications. La confiance que vous nous accorderez lors d'études et de réalisations de services ou de fabrications nous honorera, en respectant vos exigences et en vous faisant bénéficier de notre longue expérience.

Flashlamps and Arc Lamps :

Technical Overview

Presentation…

Flashlamps and arc lamps are currently used in different application fields such as optical laser pumping or studio photography and stroboscopic analysis of ultra-fast phenomena.
Laser pumping (solid-state, dye…) needs a very important light source characterized by its very great optical power, in order to fill the upper energy levels of the active medium. Solid-state lasers are often Ruby, Nd : glass, Nd : YAG, Alexandrite, Ti : Sapphire and many others. It is also possible to “pump” dye lasers (such as for example the Rhodamine 6G) for which a very short pulse duration is required to reach the high levels of the excitation bands of the solution.
The rare gas lamp emission characteristics give a very interesting light source in the visible region of the spectrum, especially useful for photography (the light appears “white”) and stroboscopy.

Mechanical characteristics

Glass to metal seals

One of the most important part of a flashlamp construction is the introduction of the tungsten electrode in the lamp silica body. The currently used method is the glass-to-metal seal, i.e. the seal of the tungsten rod and the glass. This technique has several advantages, such as the extreme precision of the mechanical characteristics from one lamp to the other, the faculty to whitstand very high peak currents or average currents and the accessible temperatures during lamp working. The great stability of such a seal allows manufacturings of flashlamp series.

Electrodes types

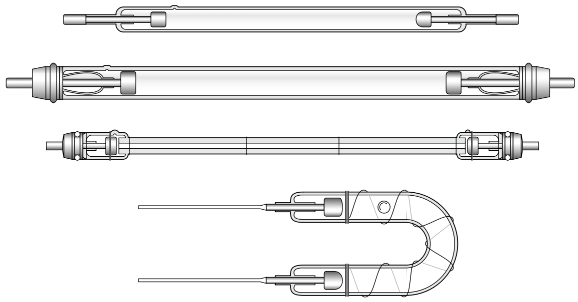
Standard electrodes

Used for low power densities (typically 40 $W.cm^{-2}$). The electrode temperatures do not reach values that impose to the lamp to be used at the limit of its maximum average power, so it is not necessary to place the electrode closed to the quartz envelope to ensure a better cooling. These lamps are often used with a classical air cooling system with respect of the maximum average power given for each model. Forced air coolings allow to increase threefold the value of maximum power.

Re-entrant seal standard electrodes

Another type of electrodes is also used thanks to “re-entrant seal” method. The allowed power densities reach 70 $W.cm^{-2}$. The seal technique consists of the sealing of the tungsten rod with the invert part of the quartz on two points, leading to a stronger mechanical stability. The dead volume region is totally modified and the shock waves from the plasma expansion during each pulse cause lower strengths on the seal.

Flashlamps : “Standard Series” for lasers, photography and stroboscopy.

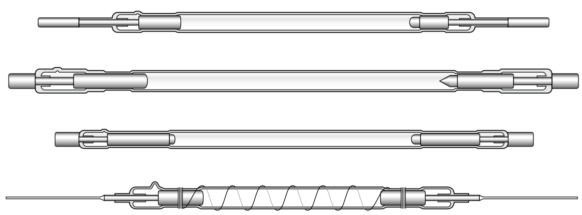


Standard Electrodes

Shrunk electrodes

Beyond 70 $W.cm^{-2}$, lamps must preferentially be used in a water cooling system. The very high temperatures reached in the electrode body impose an important cooling. The technique used consists of “shrinking” the electrode on the quartz itself. The heat removal is made easier and the power densities in pulsed regimes may be as high as 200 $W.cm^{-2}$, and 350 $W.cm^{-2}$ in CW use (wall thickness 0,5 mm). This technique gives on the other side a very great mechanical stability, and is currently used.

Flashlamps : “JA, DC, DU Series” for lasers
“JA Series” for photography”



Shrunk Electrodes

Description of the electrodes

The anode is principally composed of pure or thoriated tungsten. Generally of massive construction, the anode must whitstand very high thermal conditions, and the using material must resist to very important temperatures.

The cathode main body is composed of thoriated tungsten, ant the tip contains poreous tungsten impregnated with emissive compounds such as Barium, Strontium, Aluminum, Zirconium, etc. The metallic impregnation allows the cathodes to have an optimal work function.

According to the working conditions (CW or pulsed regimes), the cathode shape is variable.

In CW regime, the cathode tip is pointed to increase the effect of the electric field and favor the centering of the cathodic spot. This type of cathodes is found on all the "DC" models. In pulsed regimes, the cathode shapes are however rounded to allow the very high peak currents (LC discharges : "JA" models) or important pulse durations (greater than 1 ms.) implicating high temperatures reached in the cathode tips (electronically controlled pulses and rectangular current profiles, "DU" models). The rounded tip permits to dissipate heat in the better conditions.

The "DU" series are characterized by a particular construction of the cathode, favorizing the cathodic spot, whereas a very useful thermal bridge allows the emissive compounds to be perfectly diffused in the top of the cathode. DU series anodes are also manufactured for centering the anodic spot on the top. At equal average power, DU cathode will be cooler than another type of electrode, avoiding the emissive compounds to be rapidly diffused, reducing also the apparition of a black deposit due to local melting of the thermal matrix, and delaying local formations of silicon deposits ochre-looking, on account of the high temperatures existing inside the tube. The DU electrodes are particularly recommended for conditions where very short pulse durations are needed, and where very long quasi-flat pulse profiles are used. The DU series cathodes are used for typical pulses from 100 µs up to 10 ms and more, with average peak current in stabilized pulses widths. Sprung from the DU series, two other types of lamps were created : the DUM and DUS series. The electrodes of the DU, DUM and DUS series are physically similar, only their temperature, in the same working conditions, are different as they have different techniques of thermal evacuation. The DUS series are used for shorter pulses, from 1 µs to 500 µs. Silica thickness is 1 mm all along the lamp, which is adapted for short pulse durations and high peak currents.

Envelope

Lamps are principally composed of cylindrical envelopes made of transparent silica glass or sometimes borosilicate (low power applications). Quartz is often used thanks to its excellent mechanical and thermal behaviour. It is possible to reach important energy pulses and high average powers. Its constitution is silica SiO_2 at its natural amorphous state.

Borosilicate

Standard glass especially used in the "photoflashtubes" where high power densities are not required. This glass may be used in thermal environment as high as 300°C, with a correct forced air cooling.

VQF Denomination : B

Quartz

- Synthetic fused silica : pure synthetic nonfluorescent silica. Its very low level of impurities allows this silica to be transparent in the UV range from 160 nm and is then very useful for all applications that require sources in the ultraviolet. The OH radicals are in great proportion in this type of silica and disturbs the starting characteristics of the flashtube. However, the synthetic fused silica possesses remarkable time resisting characteristics, and does not solarise. Its high cost compared with the other silicas remains an obstacle for the choice of the envelope.

VQF Denomination : H

- Natural fused silica : this type of quartz, widely used in flashlamps, has a level of impurities more important than the synthetic fused silica : absorption bands appear near 540 nm after extensive use (solarisation). This quartz is very robust. Its optical transmission curve begins around 220 nm and the allowed temperature can reach 800°C without any damage. Its availability is very high, allowing to provide this silica at low costs.

VQF Denomination : N

- Cerium doped silica : the UV radiation is often prejudicial for all the laser components (pumping chamber, active medium, optical components). The very strong absorption of the UV radiation in this quality of quartz is accompanying by a little fluorescence in the visible range of the spectrum (around 435 nm). This silica has noticeable time resisting qualities and solarisation phenomena are pratically nonexistent. This quartz is widely used on Nd : YAG lasers pumped lamps in order to avoid ozone production resulting on solarisation of the active medium rods, and for all applications where UV radiation is not accepted in general.

VQF Denomination : R

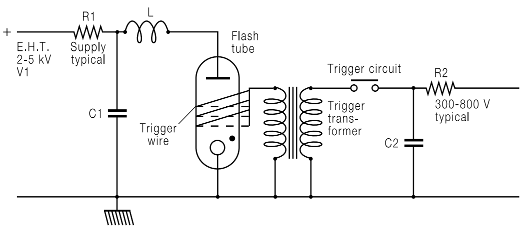
Electrical characteristics

TRIGGER-LAMP IGNITION

Flashlamps are filled with a rare gas and the ignition of the system is not obvious. At first, flashlamps behave before ionization like very low capacitances (between 100 and 500 pF). An intense external electromagnetic source must be applied on the lamp to provoke the gas dielectric breakdown : the filling gas has, in the non ionized state, a very great impedance (several tens of MΩ). The application of a high voltage source (several kilovolts) must result on the gas breakdown and a spark streamer is generated between both electrodes. The ionized lamp is now a low impedance system. The initiation phases of the discharge formation are complex and are strongly dependent upon the immediate environment of the lamp (presence of the wire, the cooling water nature may even have its own importance on the starting conditions). The most influent factor on the starting conditions is the presence of the silica. In the first moments, a spark is generated between one of the electrodes and the inside wall in proximity. The propagation runs all along the envelope up to the formation of a ionized channel linking the electrodes.
Several trigger starting methods are possible :

External triggering

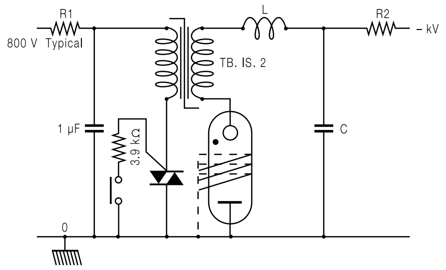
The most commonly used method and the easier is the application of a high voltage on a metallic wire wrapped around or running along the lamp. The transformer can deliver high voltage pulses from 5 to 20 kV or more. It is composed of primary and secondary circuits were the ratio may be as high as 40. The trigger coil is of low size and its cost remains very interesting.



Basic flashtube circuits : External Trigger

Series triggering

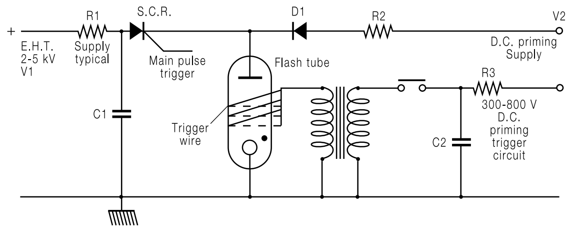
The high voltage is directly applied on one of the electrodes of the lamp. This is supposing that the discharge current will pass through the secondary of the transformer, placed in series with the lamp. It is the reason why these transformers are of important size, heavy and expensive. The using conditions on the other side offer a better security since the high voltage is not present in the external parts of the lamp, as for external triggering. The starting is realized at lower bias voltages. The secondary of the transformer behaves as a supplementary passive inductance so an inductive component is in some cases not necessary for the pulse forming network (PFN) setting. For CW power supplies with series triggers, the secondary is preferentially connected on the cathode. This allows a perfectly stable spot fixation on the tip of the cathode even on used models.



Basic flashtube circuits : Series Trigger

Simmer operation

The simmer current consists of holding a ionized channel centering the tube axis. This is a good electrical "standby" for the main discharges. The simmer mode is not necessary after triggering, but it is generally recommended for the following reason : although of low value, the characteristic discharge in the simmer mode can be assimilated to an arc where current densities reach important values due to the little section of the arc itself. Within those conditions, the voltage drop varies according to the cases from 8 V/cm to 15 V/cm at 500 mA and the ionized channel remains correctly centered between both electrodes. The use of a simmer current supposes the supplementary presence of a DC power supply in the driving circuit of the lamp.
The minimum recommended value is 300 mA for JA models and 3 A for DU models, for good stability of the arc.
The voltage / current characteristic curve in such a regime is in the negative part. The voltage will not be dependent upon lamp bore diameter but increases with pressure, is proportional to the arc length, and varies as $i^{-0,3}$ where "i" is the current.



External Trigger and DC priming mode (simmer)

High power switching transistors

In high power lasers, lamp pulse duration can be controlled electronically by using high power switching transistors (IGBT or MosFET) placed in series with the lamp. The pulse shape is almost rectangular (square- shaped) and the typical pulsewidths are in the range 0,1ms up to 10ms, or more. The use of this electronic component is associated with a simmer circuit (for high power flashlamps, the value of the simmer current varies from 1 to 5A). The maximum current is between 300A and 600A typically. These lasers are mainly used for high power industrial applications

LC discharges

The characterization of the different electrical parameters was studied by many authors and the most well known study has been carried out by Markiewicz and Emmett in 1966.
During pulse duration, the lamp is not considered as a linear resistance. Goncz has formulated an empirical expression which describes the voltage evolution as a function of the current passing through the lamp (high current regimes) :

$$V(t) = \pm K_o(t) \,.\, | I(t) |^{1/2}$$

where
- $V(t)$: voltage in Volts at time t
- $I(t)$: current in Amps at time t
- $Ko(t)$: impedance parameter in $\Omega.A^{1/2}$ of the lamp at time t

The impedance parameter K_o can be expressed using the following formula :

$$K_o = 1{,}28\,(\ell/d).(P/P_G)^{0,2}$$

where
- ℓ : arc length
- d : bore diameter
- P : gas filling pressure in Torrs
- P_G = 450 for Xenon
  = 805 for Krypton

Thanks to : $E_o = \frac{1}{2} C V_o^2$ (energy stored in the capacitance C, V_o : voltage)
capacitance C and inductance L are expressed :

$$C = \left(\frac{2E_o\alpha^4 T^2}{K_o^4}\right)^{1/3} \qquad \text{where : } \alpha = \frac{K_o}{\sqrt{V_o.Z_o}}$$

$$Z_o = \sqrt{\frac{L}{C}} \quad \text{and} \quad T = \sqrt{LC}$$

$$L = \frac{C^2 K_o^4}{2E_o\alpha^4} \qquad \text{or} \quad L = \frac{T^2}{C}$$

"Critically-damped conditions" are obtained when current rise times are slightly equal to current decay times (better efficiency and optimal peak intensities) : this is reached when damping parameter $\alpha = 0{,}8$. The pulse duration at 1/3 of the peak current is then given by :

$$T_{1/3} = 3\sqrt{LC}$$

for which more than 95 % of the energy has been dissipated in the lamp.
With $\alpha = 0{,}8$ the value of peak current is described by :

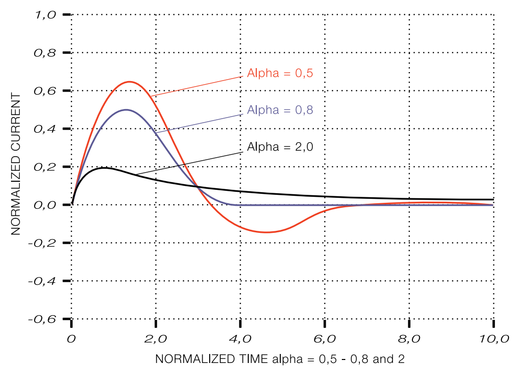
$$i_p = 0{,}5\,\frac{V_o}{Z_o}$$

This value is reached after the following time :

$$t_r = 1{,}25\sqrt{LC}$$

If $\alpha < 0{,}8$ (typically between 0,2 and 0,8), the lamp is "underdamped" (current oscillations occur with cyclic negative values of the current) : this type of regime is not recommended due to the inverse role of the electrodes on polarized models, and lead to strong decrease of efficiency.

When $\alpha > 0{,}8$ (typically between 0,8 and 3), the lamp is "overdamped", characterized by a fast increase of intensity followed by a slow decrease with time up to the flash extinction : this regime, currently used on non-selfic circuits, has also a bad efficiency. The optimal peak intensity is actually not reached.
Values of α around 0,8 must be preferentially chosen. "JA series" lamps are typically adapted for LC networks.



High power pulses

The growing needs for high power lasers used in the industry for welding or drilling bound to the elaboration of high power lamps used in pulsed regimes generated electronically where quasi flat current profiles are used.

The basic equations are simply given by :

$$P_{av} = V \,.\, I \,.\, T_p \,.\, v$$
$$V = K_o \,.\, I^{1/2}$$

Where :
- P_{av} : average power in Watts
- V : voltage in Volts
- I : current in Amperes
- T_p : pulse duration
- v : pulse frequency in Hertz

All the DU series flashlamps are built for working under such discharge regimes.

CW arc lamps

The simmer operation is characterized by a negative slope of the voltage / current characteristic curve : this is the region where the voltage is decreasing while the current is increasing. Dependent on pressure, type of gas and dimensions of the lamp, a current value is reached corresponding to the minimum of the voltage (typically between 4 and 8 A) : it is the region where the plasma begins to grow up radially to fill the entire volume of arc length. A new type of regime is characterized by a DC current passing through the lamp and its maximum value does not exceed 50 A in the major cases. This is a low current density regime (170 A.cm^{-2}).

When the current is increasing, the voltage is increasing and follows a linear law :

$V = R_d\, I + V_s$

where V : voltage in Volts
R_d : dynamic (or differential) impedance in Ω
I : DC current in Amperes
V_s : base voltage in Volts

Despite of the apparent simpleness of this formula, the impedance R_d and voltage V_s are closely dependent on the nature of the gas, its pressure and on the lamp dimensions. It is obvious that V increases linearly with the arc length but R_d and V_s increase while the pressure is increasing, and decrease while the lamp bore diameter increases. Generally, the cold filling pressures vary from 1 Atm. to maximum 6 Atm. (8 Atm. in special cases). Static impedance is sometimes mentioned: this is typically the voltage / current ratio, its expression is often used at its maximum power (max. voltage / max. current ratio). All the “DC” series models are working under CW regimes.

CW modulation

The lamp is used in a circuit where the current is regularly switched between a minimum value and the maximum operating value over few seconds each period. Current is constant cyclically, so that pulses are square-shaped. Generally, the maximum current is the max value depending of the arc lamp (see tables on p. 16 and 17). The minimum values of the current are variable on users requirements. The “DCU” series models are suitable for this type of use.

Plasma characteristics

Types of gases

The typical filling gas used in the lamps is a rare (or noble) gas such as Xenon, Krypton, Krypton-Xenon and sometimes Argon. This type of gas is well justified for the following reasons :

- emission on a wide band of wavelength from the UV to the IR region, and this is appreciated for studio photography for example (quasi-white light)
- strong emissivity for current densities over 3000 A.cm^{-2}
- relatively low thermal conductivity
- easy excitation and good ionization state.

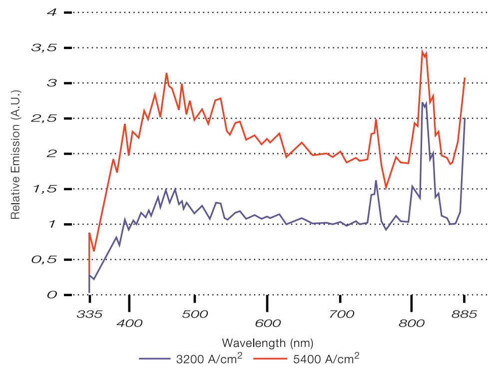
In specific use as laser pumping, rare gases possess in the near IR very strong line radiations which fits with the YAG crystal absorption for example.

Rare gas flashlamps are very useful thanks to the high reproductible characteristics of the spectral output throughout lamp lifetime (Xenon or Krypton), and from one model to another identical.

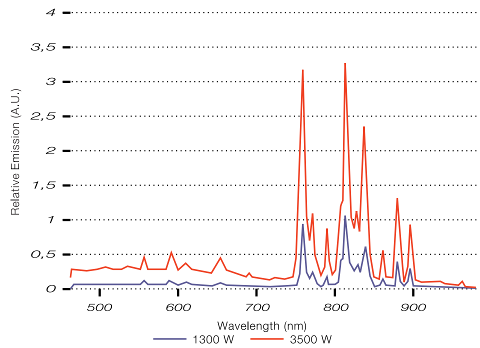
Radiation characteristics

The radiative phenomena are preponderant. It is very useful to characterize the spectral profile of the plasma.

- Pulsed flashlamps : spectral emission of the gas between 3200 A.cm^{-2} and 5400 A.cm^{-2} is not uniformly increased : the continuum radiation (between 400 and 750 nm) increases faster compared with line radiation of the IR region (from 750 nm). This tends to prove that the collisional processes are preponderant in this type of excitation and that increase of radiation is mainly due to the increase of the gas emissivity.
- CW arc lamps : in these cases, current densities are weak compared with those obtained in the pulsed regimes. The spectrum is highly dominated by the IR line radiation. These lamps are in the mainly filled with Krypton and are used for continuous Nd:YAG lasers optical pumping : the Krypton spectral structure is composed of strong line radiation between 750 nm and 850 nm, and this may assure an optimum spectral coupling for crystal absorption in this region of the spectrum. All spectra given here have been recorded on Cerium doped quartz lamps and this explains the very low emission in the UV range around 400 nm.



Xenon emission of a pulsed “JA type” flashlamp



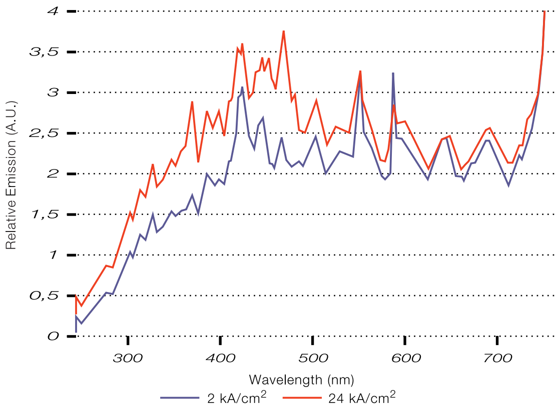
Krypton emission of a CW “DC” arc lamp

The 2 following spectra show evolution of the emission (UV - visible and visible - IR) for a krypton pulsed flashlamp with the same input energy (50 Joules) and 2 different flash durations :

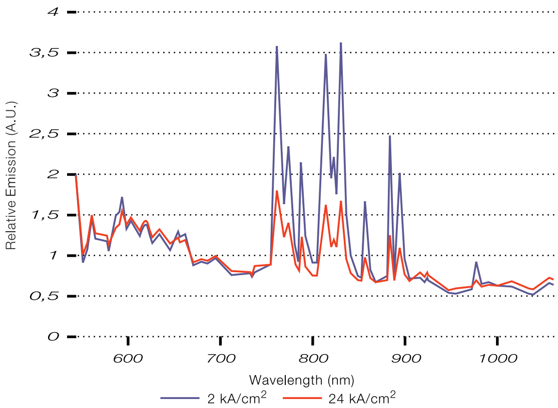
600 µs : 2000 A/cm²

50 µs : 24000 A/cm²

The higher current densities (shorter flash durations) shift the spectral profile to the stronger UV emission while the lower current densities (longer flash durations) allow stronger IR emission. This remark is also valid for Xenon.



Krypton emission : U.V. - Visible



Krypton emission : Visible - I.R.

Lamp lifetime

General

The real definition of the flashlamp lifetime is not explicit : it depends on what is the exact user's requirement. Flashlamp connections may have effects on lamp lifetime : note for example that 2 (or more) flashlamps connected in parallel are misused, leading to lamp anormal behaviour and decreasing lifetime. In the CW mode operation, the VQF lamps reach now 1500 hours of working without electrodes and/or silica damage because only 5 % of light weakens in the blue/green region of the spectrum : warranty is fixed at 1000 hours of working in normal conditions - maximum power - if recommended technical specifications are respected. In pulsed regimes however, the imposed strengths on the lamps are radically different and each pulse causes injurious effects on quartz behaviour :

Two major phenomena clearly append at the end of the lamp life :

- electrode deterioration by metallic sputtering.
- silica degradation appearing ochre.

Electrode deterioration

The material deterioration of the tungsten matrix in the cathode tip (sputtering) leads to the ejection of particles which are afterwards depositing on the inside part of the quartz. This black-looking deposit darkens lamp radiation. Moreover, physico-chemical mechanisms tend to cause local strengths on the silica which may break afterwards.

In pulsed discharges, the important energy transfers endured by the cathode between each pulse lead to a braun-looking localized deposit on the silica : these are the first attacks of the emissive materials which are reacting on silica. After long working, the inner wall of the lamp on all the arc length is progressively recovering by a yellow deposit (silicon formation) due to the silica attack of alkaline oxides.

It is clearly obvious that these different phenomena, even not totally eliminated, may however be minimized thanks to the contribution of a new metallic compound resisting to very high temperatures. The manufacturing techniques, more and more reliable, permit our Company to bring solutions that reduce the black deposit on silica during lamp working, such as the introduction of metallic compounds reducing tungsten sputtering, optimal thermal gradient in the electrodes themselves thanks to materials of high thermal conductivity, better techniques of electrode cooling …

Quartz behaviour

Strengths on quartz are essentially of thermal origin. In the CW mode operation, these strengths are closely dependent upon the input average power in the lamp when plasma completely fills up the tube. After long working, the heat flux from the plasma induces quartz superficial evaporation modifying its own structure (which becomes crystalline) and white-looking deposits appear. This is a quite isolated phenomenon regarding the yellow deposit which absorbs light radiation.

In pulsed regimes, however, quartz is submitted to very hard thermal strengths during each pulse. Since the silica has a bad thermal conductivity, the thermal gradient in the envelope thickness remains high from pulses to pulses.

The important thermal gradient however causes formation of cracks, first localized, then progressively extending all along the lamp.

The cracks become failures more and more deeper, and the lamp finally explodes. All these phenomena are of course enlarged if the power density becomes very high, but may be rather non existent if the working conditions remain under the limit of silica brittleness.

Explosion energy

This is the sufficient amount of energy required to cause instantaneous explosion of the tube during the first pulse. It is dependent on lamp dimensions, on the flash duration, on physical silica parameters and on the heat flux absorbed by the silica due to radial expansion of plasma.

The explosion energy may be written as :

$$E_X = C_X \cdot \ell \cdot d \cdot \sqrt{T_{1/3}} \qquad \text{or} \qquad E_X = K_X \cdot \sqrt{T}$$

where :

- ℓ : arc length in mm.
- d : bore diameter in mm.
- $T_{1/3}$: flash duration (α = 0,8) in µsec.
- $T_{1/3} = 3\sqrt{LC}$
- $T = \sqrt{LC}$
- C_X = 0,14 for d < 8 mm.
- C_X = 0,12 for 8 ≤ d ≤ 15 mm.
- K_X : explosion constant
- $K_X = 0{,}246\, \ell\, d$ (d < 8 mm.)
- $K_X = 0{,}20\, \ell\, d$ (8 ≤ d ≤ 15 mm.)

This relation is valid for Xenon with pressures between 300 and 450 Torrs, for quartz thickness of 1mm (natural fused, N type) and for a critically damped circuit.
It is very interesting to compare the input energy with the explosion energy. In other terms, we consider its input energy E_O to be a fraction of its explosion energy E_X. When the lamp is working far below 20 % of the energy E_X, we can predict a good lifetime. When the fraction of the explosion energy exceeds 30 %, the thermal envelope degradation are rapidly increasing. Beyond 80 %, only some tens of shots may be accomplished.
A significative expression can be written for the approximation of the number of pulses dependent on the explosion energy :

$$N = \left(\frac{E_O}{E_X}\right)^{-8{,}5}$$

In the optimal working conditions, lifetimes of 10^6 to 10^7 pulses are current : they correspond to fractions of explosion energy respectively equal to 0,20 and 0,15. In pulse discharges, the simmer current has a great influence on the predicted number of pulses : it is admitted that the lamp number of shots may be increased of roughly 30 % in simmer operation compared to the same lamp without simmer.

References

Some examples of bibliography, among many others …

J.P. Markiewicz, J.L. Emmett :
Design of Flashlamp Driving Circuits,
IEEE J. QE-2, 11, 707 (1966)

J.H. Goncz :
Resistivity in Xenon Plasma,
J. Appl. Phys., 36, 742 (1965)

D.E. Perlman :
Characteristics and Operation of Xenon Filled Linear Flashlamps,
Review of Scientific Instruments, Vol 37, 3, 340 (1966)

M.J. Kushner :
Arc Expansion in Xenon Flashlamps,
J. Appl. Phys., 57, 7, 2486 (1985)

J.F. Holzrichter, J.L. Emmet :
Design and Analysis of a High Brightness Axial Flashlamp,
Applied Optics, 8, 7, 1459 (1969)

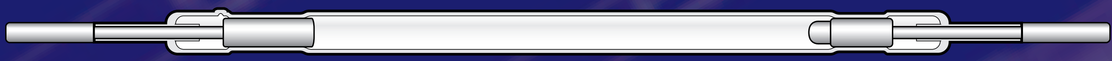
Laser Technology : W. Koechner
Solid-State Laser Engineering
5th Edition (rev. 1999), Springer Verlag
"Optical Pump Sources" : Ch. 6

M. Skowronek :
Les tubes à éclairs,
1992, Ed. Masson, Physique fondamentale et appliquée.

Techniques d'utilisation des photons, Principes et applications,
Electra, 1992, Ed. Dopee 85
"Lampes à éclats et lampes à arc" : Ch. 3.2

Standard Linear Flashlamps

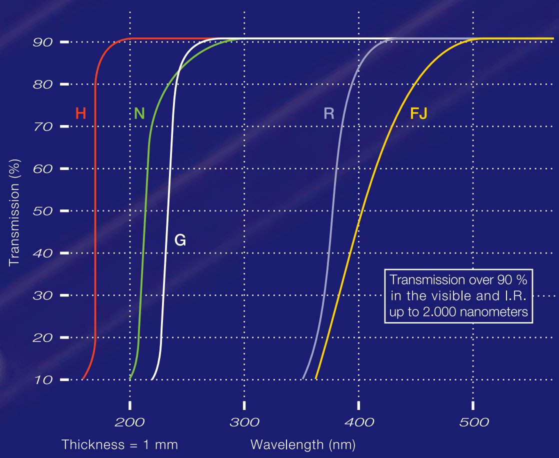
JA SERIES



EXAMPLE : ORDERING INFORMATION

Flashtube	VQ
Xenon	X
Quartz envelope	R
Ref N°	8P4
(JA Serie)	JA
Pressure in Kg/cm2	1
Tube end	E4R

DIFFERENT TYPES OF SILICA TUBING



TYPICAL XENON OUTPUT SPECTRUM
Pulsed Flashlamp

R : Cerium doped silica. Even after extensive use there is pratically no violet coloured absorption center near 540 nanometers.
This silica filters pratically all the UV, no deterioration of doped glass rods or reflectors, no ozone formation, and has no damaging effect on the eyes.
Considerable conversion of UV into fluorescence centered at 435 nanometers : particularly recommended for pumping Yag crystals.

N : Natural fused silica with little fluorescence (selection of quartz crystals). After long use, coloured centers appear near 540 nanometers. Robust material.

H : Pure synthetic non-fluorescent silica. No appearance of absorption at 540 nanometers. This silica is mainly used for optical pumping of rubies and for distant UV flash sources.

G : Titanium doped silica (germicidal) absorbing UVC. No ozone formation. Very rapid appearance of coloured absorbtion centers around 540 nanometers.

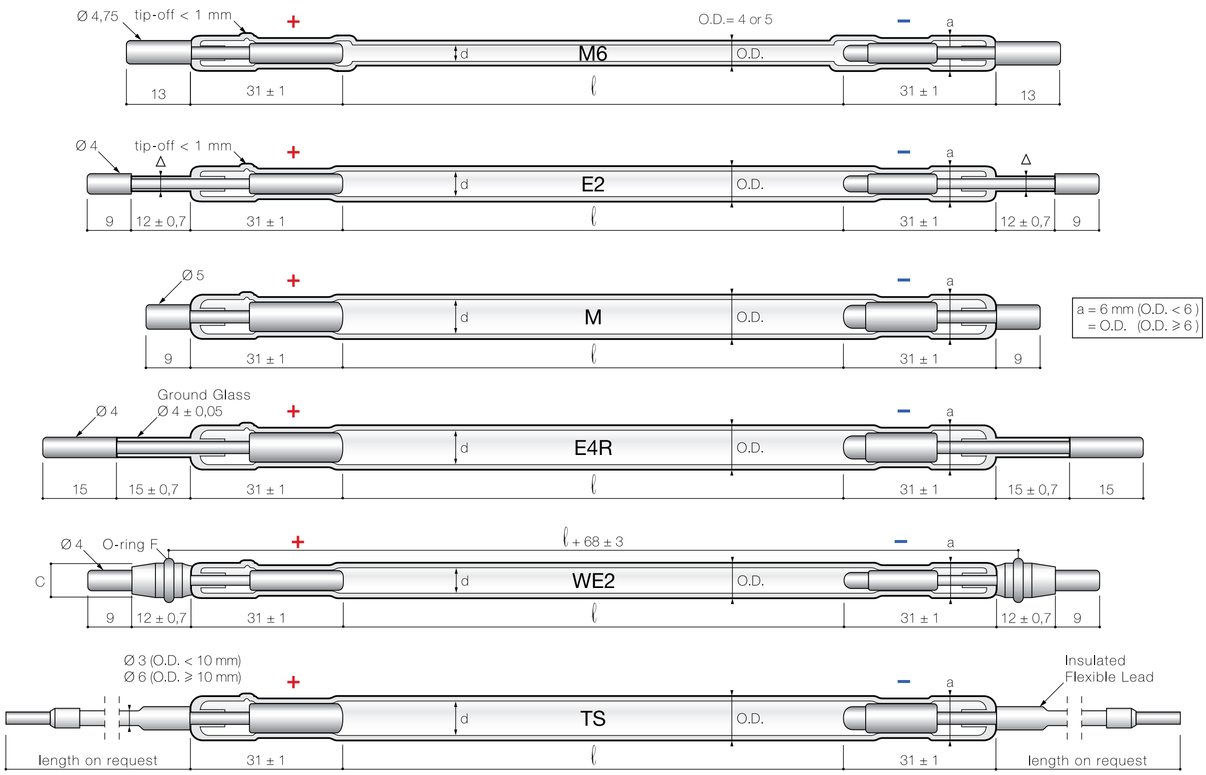
FJ : Yellow filters stopping all UV, correcting filter for colour photography. Withstands more than 600°C in permanent use, in air. Coated on R silica. No immersion.

The spectral profile of xenon (and for rare gases in general) is composed of continuum of radiation - visible part from 350 nm up to 750 nm - and line radiation (atomic radiative transitions between energy levels) - IR part from 750 nm. (see figure beside)
Evolution of the radiation for 2 different current densities : 3200 A/cm² and 5400 A/cm².

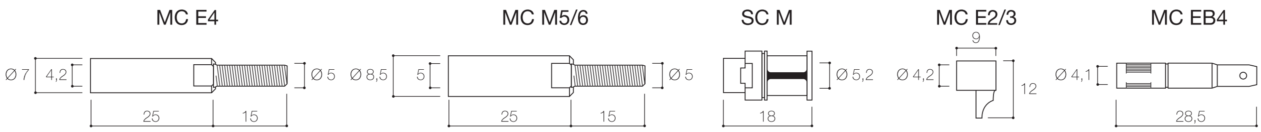
FLASHLAMPS
Verre & Quartz

Standard Linear Tube ends

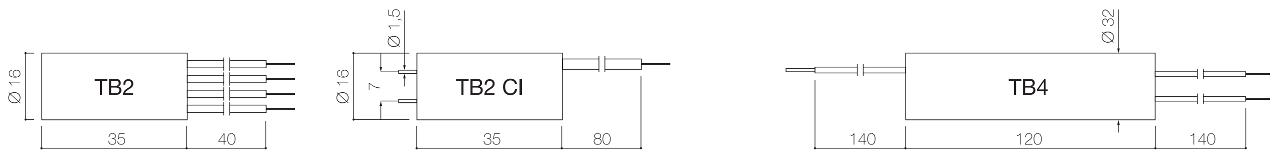
JA SERIES



Standard Plugs



Typical Trigger Coils



TB2 or TB2 CI

Primary Voltage : Max. 600 V
Secondary Voltage : Max. 22 kV
Discharge Capacitor : Typ. 0,47 µF
TB2 CI : output pins for soft soldering on elec. cards.

TB4

Primary Voltage : Max. 700 V (Typ. 600 V)
Secondary Voltage : Typ. 40 kV (Max. 50 kV)
Discharge Capacitor : Typ. 0,22 µF
Typ. useful frequency : 2 kHz

For more details about trigger transformers, please see section : “TRIGGER TRANSFORMERS FOR EXTERNAL AND SERIES TRIGGERING”.

30, Route d’Aulnay - 93140 Bondy - FRANCE
Tel + 33 (0)1 48 49 74 21 - Fax + 33 (0)1 48 48 44 22
e-mail : flashlps@club-internet.fr
FLASHLAMPS Verre & Quartz

30, Route d'Aulnay
93140 Bondy - FRANCE
Tel + 33 (0)1 48 49 74 21 - Fax + 33 (0)1 48 48 44 22
e-mail : flashlps@club-internet.fr

FLASHLAMPS
Verre & Quartz

JA SERIES

ORDERING CODE VQX R . . . JA1 E2 Note 1	4P1.5	4P2	4P2.5	5P2	5P2.5	5P3	5P4	6P2	6P2.5	6P3	6P4	6P5
d (I.D. ± 0,2 mm) (O.D. = d+2 mm)	2			3				4				
l **Arc length** (mm)	38,1	50,8	63,5	50,8	63,5	76,2	101,6	50,8	63,5	76,2	101,6	127
Δ (± 0,1) (mm)	3	3	3	3	3	3	3	3	3	3	3	3
F (mm) Note 2	8	8	8	8	8	8	8	8	8	8	8	8
C (± 0,1) (mm)	7,7	7,7	7,7	7,7	7,7	7,7	7,7	7,7	7,7	7,7	7,7	7,7
Ø of hole in flashtube supporting plate	8	8	8	8	8	8	8	8	8	8	8	8
Max. Power (W) Note 3 — Forced Air	90	120	150	180	230	270	360	240	300	360	480	600
Max. Power (W) Note 3 — Water Note 4	480	640	800	960	1200	1440	1920	1280	1600	1900	2560	3200
Operating Voltage (V) — Min.	540	600	660	600	660	720	840	600	660	720	840	960
Operating Voltage (V) — Max.	1400	1600	1700	1600	1700	1900	2200	1600	1700	1900	2200	2500
Max. Peak Current (A) Flash Duration 500 µsec.	500	500	500	500	500	500	500	500	500	500	500	800
Trigger Voltage (kV)	15-22	15-22	15-22	15-22	15-22	15-22	16-22	15-22	15-22	15-22	16-22	17-22
Typical Transformer	TB2	TB2	TB2	TB2	TB2	TB2	TB2	TB2	TB2	TB2	TB2	TB2

JA SERIES

ORDERING CODE VQX R . . . JA1 E2 Note 1	7P2	7P3	7P4	7P5	8P2	8P3	8P4	8P5	9P3	9P4	9P6	9P8
d (I.D. ± 0,2 mm) (O.D. = d+2 mm)	5				6				7			
l **Arc length** (mm)	50,8	76,2	101,6	127	50,8	76,2	101,6	127	76,2	101,6	152,4	203,2
Δ (± 0,1) (mm)	3	3	3	3	3	3	3	3	3,5	3,5	3,5	3,5
F (mm) Note 2	9	9	9	9	9	9	9	9	11	11	11	11
C (± 0,1) (mm)	7,7	7,7	7,7	7,7	8,7	8,7	8,7	8,7	10,2	10,2	10,2	10,2
Ø of hole in flashtube supporting plate	8	8	8	8	9	9	9	9	11	11	11	11
Max. Power (W) Note 3 — Forced Air	300	450	600	750	360	540	720	900	630	840	1260	1680
Max. Power (W) Note 3 — Water Note 4	1600	2400	3200	4000	1920	2880	3840	4800	3360	4480	6720	8960
Operating Voltage (V) — Min.	600	720	840	960	600	720	840	960	720	840	1080	1320
Operating Voltage (V) — Max.	1600	1900	2200	2500	1600	1900	2200	2500	1900	2200	2900	3500
Max. Peak Current (A) Flash Duration 500 µsec.	800	800	800	800	1100	1100	1100	1100	1400	1400	1400	1400
Trigger Voltage (kV)	16-22	16-22	17-22	18-22	16-22	16-22	17-22	18-22	17-22	17-22	19-22	19-22
Typical Transformer	TB2	TB2	TB2	TB2	TB2	TB2	TB2	TB2	TB2	TB2	TB2	TB2

Specifications are subject to change without notice - Standard features given in the table : other specifications on request.

Note 1

XENON FLASHTUBE (VQX…JA 1)

Standard silica : R (N, H and G available on request, as well as FJ coating).
The last figure in our reference indicates cold filling pressure in kg/cm^2 for JA tube series.
Standard pressure fill : 1 kg/cm^2 (1 to 4 kg/cm^2 on request).

Typical operating energy (critical damping discharge).

$J = \sqrt{T} \times \ell \times d \times 0{,}029$ T in µs, ℓ and d in mm.
This formula is given for recommended typical operation where discharge energy is equal to 20% of the energy at which the lamp explodes at the first shot in air at 20°C (explosion due to over high pressure and to stresses brought to bear by the temperature gradient upon the tube in natural fused silica (N) under the best mechanical mounting conditions with typical input energy (B = 1)). With typical energy, lifetime varies from 10^5 to 10^6 shots or more according to the way in which the tube is used, irrespective of type of end or type of silica chosen. Lifetime is defined as the number of pulses after which light intensity drops to 50% due to silica and electrode erosion.

Calculation of maximum critical damping operation energy for linear flashtubes as a function of their structure and environment.
(Mounting with "FLASHLAMP - Verre & Quartz" W type tube ends, ceramic with silicone 0 ring on supporting plate, or equivalent, at ambient temperature of 20°C to 80°C, for flash durations between 40 µs and 4 ms).

Maximum energy in joules $= \dfrac{\sqrt{T} \times \ell \times d \times A \times B}{P}$

Where : T = total duration (1/3 peak) in µs ; ℓ (arc length) and d are in mm.
P = pressure of Xenon or Krypton in kg/cm^2 (last figure in the tube reference, max. 4 kg/cm^2).

Coefficient A (strength of tube depending on envelope material used).

silica thickness = 1 mm
A = 0,085 for N silica
A = 0,084 for G and H silica
A = 0,078 for R silica

silica thickness = 0,5 mm
A = 0,051 for N silica
A = 0,05 for G and H silica
A = 0,047 for R silica

Coefficient B (strength of tube end, environment) tube ends : E2, M, M6, E4R, WE2, TS…
B = 1 in air with reflector (in neutral atmosphere or for flash durations above 300 µs).
B = 0,45 in water in a laser cavity with very tight coupling.
B = 0,8 in water where there is an ample room for water to dilate during shots without causing extra mechanical stress on flashtubes.

Calculation of parameters for obtaining flash duration with critical damping at standard filling pressure.
(rise time = decay time)

$$C = 10^2 \sqrt[3]{\frac{2E\alpha^4\, t^2}{Ko^4}} \qquad L = \frac{t^2}{C}$$

$$Ko = 1{,}33\,\frac{\ell}{d} \qquad V = 10^3 \sqrt{\frac{2E}{C}} \qquad T = 3t\ (\alpha = 0{,}8)$$

T = total duration (1/3 peak) in µs.
E in joules. V in volt. C in µF. L in µH.
ℓ (arc length). d in mm and Ko in $\Omega\, A^{1/2}$.

KRYPTON FLASHTUBE (VQK…JA 1)

Pressure on request from 1 to 8 kg/cm^2.
Maximum power in watts the same as for Xenon (see table).
Maximum energy in joules as recommended above for Xenon.
Electrical ignition characteristics (trigger) are about 20% above those given in the table for 1kg/cm^2 of Xenon, for the same filling pressure.
Discharge characteristics : formulae given above for Xenon lamps give a good approximation for discharge parameters as a function of the energy and flash duration desired.

Standard tube ends : E2 (M, M6, E4R, WE2, available on request. See drawing).
High voltage insulation flexible leads with specific lengths available : TS…
- Ø 3 mm ext : temperatures -70°C +250°C, insulation 22 kV.
- Ø 6 mm ext : temperatures -70°C +250°C, insulation 37 kV.

Note 2

F is Ø of hole in plate supporting flashtubes fitted with WE2 ends.
Maximum operating temperature for continuous use in oxiding atmosphere (dry air) for lamps fitted with WE2 ends : 200°C.

Note 3

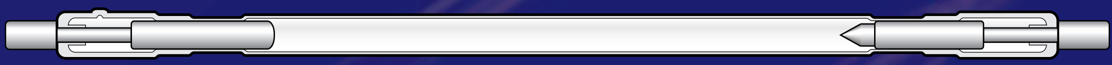
Maximum operating frequency is 30 Hz in air, 100 Hz in water, for tubes with pressure fill of 1kg/cm^2. For higher frequencies please consult us, see section : "Stroboscopic Xenon Flashtubes".

Note 4

Use only demineralized or preferably distilled water in a closed circuit. We recommend a deionizer in series, with an average flow of 8 liters per minute, and exchanger made of non-metallic material. If that is impossible, use only one metal, preferably stainless (no copper or derivatives). Temperature around the lamp should not exceed 40°C.
For silica thickness = 0,5mm, the max. power in water can be increased :
P x 1,6 (in Watt) for N, G and H silicas
P x 1,4 (in Watt) for R silica

Standard Linear Arc Lamps

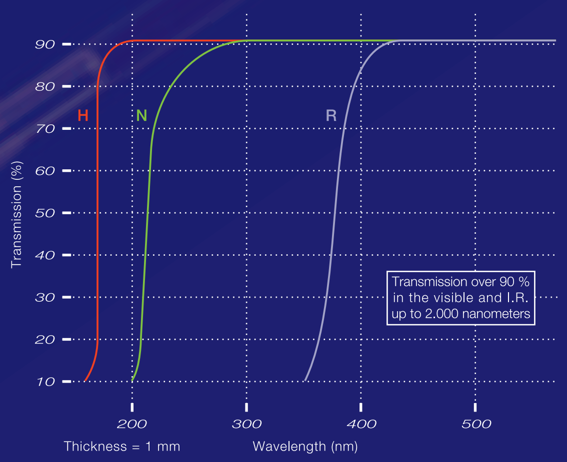
DC SERIES



EXAMPLE : ORDERING INFORMATION

Arc lamp	VQ
Krypton	K
Quartz envelope	N
Ref N°	7P4
(DC Serie)	DC
Pressure in Kg/cm2	4
Tube end	M

DIFFERENT TYPES OF SILICA TUBING

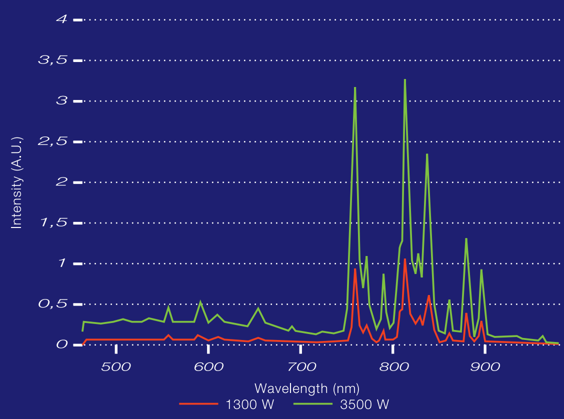


R : Cerium doped silica. Even after extensive use there is pratically no violet coloured absorbtion center near 540 nanometers.
This silica filters pratically all the UV, no deterioration of doped glass rods or reflectors, no ozone formation, and has no damaging effect on the eyes.
Considerable conversion of UV into fluorescence centered at 435 nanometers : particularly recommended for pumping Yag crystals.

N : Natural fused silica with little fluorescence (selection of quartz crystals). After long use, coloured centers appear near 540 nanometers. Robust material.

H : Pure synthetic non-fluorescent silica. No appearance of absorption at 540 nanometers. This silica is mainly used for optical pumping of rubies and for distant UV flash sources.

TYPICAL KRYPTON OUTPUT SPECTRUM CW ARC LAMP



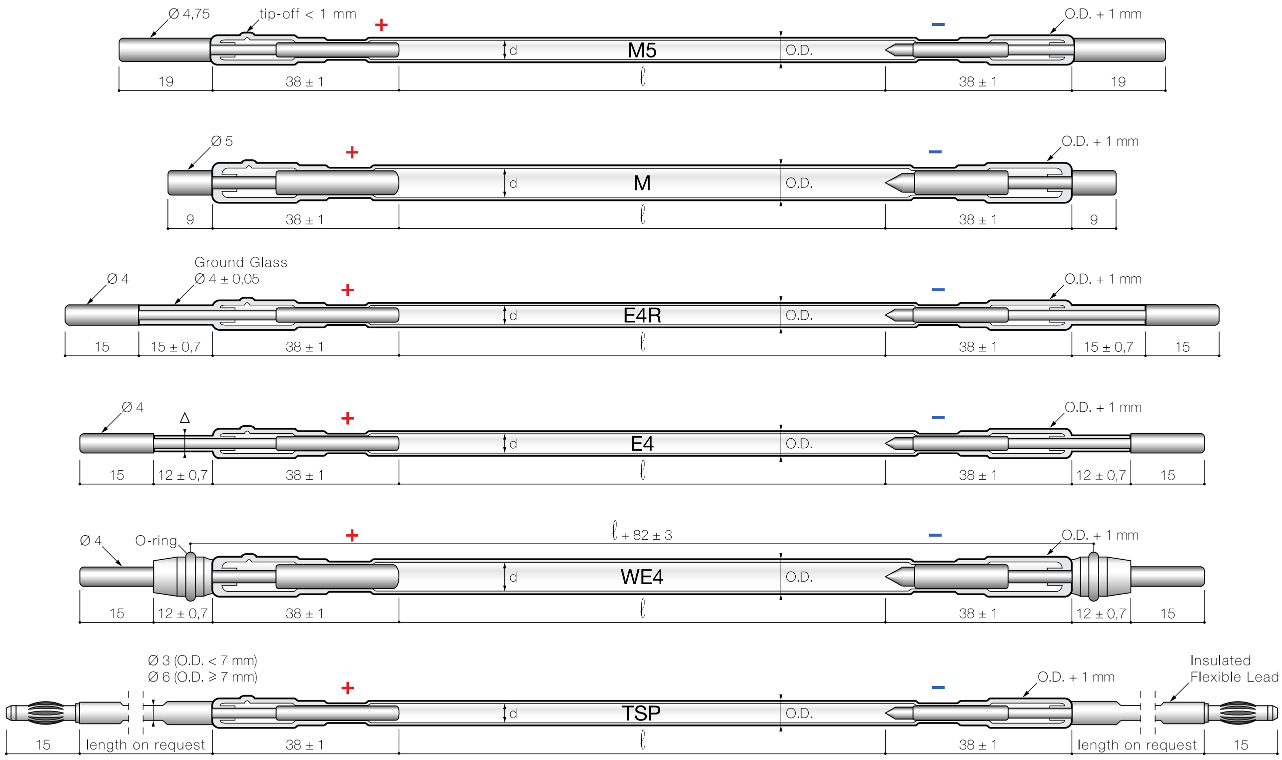
The krypton spectral structure is composed of strong line radiation between 750 and 900 nanometers for optimal spectral coupling of Nd : YAG or Nd : glass crystal.

Figure shows emission of a 150 mm arc length, 4 mm bore diameter CW krypton arc lamp for 2 different powers :
1300 W and 3500 W.

FLASHLAMPS
Verre & Quartz

Standard Linear Tube ends

DC SERIES



Note 1

KRYPTON ARC LAMP (VQK…DC4)

Continuous operation in water for CW laser pumping.
Standard pressure fill : 4 kg/cm² (1 to 8 kg/cm² on request).
DC operation (preferably filtered current).
Standard silica : N (H, R available on request).
Standard tube ends : M5 (M, E4, E4R, WE4, available on request).
High voltage insulation flexible leads with specific length available : TS…

- Ø 3 mm ext : temperatures -70°C +250°C, insulation 22 kV.
- Ø 6 mm ext : temperatures -70°C +250°C, insulation 37 kV.

The last figure in our reference indicates cold filling pressure in kg/cm² for DC tube series.

N.B. The DC tubes filled with Krypton have an output twice as high as that of the same tubes filled with Xenon when used for YAG crystal pumping. When these lamps are to be used as a very powerful light source with spectral characteristics similar to those of the sun, a Xenon fill is recommended.

Ignition Characteristics for all DC series (with pressure 4 kg/cm²)

Minimum anode voltage : 1 - 2 KVDC.
Minimum trigger voltage : 15 - 20 KV.

Approximate calculation of voltage U and current I for a desired power W,

based on values indicated in the table.

$$U \simeq \frac{U'}{\sqrt[4]{\frac{W'}{W}}} \qquad I \simeq \frac{W}{U}$$

Where : W = desired power (watts) at pressure of «x» kg/cm².
W' = maximum power (watts) at pressure of «x» kg/cm² given in table.
U' = voltage given in table for «x» kg/cm².
U = voltage to be used to obtain desired power W at «x» kg/cm².
I = current to be used to obtain desired power W at «x» kg/cm².

N.B. I) This formula can also be used for other types of continuous operation lamps to calculate the voltage U and current I corresponding to the disired power W, from the values of U' and W' measured on the lamps.
II) The values indicated are understood for filtered DC voltage. In the case of pulsed repetitive operation (with constant mean power) the above formula remains applicable when values are measured on the lamp used in this way.

Approximate calculation of voltage/current values for different desired pressures,

From voltage and current values measured on a lamp operated at «y» watts (pressure from 1 to 8 kg/cm²).

$$I \simeq \frac{I'}{\sqrt[4]{\frac{P}{P'}}} \qquad U \simeq U' \cdot \sqrt[4]{\frac{P}{P'}}$$

Where : P' = pressure in kg/cm² of gas fill in lamp on which voltage and current have been measured for «y» watts.
P = desired pressure in kg/cm².
U' = measured voltage for «y» watts and with pressure P' in the lamp.
I' = measured current in amperes for «y» watts and with pressure P' in the lamp.
I = current in amperes with pressure P in the lamp.
U = voltage for the lamp with pressure P.

Note 2

The standard wall thickness of our DC tube series is 0,5 mm, favorable to heat exchange and the avoidance of cristobalite formation. However we can make tubes on request with a constant wall thickness of 1 mm, where mechanical strength is particularly important. In this case, 1 is added to the first figure of the reference in the table and J is added before DC.
Example : VQK N 6P2 DC2 E2 becomes
VQK N 7P2 JAC2 E2.
(The first figure of the VQ reference always indicates tube O.D.).
The other characteristics given in the table remain unchanged.

Note 3

F is Ø of hole in plate supporting flashtubes fitted with WE2 ends. Maximum operating temperature for continuous use in oxiding atmosphere (dry air) for lamps fitted with WE4, WDE2 ends : 200°C.

Note 4

Cooling requirements : Fluid cooled only. Use deionised water with average flow of 8 liters/min.
Exchangers must be made of non-metallic material, except stainless (no copper or derivatives).
Lifetime : depends on the number of lamp firings, type of HV booster used and direct lamp confinement. 1000 hours can be reached at maximum power given in the table, 2000 hours when the lamp is used at 50% of maximum power, lifetime being defined as ending when output drops below 80% of initial output power.
Minimum power given in the table shows wattage below which lamps should not be operated with continuous rating. This value should be used for standby power when lamps reach maximum power from time to time and not be switched off in between.

Note 5

Voltages are given with a fluctuation of ± 5 volts.
Mean values measured under filtered DC, lamp power being adjusted to the current.
Mean values may vary with inside tolerances of the tubes and with the precision of Krypton filling pressure (pressure precision is highly reproducible in our fabrication).

N.B. It is strongly recommended **not to exceed 55A** on DC arc lamps (standard dimensions as per pictures above), for bore diameters d = 7mm, whatever the conditions. For other dimensions, please consult us. Adjust DC series lamp power to current rather than to voltage.

DC tubes with a filling pressure of 4 kg/cm² have a greater light yield than tubes with standard pressure of 2 kg/cm². These lamps can be furnished with filling pressures of up to 8 kg/cm². For example, a light yield increase of 20 to 50% (according to the type of utilisation) can be obtained by changing pressure from 2 to 8 kg/cm². The greater the pressure, the higher the continuous operating voltage and ignition voltage should be, and the greater is the light yield.

Note 6

Lamp impedance given by the voltage to current ratio. (Max power).

Specifications are subject to change without notice.

30, Route d'Aulnay
93140 Bondy - FRANCE
Tel + 33 (0)1 48 49 74 21 - Fax + 33 (0)1 48 48 44 22
e-mail : flashlps@club-internet.fr

FLASHLAMPS
Verre & Quartz

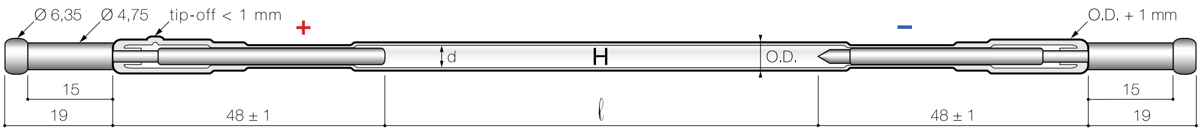
DC SERIES ORDERING CODE VQK N . . . DC4 M5 Note 1		5P2	5P3	5P4	5P5	6P2	6P3	6P4	6P5
d (I.D. ± 0,2 mm) (O.D. = d+1 mm) Note 2		4				5			
Arc length (mm)		50,8	76,2	101,6	127	50,8	76,2	101,6	127
Δ (± 0,1) (mm)		3	3	3	3	3	3	3	3
F (mm) Note 3		8	8	8	8	8	8	8	8
Average Power in water (W) Note 4	Max.	2000	3000	4000	5000	2600	4000	5200	6500
	Min.	340	510	680	850	400	600	800	1000
Voltage (V) Note 5	Max. Power	87	132	175	217	80	120	160	200
	50% Max. Power	75	113	150	184	67	101	135	169
Current (A) Note 5	Max. Power	23	23	23	23	32	32	32	32
	50% Max. Power	13	13	13	13	19	19	19	19
Static Impedance (Ω) Note 6		3,8	5,7	7,6	9,4	2,5	3,7	5	6,2
Dynamic Impedance (Ω)		1,3	1,9	2,5	3,1	0,9	1,4	1,9	2,3

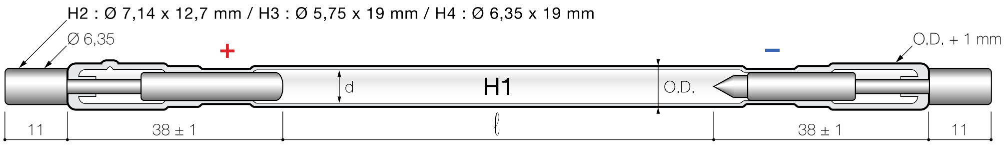
DC SERIES ORDERING CODE VQK N . . . DC4 M5 Note 1		7P2	7P3	7P4	7P5	8P2	8P3	8P4	8P5
d (I.D. ± 0,2 mm) (O.D. = d+1 mm) Note 2		6				7			
Arc length (mm)		50,8	76,2	101,6	127	50,8	76,2	101,6	127
Δ (± 0,1) (mm)		3	3	3	3	3,5	3,5	3,5	3,5
F (mm) Note 3		9	9	9	9	11	11	11	11
Average Power in water (W) Note 4	Max.	3400	5100	6800	8500	4000	6000	8000	10000
	Min.	440	660	880	1100	460	690	920	1150
Voltage (V) Note 5	Max. Power	76	114	152	190	71	107	143	180
	50% Max. Power	63	95	127	158	59	89	119	148
Current (A) Note 5	Max. Power	44	44	44	44	54	54	54	54
	50% Max. Power	27	27	27	27	34	34	34	34
Static Impedance (Ω) Note 6		1,7	2,6	3,4	4,3	1,3	2	2,6	3,3
Dynamic Impedance (Ω)		0,7	1,1	1,5	1,8	0,6	0,9	1,2	1,5

Specifications are subject to change without notice - Standard features given in the table : other specifications on request.

Arc Lamps for Industry

DC SERIES Krypton Arc Lamps for CW solid-state laser pumping





Note 7

Lamps fitted with H2 ends have the same dimensions as those with H1 ends, except for the electrical connection itself (H1 : Ø 6,35 mm, length 11 mm. H2 : Ø 7,14 mm, length 12,7 mm. H3 : Ø 5,75 mm, length 19 mm. H4 : Ø 6,35 mm, length 19 mm). These standard lamps can be fitted with any of the above types of connection (or other standard tube-ends as shown in the catalog) upon request.

Note 8

The standard wall thickness of our DC tube series is 0,5 mm, favorable to heat exchange and the avoidance of cristobalite formation.

Note 9

Lamp impedance given by the voltage to current ratio at maximum power.

Note 10

Voltages are given with a fluctuation of + or – 5 Volts.

Note 11

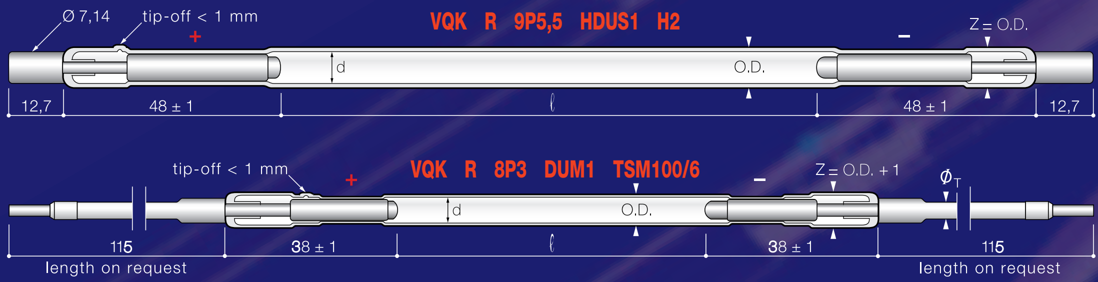
Lifetime : depends on the number of lamp firings, type of HV booster used and direct lamp confinement. 1000 hours can be reached at maximum power given in the table, 2000 hours when the lamp is used at 50% of maximum power, lifetime being defined as ending when output drops below 80% of initial output power. Minimum power given in the table shows wattage below which lamps should not be operated with continuous rating. This value should be used for standby power when lamps reach maximum power from time to time and not be switched off in between.

DC SERIES ORDERING CODE — VQK N . . . / Type / Tube end . *Note 7*		5P2 DC8 H	5P3 DC8 H	6P2 DC6 H1	6P3 DC6 H1	7P3 DC6 H1	7P4 DC6 H1	7P4 DC6 H	8P3 DC4 H2	8P4 DC4 H2
d (I.D. ± 0,2 mm) (O.D. = d+1 mm) Note 8		4		5		6			7	
ℓ **Arc length** (mm)		50,8	76,2	50,8	76,2	76,2	101,6	101,6	76,2	101,6
Overall length (mm)		185	210	149	175	175	200	236	178	203
Average Power in water (W) Note 11	Max.	2200	3300	2600	3900	5100	6800	6800	6000	8000
	Min.	400	600	460	700	700	930	930	700	930
Voltage (V) Note 10	Max. Power	110	165	90	134	127	170	166	107	143
	Min.Power	80	120	55	98	87	115	104	68	91
Current (A)	Max. Power	20	20	29	29	40	40	41	54	54
	Min.Power	5	5	7	7	8	8	9	10	10
Static Impedance (Ω) Note 9		5,5	8,2	3,1	4,6	3,2	4,2	4	2	2,6
Dynamic Impedance (Ω)		2	3	1,1	1,7	1,3	1,7	1,9	0,9	1,2

Specifications are subject to change without notice - Standard features given in the table : other specifications on request.

High Average Power Pulsed Flashlamps

DU SERIES

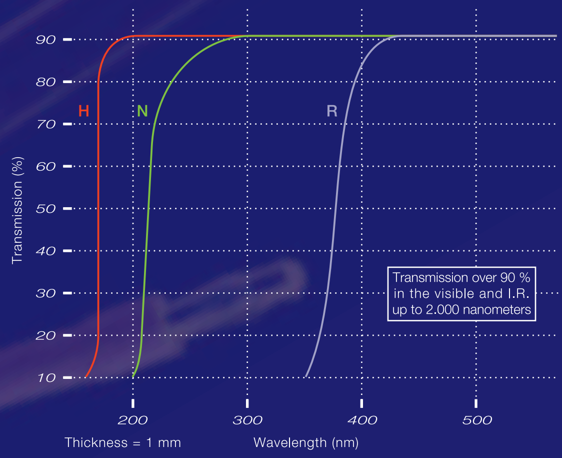


DU SERIES Flashlamps for HIGH POWER PULSED SOLID-STATE LASERS

"DU" type electrode manufacturing allow great lamp lifetime for the high power applications.
These electrodes withstand high currents over 1 ms and thermal gradients are optimised for each use.
DU series krypton flashlamps are suitable for typical pulse durations between 100 µs and 10 ms +.
For improved lamp lifetime, optimized DU series are :

DUS	from 1 µs to 500 µs
DU	from 500 µs to 3 ms
DUM	from 3 ms to 10 ms +

DIFFERENT TYPES OF SILICA TUBING

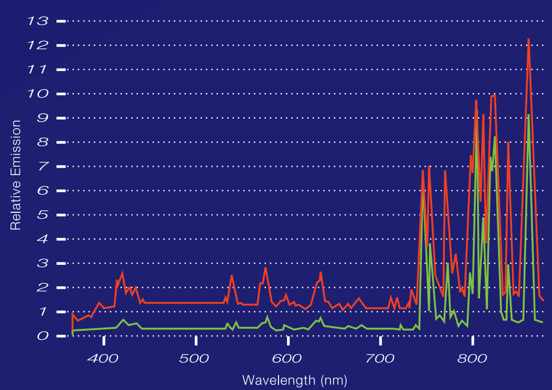


R : Cerium doped silica. Even after extensive use there is pratically no violet coloured absorbtion center near 540 nanometers.
This silica filters pratically all the UV, no deterioration of doped glass rods or reflectors, no ozone formation, and has no damaging effect on the eyes.
Considerable conversion of UV into fluorescence centered at 435 nanometers : particularly recommended for pumping Yag crystals.

N : Natural fused silica with little fluorescence (selection of quartz crystals). After long use, coloured centers appear near 540 nanometers. Robust material.

H : Pure synthetic non-fluorescent silica. No appearance of absorption at 540 nanometers. This silica is mainly used for optical pumping of rubies and for distant UV flash sources.

TYPICAL KRYPTON OUTPUT SPECTRUM High Power Pulsed Flashlamp



The current profile is quasi flat during the pulse width.
The emission of continuum is increasing with current faster than the IR emission of spectral lines. Variation of the emission with 2 different current densities : 300 A/cm² and 800 A/cm².

FLASHLAMPS Verre & Quartz

DU SERIES ORDERING CODE VQK R . . . DUS1 + Tube end	6P2	6P3	6P4	7P2	7P3	7P4	7P5	8P3	8P4	8P5	8P6
d (I.D. ± 0,2 mm) (O.D. = d+2 mm)	4			5				6			
ℓ Arc length (mm)	51	76	101	51	76	101	127	76	101	127	152
ℓ Arc length (inch)	2	3	4	2	3	4	5	3	4	5	6
Φ_T leads (± 0,1 mm)	3	3	3	3	3	3	3	6	6	6	6
Ko ($\Omega A^{1/2}$)	15,6	23,3	30,8	12,5	18,6	24,8	31,1	15,5	20,6	25,9	31
Voltage (V) Min.	600	720	840	600	720	840	960	720	840	960	1080
Voltage (V) Max.	1600	1900	2200	1600	1900	2200	2500	1900	2200	2500	2900
Max. Power in water (W)	1300	1900	2600	1600	2400	3200	4000	2900	3800	4800	5700
Trigger Voltage (kV)	15/22	15/22	16/22	16/22	16/22	17/22	18/22	16/22	17/22	18/22	19/22

DU SERIES ORDERING CODE VQK R . . . DUS1 + Tube end	9P3	9P4	9P5	9P5,5	10P4	10P5	10P5,5	10P6	12P5	12P5,5	12P6
d (I.D. ± 0,2 mm) (O.D. = d+2 mm)	7				8				10		
ℓ Arc length (mm)	76	101	127	139	101	127	139	152	127	139	152
ℓ Arc length (inch)	3	4	5	5,5	4	5	5,5	6	5	5,5	6
Φ_T leads (± 0,1 mm)	6	6	6	6	6	6	6	6	6	6	6
Ko ($\Omega A^{1/2}$)	13,3	17,7	22,2	24,3	15,5	19,4	21,3	23,3	15,6	17	18,6
Voltage (V) Min.	720	840	960	1020	840	960	1020	1080	960	1020	1080
Voltage (V) Max.	1900	2200	2500	2700	2200	2500	2700	2900	2500	2700	2900
Max. Power in water (W)	3300	4500	5600	6100	5100	6400	7000	7700	8000	8800	9600
Trigger Voltage (kV)	17/22	17/22	18/22	18/22	18/22	19/22	19/22	20/22	19/22	20/22	20/22

Above specifications valid for all DU series (DUM, DU and DUS) except for Max. Power in water 10 % higher for the DUM and DU models.

Physical characteristics

Standard silica : R (N or H silica available on request)
Wall thickness : 0,5 mm (DUM - DU) : O.D. = d + 1 mm
1 mm (DUS) : O.D. = d + 2 mm
Z = d + 2 mm (DUM - DU - DUS)
Gas type : Krypton (Xenon or Krypton/Xenon available)
Fill pressure : 1 kg/cm² (other pressures available)
Connectors : - M6 (Ø 4,75 x 13), H1 (Ø 6,35 x 11), H2 (Ø 7,14 x 12,7)…
- High voltage insulation flexible leads with specific lengths available : TS, TS M… :
- Ø 3 mm ext : Temperatures -70°C +250° Insulation 22 kV
- Ø 6 mm ext : Temperatures -70°C +250°C Insulation 37 kV

Electrode dimensions : 38 mm (48 mm for HDU series).

Electrical characteristics

Pulsed Krypton flashlamps are used in high power solid-state lasers.
Controlled electronic devices drive voltage and current with quasi flat current profiles during each pulse.
Simmer operations are highly recommended.

Cooling requirements

Fluid cooled only. Use deionised water with average flow of 8 liters/min.
Exchangers must be made of non-metallic material, except stainless (no copper or derivatives).

Specifications are subject to change without notice - Standard features given in the table : other specifications on request.

Standard Linear Types

STANDARD SERIES

EXAMPLE : ORDERING INFORMATION

Flashtube	VQ
Xenon	X
Quartz envelope	R
Ref N°	63
Tube end	E2

DIFFERENT TYPES OF SILICA TUBING

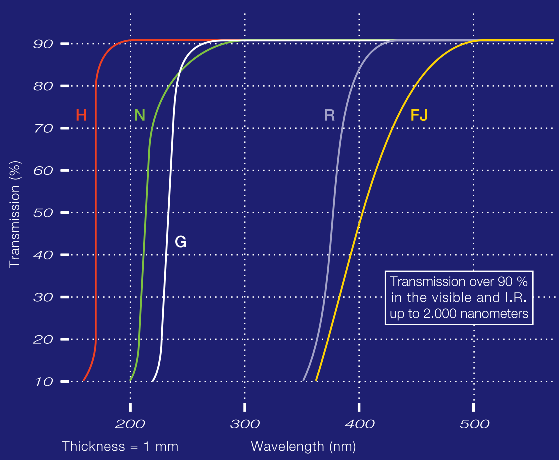
R : Cerium doped silica. Even after extensive use there is pratically no violet coloured absorbtion center near 540 nanometers.
This silica filters pratically all the UV, no deterioration of doped glass rods or reflectors, no ozone formation, and has no damaging effect on the eyes.
Considerable conversion of UV into fluorescence centered at 435 nanometers : particularly recommended for pumping Yag crystals.

N : Natural fused silica with little fluorescence (selection of quartz crystals). After long use, coloured centers appear near 540 nanometers. Robust material.

H : Pure synthetic non-fluorescent silica. No appearance of absorption at 540 nanometers. This silica is mainly used for optical pumping of rubies and for distant UV flash sources.

G : Titanium doped silica (germicidal) absorbing UVC. No ozone formation. Very rapid appearance of coloured absorbtion centers around 540 nanometers.

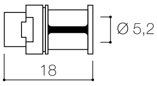
FJ : Yellow filters stopping all UV, correcting filter for colour photography. Withstands more than 600°C in permanent use, in air. Coated on R silica. No immersion.



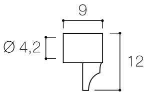
FLASHLAMPS
Verre & Quartz

Standard Linear Flashtubes Shapes

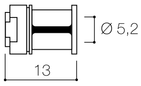
SC M



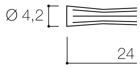
MC E2/3



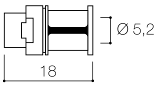
PM



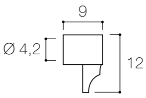
RC E2



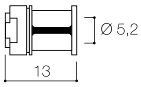
SC M



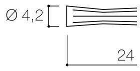
MC E2/3



PM

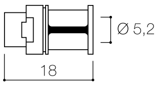


RC E2

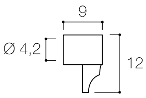


Standard Plugs

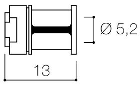
SC M



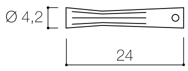
MC E2/3



PM



RC E2/3



Calculation of maximum critical damping operation energy for linear flashtubes as a function of their structure and environment.

(Mounting equivalent to that provided by "FLASHLAMPS Verre & Quartz" W type tube ends, ceramic with silicone 0 rings on supporting plate, at ambient temperature of 20°C to 80°C).

Maximum energy in joules = $\sqrt{T} \times \ell \times d \times A \times B$
T = total duration (1/3 peak) in µs. ℓ (arc length) and d in mm.

Coefficient A (strength of tube depending on envelope material used)
silica thickness = 1 mm
A = 0,085 for N silica
A = 0,084 for G and H silica
A = 0,078 for R silica
(A = 0,021 for borosilicate)
silica thickness = 0,5 mm
A = 0,051 for N silica
A = 0,05 for G and H silica
A = 0,047 for R silica

Coefficient B (strength of tube end environment).

Air with reflector :
Tube end E3 - WE3 - WDE3 : B = 1
Tube end E1 - E2 - M - WE2 - WDE2 - WE1
O.D. < 8,5 mm : B = 0,9
8,5 < O.D. < 11 mm : B = 0,70
O.D. > 11 : B = 0,45

Water in laser cavity with very tight coupling :
Tube end E3 - WE3 - WDE3 : B = 0,45
Tube end E1 - E2 - M - WE2 - WDE2 - WE1
O.D. < 11 mm : B = 0,44
O.D. > 11 mm : B = 0,39

Calculation of parameters for obtaining flash duration with critical damping.

(rise time = decay time)

$$C = 10^2 \sqrt[3]{\frac{2E\alpha^4 \ t^2}{Ko^4}} \qquad L = \frac{t^2}{C}$$

$$Ko = \frac{Kc\,\ell}{d}$$

With : Kc = 1,225 for E3, WE3, WDE3 tube ends
Kc = 1,279 for other tube ends

$$V = 10^3 \sqrt{\frac{2E}{C}} . \qquad T = 3t\ (\alpha = 0{,}8)$$

T = total duration (1/3 peak) in µs. E in joules. V in volts. C in µF. L in µH. ℓ (arc length) and d. in mm.
Ko in Ω $A^{1/2}$.
For different operating energies, modify parameters values as shown. (with α unchanged) :

Parameters of previous calculation (same time)	E (j)	U (V)	C (µF)	L (µH)
Value of energy requiered $\left(Y = \sqrt[3]{\frac{E'}{E}} \right)$	E'	U'=YxU	C'=YxC	$L' = \frac{L}{Y}$

Example : VQX R 1320 E3 : 500µs
E = 1320 J U = 2441 V C = 443 µF L = 63 µH
E'= 660 J U'= 1937 V C'= 352 µF L' = 79 µH

Operation above calculated maximum energy can bring about fast deterioration of flashtubes (explosion). Maximum operating temperature for lamps not fitted with W type ends at 50% of recommended typical energy, in non-oxidizing atmosphere : 400°C.
Maximum operating temperature for continuous use in oxidizing atmosphere (dry air) for all types of tube end : 200°C.

Note 1

Operating parameters for obtaining a critical damping discharge for 500 µs, (at 1/3 peak light intensity), with recommended typical energy and standard tube ends.

Note 2

Maximum operating frequency : 1 Hz in air, 2 Hz in water. For higher frequencies please see section : "Stroboscopic Xenon Flashtubes".

Note 3

In water : use only demineralized, or preferably distilled water, at maximum temperature of 40°C.

Note 4

a) GAS FILL (third letter of flashtube reference).
Standard : XENON (X)
On request : KRYPTON (K) or ARGON (A)
Pressure of pure gas in standard flashtubes varies, according to length, from 300 to 600 torr. Other pressures on request.
b) TUBE MATERIAL (fourth letter of flashtube reference).
Standard : R
On request : N - H - G
c) OPTIONAL TUBE ENDS DEPENDING ON TUBE DIAMETER (last letter and figure of flashtube reference).
O.D. > 11 mm : E2 - E1 - E3 - M - WD
WE3 - WDE3 - WDE2
WE1 (standard E3).
O.D. < 11 mm : E2 - E1 - M - WE2 - WDE2
WE1 (standard E2).
d) OTHER TUBE DIAMETERS
Non standard, on request : I.D. from 7 mm to 19 mm.
High voltage insulation flexible leads with specific lengths available : TS, TS M… :
- Ø 3mm ext : Temperatures -70°C +250°C, Insulation 22 kV
- Ø 6mm ext : Temperatures -70°C +250°C, Insulation 37 kV

Specifications are subject to change without notice.

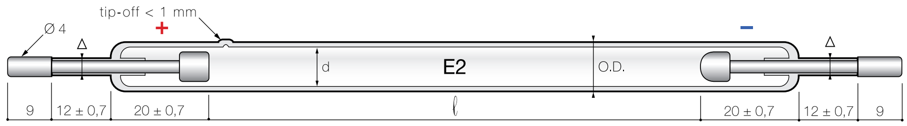
STANDARD SERIES Note 4

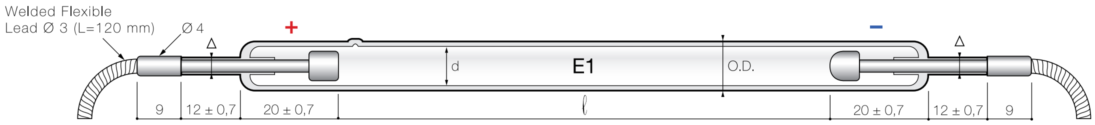
ORDERING CODE													
VQX R . . .		63	65	6P3	7P3	7P4	85	88	8P4	815	820	1010	10P8
Tube end		E2	E2	E2	E2	E2	E2	E2	E2	E2	E2	E2	E2
d (I.D. ± 0,2 mm)		4			5		6					8	
O.D. (Outer Diameter) (mm)		6			7		8					10	
ℓ Arc length (mm)		30	50	76	76	101	50	80	101	150	200	100	203
Δ (± 0,1) (mm) F (mm)		3	3	3	3	3	3	3	3	3	3	3,5	3,5
C (± 0,1 mm)		7,7	7,7	7,7	7,7	7,7	8,7	8,7	8,7	8,7	8,7	10,2	10,2
Ø of hole in flashtube supporting plate		8	8	8	8	8	9	9	9	9	9	11	11
Max. Average Power (W) Note 2	Air	40	60	90	110	150	90	140	180	270	360	240	490
	Forced Air	110	180	270	340	460	270	430	550	810	1080	720	1460
	Water Note 3	250	400	560	700	940	550	900	1120	1700	2200	1500	3000
Voltage (V)	Min.	400	450	600	600	700	450	600	700	850	1050	650	1100
	Max.	1200	1350	1800	1800	2100	1350	1800	2100	2550	3150	1950	3300
Max. Peak Current (A)		500	500	500	800	800	1100	1100	1100	1100	1100	2000	1100
Trigger Voltage (kV)		15-22	15-22	15-22	15-22	15-22	16-22	16-22	16-22	18-22	18-22	17-22	18-22
Typical Transformer		TB2	TB2	TB2	TB2	TB2	TB2	TB2	TB2	TB2	TB2	TB2	TB2
Flash Duration 500 µsec. 1/3 peak Note 1	C (µF)	575	342	225	327	247	667	421	335	224	173	548	274
	L (µH)	48	81	123	85	113	42	66	83	124	161	51	101
	V (Vdc)	527	871	1332	1236	1635	774	1213	1544	2274	3003	1376	2766
	E (J)	80	130	200	250	330	200	310	400	580	780	520	1050

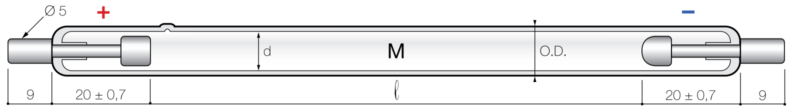
STANDARD SERIES Note 4

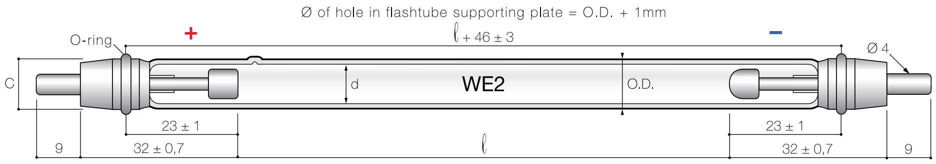
ORDERING CODE													
VQX R . . .		1310	1315	1320	13P9	13P15	13P30	1515	1520	15P12	2015	2020	2030
Tube end		E3	E3	E3	E3	E3	E3	E3	E3	E3	E3	E3	E3
d (I.D. ± 0,2 mm)		11						13			17		
O.D. (Outer Diameter) (mm)		13						15			20		
ℓ Arc length (mm)		100	150	200	229	381	762	150	200	305	150	200	300
Δ (± 0,1) (mm) F (mm)		4	4	4	4	4	4	4	4	4	4	4	4
C (± 0,1 mm)		13,2	13,2	13,2	13,2	13,2	13,2	15,2	15,2	15,2	15,2	15,2	15,2
Ø of hole in flashtube supporting plate		14	14	14	14	14	14	16	16	16	16	16	16
Max. Average Power (W) Note 2	Air	330	500	660	760	1260	2510	580	780	1190	770	1020	1530
	Forced Air	990	1490	1980	2270	3770	7540	1750	2340	3570	2300	3060	4590
	Water Note 3	2020	3040	4050	4630	7710	15420	3590	4780	7300	4700	6300	9400
Voltage (V)	Min.	650	850	1050	1200	1800	3300	850	1050	1500	850	1050	1450
	Max.	1950	2550	3150	3600	5400	9900	2550	3150	4500	2550	3150	4350
Max. Peak Current (A)		3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000	3000
Trigger Voltage (kV)		20-22	19-22	20-25	20-22	25-30	25-30	20-25	20-25	25-30	23-30	23-30	25-30
Typical Transformer		TB2	TB2	TB4	TB4	TB4	TB4	TB4	TB4	TB4	TB4	TB4	TB4
Flash Duration 500 µsec. 1/3 peak Note 1	C (µF)	1060	712	538	470	286	148	941	711	471	1372	1037	697
	L (µH)	32	48	64	73	120	232	36	48	73	20	27	40
	V (Vdc)	1160	1731	2297	2632	4350	8554	1636	2173	3303	1550	2059	3076
	E (J)	710	1070	1420	1630	2710	5420	1260	1680	2570	1650	2200	3300

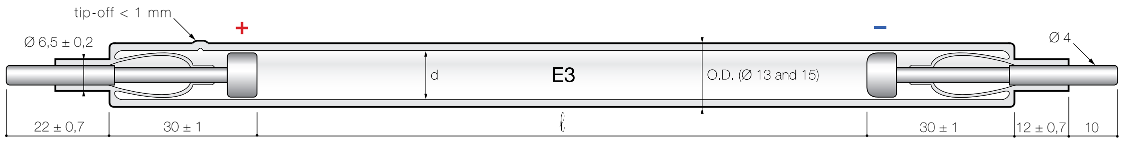
Standard Linear Tube ends



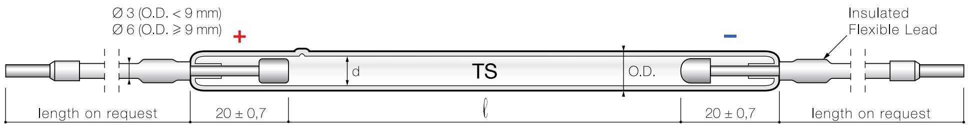


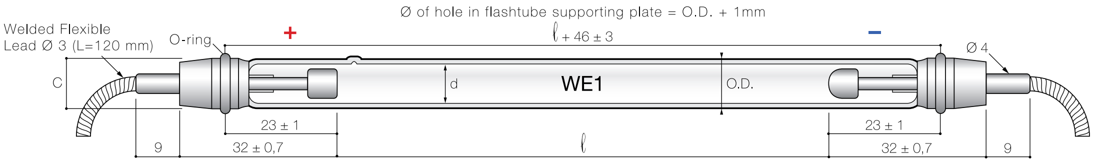


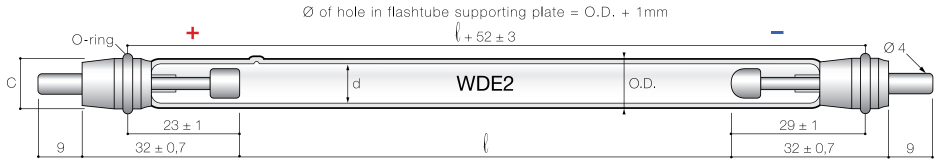


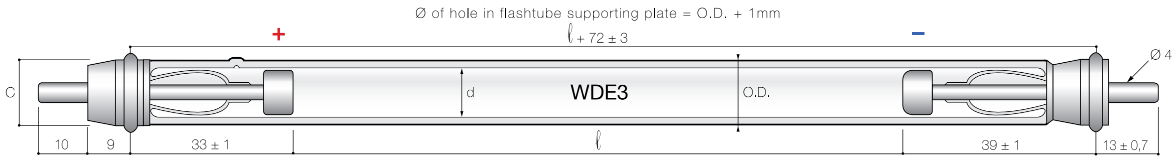


Non Standard Linear Tube ends





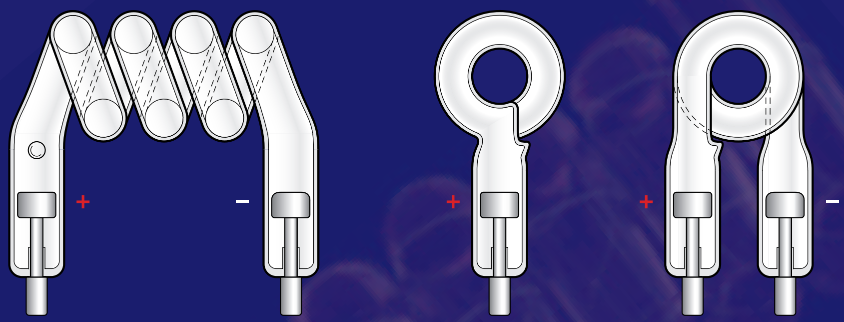




30, Route d'Aulnay - 93140 Bondy - FRANCE
Tel + 33 (0)1 48 49 74 21 - Fax + 33 (0)1 48 48 44 22
e-mail : flashlps@club-internet.fr

FLASHLAMPS
Verre & Quartz

Standard Helical Types



Electrode disposition : A B

EXAMPLE : ORDERING INFORMATION

Flashtube	VQ
Xenon	X
Quartz envelope	R
Ref N°	15S3
Electrode disposition	B
Tube end	M

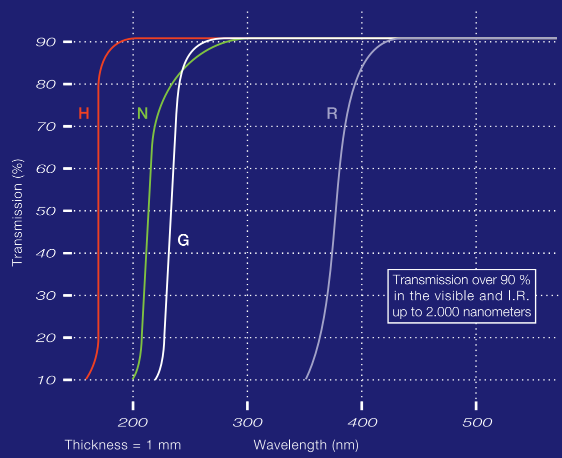
DIFFERENT TYPES OF SILICA TUBING

R : Cerium doped silica. Even after extensive use there is pratically no violet coloured absorbtion center near 540 nanometers.
This silica filters pratically all the UV, no deterioration of doped glass rods or reflectors, no ozone formation, and has no damaging effect on the eyes.
Considerable conversion of UV into fluorescence centered at 435 nanometers : particularly recommended for pumping Yag crystals.

N : Natural fused silica with little fluorescence (selection of quartz crystals). After long use, coloured centers appear near 540 nanometers. Robust material.

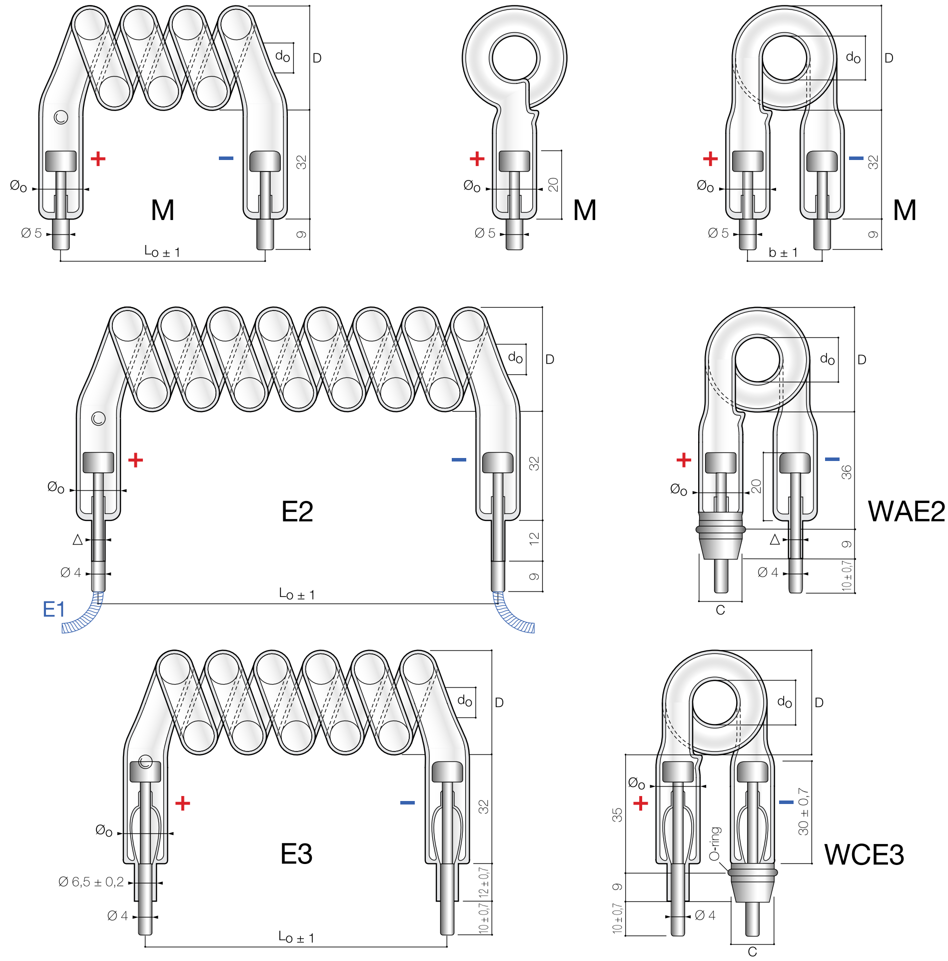
H : Pure synthetic non-fluorescent silica. No appearance of absorption at 540 nanometers. This silica is mainly used for optical pumping of rubies and for distant UV flash sources.

G : Titanium doped silica (germicidal) absorbing UVC. No ozone formation. Very rapid appearance of coloured absorbtion centers around 540 nanometers.



Standard Helical Flashtube Shapes

Electrode disposition : A B



Calculation of maximum critical damping operation energy for linear flashtubes as a function of their structure and environment.

(Mounting equivalent to that provided by "FLASHLAMPS Verre & Quartz" W type tube ends, ceramic with silicone 0 rings on supporting plate, at ambient temperature of 20°C to 80°C).

Maximum energy in joules = $\sqrt{T} \times \ell \times d \times A \times B$
T = total duration (1/3 peak) in µs. ℓ (arc length) and d in mm.

Coefficient A (strength of tube depending on envelope material used).
N : A = 0,085
G and H : A = 0,084
R : A = 0,078
(Borosilicate : A = 0,021)

Coefficient B (strength of tube end environment).
Air with reflector :
Tube end E3 - WAE3 - WCE3 : B = 0,75
Tube end E1 - E2 - M - WAE2
$\varnothing_o$ = Ø 10 mm : B = 0,56
$\varnothing_o$ = Ø 13 mm and Ø 15 mm : B = 0,34
Water in laser cavity with very tight coupling :
Tube end E3 - WAE3 - WCE3 : B = 0,39
Tube end E1 - E2 - M - WAE2
$\varnothing_o$ = Ø 10 mm : B = 0,37
$\varnothing_o$ = Ø 13 mm and 15 mm : B = 0,3

Calculation of parameters for obtaining flash duration with critical damping.

(rise time = decay time)

$$C = 10^2 \sqrt[3]{\frac{2E\alpha^4 \, t^2}{Ko^4}} \qquad L = \frac{t^2}{C}$$

$$Ko = \frac{Kc\,\ell}{d}$$

With : Kc = 1,225 for E3, WAE3, WCE3 tube ends
Kc = 1,279 for other tube ends

$$V = 10^3 \sqrt{\frac{2E}{C}} . \qquad T = 3t \ (\alpha = 0{,}8)$$

T = total duration (1/3 peak) in µs. E in joules. V in volts. C in µF. L in µH. ℓ (arc length) and d. in mm. Ko in Ω $A^{1/2}$.
For different operating energies, modify parameters values as shown. (with ∝ unchanged).

Parameters of previous calculation (same time)	E (j)	U (V)	C (µF)	L (µH)
Value of energy requiered $\left(Y = \sqrt[3]{\frac{E'}{E}}\right)$	E'	U'=YxU	C'=YxC	$L' = \frac{L}{Y}$

Example : VQX R 15S3 BM : 500µs
E = 710 J U = 2244 V C = 282 µF L = 98 µH
E'= 500 J U'= 1997 V C'= 251 µF L' = 111 µH

Operation above calculated maximum energy can bring about fast deterioration of flashtubes (explosion).
Maximum operating temperature for lamps not fitted with W type ends at 50% of recommended typical energy, in non-oxidizing atmosphere : 400°C.
Maximum operating temperature for continuous use in oxidizing atmosphere (dry air) for all types of tube end : 200°C.

Note 1

Operating parameters for obtaining a critical damping discharge for 500 µs and 1 ms. (at 1/3 peak light intensity), with recommended typical energy and standard tube ends.

Note 2

Maximum operating frequency : 0,25 Hz in air, 0,5 Hz in water. For higher frequencies please see section : "Stroboscopic Xenon Flashtubes".

Note 3

In water : use only demineralized, or preferably distilled water, at maximum temperature of 40°C.

Note 4

a) GAS FILL (third letter of flashtube reference).
Standard : XENON (X)
On request : KRYPTON (K) or ARGON (A)
Pressure of pure gas in standard flashtubes varies, according to length, from 200 to 600 torr. Other pressures on request.
b) TUBE MATERIAL
(fourth letter of flashtube reference).
Standard : R
On request : N - H - G
c) OPTIONAL TUBE ENDS DEPENDING ON TUBE DIAMETER (last letter and figure of flashtube reference).
$\varnothing_o$ = 10 mm : M - E1 - E2 - WAE2 (standard M).
$\varnothing_o$ = 13 and 15 mm : E3-M-E1-E2-WCE3-WAE2.
d_o < 10 mm : standard tube ends M.
d_o > 10 mm : standard tube ends E3.
d) OTHER TUBE DIAMETERS
Non standard, on request : I.D. from 7 mm to 50 mm.

Note 5

When indicated voltage is above higher limit of the operating voltage a trigger-gap or an ignitron must be used in order to be in the critically damped case. In water, the higher operating voltage limit is reduced by a factor of 2 in the case of rapid loading.

Note 6

"ℓ" is developed length of standard helical tubes in mm. For configuration A. add 10 mm to "ℓ" in order to calculate flashtube parameters. For tubes for which M type ends are standard, deduct 20 mm from "ℓ" if you choose E3, WAE2 or WCE3 ends. Where E3 are standard, add 20 mm if you choose M, E1, E2 or WAE2 ends.

30, Route d'Aulnay
93140 Bondy - FRANCE
Tel + 33 (0)1 48 49 74 21 - Fax + 33 (0)1 48 48 44 22
e-mail : flashlps@club-internet.fr

FLASHLAMPS
Verre & Quartz

STANDARD HELICAL SERIES

ORDERING CODE VQX R . . . Electrode disposition Tube end Note 4		7SP1 B M	7S5 B M	9S4 B M	9SP2 B M	10S8 B M	12S5 B M	12S10 B M	13S4 B M	13S8 B M
d_o (+1/0) (mm)		7		9		10	12		13	
L_o (± 0,5) (mm)		25,4	50	40	50,8	80	50	100	40	80
D (± 1) (mm)		22,5	22,5	28	28	27	31	31	33	33
$Ø_o$ (± 0,3) (mm)		10	10	13	13	13	13	13	13	13
b (± 0,5) (mm)		14	14	22	22	18,5	21,5	21,5	23	23
Δ (± 0,1) (mm)		3,5	3,5	4	4	4	4	4	4	4
Number of Turns		2,5	4,5	3,5	4,5	6,5	3,5	7,5	2,5	5,5
C (± 0,1) (mm) Ø of hole in flashtube supporting plate		10,2 11	10,2 11	13,2 14	13,2 14	13,2 14	13,2 14	13,2 14	13,2 14	13,2 14
Tube average d (I.D.) (mm)		6,4	6,4	7	7	6,3	6,5	6,5	7	7
Developed length ℓ (mm) Note 6		160	251	252	310	472	307	562	227	402
Max. Power (W) Note 2	Convection	165	260	280	350	480	320	600	255	450
	Forced Air / Water	500	770	850	1050	1430	960	1750	760	1350
Voltage (kV) Note 5	Min.	0,9	1,3	1,3	1,5	2,1	1,5	2,4	1,2	1,8
	Max.	2,9	3,5	3,5	4,7	6,8	4,7	8	3,4	5,5
Flash Duration 500 µsec. 1/3 peak Note 1	C (µF)	226	143	165	135	87	120	78	183	122
	L (µH)	123	194	168	206	318	230	358	152	227
	V (Vdc)	2380	3424	3333	4090	6802	4153	7994	3010	5591
	E (J)	640	840	920	1130	2020	1040	2480	830	1910
Flash Duration 1 msec. 1/3 peak Note 1	C (µF)	401	255	295	241	156	215	138	326	218
	L (µH)	277	435	377	461	714	516	803	341	510
	V (Vdc)	2116	3052	2969	3645	6062	3707	7124	2680	4981
	E (J)	900	1190	1300	1600	2860	1480	3510	1170	2700

Specifications are subject to change without notice - Standard features given in the table : other specifications on request. See notes on page 25.

30, Route d'Aulnay
93140 Bondy - FRANCE
Tel + 33 (0)1 48 49 74 21 - Fax + 33 (0)1 48 48 44 22
e-mail : flashlps@club-internet.fr

FLASHLAMPS
Verre & Quartz

STANDARD HELICAL SERIES

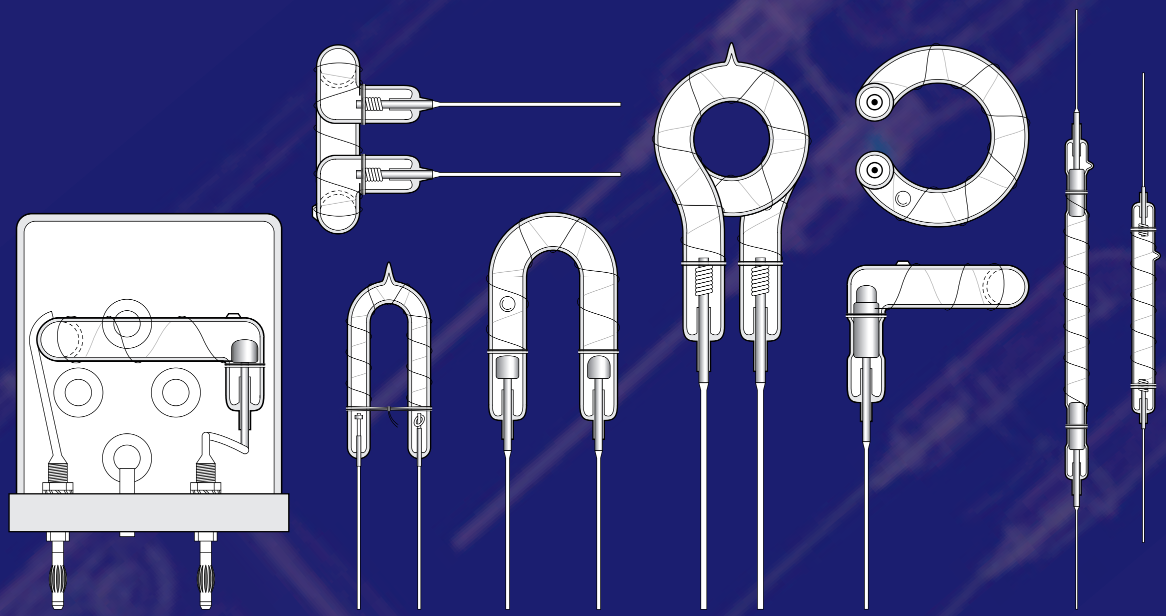
ORDERING CODE

VQX R . . . / Electrode disposition / Tube end / Note 4	15S3 B M	15S6 B M	15S12 B M	20SP3 B M	20S15 B M	25S5 B M	25S10 B M	25S20 B M	40S5 B M
d_O (+1/0) (mm)	15			20		25			40
L_O (± 0,5) (mm)	30	60	120	76,2	150	50	100	200	50
D (± 1) (mm)	36	36	36	42	42	50	50	50	66
$Ø_O$ (± 0,3) (mm)	13	13	13	15	15	15	15	15	15
b (± 0,5) (mm)	25,5	25,5	25,5	31	31	37,5	37,5	37,5	53
Δ (± 0,1) (mm)	4	4	4	4	4	4	4	4	4
Number of Turns	1,5	3,5	7,5	4,5	9,5	2,5	5,5	11,5	2,5
C (± 0,1) (mm)	13,2	13,2	13,2	15,2	15,2	15,2	15,2	15,2	15,2
Ø of hole in flashtube supporting plate	14	14	14	16	16	16	16	16	16
Tube average d (I.D.) (mm)	7,8	7,8	7,8	8,6	8,6	10	10	10	10,5
Developed length ℓ (mm) Note 6	175	306	607	487	962	344	687	1362	405
Max. Power (W) Note 2 — Convection	220	400	750	670	1320	550	1100	2200	680
Max. Power (W) Note 2 — Forced Air / Water	660	1150	2300	2010	4000	1650	3300	6500	2040
Voltage (kV) Note 5 — Min.	0,9	1,5	2,5	2,1	3,8	1,6	2,8	4,9	1,8
Voltage (kV) Note 5 — Max.	2,9	4,7	8	6,3	13	4,8	8,5	16,5	5,5
Flash Duration 500 µsec. 1/3 peak Note 1 — C (µF)	282	190	99	142	74	255	132	69	238
Flash Duration 500 µsec. 1/3 peak Note 1 — L (µH)	98	146	282	195	372	109	211	400	116
Flash Duration 500 µsec. 1/3 peak Note 1 — V (Vdc)	2244	4133	8080	6330	12277	4280	8417	16341	4923
Flash Duration 500 µsec. 1/3 peak Note 1 — E (J)	710	1620	3220	2850	5620	2340	4670	9260	2890
Flash Duration 1 msec. 1/3 peak Note 1 — C (µF)	503	338	176	253	133	455	235	123	425
Flash Duration 1 msec. 1/3 peak Note 1 — L (µH)	221	328	632	438	836	244	473	899	261
Flash Duration 1 msec. 1/3 peak Note 1 — V (Vdc)	2003	3687	7200	5639	10943	3809	7497	14559	4387
Flash Duration 1 msec. 1/3 peak Note 1 — E (J)	1010	2300	4550	4030	7960	3300	6600	13100	4090

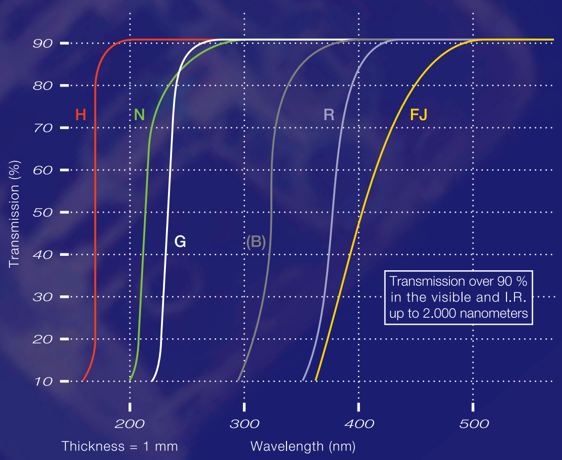
Specifications are subject to change without notice - Standard features given in the table : other specifications on request. See notes on page 25.

Photo Flashtubes

STUDIO PHOTOGRAPHY & INSTANTANEOUS PHENOMENA

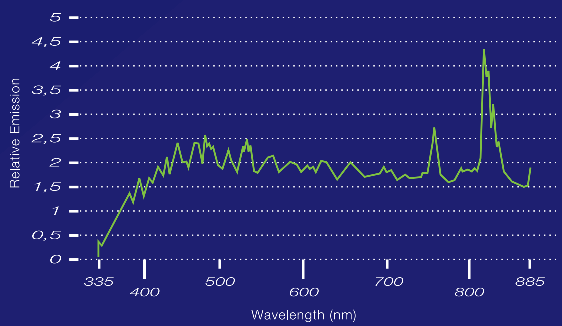


DIFFERENT TYPES OF SILICA TUBING



TYPICAL EMISSION OF XENON

For photoflashtubes with no UV radiation.



R : Special silica filtering UV radiation. Transmission in the visible part of the spectrum is the same as natural fused silica (> 90%).

N : Natural fused silica, allowing UVA, UVB and partly UVC to be transmitted. Standard silica for photoflashtubes.

H : Special silica allowing all the UV radiation. For special applications needing strong ultra-violet.

G : Titanium doped silica (germicidal) absorbing UVC.

B : Borosilicate. Standard material for photoflashtubes of hard glass.

FJ : Yellow filters, for specified color temperatures.
Stops the UV radiation, for R and N silica and hard glass.
Withstands 600°C and more in permanent use, in air.

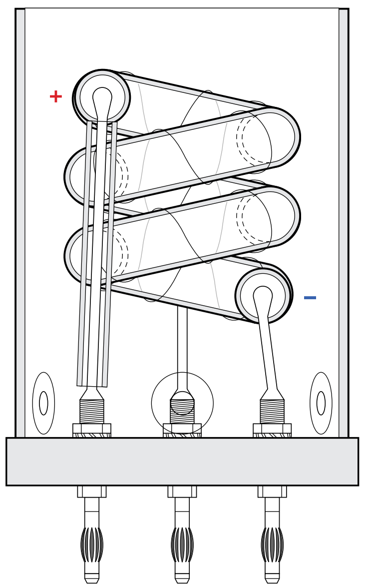
Xenon spectrum allows to appreciate the wide range of emision of the gas between 400 and 800 nanometers (visible part), beyond which begins the Infra-red radiation.
Xenon permits a “quasi-white” light, approaching the current day light.

FLASHLAMPS
Verre & Quartz

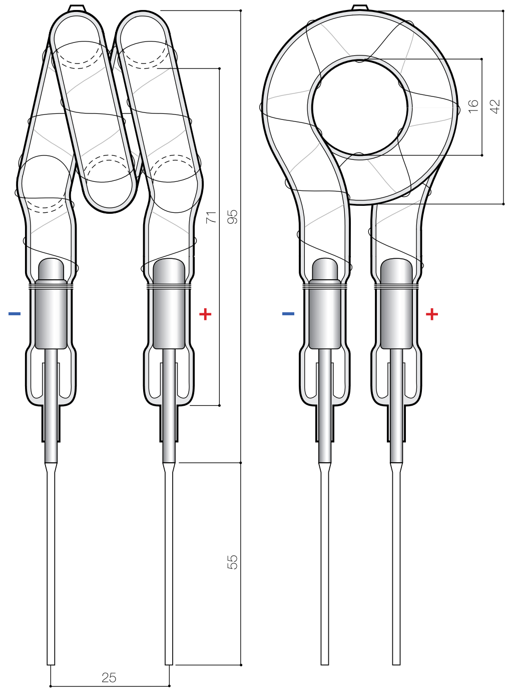
Quartz Flashtubes

Medium and High average power - High energy applications

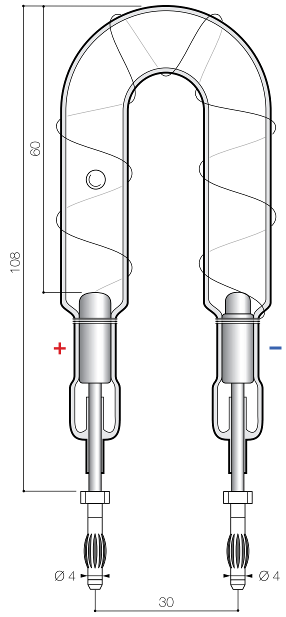
VQ 252 H / CLD8 / AL8 / S74 / CO



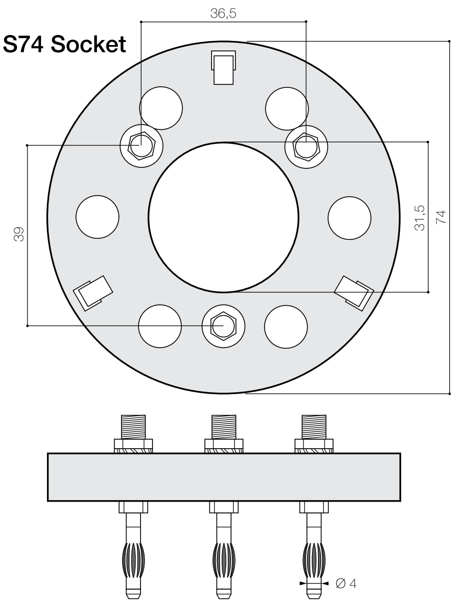
VQ 162 B / JA



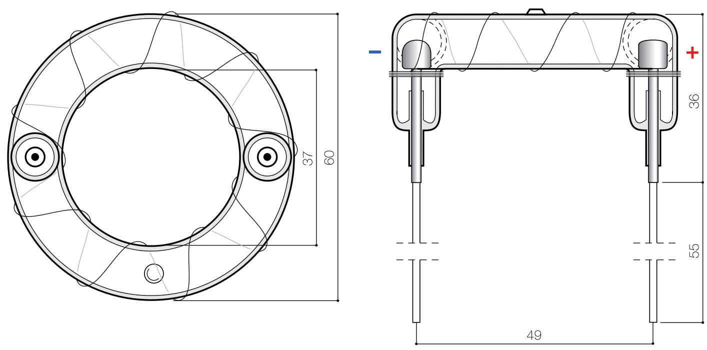
VQ 6030 U / JA / F4



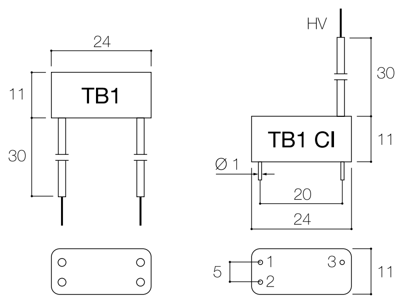
S74 Socket

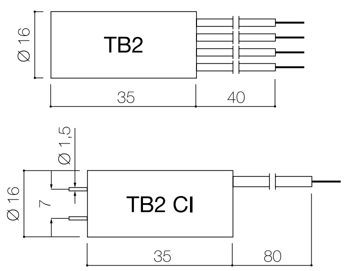


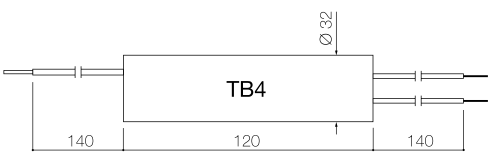
VQ 3728 T / CLD8 / AL8



Typical Trigger Coils (External Triggering)







TB1 or TB1 CI

Primary Voltage : Max. 600 V (Typ. 400 V)
Secondary Voltage : Typ. 8 kV (Max. 12 kV)
Discharge Capacitor : Typ. 0,1 µF
TB1 CI : output pins for soft soldering on elec. cards.

TB2 or TB2 CI

Primary Voltage : Max. 600 V
Secondary Voltage : Max. 22 kV
Discharge Capacitor : Typ. 0,47 µF
TB2 CI : output pins for soft soldering on elec. cards.

TB4

Primary Voltage : Max. 700 V (Typ. 600 V)
Secondary Voltage : Typ. 40 kV (Max. 50 kV)
Discharge Capacitor : Typ. 0,22 µF
Typ. useful frequency : 2 kHz

For more details about trigger transformers, please see section : “TRIGGER TRANSFORMERS FOR EXTERNAL AND SERIES TRIGGERING”.

Specifications are subject to change without notice.

30, Route d'Aulnay - 93140 Bondy - FRANCE
Tel + 33 (0)1 48 49 74 21 - Fax + 33 (0)1 48 48 44 22
e-mail : flashlps@club-internet.fr
FLASHLAMPS Verre & Quartz

TYPE	**Linear**				**U-shaped**								
ORDERING CODE **TUBE DESIGNATION**	VQ 12Q 120	VQ 10Q 200	VQ 13Q 150 CLD8 AL8	VQ 12Q 150 JA	VQ 10100 UDQ	VQ 12100 UDQ	VQ 10150 UDQ	VQ 12150 UDQ	VQ 10200 UDQ	VQ 7017U	VQ 5040U CLD7/ P3	VQ 6040U	VQ 6040U JA
O.D. (± 5%) *mm*	12	10	13	12	10	12	10	12	10	10	12	12	12
I.D. (± 5%) *mm*	10	8	11	10	8	10	8	10	8	8	10	10	10
ℓ ***Arc length (± 1)*** *mm*	120	200	150	150	100	100	150	150	200	135	115	135	135
D (± 0,6) *mm*	180	260	210	210	112	112	162	162	212	100	80	90	100
d (± 0,6) *mm*	120	200	150	150	40	42	40	42	40	70	50	60	60
a (± 0,6) *mm*	50	50	60	60	100	100	150	150	200	17	40	40	40
Max. Energy *(J) Note 1* *E= 1/2 CV²*	1040	1390	1430	4030	690	870	1040	1300	1390	940	1000	1170	2720
Max. Power *(W) Note 2* *J x flash rate (Forced Air)*	360	480	740	1330	240	300	360	450	480	320	440	400	1600
Flash Rate *(/Minute)* *Note 3*	20,7	20,7	31	19,9	20,8	20,7	20,7	20,7	20,7	16,4	26,4	20,5	35,2
Voltage *(V)* *Note 4* ***Min.***	250	450	300	450	240	240	330	310	440	300	260	270	360
Max.	500	900	600	900	460	470	660	620	880	600	520	550	730
S *Coefficient of Strength* *Note 5*	2,74	2,74	2,74	8,5	2,74	2,74	2,74	2,74	2,74	2,74	2,74	2,74	6,37
FIG. N°... *Note 6*	2	2	(2)	1	10	10	10	10	10	7	6	(6)	(6)

TYPE	**Ring-shaped**						**Helicoid**		
ORDERING CODE **TUBE DESIGNATION**	VQ 3730 *Note 7*	VQ 5830 *Note 7*	VQ 3720	VQ 3720 CLD9/ AL8 S74	VQ 5820	VQ 3720 JA/ S74	VQ 82PQ	VQ 162A	VQ 252A
O.D. (± 5%) *mm*	11,5	10	11,5	11,5	10	11,5	5,5	11,5	11,5
I.D. (± 5%) *mm*	9,6	7,8	9,6	9,6	7,8	9,6	4,2	8	8
ℓ ***Arc length (± 1)*** *mm*	145	195	145	145	195	145	97	195	252
D (± 0,6) *mm*	60	78	60	60	78	60	19	38	47
d (± 0,6) *mm*	37	58	37	37	58	37	8	16	25
a (± 0,6) *mm*	19	23	19	19	23	19	18	25	25
Max. Energy *(J) Note 1* *E= 1/2 CV²*	850	930	1210	1210	1320	2810	390	1350	1750
Max. Power *(W) Note 2* *J x flash rate (Forced Air)*	410	450	410	650	450	1240	150	460	600
Flash Rate *(/Minute)* *Note 3*	28,9	29	20,3	32,2	20,4	26,4	23	20,4	20,6
Voltage *(V)* *Note 4* ***Min.***	270	380	300	300	430	400	270	430	550
Max.	540	770	600	600	870	800	550	860	1100
S *Coefficient of Strength* *Note 5*	2,74	2,74	2,74	2,74	2,74	6,37	3	2,74	2,74
FIG. N°... *Note 6*	15	15	14	16	14	17	(11)	11	11

Specifications are subject to change without notice - Standard features given in the table : other specifications on request. See notes on page 33.

Quartz Flashtubes

Medium and High average power - High energy applications

FIG.1

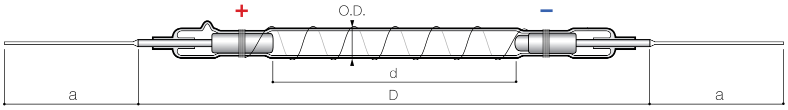


FIG.2

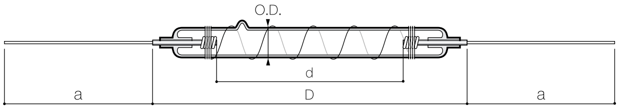


FIG.6

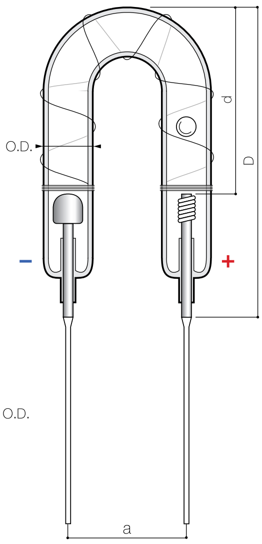


FIG.7

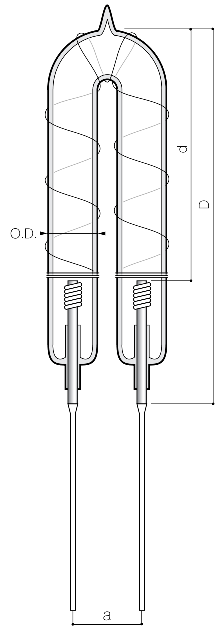
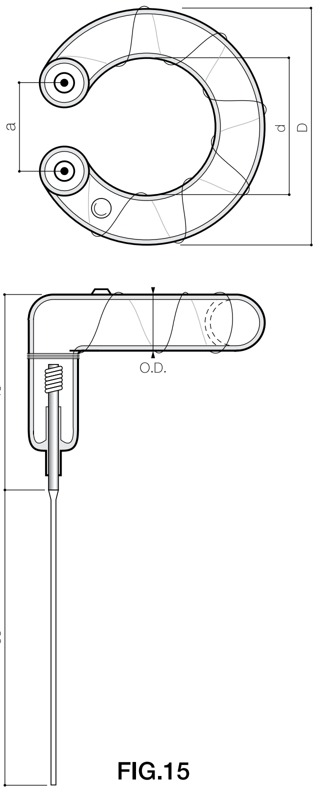


FIG.14



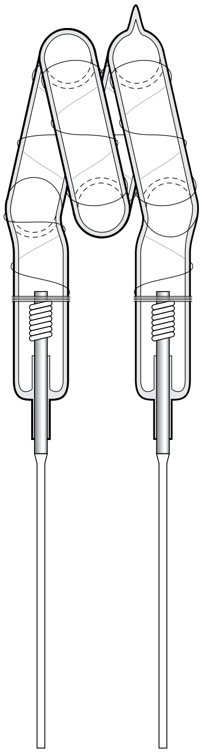


FIG.11

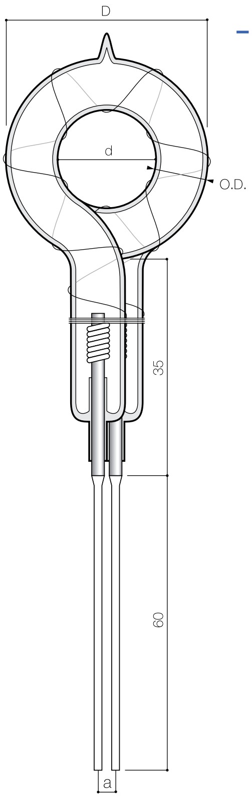


FIG.16

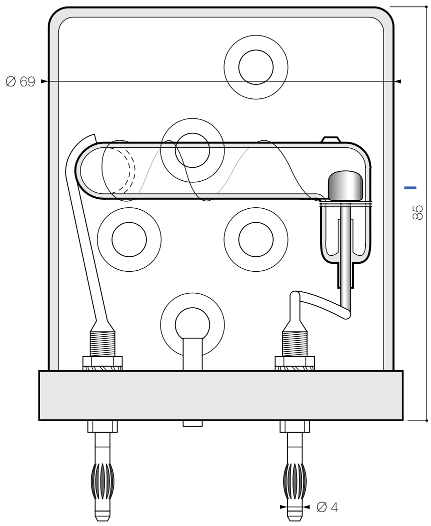


FIG.15

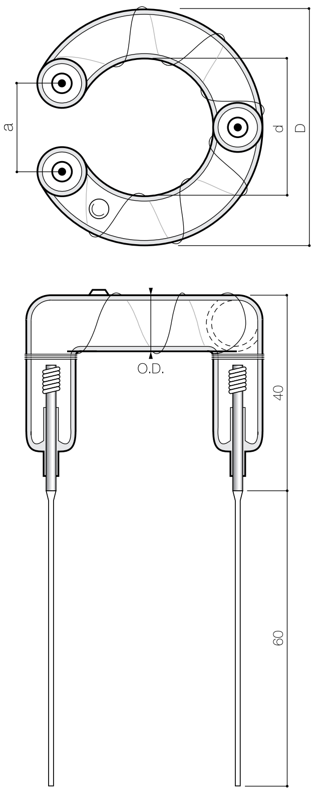


FIG.10

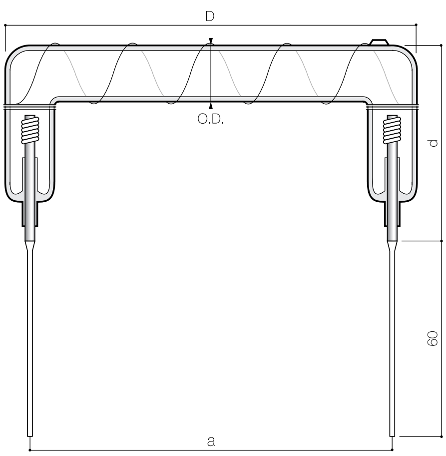
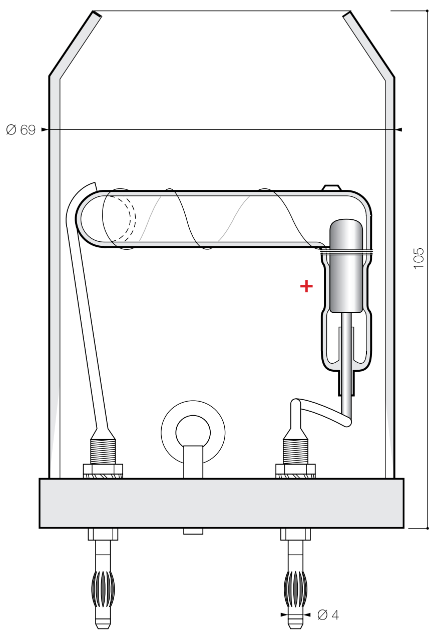


FIG.17



FLASHLAMPS
Verre & Quartz
30, Route d'Aulnay - 93140 Bondy - FRANCE
Tel + 33 (0)1 48 49 74 21 - Fax + 33 (0)1 48 48 44 22
e-mail : flashlps@club-internet.fr

30, Route d'Aulnay
93140 Bondy - FRANCE
Tel + 33 (0)1 48 49 74 21 - Fax + 33 (0)1 48 48 44 22
e-mail : flashlps@club-internet.fr

FLASHLAMPS
Verre & Quartz

TYPE	Linear								U-shaped	
ORDERING CODE TUBE DESIGNATION	VQ 3B15P	VQ 4B20P	VQ 4B25P	VQ 4B30P	VQ 5B40P	VQ 5B50P	VQ 6B50P	VQ 10B200	VQ 2512UP	VQ 3516UP
O.D. (± 5%) mm	3,2	3,5	4	4	4,5	4,5	6	10	6	6
I.D. (± 5%) mm	2	2,4	2,7	2,7	3,4	3,4	4,4	7,4	4,4	4,4
ℓ **Arc length** (± 1) mm	15	20	24	29	37	47	50	200	55	71
D (± 0,6) mm	24	36	42	44	53	62	71	222	41	53
d (± 0,6) mm	15	20	24	29	37	47	50	200	22	35
a (± 0,6) mm	2	2	4	3	3	5	40	40	12	16
Max. Energy (J) Note 1 E= 1/2 CV²	16	26	35	42	68	86	107	640	120	150
Max. Power (W) Note 2 J x flashes / s (Forced Air)	1,4	2,3	3,1	3,8	6	7,7	11	70	12	15
Flash Rate (/Minute) Note 3	5,2	5,3	5,3	5,4	5,3	5,3	6,1	6,5	6	6
Voltage (V) Note 4 **Min.**	220	220	220	220	220	230	230	360	230	230
Max.	330	330	330	330	350	380	400	720	420	450
S Coefficient of Strength Note 5	1,71	1,71	1,71	1,71	1,71	1,71	1,54	1,37	1,54	1,54
FIG. N°... Note 6	4	4	4	4	4	4	3	2	5	5

TYPE	Ring-shaped							Helicoid
ORDERING CODE TUBE DESIGNATION	VQ 2521 DP	VQ 2221 DP	VQ 4029 P	VQ 4531 Note 7	VQ 4523 D	VQ 3721	VQ 5823	VQ 82 PB
O.D. (± 5%) mm	5,5	10	6,2	10	10	11,5	10	5,5
I.D. (± 5%) mm	4,1	7,7	4,4	7,6	7,6	9	7,6	4,2
ℓ **(arc length)** (± 1) mm	84	90	138	159	159	145	195	97
D (± 0,6) mm	36	42	52	65	65	60	78	19
d (± 0,6) mm	25	22	40	45	45	37	58	8
a (± 0,6) mm	16	9	12	19	19	19	23	18
Max. Energy (J) Note 1 E= 1/2 CV²	170	300	300	370	520	570	640	200
Max. Power (W) Note 2 J x flashes / s (Forced Air)	16,5	30	30	60	60	60	70	19,6
Flash Rate (/Minute) Note 3	5,8	6	6	9,7	6,9	6,3	6,5	5,8
Voltage (V) Note 4 **Min.**	230	220	310	250	280	250	340	230
Max.	380	330	620	500	560	490	690	440
S Coefficient of Strength Note 5	1,54	1,37	1,54	1,37	1,37	1,37	1,37	1,54
FIG. N°... Note 6	(9)	(9)	13	(15)	9	12	12	(11)

Specifications are subject to change without notice - Standard features given in the table : other specifications on request.

Borosilicate Flashtubes

Low and Medium average power - Low flash rate applications

FIG.4

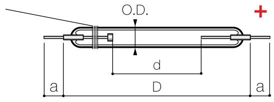


FIG.3

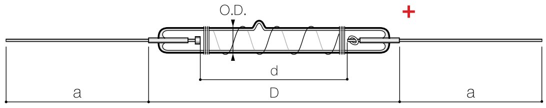


FIG.2

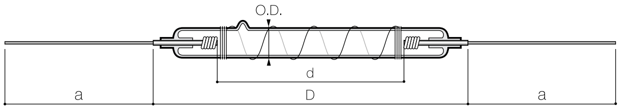


FIG.5

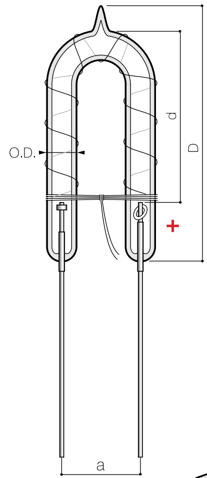


FIG.9

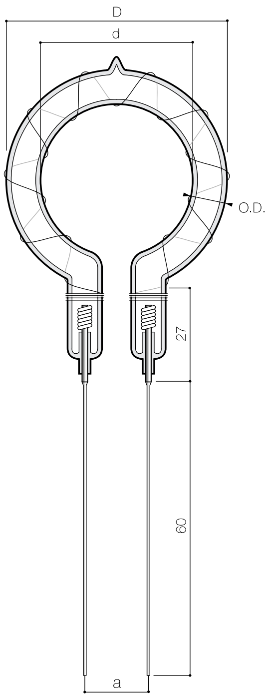


FIG.11

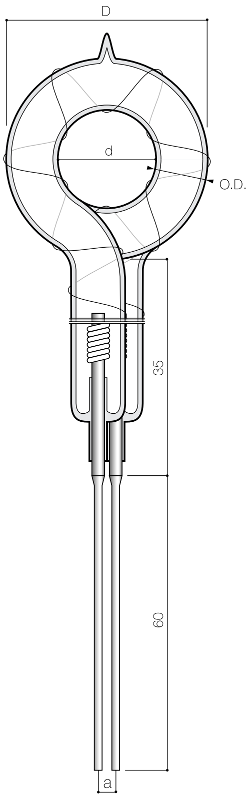


FIG.12

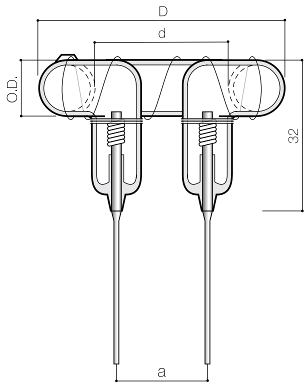


FIG.13

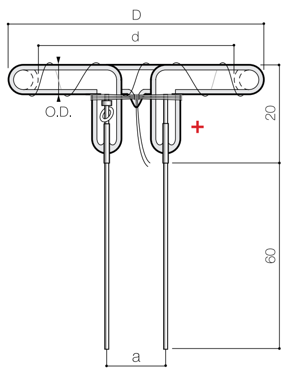
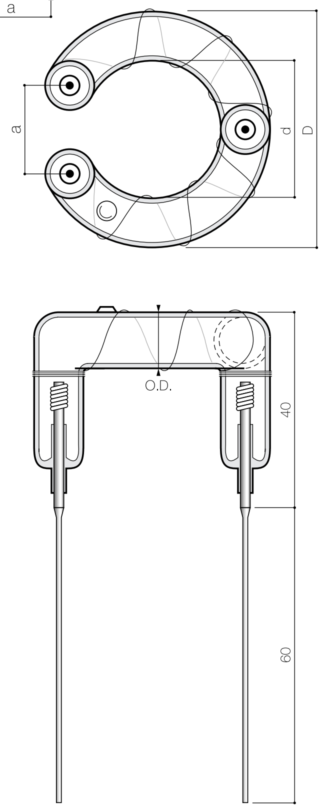


FIG.15



Note 1

Max. energy (in joules) is determined for a flashtube by its coefficient of strength «S» (note 5), the inter-electrode arc length, the I.D., and the discharge time. (Tubes should always be mounted so as to avoid mechanical stress). Lifetime is inversely proportional to the energy put into the flashtube (about 10.000 shots at typical energy and 100.000 shots for polarized CLD and JA types).

Max. energy (joules) :

$$* J = \frac{\sqrt{1000} \times l \times I.D. \times S}{100} \quad (\text{max. } J = 0{,}316 \times l \times I.D. \times S)$$

Above the operating max. there is a risk of de-vitrification or cracking due to superficial fusion inside the flashtube and consequent deterioration.

Typical operating energy : J = max. energy x 0,8.

Min. energy for obtaining very good reproductibility from one shot to another :

Min. energy : * J = √1000 x l x I.D. x 0,01157.

(The use of circular or wide U-shaped tubes helps considerably to improve luminous reproductibility from shot to shot for operation below the minimum given above).

* The figure 1000 (measured at half-peak) corresponds to a flash duration of 1000 micro-seconds (1000 micro-seconds = 1/1000 of a second). It should be modified according to the value of time required in micro-seconds. Calculation with current rise time shorter than decay time.

Note 2

Forced air cooling. Reduce by 1/3 (coef. 0,666) for natural convection cooling.

Max. power : W = max. energy (J) x flash rate (number of shots /min. or /s.).

Max. power (watts) of a tube is determined by nature of electrodes (emissivity, structure, material and volume), envelope material, diameter, arc length and cooling method.

Note 3

Max. values given for permanent operation so as to avoid the melting of the lamp's borosilicate or quartz envelope at the pulse maximum. For momentary utilisation in «bursts»,do not exceed 300°C on the borosilicate envelopes, 700°C on the quartz (measured 1 cm from the electrodes). In no case should the mean power per minute of operation exceed the maximum power (watts) recommended.

Note 4

With trigger coil TB1 (& 0,1 µF), primary voltage 400V. (Where the primary voltage of the coil is the same as the voltage at the tube connections, increase the min. voltage given by about 5V per cm between electrodes).

It is recommended to use a flashlamp at the max. given voltage when max. energy is used so as to avoid having to increase the discharge time.

Note 5

Coefficient of mechanical strength «S» (envelope material, electrode mounting structure).

Note 6

Numbers in brackets represent the type of the tube given in the figure with slight modifications in aspect at the electrodes.

Note 7

Tube with 3 electrodes, the cathodes of which (-), furthest from the luminuous column are to be put together. The third central electrode is the anode. In order to calculate the max. energy, halve the discharge time. (The same tube but with 2 electrodes and the same supply circuit gives a flash duration twice as long).

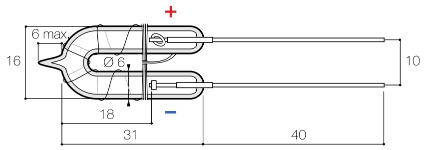
Specifications are subject to change without notice.

Stroboscopic Xenon Flashtubes

FOR SIGNAL-SYSTEMS, SCIENTIFIC / INDUSTRIAL APPLICATIONS

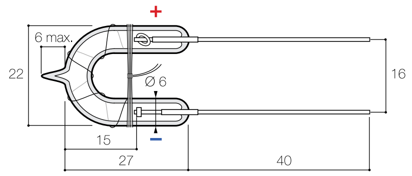
Low Power Borosilicate Flashtubes

High Repetition Rate Lamps with no UV Radiation - HV Trigger Nickel Wire / Cathode (–) and Anode (+) black mark



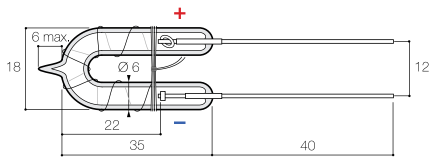
VQX S 2010 P

Voltages : Typ. 300 V (160/400 V)
Max. Power in air : 5 W
Max. Frequency : 300 Hz (0,017 J/pulse)
Max. Energy : 10 Joules
Trigger Voltage : 8 kV (TB1/TB1 CI)
Lifetime : 1 to 50 M shots



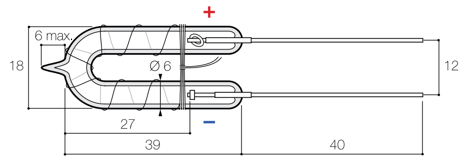
VQX S 1516 P

Voltages : Typ. 300 V (170/500 V)
Max. Power in air : 8 W
Max. Frequency : 250 Hz (0,032 J/pulse)
Max. Energy : 16 Joules
Trigger Voltage : 8 kV (TB1/TB1 CI)
Lifetime : 1 to 50 M shots



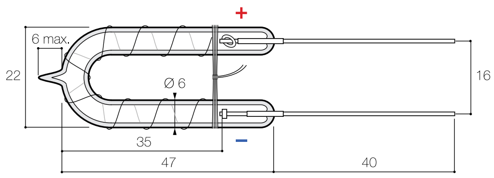
VQX S 2512 P

Voltages : Typ. 350 V (180/500 V)
Max. Power in air : 9 W
Max. Frequency : 250 Hz (0,036 J/pulse)
Max. Energy : 18 Joules
Trigger Voltage : 8 kV (TB1/TB1 CI)
Lifetime : 1 to 50 M shots



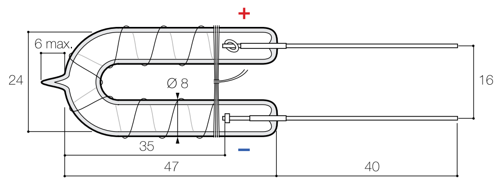
VQX S 3012 P

Voltages : Typ. 400 V (190/550 V)
Max. Power in air : 10 W
Max. Frequency : 250 Hz (0,05 J/pulse)
Max. Energy : 20 Joules
Trigger Voltage : 8 kV (TB1/TB1 CI)
Lifetime : 1 to 50 M shots



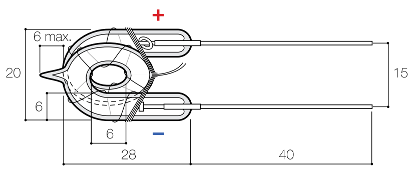
VQX S 3516 P

Voltages : Typ. 400 V (210/600 V)
Max. Power in air : 15 W
Max. Frequency : 150 Hz (0,1 J/pulse)
Max. Energy : 30 Joules
Trigger Voltage : 8 kV (TB1/TB1 CI)
Lifetime : 1 to 50 M shots



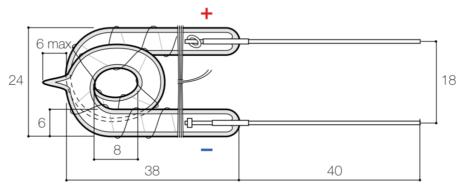
VQX S 20 W

Voltages : Typ. 450 V (210/650 V)
Max. Power in air : 20 W
Max. Frequency : 150 Hz (0,133 J/pulse)
Max. Energy : 50 Joules
Trigger Voltage : 8 kV (TB1/TB1 CI)
Lifetime : 1 to 50 M shots



VQX S 52 P

Voltages : Typ. 400 V (190/550 V)
Max. Power in air : 10 W
Max. Frequency : 250 Hz (0,04 J/pulse)
Max. Energy : 18 Joules
Trigger Voltage : 8 kV (TB1/TB1 CI)
Lifetime : 1 to 50 M shots



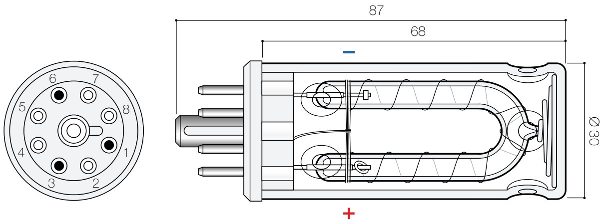
VQX S 82 P

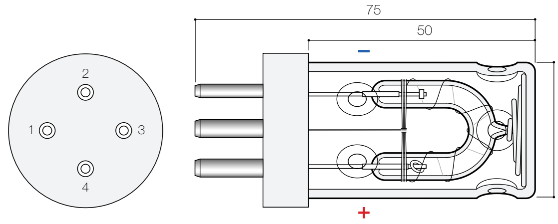
Voltages : Typ. 450 V (220/700 V)
Max. Power in air : 18 W
Max. Frequency : 150 Hz (0,12 J/pulse)
Max. Energy : 40 Joules
Trigger Voltage : 8 kV (TB1/TB1 CI)
Lifetime : 1 to 50 M shots

Above mentioned max energy may be 4 times greater for all the tubes which are not exceeding 20 Watts, only for working conditions such as 10 flashes per minute with a rest period of 1 minute between each working minute. Calculation of max. energies are based on typical flash duration of 30 µs.

Mounting Possibilities : Pyrex Protection Dome and Sockets

For borosilicate strobe lamps





Mounting Example : VQX S 3516P / OCTAL

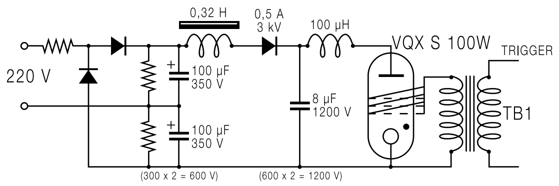
Lamp specifications same as VQX S 3516P
8 pins Ø 31 socket : 1 trigger / 3 Anode + / 6 Cathode –
Bearing spring - Pyrex dome Ø 30 with air cooling holes.

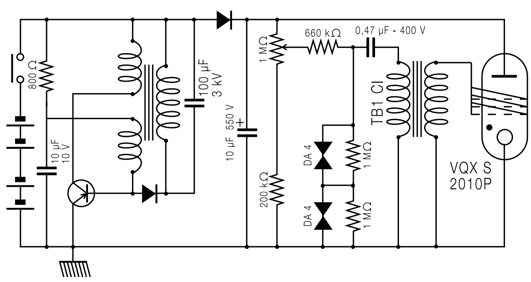
Mounting Example : VQX S 1516P / USC

Lamp specifications same as VQX S 1516P
4 pins bakelite Ø 34 socket : 3 trigger / 4 Anode + / 2 Cathode –
Bearing spring - Pyrex dome Ø 30 with air cooling holes.

Mounting possibilities for other borosilicate flashtubes on request : please consult us.

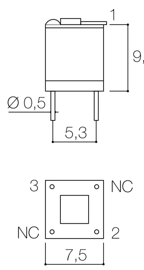
Typical Stroboscopic Power Supplies

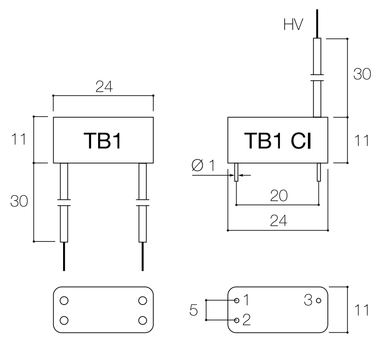


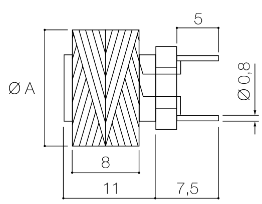


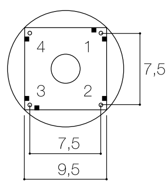
Ask for our electronic schemes for different working conditions.

Typical Trigger Coils (External Triggering)









TB KR8

Primary Voltage : Max. 300 V
Secondary Voltage : Max. 8 kV
Discharge Capacitor : Typ. 0,047 µF

TB1 or TB1 CI

Primary Voltage : Max. 600 V (Typ. 400 V)
Secondary Voltage : Typ. 8 kV (Max. 12 kV)
Discharge Capacitor : Typ. 0,1 µF
TB1 CI : output pins for soft soldering on elec. cards.

TB4 kV CI

Max. Primary Voltage : 300 V
Max. Secondary Voltage : 4 kV
Typ. C. : 0,022 µF
A (mm) : 14

TB6 CI2

300 V
6 kV
0,047 µF
16

For more details about trigger transformers, please see section : "TRIGGER TRANSFORMERS FOR EXTERNAL AND SERIES TRIGGERING".

30, Route d'Aulnay - 93140 Bondy - FRANCE
Tel + 33 (0)1 48 49 74 21 - Fax + 33 (0)1 48 48 44 22
e-mail : flashlps@club-internet.fr

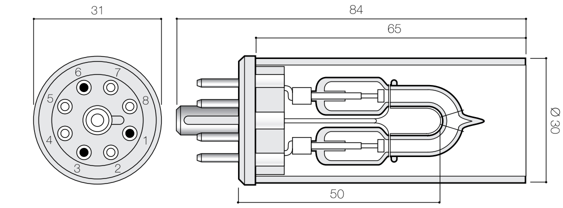
FLASHLAMPS
Verre & Quartz

Stroboscopic Xenon Flashtubes

FOR SIGNAL-SYSTEMS, SCIENTIFIC / INDUSTRIAL APPLICATIONS

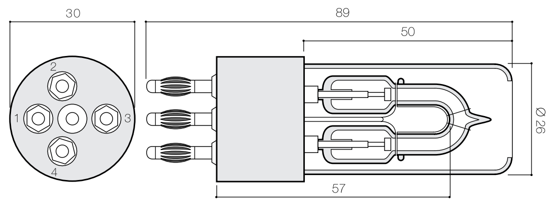
Low, Medium & High Power Quartz Flashtubes

U-Shape Stroboscopic Quartz Flashlamps Mounted on Various Sockets & Borosilicate Protection Domes.
Helicoid High Power Quartz Lamps Mounted on Ceramic Sockets & Borosilicate Dome with Forced Air Cooling.



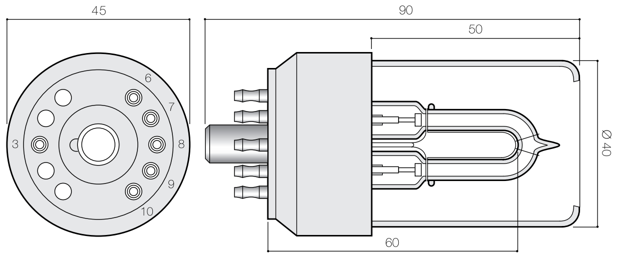
VQX SN 2012 UP / 15 W / OCTAL

8 pins socket connections : 1 trigger / 3 - 6 : electrode connections
Voltages : Typ. 800 V (300 / 1000 V) — Max. Energy : 10 J (10 µs half peak)
Max. Power in air : 15 W — Trigger Voltage : 8 kV (TB1 / TB1 CI)
Max. Frequency : 1000 Hz — Lifetime : 300 Hours / 1000 Hz



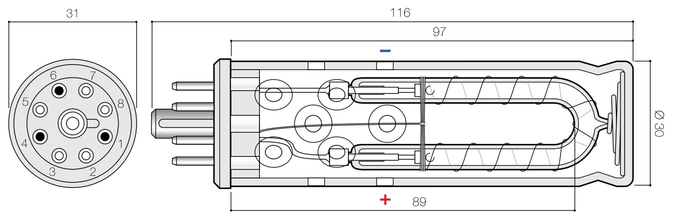
VQX SN 2012 UP / 15 W / D 30

4 pins socket : 1 not connected / 3 trigger / 2 - 4 : electrode connections
Voltages : Typ. 800 V (300 / 1000 V) — Max. Energy : 10 J (10 µs half peak)
Max. Power in air : 15 W — Trigger Voltage : 8 kV (TB1 / TB1 CI)
Max. Frequency : 1000 Hz — Lifetime : 300 Hours / 1000 Hz



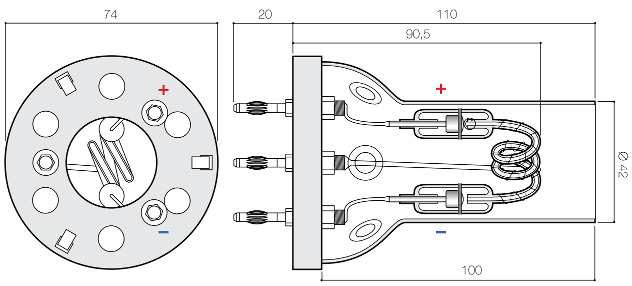
VQX SN 3012 UP / 40 W / D 45

6 pins socket : 7 - 8 - 9 not connected / 3 trigger / 6 - 10 : electrode connections
Voltages : Typ. 1200 V (600 / 1500 V) — Max. Energy : 15 J (10 µs half peak)
Max. Power in air : 40 W — Trigger Voltage : 8 kV (TB1 / TB1 CI)
Max. Frequency : 1000 Hz — Lifetime : 300 Hours / 1000 Hz



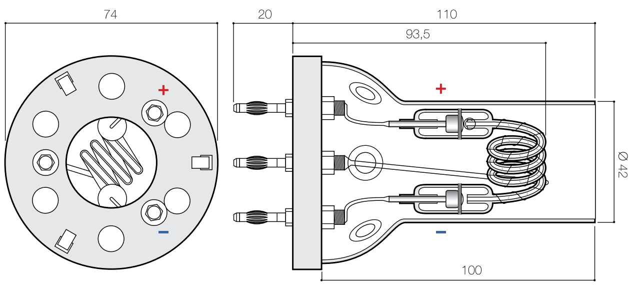
VQX S 100 W / 1200 V / OCTAL

8 pins socket : 1 trigger / 4 Anode + / 6 Cathode –
Voltages : Typ. 1200 V — Max. Energy : 30 J (10 µs half peak)
Max. Power in air : 150 W (typ. 100 W) — Trigger Voltage : 8 kV (TB1 / TB1 CI)
Max. Frequency : 30 Hz (5,4 J/pulse) — Lifetime : 10 M shots (5,4 J/pulse)
100 µH Self inductance duty placed in series with the lamp.
This lamp may be sold without mounting. Also supplied 600 V.



VQX SH 250 W S74

3 pins ceramic socket Ø 74 and borosilicate dome. FORCED AIR ONLY.
Voltages : Min. 730 V Max. 2000 V — Max. Energy : 100 J (1 ms half peak) with 2 mH inductance
Max. Power in forced air : 250 W — Trigger Voltage : 22 kV (TB2)
Max. Frequency : 1000 Hz (TB2) 2000 Hz (TB4) — Lifetime : 300 Hours / 1000 Hz



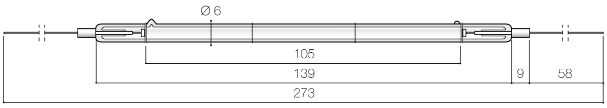
VQX SH 500 W S74

3 pins ceramic socket Ø 74 and borosilicate dome. FORCED AIR ONLY.
Voltages : Min. 1000 V Max. 2800 V — Max. Energy : 200 J (1 ms half peak) with 2 mH inductance
Max. Power in forced air : 500 W — Trigger Voltage : 22 kV (TB2)
Max. Frequency : 1000 Hz (TB2) — Lifetime : 300 Hours / 1000 Hz

Examples of production are shown : many other models available or on special request : please consult us.

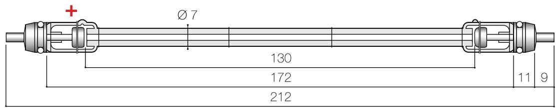
Medium / High Power Quartz Flashtubes

Linear lamps with cerium-doped silica (transmission from 380 nm) or natural fused silica (transmission from 220 nm). Ring-shaped flashlamps for aerospace signal-systems. Cerium doped silica.



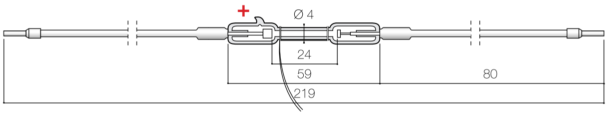
VQX SD 100 W

Cerium doped silica. High voltage trigger : nickel wire and band
Voltages : Typ. 600 V (max. 800 V)
Max. Power in air : 100 W
Max. Frequency : 100 Hz
Max. Energy : 400 Joules
Trigger Voltage : 8 kV (TB1/TB1 CI)
Lifetime : 1 to 20 M shots



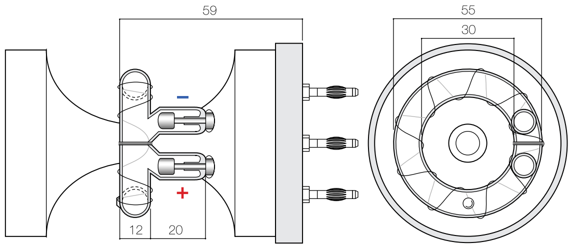
VQX SD 250 W / WE2

Cerium doped capillary tube : Ø 7 x 2 mm / arc length 130 mm
Ceramic tube ends and O-rings. FORCED AIR OR WATER COOLING ONLY.
Voltages : Min. 730 V Max. 2000 V
Max. Power in forced air : 250 W
Max. Frequency : 1000 Hz (TB2)
2000 Hz (TB4)
Max. Energy : 100 Joules (2,5 Hz max.) with 2 mH inductance
Trigger Voltage : 22 kV (TB2)
Lifetime : 300 hours
Other model : VQX SD 500 W / WE2 : same elec. specs as VQX SH 500 W S74



VQX S 4CA24 / A45 / P5

Natural fused silica allowing radiation from 220 nm. No UV rad. on request.
Voltages : Min. 300 V (max. 600 V)
Max. Power in air : 10 W
Max. Frequency : 1000 Hz
Max. Energy : 45 Joules
Trigger Voltage : 8 kV (TB1/TB1 CI)

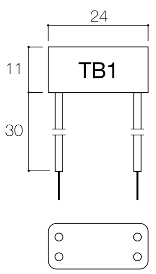


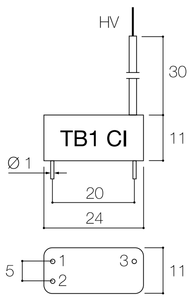
VQX R 3020J D12 / CLD7 / AL7 S74

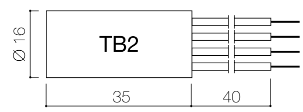
Cerium doped silica. Flashlamp mounted on parabolic chrome reflector.
Voltages : Min. 350 V Max. 650 V
Max. Power in air : 250 W
Max. Frequency : 6 Hz
Max. Energy : 300 Joules
Trigger Voltage : 8 kV (TB1/TB1 CI)

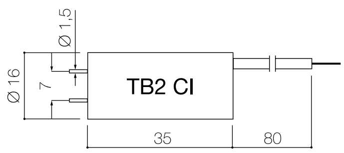
Calculations of max. energies are based on typical flash duration of 1 ms (please see section : "**PHOTO FLASHTUBES**")
Typical operating energy = max. energy x 0,8.
Examples of production are shown : many other models available or on special request : please consult us.

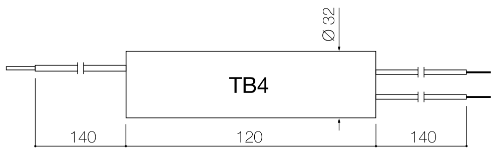
Typical Trigger Coils (External Triggering)











TB1 or TB1 CI

Primary Voltage : Max. 600 V (Typ. 400 V)
Secondary Voltage : Typ. 8 kV (Max. 12 kV)
Discharge Capacitor : Typ. 0,1 µF
TB1 CI : output pins for soft soldering on elec. cards.

TB2 or TB2 CI

Primary Voltage : Max. 600 V
Secondary Voltage : Max. 22 kV
Discharge Capacitor : Typ. 0,47 µF
TB2 C1 : output pins for soft soldering on elec. cards.

TB4

Primary Voltage : Max. 700 V (Typ. 600 V)
Secondary Voltage : Typ. 40 kV (Max. 50 kV)
Discharge Capacitor : Typ. 0,22 µF
Typ. useful frequency : 2 kHz

For more details about trigger transformers, please see section : "TRIGGER TRANSFORMERS FOR EXTERNAL AND SERIES TRIGGERING".

30, Route d'Aulnay - 93140 Bondy - FRANCE
Tel + 33 (0)1 48 49 74 21 - Fax + 33 (0)1 48 48 44 22
e-mail : flashlps@club-internet.fr
FLASHLAMPS Verre & Quartz

Trigger Transformers

External/ Series Triggering

Typical High Voltage Trigger Transformers for Flashlamps and CW Arc Lamps

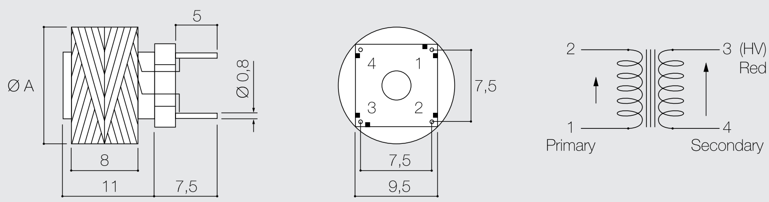
External Triggering

TB4 KV CI

Dimensions :	A = 14 mm
Max. Prim. Voltage :	300 V
Secondary Voltage :	4 kV
Typ. Discharge Capacitor :	0,022 µF

TB6 CI2

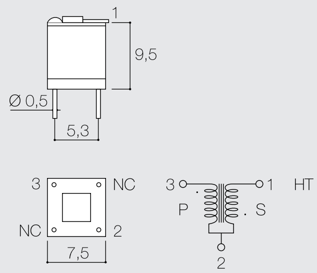
Dimensions :	A = 16 mm
Max. Prim. Voltage :	300 V
Secondary Voltage :	6 kV
Typ. Discharge Capacitor :	0,047 µF



TB KR8

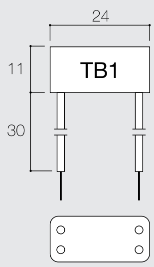
Max. Prim. Voltage :	300 V
Max. Secondary Voltage :	8 kV
Discharge Capacitor :	Min. 0,022 µF
	Max. 0,1 µF
	Typ. 0,047 µF

Prim. : 3
Common : 2
Sec. : 1 (HV)



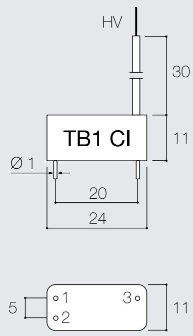
TB1 / TB1 CI (Output pins for soft soldering on elec. cards)

Primary Voltages :	Typ. 400 V / Max. 600 V
Secondary Voltages :	Typ. 8 kV / Max. 12 kV
Isolation Voltage prim./sec. :	15 kV
Isolation Voltage (earthed) :	1 kV
Max. peak current on primary :	15 A (25 µs)
Average Power :	1 W
Discharge Capacitor :	Min. 0,047 µF
	Max. 0,47 µF
	Typ. 0,1 µF



TB1

Prim. : blue
yellow (earth)
Sec. : brown (HV)
red (earth)



TB1 CI

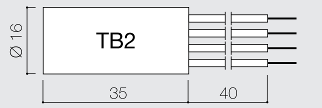
Prim. : 2
3
Sec. : HV
1 (earth)

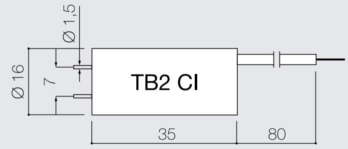
Specifications are subject to change without notice.

External Triggering

TB2 / TB2 CI (Output pins for soft soldering on elec. cards)

Max. Primary Voltage :	600 V
Max. Secondary Voltage :	22 kV
Max. peak current on primary :	20 A (50 µs)
Average Power :	2,2 W
Discharge Capacitor :	Min. 0,22 µF
	Max. 1 µF
	Typ. 0,47 µF





TB2

Prim. :	blue
	yellow (earth)
Sec. :	brown (HV)
	black (earth)

TB2 CI

Common (prim./sec.) :	1st plug (red mark)
Prim. :	2nd plug
Sec. :	red wire (HV)

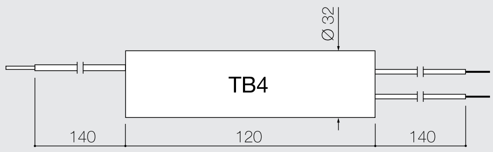
TB4

Primary (13 turns) :

Voltage :	Typ. 600 V
	Max. 700 V (800 V / 1 Hz)
Discharge Capacitor :	Typ. 0,22 µF
	Max. 1 µF
	Min. 0,022 µF
Max. Average Power :	50 W
Frequency (0,1 µF / 600 V) :	2000 Hz
Max. Frequency :	4000 Hz

Secondary (2000 turns) :

Voltage :	40 kV (0,22 µF / 600 V)
Max. Voltage :	50 Kv (0,22 µF / 700 V)



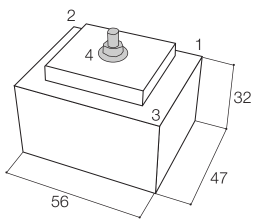
Prim. :	green
Common (prim./sec.) :	yellow
Sec. :	White (HV)

Series Triggering

TB IS1

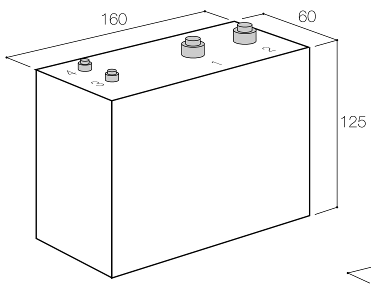
Primary Voltage :	600 V - 0,47 µF
Secondary Voltage :	10 kV
Inductance :	490 µH
Connections :	Primary : 1 - 2
	Secondary : 3 - 4 (HV)
	(section 0.3 mm²)

(1, 2 and 3 output pins, about Ø 0.9)



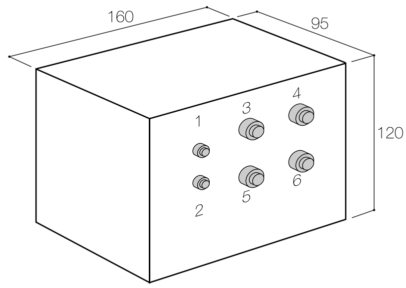
TB IS2

Primary :	1 coil
Secondary :	1 coil
Primary Voltage :	800 V - 1 µF
Secondary Voltage :	16 kV
Inductance :	110 µH
Connections :	Primary : 3 - 4
	Secondary : 1 - 2
	(section 4 mm²)



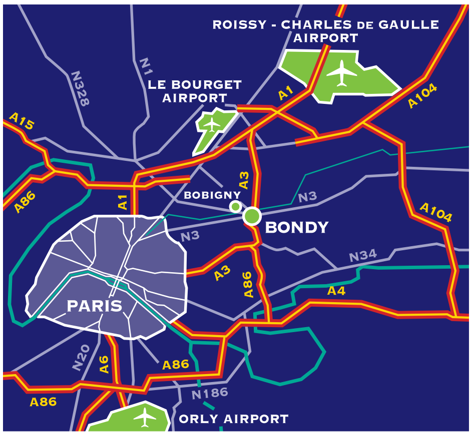
TB IS3

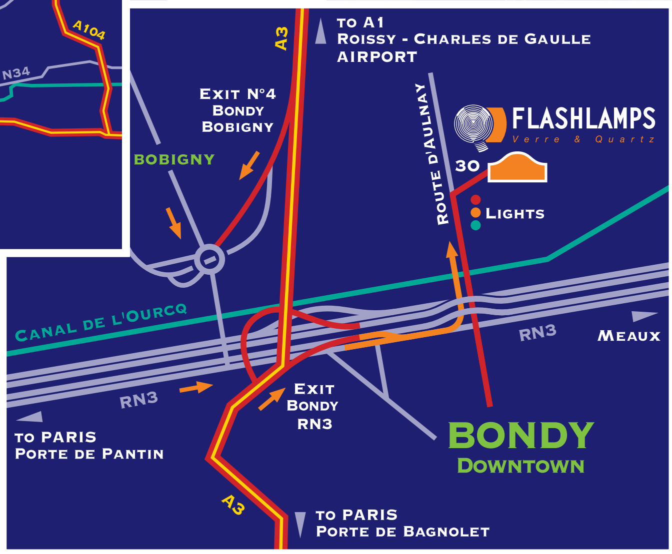
Primary :	1 coil
Secondary :	2 coils
Primary Voltage :	800 V- 1 µF
Secondary Voltage :	2 x 16 kV
Inductance :	2 x 110 µH
Connections :	Primary : 1 - 2
	1st Secondary 16 kV : 3 - 4
	2nd Secondary 16 kV : 5 - 6
	(section 4 mm²)



30, Route d'Aulnay - 93140 Bondy - FRANCE
Tel + 33 (0)1 48 49 74 21 - Fax + 33 (0)1 48 48 44 22
e-mail : flashlps@club-internet.fr
FLASHLAMPS
Verre & Quartz


photo flashtube
laser flashlamp
laser flashlamp
laser flashlamp
laser cw arc lamp
strobe flashlamps
strobe flashlamps
strobe flashlamps
photo flashtube
fast repetition rate flashlamp
strobe flashlamps
photo flashtube
photo flashtube
strobe flashtube
photo flashtube





FLASHLAMPS
Verre & Quartz

30, Route d'Aulnay - 93140 Bondy - FRANCE
Tél + 33 (0)1 48 49 74 21 - Fax + 33 (0)1 48 48 44 22
E-mail : flashlps@club-internet.fr
www.flashlamps-vq.com

SARL au capital de 341.485,80 € - RC B 332 965 896
CCP 30041/00001/0181853X020/45 - N° TVA FR 42 332 965 896

• Imp. Graphic Eclair • Tél. : 01 43 30 99 99 • 05/2005