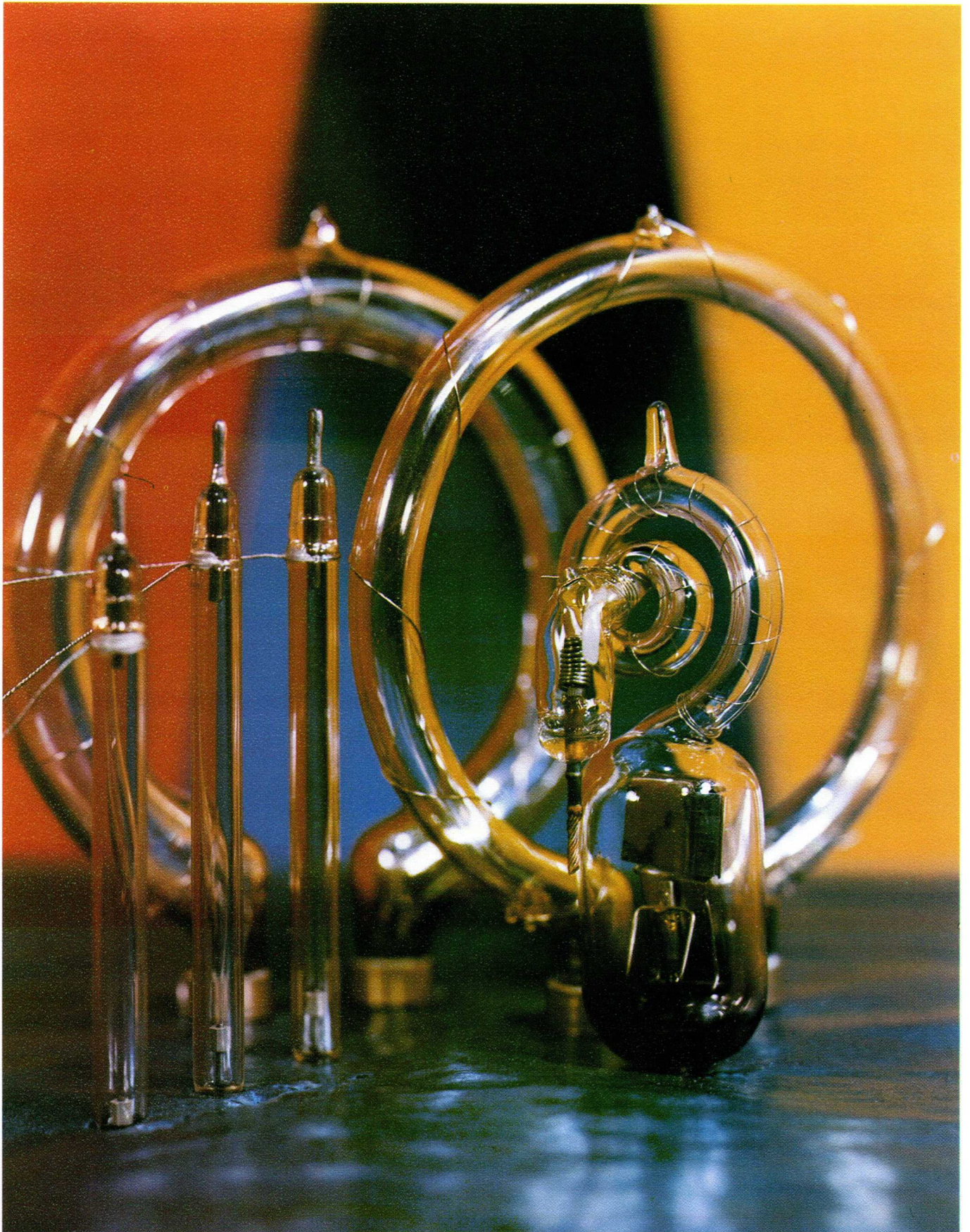


# HEIMANN

Optoelectronics  
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## Xenon Flashtubes







## 1. General

Xenon flashtubes convert electrical energy stored in a flash capacitor into a light flash with a high degree of efficiency. The emitted light extends from ultra-violet through infra-red. Refer to spectral distribution curve on page 2

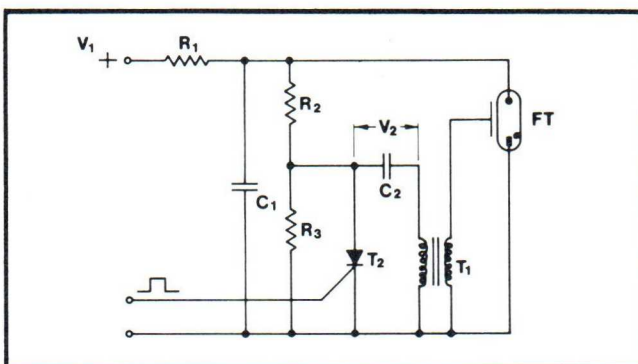
## 2. Typical Applications

Xenon flashtubes emit light of high intensity which is required in a wide field of applications.

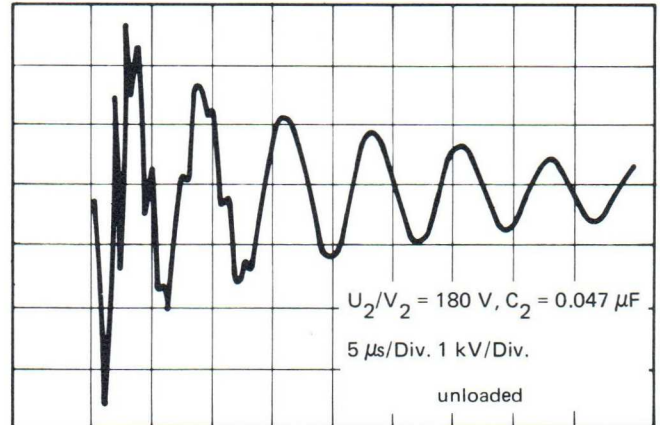
- a) **Photographic:** Amateur and professional flash equipment.
- b) **Traffic:** Warning beacons for traffic control, aircraft, boats, and emergency vehicles (more intense than incandescent lamps in rotating flashers); airport runways.
- c) **Industry:** Stroboscopic applications such as automotive timing lights, dynamic balancing machines, high speed photo copiers and type setting.
- d) **Publicity:** Strobes for window displays, psychedelic lighting.
- e) **Science:** Stroboscopic applications, laser pumping, colorimetry.
- f) **Medicine:** Endoscopic applications.

## 3. Electrical Circuit

For most applications the following standard circuit may be used:



$V_1$	=	Input voltage
$V_2$	=	Trigger voltage, primary
$C_1$	=	Flash capacitor
$C_2$	=	Trigger capacitor
$T_1$	=	Trigger transformer
$T_2$	=	Thyristor for triggering
$R_1, R_2, R_3$	=	Resistors
FT	=	Flashtube



## 4. Triggering

The discharge of the flash capacitor is initiated by a high frequency oscillation with high voltage amplitude applied to one of the electrodes of the flashtube (refer to the diagram). This high voltage pulse is created when discharging the trigger capacitor ( $C_2$ ) via the primary windings of the trigger transformer ( $T_1$ ).

It is important that the correct trigger assembly be selected for each type of flashtube.

## 5. Flash Energy

The flash energy  $E$ , i.e. the electrical energy stored in the capacitor, is proportional to the light output and is expressed in watt seconds (Ws). The following equation holds:

$$E = 1/2 \cdot C_1 V_1^2 \cdot 10^{-6}$$

$E$  = flash energy in joules

$C_1$  = Capacitance of flash capacitor ( $\mu F$ )

$V_1$  = Voltage to which capacitor is charged (V)

In the case of stroboscopic flashtubes, the rating is given in terms of continuous output in watts (P), in accordance with equation

$$P = 1/2 C_1 V_1^2 \cdot f \cdot 10^{-6}$$

$f$  = number of flashes per second

## 6. Flash Duration

The flash duration is determined by the capacitance of the flash capacitor  $C_1$ , by the resistances and inductances in the circuit as well as the internal resistance  $R$  of the flashtube. The equation

$$\tau \approx \frac{R \cdot C_1}{2}$$

has approximate validity, with  $\tau$  being the interval between the time when the flash intensity has risen to 1/3 of maximum and the time when the flash intensity

has fallen to 1/3 of maximum.

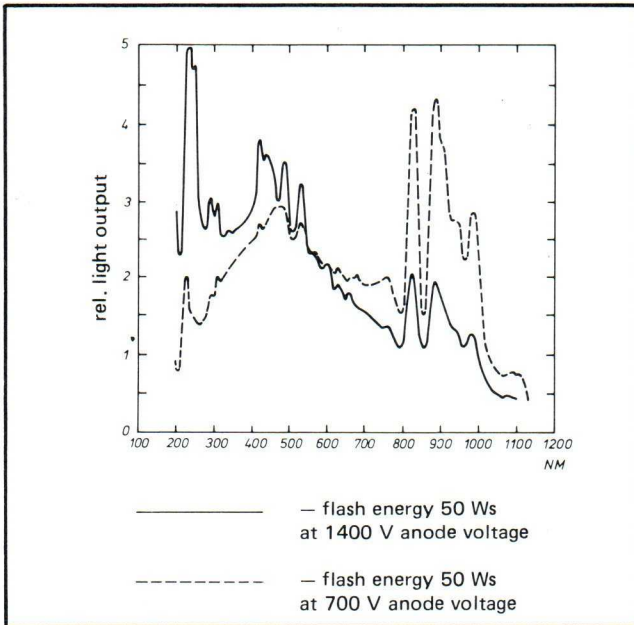
With Xenon Flashtubes, light pulses of 1 micro to 10 milliseconds duration can be produced. By means of special circuits with thyristor or Quench Tubes it is possible to vary the flash duration ( $\tau$ ) within certain limits.

## 7. Internal Resistance

Circuits with automatic light control system having a thyristor in series with the flashtube, require high impedance flashtubes. The internal resistance is proportional to  $e^{3/2}$  and  $d_i^{-2}$  ( $e$  = electrode spacing,  $d_i$  = inner diameter of flashtube).

## 8. Spectral Distribution

The spectral distribution of a flashtube is influenced by peak current. High current densities cause an increase of emission in the blue region and may be achieved by reducing the electrode spacing and increasing the anode voltage. For photographic applications it is desired to have an emission curve which is similar to day light, this may be achieved by using special envelope materials or color correction coatings on the flashtube.



## 9. Light Output

The quantity of emitted light is determined by means of a photoelectric detector, adapted to eye sensitivity, and an integrating sphere. The quantity of light is indicated in Lumen-seconds (Lms). The efficiency of a flashtube, being the ratio between the quantity of light emitted and the electrical energy input, is expressed in Lumens per watt (Lm/W).

## 10. Life

The flashtube life is defined as the number of flashes or hours of operation at nominal energy input when original light output has been reduced by 15%.

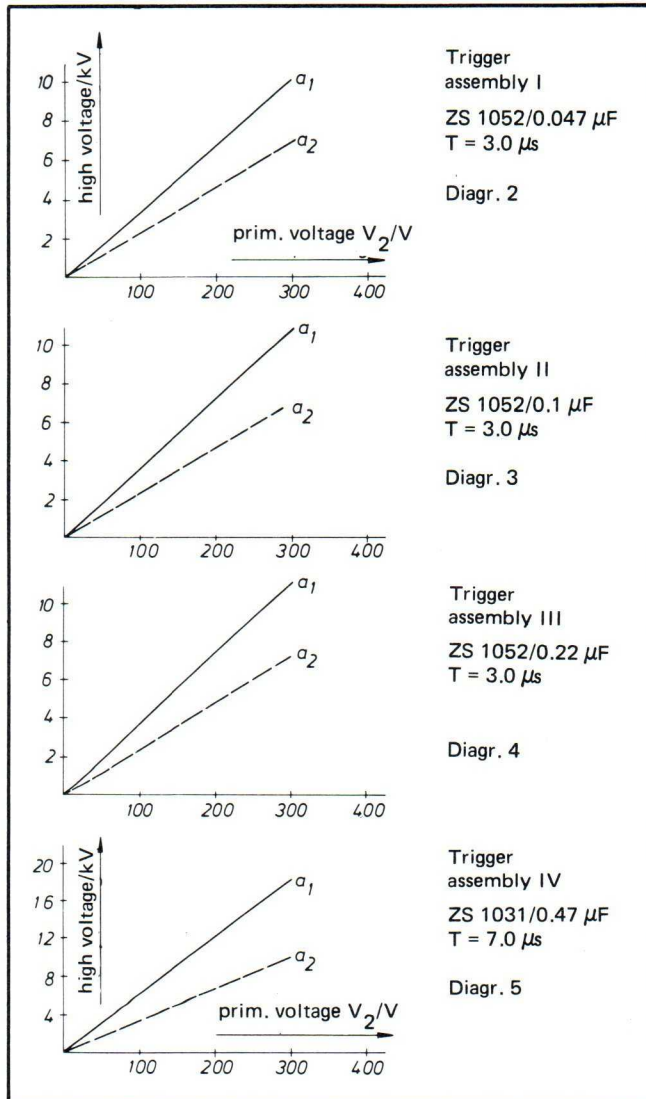
## Trigger Assemblies

Trigger assembly trigger capacitor  $C_2$  trigger transformer  $T_1$

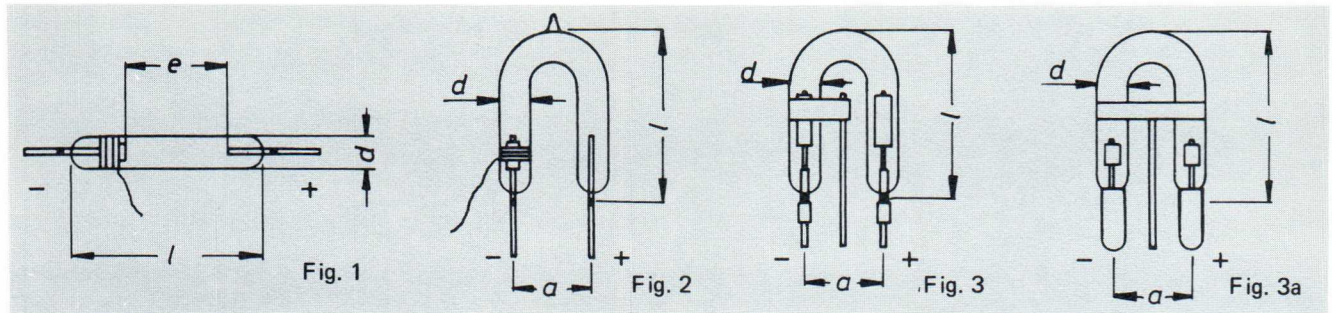
I	K 300 - 0.047 $\mu$ F	ZS 1052
II	K 301 - 0.1 $\mu$ F	ZS 1052
III	K 302 - 0.22 $\mu$ F	ZS 1052
IV	K 304 - 0.47 $\mu$ F	ZS 1031

Diagrams 2 through 5 show the dependance of the first positive amplitude  $a_1$  and the second positive amplitude  $a_2$  of the high voltage pulse on the primary voltage of the trigger circuit for different trigger assemblies.

The trigger assemblies listed for each flashtube show the type of trigger assembly and the primary voltage required to insure safe triggering of the flashtube. (Example: II/150, means trigger assembly type II, primary voltage 150 V).



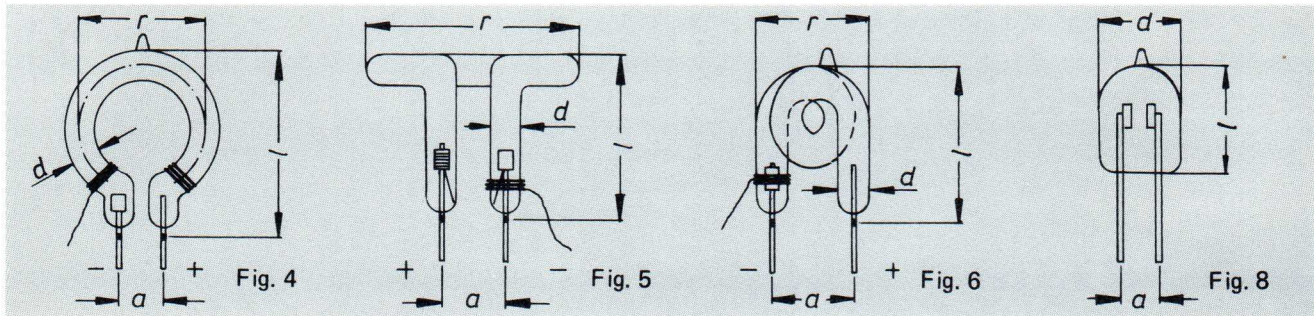




## Flashtubes for photographic applications

type	shape/ Fig.	Ws	V <sub>1</sub> min.	V <sub>1</sub> nom.	trigger assembly	dimensions/mm.					flashes/ life		envelope material
						e	l	d	r	a	min.	flashes	
<b>Standard tubes</b>													
CG 0212	1	10	270 V	360 V	II/200	12	28	3,5	—	—	6	2.500	hardglass
CG 1217	1	20	270 V	360 V	II/200	17	31	3,5	—	—	6	2.500	hardglass
CG 2220	1	25	250 V	360 V	II/200	20	36	3,5	—	—	6	2.500	hardglass
CG 3225	1	35	250 V	360 V	II/200	25	41	3,5	—	—	6	2.500	hardglass
CG 3230	1	40	250 V	360 V	II/200	30	46	3,5	—	—	6	2.500	hardglass
CG 4330	1	60	250 V	360 V	II/200	30	46	4,5	—	—	6	2.500	hardglass
CG 4337	1	60	270 V	360 V	II/200	37	53	4,5	—	—	6	2.500	hardglass
CG 5437	1	70	270 V	360 V	II/200	37	55	4,5	—	—	6	5.000	hardglass
CG 5444	1	80	270 V	360 V	II/200	44	63	4,5	—	—	6	5.000	hardglass
CG 7545	1	145	280 V	360 V	II/200	45	70	5,5	—	—	6	5.000	hardglass
CG 7752	1	150	300 V	550 V	II/200	52	78	6,0	—	—	6	5.000	hardglass
<b>Flashtubes with approx. 20% higher light efficiency</b>													
DGI 1010	1	7	270 V	330 V	II/200	10	20	3,5	—	—	6	1.000	hardglass
DGI 1012	1	10	270 V	330 V	II/200	12	22	3,5	—	—	6	1.000	hardglass
DGI 1014	1	12	270 V	360 V	II/200	14	24	3,5	—	—	6	2.500	hardglass
DGI 2020	1	25	270 V	360 V	II/200	20	30	3,5	—	—	6	2.500	hardglass
DGI 2025	1	30	270 V	360 V	II/200	25	41	3,5	—	—	6	2.500	hardglass
<b>High impedance flash tubes (&gt; 1.3 Ohm)</b>													
CGI 3030	1	30	270 V	360 V	II/200	30	46	3,0	—	—	6	2.000	hardglass
CGI 3135	1	40	270 V	360 V	II/200	35	51	3,5	—	—	6	2.000	hardglass
CGP 6340	1	100	270 V	360 V	II/200	40	66	4,0	—	—	6	2.500	hardglass
CGP 6345	1	120	270 V	360 V	II/200	45	71	4,0	—	—	6	2.500	hardglass
CGP 7660	1	160	280 V	360 V	II/200	64	90	6,0	—	—	6	10.000	hardglass
<b>Special type tubes</b>													
DG 7650	1	200	400 V	500 V	II/200	50	75	6,0	—	—	6	10.000	quartz
GG 8801	1	300	800 V	1.500 V	III/300	100	130	8,0	—	—	6	5.000	hardglass
HG 8802	1	500	1.500 V	2.500 V	III/300	200	230	8,0	—	—	6	5.000	hardglass
EG 9901	1	800	420 V	500 V	III/300	100	130	12,0	—	—	12	10.000	quartz
EG 9902	1	1.500	420 V	500 V	III/300	200	230	12,0	—	—	12	10.000	quartz
DU 4457	2	50	400 V	500 V	II/200	57	39	5,0	—	11,0	10	10.000	hardglass
DU 7670	2	150	400 V	500 V	II/200	70	45	6,0	—	17,5	6	10.000	hardglass
DU 8901	2	250	400 V	500 V	II/200	109	60	10,0	—	14,0	6	10.000	hardglass
DU 8902	2	500	400 V	500 V	III/200	109	60	10,0	—	14,0	6	10.000	quartz
DU 9903	2	1.000	400 V	500 V	III/200	160	100	12,0	—	20,0	4	10.000	hardglass
DU 9904	2	1.500	400 V	500 V	III/200	160	100	12,0	—	20,0	30	10.000	quartz





## Flashtubes for photographic applications

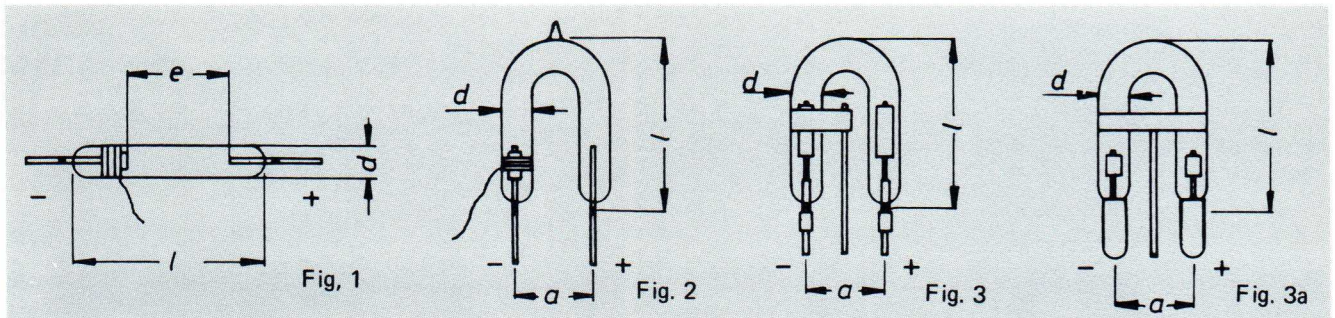
### Special type tubes

type	shape/ Fig.	Ws	$V_1$ min.	$V_2$ nom.	trigger- assembly	dimensions/mm.					flashes/ life		envelope material
						e	l	d	r	a	min.	flashes	
DR 7760	4	230	350 V	500 V	III/200	60	40	7,0	20.		10	10.000	quartz
DR 6685	4	100	400 V	500 V	III/200	85	50	6,0	31.	15,0	10	10.000	hardglass
DR 8690	4	500	400 V	500 V	III/200	90	67	6,0	32.	15,0	10	10.000	quartz
DR 8701	4	250	400 V	500 V	III/200	120	57	7,0	43.	12,5	6	10.000	hardglass
DR 9701	4	600	400 V	500 V	III/200	120	57	7,0	43.	12,5	10	10.000	quartz
DR 8602	4	300	400 V	500 V	III/200	206	92	6,0	70.	12,5	6	10.000	hardglass
DR 9602	4	1.000	400 V	500 V	III/200	206	92	6,0	70.	12,5	6	10.000	quartz
DR 9802	4	600	400 V	500 V	III/200	207	97	8,0	71.	15,0	6	10.000	hardglass
DR 9902	4	1.500	400 V	500 V	III/200	207	97	12,0	71.	15,0	30	10.000	quartz
DW 7701	6	150	400 V	500 V	III/200	100	37	7,0	27.	20,0	6	10.000	hardglass
DW 8790	6	500	400 V	500 V	III/200	90	40	7,0	25.	17,5	6	10.000	quartz

## Flashtubes for stroboscopic applications

type	shape/ Fig.	watts	$V_1$ min.	$V_1$ nom.	trigger assembly	dimensions/mm.					flashes/ sec.	life/h	envelope material
						e	l	d	r	a			
SG 200	1	2	400 V	600 V	II/170	12	28	4,5	—	—	5 - 300	250	hardglass
SG 414	1	3	250 V	600 V	II/150	14	30	4	—	—	5 - 300	250	hardglass
SG 301	1/cap	4	400 V	600 V	II/170	20	45	6	—	—	5 - 1000	250	hardglass
SG 302	1	6	400 V	600 V	II/170	40	66	6	—	—	5 - 300	250	hardglass
SG 303	1/cap	6	400 V	600 V	II/170	40	65	6	—	—	5 - 1000	250	hardglass
SG 304	1	100	400 V	600 V	III/300	100	130	8	—	—	5 - 100	250	quartz
SG 305	1	25	400 V	600 V	III/300	40	70	8	—	—	5 - 300	250	quartz
BGS 5903	7	80	250 V	1.250 V	—	3	78	10	—	—	5 - 500	80	quartz
BUS 0635	2	3	220 V	400 V	II/150	35	29	6	—	17,5	5 - 300	250	hardglass
BUS 0660	2	4	220 V	400 V	II/150	60	40	6	—	13,5	5 - 300	250	hardglass
BUS 0661	2	8	220 V	400 V	II/150	60	40	6	—	13,5	5 - 300	250	hardglass
CUS 0660	2	4	270 V	500 V	II/150	60	40	6	—	13,5	5 - 300	250	hardglass
CUS 0661	2	8	270 V	500 V	II/150	60	40	6	—	13,5	5 - 300	250	hardglass
FUS 0660	3a	6	300 V	600 V	II/150	40	40	6	—	12,5	5 - 500	250	hardglass
SU 380	2	1	400 V	650 V	I/150	46	30	3,5	—	5,5	5 - 100	250	hardglass
SU 401	3	4	400 V	650 V	I/150	39	40	6	—	12	5 - 300	250	hardglass
SU 402	3	8	400 V	650 V	I/150	39	40	6	—	12	5 - 300	250	hardglass
SU 403	3	12	600 V	1.000 V	II/200	65	60	6	—	15	5 - 300	250	hardglass
SU 414	2	25	600 V	1.000 V	II/200	30	45	7	—	15	5 - 500	250	quartz
SU 405	2	150	600 V	1.000 V	II/300	200	110	9	—	17,5	5 - 300	250	quartz



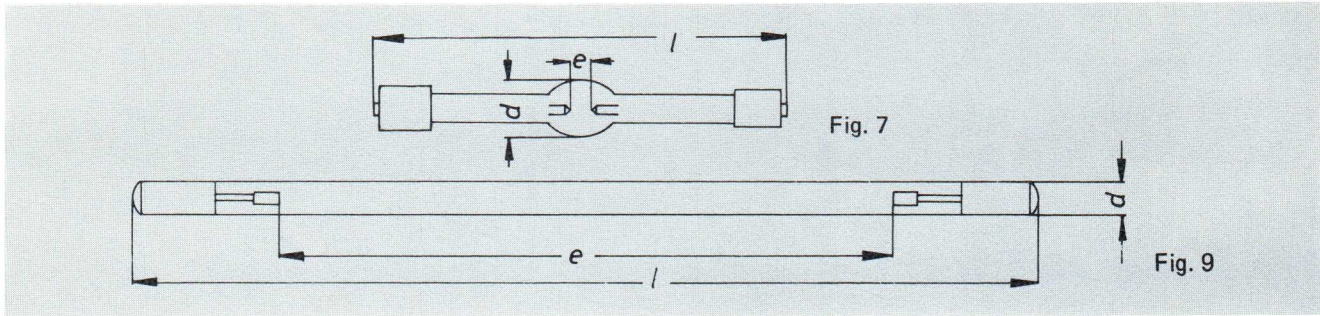


### Flashtubes for stroboscopic applications

type	shape/ Fig.	watts	$V_1$ min.	$V_1$ nom.	trigger assembly	e	dimensions/mm.				flashes/ sec.	life/h	envelope material
							l	d	r	a			
SH 203	6	10	300 V	600 V	III/200		22	6	—	14	5 - 300	250	hardglass
SH 204	6	20	400 V	700 V	III/200	110	50	6	—	17	5 - 300	500	hardglass
SH 205	6	30	400 V	700 V	III/200	110	70	6	—	17	5 - 300	250	hardglass
SK 153	8	4	200 V	600 V	II/170	4	18	11	—	6	5 - 300	250	hardglass
SK 154	8	4	200 V	600 V	II/170	6	18	11	—	6	5 - 300	250	hardglass
SW 503	6	30	400 V	700 V	III/300		40	7		17,5	5 - 300	250	quartz

### Flashtubes for warning beacons

type	shape/ Fig.	watts	$W_s$	$V_1$ min.	$V_1$ nom.	trigger assembly	e	dimensions/mm.				flashes/ sec.	life flashes	envelope material
								l	d	r	a			
BUB 0641	2	6	6	200 V	500 V	III/120	41	31	6	—	10	0.3 - 4	$5 \times 10^6$	hardglass
BUB 0660	2	4	8	220 V	400 V	II/150	60	40	6	—	13,5	0.3 - 4	$5 \times 10^6$	hardglass
BUB 0661	2	8	8	220 V	400 V	II/150	60	40	6	—	13,5	0.3 - 4	$5 \times 10^6$	hardglass
CUB 0660	2	4	8	270 V	500 V	II/150	60	40	6	—	13,5	0.3 - 4	$5 \times 10^6$	hardglass
CUB 0661	2	8	8	270 V	500 V	II/150	60	40	6	—	13,5	0.3 - 4	$5 \times 10^6$	hardglass
CU 1640	2	6	18	400 V	500 V	II/150	40	38	6	—	9,5	0.3 - 4	$5 \times 10^6$	hardglass
CU 4668	2	15	45	400 V	500 V	II/200	68	53	6	—	17,5	0.3 - 4	$5 \times 10^6$	hardglass
DG 3790	1	30	30	350 V	500 V	II/200	90	120	7	—	—	0.3 - 4	$10^7$	quartz
ER 2680	5	25	25	420 V	500 V	II/200	80	28	6	25	10	0.3 - 4	$10^6$	hardglass
ER 3701	5	30	30	350 V	500 V	II/200	100	42	7	35	15	0.3 - 4	$10^7$	quartz
DH 6670	6	8	15	320 V	400 V	II/270	70	38	6	—	27	0.3 - 4	$10^6$	hardglass
DH 2601	6	20	20	330 V	450 V	II/200	100	44	7	19	12	0.3 - 4	$10^6$	hardglass
DHQ 8801	6	40	60	300 V	400 V	III/250	100	35	7	23	16	0.3 - 4	$10^7$	quartz



### Flashtubes for photo copiers

type	shape/fig.	watts	Ws	V <sub>1</sub> min.	V <sub>1</sub> nom.	trigger assembly	dimensions/mm			flashes/sec	life flashes	envelope material
							e	l	d			
EG 3840	1	40	40	400 V	600 V	IV/350	40	70	8	1	5 x 10 <sup>5</sup>	quartz
KG 4805	9	60	60	3.300 V	3.800 V	IV/350	500	560	8	1	10 <sup>6</sup>	quartz
JG 3703	9	76	38	2.800 V	3.300 V	IV/250	305	385	7	2	4 x 10 <sup>6</sup>	quartz *)
FG 7802	9	400	400	1.400 V	4.000 V	IV/450	220	270	10	1	10 <sup>6</sup>	quartz **)
HG 9903	9	360	480	1.700 V	4.000 V	IV/350	310	300	10	0.75	10 <sup>6</sup>	quartz **)
GG 7903	9	125	125	800 V	1.300 V	IV/300	315	370	10	1	10 <sup>6</sup>	quartz
KG 5704	9	124	62	3.600 V	4.100 V	IV/250	430	510	7	2	4 x 10 <sup>6</sup>	quartz *)
TG 7904	9	145	145	2.900 V	3.300 V	IV/250	380	440	10	1	10 <sup>6</sup>	quartz **)
QG 8902	9	300	240	480 V	650 V	IV/250	225	280	14	1.25	10 <sup>6</sup>	quartz

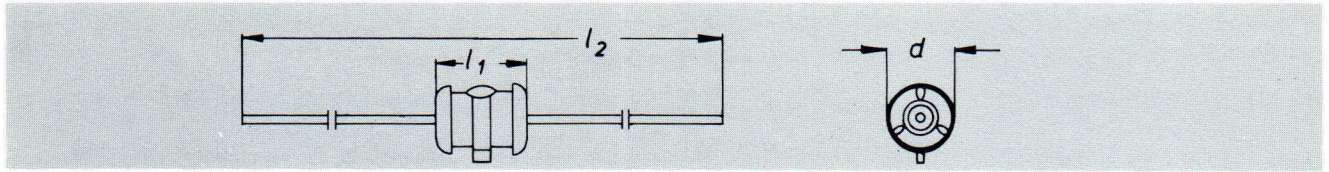
\*) UV-absorbing quartzglass

\*\*) with color correction coating

### Flashtubes for laser application

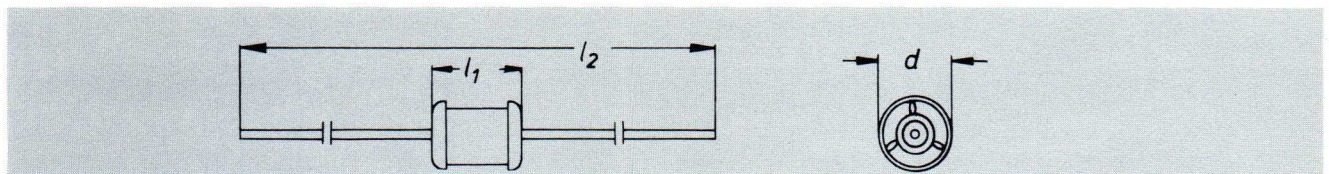
Type		XL 9976	XL 9901	XL 9903	XL 9902
nom. flash energy	Ws	1500	3000	8100	10000
nom. power	W	60	80	125	150
with air cooling	W	480	640	1000	1200
with water cooling	W	4000	8000	12500	15000
anode voltage max.	V	2100	2400	6000	3400
min.	V	1000	1100	1500	1200
nom.	V	1360	1700	4200	2100
trigger voltage min.	KV	20	20	25	25
flash duration = 100 μs					
at flash energy max.	Ws	460	920	3400	3420
anode voltage	V	2100	2400	6000	3400
inductance	μH	8	15	8.5	2.8
capacity	μF	210	106	188	580
internal resistance	Ω	0.3	0.6	0.34	0.11
light output drop in	%	50	50	50	50
after 5 · 10 <sup>5</sup> flashes of	Ws	150	300	800	1000
Dimensions in mm:					
figure		9	9	9	9
arc length	e	76	152	304	203
total length max.	l	149	226	389	329
tube diameter	d	9	9	15	22
diameter of end caps		7	7	7	7





## Quench tubes

type	Ws	self-breakdown voltage (VDC)	max. switching current		trigger assembly	life flashes	dimensions/mm			envelope material		
			$V_{1 \text{ min.}}$	$V_{1 \text{ nom.}}$			e	$l_1$	$l_2$		d	
KAT 05-01 J	40	>600	5 kA	120	360	I/120	5.000	—	10	73	10	hardglass
KAT 05-02 J	40	>700	1 kA	250	360	I/120	5.000	—	10	73	10	hardglass
KATL05-01	65	>600	10 kA	120	360	I/120	5.000	—	10	73	10	hardglass



## Spark gaps

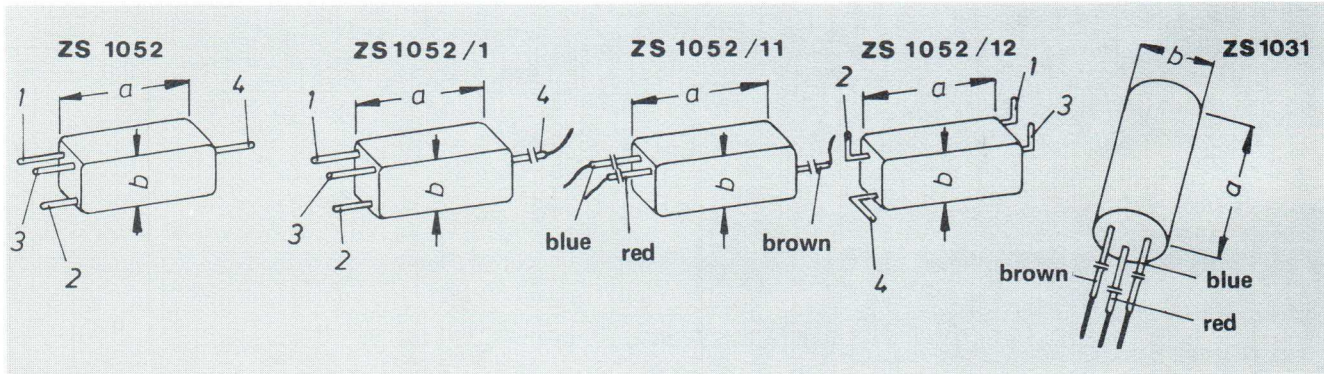
type	self-breakdown voltage (VDC)	switching current		repetition rate max. (1/sec)	max. transported charge per discharge	insulation resistance	dimensions/mm			envelope material
		min.	max.				$l_1$	$l_2$	d	
FST 210	210 V $\pm$ 15 %	5 A	100 A	300 (AC) 50 (DC)	1 As	$10^8 \Omega$	7	46	9	hardglass
FST 350	350 V $\pm$ 15 %	5 A	100 A	300 (AC) 50 (DC)	1 As	$10^8 \Omega$	7	46	9	hardglass

## Capacitors

type	version	capacity/ $\mu\text{F}$	voltage	dimensions/mm	application
K 300	MKH	0.047	400 V	5,5 x 11 x 18	trigger capacitor
K 301	MKH	0.1	400 V	7,0 x 13 x 18	trigger capacitor
K 302	MKH	0.22	400 V	6,5 x 15 x 27	trigger capacitor
K 303	MP	0.1	400 V	10,8 $\emptyset$ x 26	trigger capacitor for high performance
K 304	MP	0.47	400 V	16,8 $\emptyset$ x 32	trigger capacitor for high performance
B43405-A9327-Q550	Elko	325	360 V	22 $\emptyset$ x 50	discharge capacitor for e.g. CG 2220
B43405-A9467-Q50	Elko	460	360 V	26 $\emptyset$ x 50	discharge capacitor for e.g. CG 3225
B43405-A9907-Q50	Elko	900	360 V	35 $\emptyset$ x 50	discharge capacitor for e.g. CG 4330
B43406-A9108-Q50	Elko	1400	360 V	40 $\emptyset$ x 80	discharge capacitor for e.g. CG 7752
K 320	Elko	2.2	350 V	8,5 $\emptyset$ x 20	pulse capacitor for stroboscope devices
K 324	MP	6.3	3.150 V	102 $\emptyset$ x 153	pulse capacitor for stroboscope devices
K 325	MPY	2.0	630 V	25 $\emptyset$ x 80	pulse capacitor for stroboscope devices
K 326	MPY	5.0	630 V	35 $\emptyset$ x 80	pulse capacitor for stroboscope devices
K 327	MPY	10.0	630 V	45 $\emptyset$ x 80	pulse capacitor for stroboscope devices

other versions available on request





### Trigger coils

type	sec. voltage max.	prim. voltage max. unloaded	trig-ger energy max.	trig-ger power max.	trans-former ratio	prim. induc-tance	frequency of sec. voltage Cz = 0.047 $\mu$ F	Dimensions mm	
								a	b
ZS 1052	11 kV	300 V	10 mWs	0.5 W	1:36-38	$25 \pm 5 \mu$ H	120 ... 160 kHz	16	8
ZS 1052/1	11 kV	300 V	10 mWs	0.5 W	1:36-38	$25 \pm 5 \mu$ H	120 ... 160 kHz	16	8
ZS 1052/11	11 kV	300 V	10 mWs	0.5 W	1:36-38	$25 \pm 5 \mu$ H	120 ... 160 kHz	16	8
ZS 1052/12	11 kV	300 V	10 mWs	0.5 W	1:36-38	$25 \pm 5 \mu$ H	120 ... 160 kHz	16	8
ZS 1031	20 kV	400 V	30 mWs	1.0 W	1:70		120 ... 160 kHz	35	16

### Lead wires

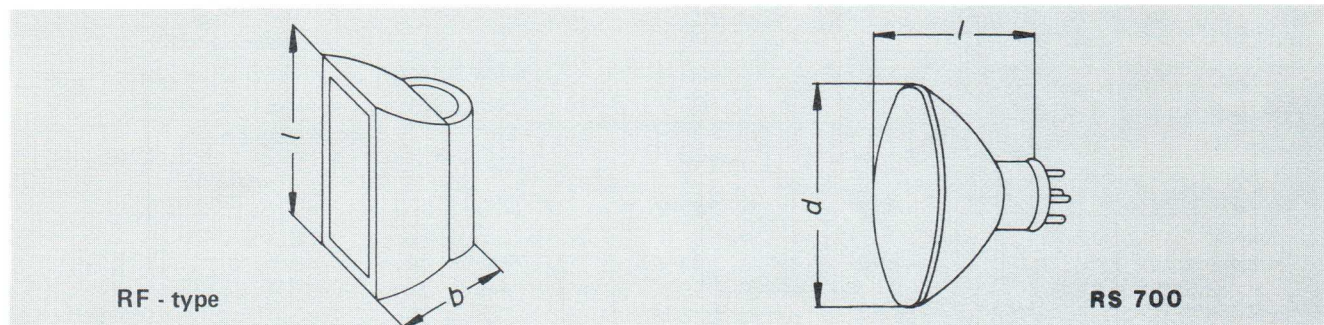
ZS 1052/11 and ZS 1031

red = prim. and sec.  
blue = prim  
brown = sec., high voltage

ZS 1052, ZS 1052/1 and ZS 1052/12

1 = primary, 3 = secondary,  
2 = primary, 4 = sec., high voltage

Series injection trigger coils available on request



### Reflectors

type	dimensions/mm.			area of light output $\text{mm}^2$	application for flashtube, type
	l	b	d		
RF 120	35	24	31	840	CG 2220
RF 122	39	26	28	1010	CG 3225
RF 128	46	26	30	1090	CG 4330
RF 130	50	36	40	1800	CG 4337
RF 135	60	36	41	2160	CGP 6340
RF 140	64	40	43	2560	CG 5444
RS 700	76	—	128	11300	DHQ 8801





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