CERBERUS-Röhrenhandbuch RH
Manuel Tubes CERBERUS RH
CERBERUS Tube Manual RH

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CERBERUS AG CH-8708 Männedorf

CERBERUS AG
WERK FÜR ELEKTRONENTECHNIK
ABTEILUNG VR
CH-8708 MÄNNEDORF
SUISSE

CERBERUS INFORMATION

GAS DISCHARGE ELECTRONICS

R

No 47 - e
June 1974

Latest position summary of tube manual

Replaces Information R No 40-e December 1972

Sheet no *encl.	present state: not modified	present state: new	present state: modified	present state: deleted	Last ed.	earlier ed.: valid	earlier ed.: invalid	Modifications, resp. (Objects of new sheets)
*1.07e			x		5.74		x	Adapted to the latest situation
*RP78			x		-		x	Sales Areas
1.41	x				7.66		x	
2.01e	x				12.70		x	
2.02e	x				3.69		x	
3.01	x				10.70		x	
3.15	x				11.65	x		
3.16	x				5.66		x	
3.17	x				1.57	x		
3.31	x				10.65	x		
3.44				x	10.65		x	
3.46e	x				6.70			
4.04e	x				5.62	x		
4.06e	x				5.64	x		
4.21	x				10.65	x		
5.01	x				1.70		x	
5.04e	x				9.63	x		
5.07e	x				11.63	x		
5.12	x				4.66		x	
5.13	x				4.66		x	
5.44	x				5.72		x	
5.45	x				11.67	x		
8.11				x	12.65		x	
8.42	x				9.66			
12.22				x	12.65		x	
*12.31		x			5.74			(High current switching diode BD 31)
*12.32		x			5.74			(High current switching diode BD 32)

Sheet no *encl.	present state				Last ed.	earlier ed.		Modifications, resp. (Objects of new sheets)
	not modified	new	modified	deleted		valid	invalid	
13.06	x				4.71		x	
*13.08		x			8.73			(Surge Arrester UAM 470)
*13.09		x			2.73			(Surge Arrester UAM 600)
13.12	x				1.70	x		
13.23	x				4.71		x	
13.24	x				5.69			
13.25	x				8.70			
13.26	x				8.70			
13.35	x				3.71	x		
13.36	x				8.70			
13.60	x				4.71		x	
16.15e	x				2.69			
16.16e				x	2.69			
*RP112		x			-			(Leaflet "Cerberus Glow Lamps for Flush-mounting")
18.01	x				9.67			
18.02	x				3.67			
*19.01			x		5.74		x	Adapted to the latest situation
50.11	x				8.63			
50.12e	x				7.67			
51.12	x				10.63	x		
51.16	x				5.65	x		
51.17e	x				10.65			
52.13	x				8.65	x		
52.14	x				10.62	x		
52.15	x				8.63	x		
52.23	x				12.65		x	
53.13e	x				3.66		x	
53.14e	x				8.69		x	
53.17e	x				9.66	x		
53.18e	x				9.66			
53.19e	x				6.69		x	
53.20e	x				11.68		x	
54.12	x				10.66			
55.20e	x				1.65	x		
58.11	x				6.64			
63.11	x				8.63			

Latest position summary of tube manual

Replaces Information R No 36-e January 1971

Sheet no *encl.	present state: not mod.	new	mod.	deleted	Last ed.	earlier ed.: valid	invalid	Modifications, resp. (Objects of new sheets)
1.07e	x				12.70		x	
1.20				x	9.70		x	replaced by RP 78 def C 1000*
1.41	x				7.66		x	
2.01e	x				12.70		x	
2.02e	x				3.69		x	
3.01	x				10.70		x	
3.15	x				11.65	x		
3.16	x				5.66		x	
3.17	x				1.57	x		
3.31	x				10.65	x		
3.44	x				10.65	x		
3.46e	x				6.70			
4.04e	x				5.62	x		
4.06e	x				5.64	x		
4.21	x				10.65	x		
5.01	x				1.70		x	
5.04e	x				9.63	x		
5.07e	x				11.63	x		
5.12	x				4.66		x	
5.13	x				4.66		x	
*5.44			x		5.72		x	max. length of tube 32 mm
5.45	x				11.67	x		
8.11	x				12.65	x		
8.42	x				9.66			
12.22	x				12.65	x		
*13.06			x		4.71		x	Typical voltage-current characteristic deleted
13.12			x		1.70	x		
*13.23			x		4.71		x	Supplement (Pt.4)
13.24	x				5.69			
13.25	x				8.70			
13.26	x				8.70			
*13.35			x		3.71	x		Alterations of expressions
13.36			x		8.70			
*13.60			x		4.71		x	Alterations of expressions and dynamic breakdown voltage (1200 V)

Sheet no *encl.	present state: not mod.	new	mod.	deleted	Last ed.	earlier ed.: valid	invalid	Modifications, resp. (Objects of new sheets)
16.15e	x				2.69			
16.16e	x				2.69			
18.01	x				9.67			
18.02	x				3.67			
* 19.01			x		4.72		x	Arcotron BT 31 deleted
50.11	x				8.63			
50.12e	x				7.67			
51.12	x				10.63	x		
51.16	x				5.65	x		
51.17e	x				10.65			
52.13	x				8.65	x		
52.14	x				10.62	x		
52.15	x				8.63	x		
52.23	x				12.65		x	
53.13e	x				3.66		x	
53.14e	x				8.69		x	
53.17e	x				9.66	x		
53.18e	x				9.66			
53.19e	x				6.69		x	
53.20e					11.68		x	
54.12	x				10.66			
55.20e	x				1.65	x		
58.11	x				6.64			
63.11	x				8.63			

CERBERUS

Fabrikationsprogramm	Programme de fabrication	Manufacturing Program
Glimmrelais	Tubes relais	Trigger Tubes
Stabilisierungsröhren	Tubes stabilisateurs	Voltage Stabilizers
Glimmlampen	Voyants au néon	Glow Lamps
Ueberspannungsableiter	Parasurtensions	Surge Arresters
Elektronische Drucktasten	Touches électroniques	Electronic Touch Buttons
Schaltdioden	Diodes de commutation	Switching Diodes

Dokumentationen	Documentations	Documentations
Ad Produkte-Uebersicht	Af Aperçu des produits	Ae Summary of Products
Bd Glimmrelais und Glimm-Thyratrons	Bf Tubes relais et Thyratrons à effluve	Be Trigger Tubes and Glow Thyratrons
Cd Stabilisierungsröhren	Cf Tubes stabilisateurs	Ce Voltage Stabilizers
Ed Zeitkreise	Ef Circuits temporisateurs	Ee Timer Circuits
Fd Flammenüberwachung	Ff Surveillance de flammes	Fe Flame Monitoring
Gd Steuer-Schaltungen	Gf Circuits de commande	Ge Control Circuits
Id Ueberspannungsableiter	If Parasurtensions	Ie Surge Arresters

«Cerberus elektronik» Firmenzeitschrift über Kaltkathodenröhren und Signalglimmlampen

«Cerberus elektronik» Revue technique des tubes à cathode froide et lampes au néon

«Cerberus elektronik» Quarterly for cold cathode tubes and glow lamps

Cerberus AG Werk für Elektronentechnik CH-8708 Männedorf/Schweiz Telephon 051 - 73 91 51 Telex 7552

1. GENERAL INFORMATION AND SUMMARY OF PRODUCTS

II. APPLICATIONS

Verkaufsgebiete
Territoires de vente
Sales Areas

1974

G
Signalglimmlampen
Voyants au néon
Glow Lamps

R
Elektronenröhren mit kalter Kathode
Tubes électroniques à cathode froide
Electronic tubes with cold cathode

U
Überspannungsableiter
Parasurtensions
Surge Arresters

A	Österreich	G R U	Burisch GmbH & Co KG, Postfach, Scheydgasse 31 ✆ 0222 - 38 76 38, Tx 01 - 3310	**1210 Wien**
AUS	Australia	G R U	Wormald International (Aust.) Pty. Ltd., Park Works, 208 Young Street ✆ 69 0477, Tx AA 20 387	**Waterloo, N.S.W.**
B	België/Belgique	G R U	Geveke Elektronica en Automatie België nv, Arduinkaai 37 - 39 ✆ 02 - 192431, Tx 23028	**1000 Brussels**
CH	Schweiz	G R U	Cerberus AG, Werk für Elektronentechnik ✆ (01) 922 61 11, Tx 7 55 28	**8708 Männedorf**
D	BR Deutschland	R U	Enatechnik-Elektronik-Distributor GmbH, Schillerstrasse 14 ✆ 04106/612-1, Tx 02-13590	**2085 Quickborn**
			Zweigbüros: Marie-Elisabeth-Lüders-Strasse 7 ✆ (030) 341 54 65, Tx 01 – 81760	**1000 Berlin 12**
			Hildesheimer Strasse 31 ✆ (0511) 88 60 86, Tx 09 - 22054	**3000 Hannover**
			Birkenstrasse 107 ✆ (0211) 66 62 84, Tx 08 - 586685	**4000 Düsseldorf 1**
			Breitwiesenstrasse 25 ✆ (0711) 73 63 57, Tx 07 - 255483	**7000 Stuttgart 80**
			Linprunstrasse 23 ✆ (089) 524021/23	**8000 München 2**
		G	Süddeutschland: Dipl.-Ing. Friedrich Pfisterer KG, Kornbergstrasse 50 ✆ (0711) 62 75 24, Tx 7 22916	**7000 Stuttgart**
		G	Nordwestdeutschland: F. Merschjohann, Postfach 4 225, Menkebachweg 3 ✆ (05241) 77287, Tx 933 888	**4830 Gütersloh 11**
DK	Danmark	G R U	Radio-Parts A/S, Sankt Knuds Vej 13 ✆ (01) 313111, Tx 19613	**1903 Kobenhavn V**

E	Espana	G R U	MATELCO S.A., Angli, 31 ✆ 203 56 04 - 203 55 88, Tx 52081	**Barcelona-17**
F	France	G R U	Arnould Electro Industrie, 62, avenue Gabriel Péri ✆ 606–41–19, Tx 29 240 F	**93400 Saint-Ouen**
GB	Great Britain	G R U	Walmore Electronics Ltd., 11–15 Betterton Street, Drury Lane ✆ 01-836 1228, Tx 28752	**London WC2H 9BS**
HK	Hong Kong	G	Dyechem Trading Co., (H.K.), Ltd., 1125–1130, Alexandra House, P.O.B. 610 ✆ H-249116-9, Tx HX 4578	**Hong Kong**
I	Italia	G R U	Dott. Ing. Giuseppe de Mico, Via Manzoni 31 ✆ 653 131, Tx 3 30 35 Uffici regionali: Via del Rondone, 3 ✆ 229751 Riviera A. Mussato, 7b ✆ 65 29 09 Via Romeo Romei, 23 ✆ 316204 Corso Cairoli, 2 ✆ 87 41 37	**20121 Milano** **40122 Bologna** **35100 Padova** **00136 Roma** **10123 Torino**
IL	Israel	G R U	Swiss Electric Representation Ltd., P.O.B. 4541 ✆ 612983	**61040 Tel Aviv**
J	Japan	G	Impex Chemicals Ltd., No. 25, Andojibashi-Dori, 4-Chome, Minami-Ku ✆ Osaka 251–0222	**Osaka**
L	Luxembourg	G R U	Geveke Elektronica en Automatie België nv, Arduinkaai 37-39 ✆ 02-192431, Tx 23028	**1000 Brussels**
N	Norge	G R U	Elektro-Star, Nordregt. 22 ✆ 38 13 25 – 38 13 02, Tx 18553	**Oslo 5**
NL	Nederland	G R U	Geveke Electronica en Automatie bv, Kabelweg 25, Postbus 652 ✆ Amsterdam (020) 802 802, Tx12 219	**Amsterdam**
PTM	Malaysia	G R U	Wismer Automation SDN BHD, 13/14, Jalan Bersatu ✆ 53534/5, Tx PJ 319	**Petaling Jaya**
S	Sverige	G R U	Stahlberg & Nilsson Aktiebolag, Box 25, Längsjövägen 51 A ✆ Stockholm (08) 472980, Tx 10626	**12521 Aelvsjö 1**
SF	Finland	G R U	Oy Scienta Ab, Tenholantie 12 ✆ (90)-410288	**00280 Helsinki 28**
SGP	Singapore	G R U	Wismer Automation (S) SDN. BHD., William Jacks Building, 10.9KW Bukit Timah Road, P.O. Box 3062, Tx RS 21324	**Singapore 21**
USA	USA	G R	The Accro Company, P.O. Box 282	**Bellmore, N.Y. 11710**
ZA	South Africa	G R U	Globe Electrical, Pty. Ltd., P.O. Box 4346, 15 Mooi Street South ✆ 28-2662, Tx 43–6089 sa	**Johannesburg**

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CERBERUS

Cerberus AG, CH-8708 Männedorf, ✆ 01/922 61 11, Tx 75 528

RP 78x EVN 1000

1. GENERAL INFORMATION AND SUMMARY OF PRODUCTS

II. APPLICATIONS

50) BASIC CIRCUITS

Operation of cold cathode relay tubes from a 115 V AC line	50.11
Protection of power supplies against voltage- and switch-on transients	50.12 e

51) CONTROL BY CONTACT

Contact operated electronic relay with low contact voltage	51.12
Contact protection circuit with cold cathode tubes GR 44 and controlled rectifiers	51.16
Level control and monitoring with GR 16	51.17 e

52) CONTROL BY LIGHT

Flame monitoring with short-circuit proof probe	52.13
Photoelectric relay with photodiode and tube GT 21	52.14
Photoelectric relay with photoresistor and GR 16	52.15
Ionisation flame monitoring with GR 17 G	52.23

53) TIMER CIRCUITS

Time delay circuits for periods from 10 seconds to 1 hour with GR 31	53.13 e
Time delay circuits for periods from milli-seconds to minutes using GR 31 or GR 44	53.14 e
Timing circuits with switching diode G 42	53.17 e
Staircase timer with switching diode G 42	53.18 e
Relay timing circuits for 115 V AC utilizing the Cerberus G 42 diode	53.19 e
Contactless heavy duty timers with trigger tube GR 44	53.20 e

54) PULSE FORMERS AND GENERATORS

Fence equipment with the high current switching diode BD 22	54.12

55) COUNTING CIRCUITS

Ring counter for addition and substraction with GR 44	55.20 e

58) CONTROL BY TEMPERATURE

Temperature controlled relay with thermistor and GT 21	58.11

63) INDUCTIVE CONTROL

Inductive limit senser with transistor oscillator and GT 21	63.11

Verkaufsgebiete
Territoires de vente
Sales Areas

G
Signalglimmlampen
Voyants au néon
Glow Lamps

R
Elektronenröhren mit kalter Kathode
Tubes électroniques à cathode froide
Electronic tubes with cold cathode

U
Überspannungsableiter
Parasurtensions
Surge Arresters

A	Österreich	G R U	Dipl. Ing. Norbert Burisch OHG, Kröllgasse 15, Postfach 68 Tel. 927243, Telex (01) 3310	**1151 Wien**
AUS	Australia	G R U	Wormald Brothers (Aust.) Pty. Ltd., Park Works, 208 Young Street Tel. 69 0477	**Waterloo, N.S.W.**
B	Belgique	G R U	Geveke Electronique et Automation Belgique SA, 30, Place Sainctelette Tél. (02) 25 16 36 / 25 09 04, Télex 23028	**1080 Bruxelles**
CH	Schweiz	G R U	Cerberus AG, Werk für Elektronentechnik Tel. (01) 73 91 51, Telex 7 55 28	**8708 Männedorf**
D	BR Deutschland	R U	Alfred Neye-Enatechnik GmbH, Schillerstrasse 14, Postfach 42 Tel. (04106) 40 22, Telex 02 13 590	**2085 Quickborn**
			Zweigbüros: Marie-Elisabeth-Lüders-Strasse 2 Tel. (0311) 34 54 65, Telex 01 181799	**1000 Berlin 12**
			Linprunstrasse 23 Tel. (0811) 52 79 28, Telex 05 24 850	**8000 München 2**
			Adelheidweg 7 Tel. (0711) 24 25 35, Telex 07 21 668	**7000 Stuttgart 1**
			Rheinstrasse 54 Tel. (06121) 3 93 86, Telex 04 186505	**6200 Wiesbaden**
		G	Süddeutschland: Dipl.-Ing. Friedrich Pfisterer KG, Kornbergstrasse 50 Tel. (0711) 62 75 24, Telex 7 22916	**7000 Stuttgart**
		G	Nordwestdeutschland: F. Merschjohann, Postfach 4 225, Menkebachweg 3 Tel. (05241) 77287, Telex 933 888	**4830 Gütersloh 11**
DK	Danmark	G R U	Radio-Parts A/S, 13, Sankt Knuds Vej 13 Tel. (01) 313111, Telex 2413	**1903 Kobenhavn V**

E	Espana	G R U	MATELCO S.A., Avenida Generalisimo 303, 3.°, 2.ª Tel. 258 30 41 – 203 56 04	**Barcelona 9**
F	France	G R U	Arnould Electro Industrie, 62, avenue Gabriel Péri Tél. 604–41–19, Télex 29 240 F	**93 Saint-Ouen**
		R	Spetelec, 79–83, rue Jean-Jaurès Tél. 506–73–60, Télex 62 193 F	**92 Puteaux**
GB	Great Britain	G R U	Walmore Electronics Ltd., 11–15 Betterton Street, Drury Lane Tel. 01-836 0201, Telex 28752	**London WC2H 9BS**
HK	Hong Kong	G	Dyechem Trading Co., (H.K.), Ltd., 1125–1130, Alexandra House, P.O.B. 610 Tel. H249116–9	**Hong Kong**
I	Italia	G R U	Dott. Ing. Giuseppe de Mico, Via Manzoni 31 Tel. 653 131, Telex 3 30 35	**20121 Milano 112**
			Uffici regionali: Via del Rondone, 3 Tel. 229751	**40122 Bologna**
			Via Romeo Romei, 23 Tel. 316204	**00136 Roma**
			Corso Cairoli, 2 Tel. 87 41 37	**10123 Torino**
IL	Israel	G R U	Swiss Electric Representation Ltd., P.O.B. 4541 Tel. 612983	**Tel Aviv**
J	Japan	G	Impex Chemicals Ltd., No. 25, Andojibashi-Dori, 4-Chome, Minami-Ku Tel. Semba (251) 0222	**Osaka**
L	Luxembourg	G R U	Geveke Electronique et Automation Belgique S.A., 30, Place Sainctelette Tél. (02) 25 16 36 / 25 09 04, Télex 23028	**1080 Bruxelles**
N	Norge	G R U	Elektro-Star, Nordregt. 22 Tel. 38 13 25 – 38 13 02, Telex 18553	**Oslo 5**
NL	Nederlande	G R U	Geveke Electronica en Automatie nv, Kabelweg 25, Postbus 652 Tel. Amsterdam (020) 119 119, Telex 12 219	**Amsterdam-Sloterdijk**
PTM	Malaysia	G R U	Wismer Automation Ltd., No. 17, Road 19/1, P.O.B. 121 Tel. 53534/5, Telex KL 365	**Petaling Jaya**
RC	Taiwan	G	Grace Company Ltd., Import-Export-Engineering, P.O.B. 890	**Taipei/Taiwan**
S	Sverige	G R U	Stahlberg & Nilsson Aktiebolag, Box 25, Längsjövägen 51 A Tel. Stockholm (08) 472980 Vx, Telex 10626	**12521 Aelvsjö 1**
SF	Finland	G R U	Oy Scienta Ab, Ramsaynranta 3 Tel. 90 – 48 39 62	**00330 Helsinki 33**
SGP	Singapore	G R U	Wismer Automation (S) SDN. BHD., William Jacks Building, 6 3/4 m.s. Bukit Timah Road, P.O. Box 3062	**Singapore 21**
ZA	South Africa	G R U	Globe Electrical, Pty. Ltd., P.O. Box 4346, 15 Mooi Street South Tel. 23–3184, Telex 43–6089 sa	**Johannesburg**

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CERBERUS

Cerberus AG Werk für Elektronentechnik CH-8708 Männedorf

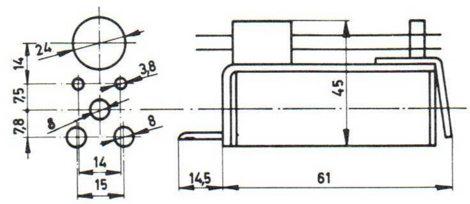
RP 78def C 1000

Zubehör zu Kaltkathodenröhren
Accessoires pour tubes à cathode froide
Accessories for cold-cathode tubes

Type	Nr.	Ed.	Fol.
	1.41	7.66	1

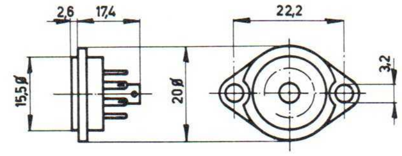
60 R / C 591

Elektromechanisches Relais zu GR 16, GR 17, GT 21 an 220 V~, Bestückung mit 2 Wechselkontakten, Starkstrom.
Relais électromécanique pour GR 16, GR 17, GT 21 à 220 V CA, 2 contacts de commutation courant fort.
Electro-mechanical relay for GR 16, GR 17, GT 21 fed with 220 V AC, arranged with 2 heavy duty changeover contacts.



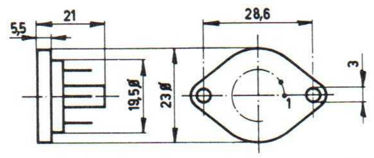
720

Miniatur-Röhrenfassung (7-polig), keramisch, von unten montierbar.
Support pour tube miniature 7 broches, en céramique, montable d'en bas.
7-p miniature socket, ceramic, mounting from the bottom.



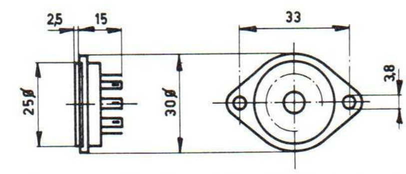
695

Noval-Röhrenfassung (9-polig), keramisch, von oben oder unten montierbar.
Support pour tube 9 broches (noval), en céramique, montable d'en haut ou d'en bas.
9-p Noval-socket, ceramic, mounting from the top or from the bottom.



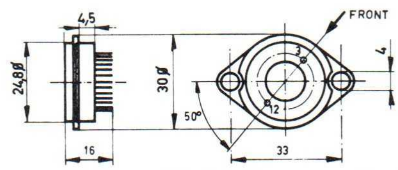
B13B

13-polige Röhrenfassung zu GA 22, von oben oder unten montierbar.
Support pour tube 13 broches pour GA 22, montable d'en haut ou d'en bas.
13-p socket for GA 22, mounting from the top or from the bottom.



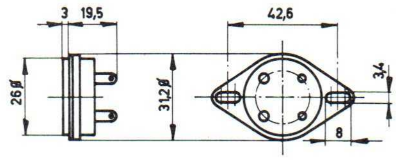
B17A

17-polige Röhrenfassung zu GA 12 und GA 21, von oben oder unten montierbar.
Support pour tube 17 broches pour GA 12 et GA 21, montable d'en haut ou d'en bas.
17-p socket for GA 12 and GA 21, mounting from the top or from the bottom.



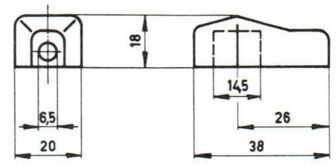
RF 2392

4-polige Röhrenfassung zu Hochstromschaltröhre BR 11, von oben oder unten montierbar.
Support pour tube 4 broches pour tube de puissance BR 11, montable d'en haut ou d'en bas.
4-p socket for high current switching tube BR 11, mounting from the top or from the bottom.



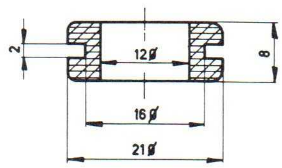
RA 2402

Anodenanschlusskappe zu BR 11.
Coiffe anodique pour BR 11.
Anode connection-cap for BR 11.



20325

Montagetülle zu GR 21 und SR 4.
Douille de montage pour GR 21 et SR 4.
Rubber grommet for GR 21 and SR 4.



2

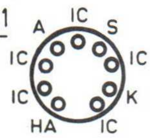
2

Type	
Nr.	**2.01 e**
Ed. 12.70	Fol. 1

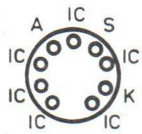
TRIGGER TUBE EQUIVALENTS

Cerberus type	Comparable type	Supply voltage	Operating current	Starter break-down voltage	Sustaining voltage	x=directly inter-changeable with Cerberus type	Base connec-tion	Differences to the Cerberus type in auxi-liary electrodes	Execution
		U_{A0} [V]	I_A [mA]	U_{ZS} [V]	U_B [V]		Fig.		
GR 15	 ER 1 Z 803 U	150...270= 180...250= 170...290=	10...40 10...40 8...25	120...140 125...140 128...137	107 107 105	 x	1 2 3	 without HA	9 pin tube for DC
GR 16	 ER 21 A Z 805 U	180...250~ 180...240~ 180...275~	10...40 8...40 5...25	120...140 125...165 137...155	111 111 123	 x	4 4 5	 S_A, S_K	9 pin tube for AC, starter positive
GR 17	 ER 22 Z 804 U	180...265~ 180...240~ 200...250~	5...40 5...40 5...40	-120...-150 -115...-150 -115...-131	113 112 110	 x	4 4 6		9 pin tube for AC, starter negative
GR 20	 ER 3	180...270= 180...250=	4...30 10...40	120...140 125...140	109 107	 x	7 7		9 pin tube with 2 starters, for DC
GR 31	 ER 2 Z 806 W (ZC 1020)	220...350= 250...340= 190...350=	10...40 15...40 12...25	125...140 125...140 118...121	111 111 110	 x	8 8 9	 S_A	9 pin tube for DC
GR 44 GR 46	 ER 32 A ZC 1010 Z 70 W	250...350= 250...350= 230...340= 150...330= 200...310=	5,5...12 5,5...12 7...15 <8 2... 4	120...140 120...145 120...140 157...167 137...153	110 110 115 121 116		13 17 14 15 16	 HK	subminiature tubes with flying leads for DC GR 44 with 2 starters GR 46 with 1 starter

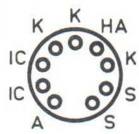
9 pin tubes

Fig.1


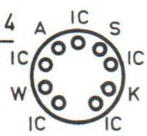
GR 15

Fig.2


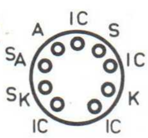
ER 1

Fig.3


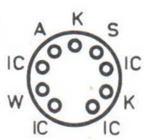
Z 803 U

Fig.4


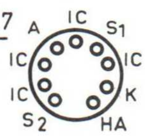
GR 16/GR 17
ER21A/ER 22

Fig.5


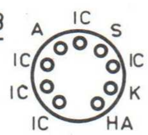
Z 805 U

Fig.6


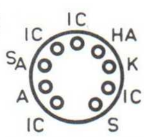
Z 804 U

Fig.7


GR 20/ER 3

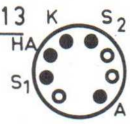
Fig.8


GR 31/ER 2

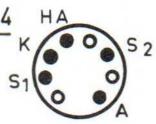
Fig.9


Z 806 W (ZC 1020)

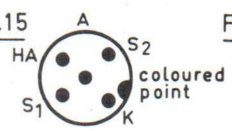
Subminiature tubes

Fig.13


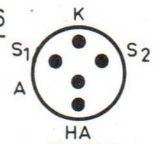
GR 44

Fig.14


ER 32A

Fig.15


ZC 1010

Fig.16


Z 70 W

Fig.17


GR 46

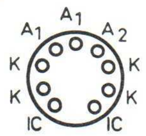
A: Anode
K: Cathode
S, S_1, S_2: Starter
HA: Auxiliary anode
HK: Auxiliary cathode
W: Internal shield
S_A: Anode screen grid
S_K: Cathode screen grid
IC: Internal Connection

	VOLTAGE STABILIZER EQUIVALENTS	Type	
CERBERUS		Nr. 2.02 e	
		Ed. 3.69	Fol. 1

Cerberus type	Comparable type	Average sustaining voltage	Operating current	Max. breakdown voltage	x=directly interchangeable with Cerberus type	Base connection	Differences to the Cerberus type in electrodes	Execution
		U_B [V]	I_A [mA]	U_Z [V]		Fig.		
SR 2B		86	2...80	125		1		9 pin tube with additional ignition anode
	ES 1	87	3...80	130	x	2		
SR 3A		105	2...80	155		1		9 pin tube with additional ignition anode
	ES 2	103	3...80	140	x	2		
SR 44		84	0,5... 5	115		6		subminiature tube with flying leads
	ES 44	84	0,5... 5	115	x	6		
	ZZ1020	82	1,7... 8	120		7	with A_Z	
	ZZ1000	81	2... 4	115	x	6		
SR 45		105	2... 5	140		6		subminiature tube with flying leads

9 pin tubes

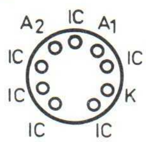
Fig. 1



SR 2 B

SR 3 A

Fig. 2

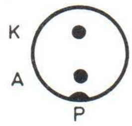


ES 1

ES 2

Subminiature tubes

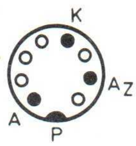
Fig. 6



SR 44

ZZ 1000

Fig. 7



ZZ 1020

P: Anode indicating dot

A, A_1, A_2: Anodes
K: Cathode

A_Z: Ignition anode
IC: Internal connection

3

3

Kaltkathoden-Relaisröhren
Tubes relais à cathode froide
Cold Cathode Relay Tubes

GR 16 2:1

GR 46 2:1

GR 46 1:1

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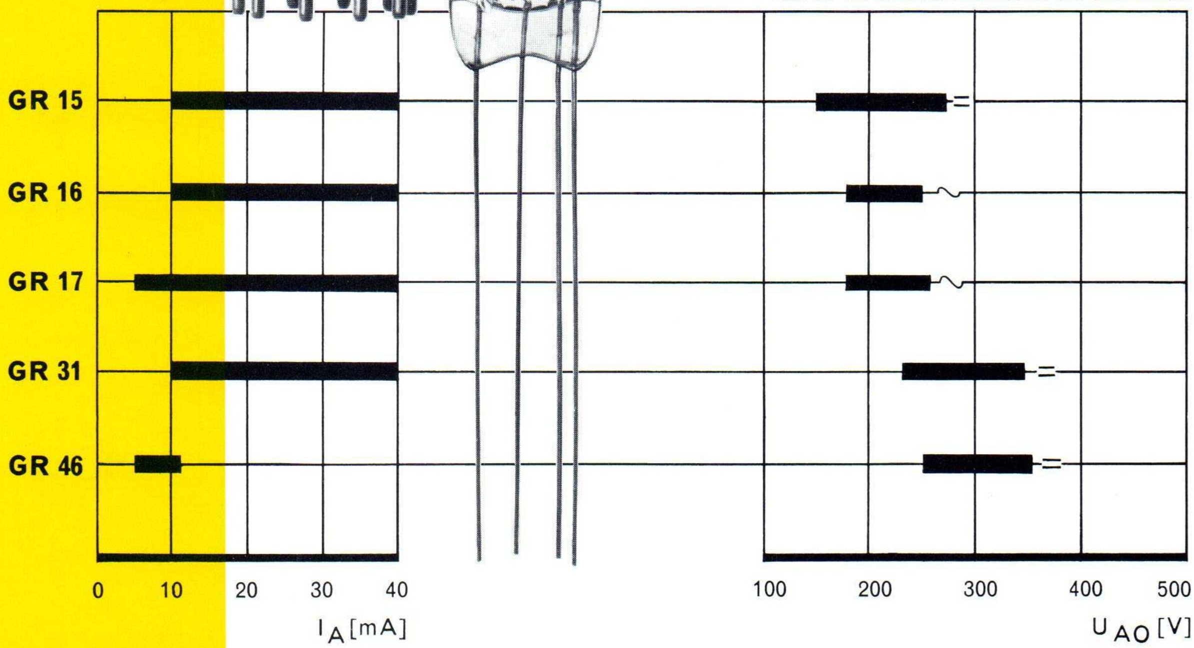
Demandez nos feuilles d'information et les notices
Ask for our detailed information and data sheets



Cerberus AG Werk für Elektronentechnik 8708 Männedorf/Schweiz Tel. 051-73 91 51 Telex 7 55 28

Hauptdaten			Données principales				Main Characteristics		
Kaltkathoden-Relaisröhren Tubes relais à cathode froide Cold Cathode Relay Tubes	Speisespannung Tension d'alimentation Supply voltage U_{A0} [V]	Arbeitsstrom Courant d'opération Operating current I_A [mA]	Starterzündspannung Tension d'amorçage du starter Starter breakdown voltage U_{ZS} [V]	Min. Steuerstrom Courant min. de commande Min. control current I_{Stc} [μA]	Min. Kippkapazität Capacité de commande min. Min. control capacity C [pF]	Typische Anwendungen Applications typiques Typical applications	Arbeitsquadranten Quadrants d'opération Operating quadrants Fig.	Max. Kolbenabmessungen Encombrements max. du tube Max. bulb dimensions [mm]	Sockelschaltung Brochage Base connections Fig.
GR15	150–270=	10–40	120–140	10^{-3}	47	g	1	22,2 × 49,2	4*
GR16	180–250~	10–40	120–140	5	220	a, b, c, f	2	22,2 × 49,2	5*
GR17	180–265~	5–40	120–150	10^{-2}	100	b, d	3	22,2 × 49,2	6*
GR31	240–350=	10–40	125–140	10^{-3}	220	g	1	22,2 × 49,2	7*
GR46	250–350=	5,5–12	120–145	10^{-3}	470	e, g	1	12 × 33	8**

Typische Anwendungen

a) Lichtrelais, Flammenwächter
b) Flammenüberwachung
c) Kontaktschutzrelais
d) Netzkommandoempfänger
e) Programmsteuerung
f) Spannungsüberwachung
g) Zeitrelais, Verzögerungsrelais

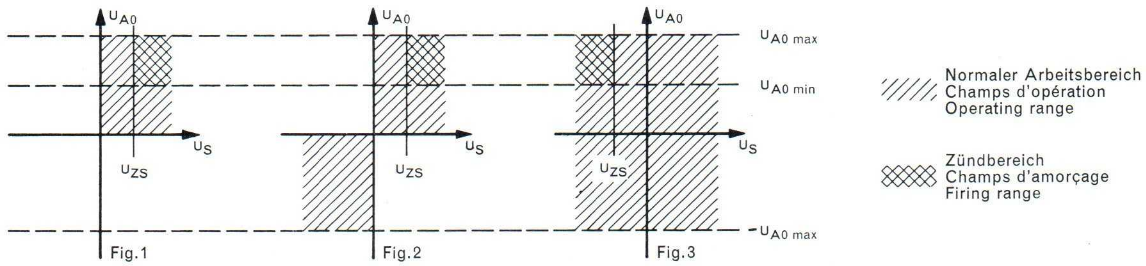
Applications typiques

a) Relais photo-électrique, contrôle de flammes
b) Surveillance de flammes
c) Relais protège-contact
d) Récepteur de télécommande
e) Commandes à programme
f) Surveillance de tension
g) Temporisateurs, relais de retardement

Typical Applications

a) Photoelectric relays, flame control
b) Flame monitoring
c) Electronic relays
d) Audio frequency control receiver
e) Automatic switching
f) Voltage supervision
g) Timers, delay circuits

Arbeitsquadranten **Quadrants d'opération** **Operating Quadrants**



Sockelschaltungen **Brochages** **Base Connections**

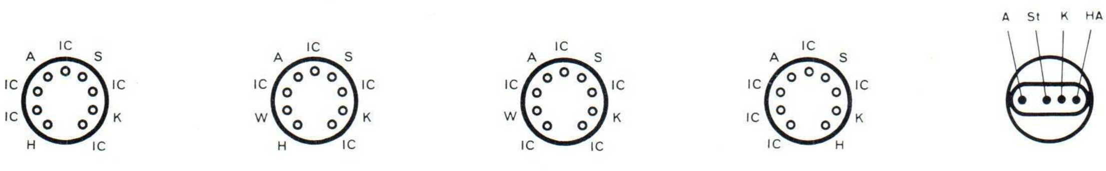


Fig. 4 GR 15 | Fig. 5 GR 16 | Fig. 6 GR 17 | Fig. 7 GR 31 | Fig. 8 GR 46

* Noval   ** Subminiatur, einlötbar / pour soudage / can be soldered

A: Anode

H: Hilfsanode / Anode auxiliaire / Auxiliary anode

K: Kathode / Cathode

IC: Interne Verbindung / Connexion interne / Internal connection

S: Starter

W: Wandableiter / Blindage interne / Internal shield

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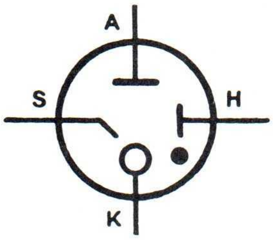
Ask for our detailed information and data sheets.

Glimmrelais GR 15 Triode für Gleichspannung Relais électronique GR 15 Triode pour courant continu Cold Cathode Relay Tube GR 15 DC-Triode	Type **GR 15**	
	Nr. 3. 15	
	Ausgabe 11. 65	Blatt 1

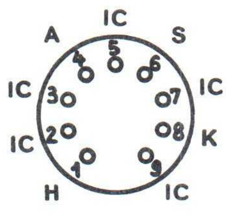
Relaisröhre mit kalter Molybdänkathode und geringer Tritiumvorionisierung. Speisung des Anodenkreises mit Gleichspannung. Speisung des Starterkreises mit Gleich-, Wechsel-, Ton- oder Hochfrequenzspannung. Betrieb mit positivem Starter. Minimaler Steuerstrom 10^{-3} µA.

Relais électronique à cathode froide en molybdène et avec faible préionisation au tritium. Alimentation du circuit anodique par courant continu. Alimentation du circuit starter par courant continu, alternatif, de basse ou de haute fréquence. Opération avec starter positif. Courant min. de commande 10^{-3} µA.

Cold cathode relay tube with molybdenum cathode and low Tritium preionization. DC anode voltage supply. Starter voltage can be DC, AC, low or high frequency. Positive starter breakdown voltage is defined. Min. control current 10^{-3} µA.

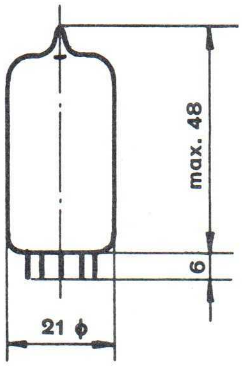


K: Kathode
Cathode
S: Starter
A: Anode
H: Hilfsanode
Anode auxiliaire
Keep alive anode



Noval

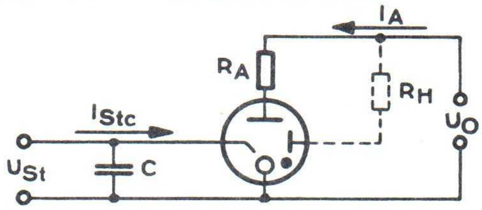
IC: Interne Verbindung frei lassen
Connexion interne ne connectez pas
Internal connection do not connect



Kenndaten und Grenzbetriebsdaten | **Caractéristiques et limites d'opération** | **Characteristics and limiting values**

				min.	normal	max.
Zündspannung A-K	Tension d'amorçage A-K	Breakdown voltage A-K	U_{ZA}	300 V	315 V	
Zündspannung S-K (Starter positiv)	Tension d'amorçage S-K (starter positif)	Breakdown voltage S-K (starter positive)	U_{ZS}	120 V	130 V	140 V
Brennspannung A-K (15 mA)	Tension d'entretien A-K (15 mA)	Sustaining voltage A-K (15 mA)	U_{BA}	103 V	107 V	112 V
Kathodenstrom Mittelwert	Courant cathodique valeur moyenne	Cathode current mean value	I_K	10 mA		40 mA 1)
Anoden-Speisespannung	Tension d'alimentation anodique	Anode supply voltage	U_O	150 V		270 V
Steuerstrom für Kippsteuerung, H nicht angeschlossen	Courant de commande (par capacité) H non connectée	Control current (capacity control) H not connected	I_{Stc}	10^{-3} µA		
Hilfsanodenstrom	Courant de l'anode auxiliaire	Keep alive anode current	I_H			20 µA 2)

Typische Betriebsdaten
Opération typique
Typical operation



U_O	220 V	
I_A	15 mA	1)
R_A	8 kΩ	3)
U_{St}	160 V	4)
I_{Stc}	1–10 µA	
C	50 pF	
R_H	10 MΩ	2)

1) Der Kathodenstrom ist mindestens so hoch zu wählen, daß die Kathodenvorderseite voll mit Glimmlicht bedeckt ist. Kurzzeitige Spitzenströme bis zu einigen Ampere sind zulässig.

2) Die Hilfsanode H wird angeschlossen, wenn extrem kurze Aufbauzeiten der Entladung von Wichtigkeit sind (Größenordnung Mikrosekunden).

3) In Steuergeräten tritt an Stelle von R_A oft ein Gleichstromrelais.

4) Positiver Spitzenwert. U_{St} kann aus einer festen Vorspannung und der Steuerspannung zusammengesetzt sein. Diese soll in der Regel nicht weniger als 20 V, besser 50 V (Spitzenwert) betragen.

Montage in beliebiger Lage

Umgebungstemperatur
–20° bis + 60 °C

Lebensdauer
Über 25000 Brennstunden bei Nennstrom

Anwendungsbeispiele
Steuerung durch Photozellen und Photowiderstände, Ionisationskammern, empfindliche und hochohmige Kontakte, Induktionsspannungen. Elektronische Zeitschalter, Zählkreise, Programmsteuerungen.

Au courant cathodique minimum toute la partie avant de la cathode doit être couverte de lueur cathodique. Des pointes de quelques ampères sont admissibles.

L'anode auxiliaire est connectée si un temps d'ionisation très court (quelques microsecondes) est exigé.

Dans les appareils de contrôle R_A est souvent remplacée par un relais.

Valeur de pointe positive. U_{St} peut être composée d'une tension fixe et de la tension de commande qui doit atteindre au moins 20 V, de préférence 50 V, de pointe.

Montage en toute position

Température ambiante
–20° à + 60 °C

Durée de service
Au-dessus de 25000 heures de service continu au courant normal

Applications
Commande par cellules et résistances photoélectriques, chambres de ionisation, contacts sensibles ou de résistance élevée, tensions d'induction. Temporisateurs électroniques, circuits compteurs, commandes automatiques.

At minimum cathode current, the cathode glow must cover the whole front of the cathode. Peak currents of several amps are admitted.

The keep alive anode is connected if a very short ionization time (some microseconds) is desired.

In control equipment, R_A is often replaced by a DC-Relay.

Positive peak value. U_{St} may be composed of a fixed prefiring voltage and the control voltage which must exceed a peak value of 20, better 50 volts.

Mounting in any position

Ambient temperature
–20° to + 60 °C

Life expectancy
Exceeding 25000 working hours at normal current

Applications
Control by photoelectric cells and resistors, ionization chambers, sensitive or high impedance contacts, induced voltages. Electronic timers, counting circuits, automatic switching.

Glimmrelais GR 15
Triode für Gleichspannung

Relais électronique GR 15
Triode pour courant continu

Cold Cathode Relay Tube GR 15
DC-Triode

Type	GR 15	
Nr.	3. 15	
Ausgabe	11. 65	Blatt

Kennlinie für Direktsteuerung

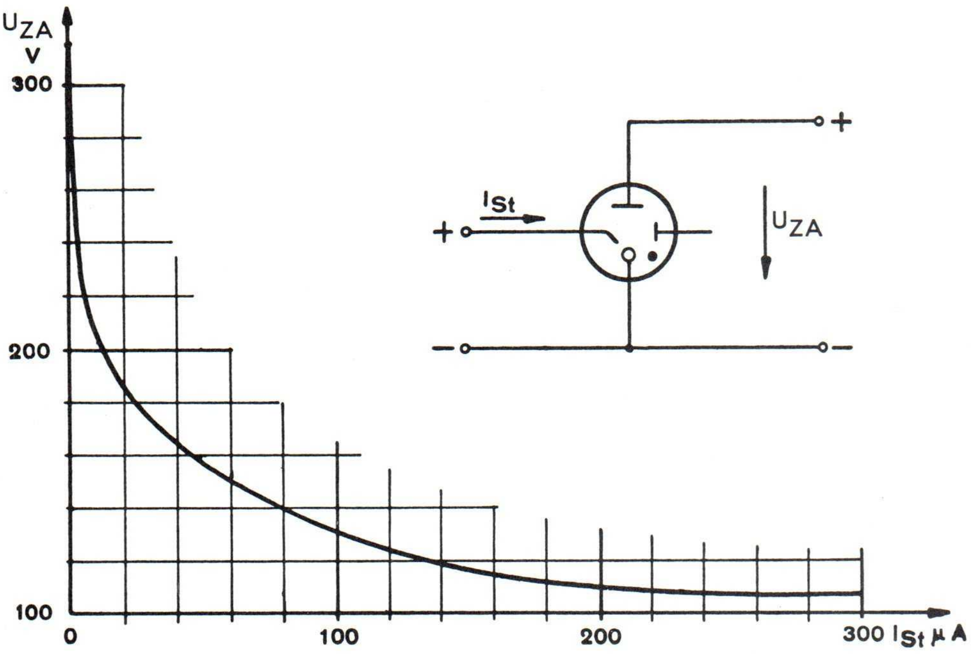
Die Kennlinie für Direktsteuerung zeigt die Anodenzündspannung in Abhängigkeit des Steuerstromes im Starterkreis.

Caractéristique de commande

La caractéristique de commande représente la tension anodique d'amorçage en fonction du courant de commande dans le starter.

Transfer characteristic

The transfer characteristic represents the anode breakdown voltage as a function of the starter control current.



Kennlinie für Kippsteuerung

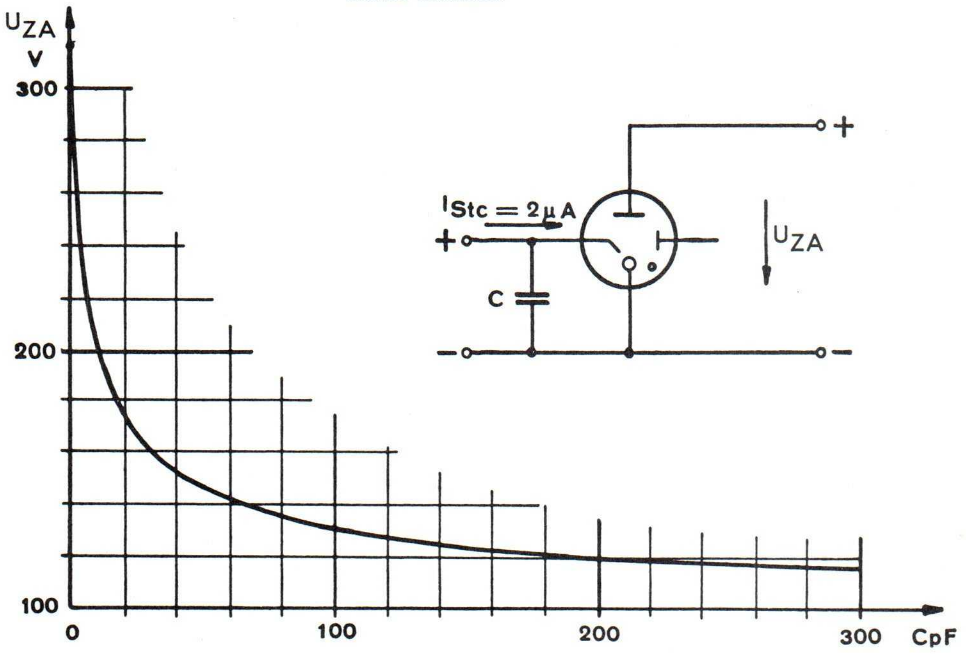
Die Kennlinie für Kippsteuerung zeigt die Anodenzündspannung in Abhängigkeit der Kapazität eines zwischen Starter und Kathode geschalteten Kondensators und ist vom Steuerstrom weitgehend unabhängig. Wegen der viel größeren Stromempfindlichkeit gegenüber der Direktsteuerung wird meist die Kippsteuerung angewendet.

Caractéristique de commande par capacité

La caractéristique de commande par capacité représente la tension anodique d'amorcage en fonction d'une capacité entre starter et cathode. Elle est pratiquement indépendante du courant de commande. Ce mode de commande est souvent préféré, parce qu'il nécessite des courants de commande minimes.

Transfer characteristic for capacity control

The transfer characteristic for capacity control represents the anode breakdown voltage as a function of a capacity between starter and cathode. It is practically independent cf the control current. Capacity control is often preferred because of it's high current sensitivity.



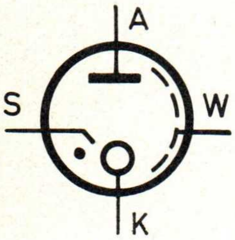
CERBERUS

Glimmrelais GR 16 für Gleich- und Wechselspannung
Relais électronique GR 16 pour courant continue et alternatif
Trigger tube GR 16 for DC and AC

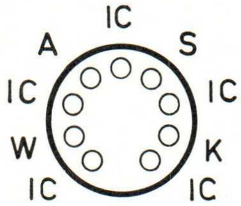
Relaisröhre mit kalter Molybdänkathode und geringer Tritiumvorionisierung. Speisung des Anodenkreises mit Gleich- oder Wechselspannung. Zündung mit positiver Anode und positivem Starter. Bei Speisung der Anode mit Wechselspannung muss der Starterkreis ebenfalls mit Wechselspannung gleicher Frequenz und annähernd gleicher Phase betrieben werden.

Triode à gaz à cathode froide en molybdène. Faible préionisation au tritium. Alimentation du circuit anodique en courant continu ou alternatif. Amorçage à l'aide d'anode et starter positifs. En alimentant l'anode en courant alternatif, le circuit starter doit aussi être alimenté en tension alternative de la même fréquence et approximativement de même phase.

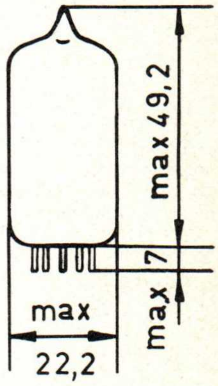
Cold cathode relay tube with molybdenum cathode and low Tritium preionization. DC or AC anode voltage supply. Ignition with positive anode and positive starter. If the anode is fed with AC, the starter voltage must also be AC of the same frequency and approximately the same phase.



K: Kathode / Cathode
S: Starter
A: Anode
W: Wandkontakt / Blindage interne / Internal shield



IC: Interne Verbindung frei lassen / Connexion interne ne connectez pas / Internal connection do not connect

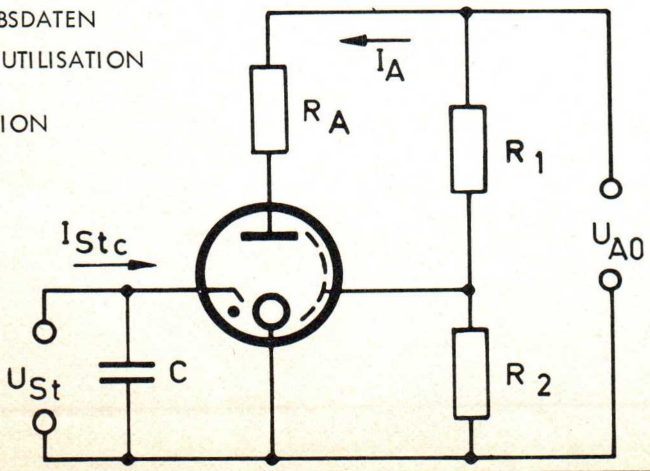


KENNDATEN	CARACTERISTIQUES	CHARACTERISTICS		min.	normal	max.	
Zündspannung A-K	Tension d'amorçage A-K	Breakdown voltage A-K	U_{ZA}	370 V= 260 V~	450 V= 320 V~		
Zündspannung S-K	Tension d'amorçage S-K	Breakdown voltage S-K	U_{ZS}	120 V=	130 V=	140 V=	
Brennspannung A-K (20 mA)	Tension d'entretien A-K (20 mA)	Sustaining voltage A-K (20 mA)	U_{BA}	106 V=	111 V=	115 V=	
DATEN FUER GLEICHSTROMBETRIEB	**NOTICES POUR COURANT CONTINU**	**DATA FOR DC OPERATION**					
Kathodenstrom	Courant cathodique	Cathode current	I_K	20 mA		40 mA	1)
Anoden-Speisespannung	Tension anodique	Anode supply voltage	U_{A0}	250 V=		350 V=	
Starter-Steuerstrom	Courant du starter	Starter current	I_{Stc}	10^{-2} µA		40 mA	2)
Kippkapazität	Capacité de commande	Control capacity	C	200 pF		10 000 pF	3)
DATEN FUER WECHSELSTROMBETRIEB	**NOTICES POUR COURANT ALTERNATIF**	**DATA FOR AC OPERATION**					
Kathodenstrom, Mittelwert	Courant cathodique, valeur moyenne	Cathode current, mean value	I_K	10 mA		40 mA	1)4)
Anoden-Speisespannung	Tension anodique	Anode supply voltage	U_{A0}	180 V~		250 V~	
Starter-Steuerstrom	Courant du starter	Starter current	I_{Stc}	5 µA		150 µA	
Kippkapazität	Capacité de commande	Control capacity		200 pF		500 pF	3)

TYPISCHE BETRIEBSDATEN

CONDITIONS D'UTILISATION NORMALES

TYPICAL OPERATION



	Gleichstrombetrieb	Wechselstrombetrieb	
U_{A0}	300 V=	220 V~	
I_A	25-30 mA	15 mA	1)
R_A	6,5 kΩ	1,6 kΩ	5)
U_{St}	160 V= 6)	150 V~	
I_{Stc}	10 µA	10 µA	
C	250 pF	250 pF	
R_1	-	1 MΩ	7)
R_2	-	0,33 MΩ	7)

1) Der Kathodenstrom ist mindestens so hoch zu wählen, dass die Kathodenvorderseite voll mit Glimmlicht bedeckt ist. Kurzzeitige Spitzenströme bis zu einigen Ampere sind zulässig.

2) Für positive Starterzündung. Wesentlich höhere Spitzenwerte sind zulässig. Wird die Röhre so betrieben, dass auch negative Starterzündungen auftreten, muss der Steuerstrom auf 200µA begrenzt werden, da sonst die Gefahr einer Desaktivierung der Kathode besteht.
Der minimale Steuerstrom bewirkt bei beliebigen Röhren die Zündung der Hauptentladung bei der minimalen Speisespannung.

3) Mit der minimalen Kippkapazität zünden beliebige Röhren bei der minimalen Anodenspannung sicher auf die Anode durch.
Für Kippkapazitäten über 10 000 pF (z.B. in Zeitrelais) ist in den Starterkreis ein Begrenzungswiderstand von 1-10 kΩ zu schalten.

4) Arithmetischer Mittelwert; mit Gleichstrominstrument gemessen.

5) Im allgemeinen wird ein Gleichstromrelais von ca. 1600Ω mit Verzögerungswicklung von 4 Lagen Ø 0,4-0,6 mm Cu oder entsprechendem Cu-Mantel verwendet. Weitere Angaben auf Blatt 3.04 "Hinweise für die Anwendung von Glimmtrioden".

6) Positiver Spitzenwert. U_{St} kann aus einer festen Vorspannung und der Steuerspannung zusammengesetzt sein. Diese soll in der Regel nicht weniger als 20 V, besser 50 V (Spitzenwert) betragen.

7) Der Wandkontakt W soll angeschlossen werden, wenn die Röhre in einem Abschirmbecher oder nahe an Metallteilen, die sich auf Kathodenpotential befinden, montiert wird oder wenn Beeinflussungen der Röhre durch äussere Felder (Spontanzündungen) beobachtet werden.

MONTAGE in beliebiger Lage

UMGEBUNGSTEMPERATUR
-20° bis +80° C

LEBENSDAUER
Ueber 25 000 Brennstunden bei Nennstrom.

ANWENDUNGSBEISPIELE
Steuerung über empfindliche oder hochohmige Kontakte (Kontaktschutzrelais), Photowiderstände (Lichtrelais, Flammenwächter). Elektronische Verzögerungsrelais und Zeitrelais.

1) Au courant cathodique minimum toute la partie avant de la cathode doit être couverte de lueur cathodique. Des pointes de quelques ampères sont admissibles.

2) Pour amorçage positive du starter. Des valeurs de pointe considérablement plus élevées sont admissibles. Si le tube est opéré de manière que des amorçages négatives du starter se montrent, le courant de commande doit être limité à 200 µA, pour éviter une désactivation de la cathode.
Le courant minimum de commande amorce la décharge principale (anodique) à la tension minima d'alimentation anodique.

3) Avec la capacité de commande minima, tous les tubes s'amorcent à la tension minima d'alimentation.
Pour les capacités de commande supérieures à 10 000 pF (par exemple pour temporisateurs électroniques) on doit insérer une résistance de 1000 à 10 000 Ω dans le circuit du starter.

4) Valeur moyenne arithmétique; mesurée avec un instrument à courant continu.

5) En général un relais pour courant continu d'environ 1600 Ω, avec un enroulement court-circuité de 4 couches Ø 0,4 à 0,6 Cu est employé. Pour informations supplémentaires voir notice 3.04.

6) Valeur de pointe positive. U_{St} peut être composée d'une tension fixe et de la tension de commande qui doit atteindre au moins 20 V, de préférence 50 V de pointe.

7) Le blindage interne W doit être connecté si le tube est monté dans un blindage ou à proximité immédiate de pièces métalliques, ainsi qu'en présence de champs qui influencent le fonctionnement du tube (par exemple amorçages spontanés).

MONTAGE en toute position

TEMPERATURE AMBIANTE
-20° à +80° C

DUREE DE SERVICE
Supérieure à 25 000 heures de service continu dans les conditions normales.

APPLICATIONS
Commande au moyen de contacts sensibles ou à résistance élevée, commande par photo-résistances (relais photo-électriques). Relais retardeurs électroniques et relais à temps électroniques.

1) At minimum cathode current, the cathode glow must cover the whole front of the cathode. Peak currents of several amps are admitted.

2) For positive starter ignition. Considerably higher peak values are admitted. If the tube is operated in a way that also negative starter ignitions occur, the control current must not exceed 200 µA, in order to avoid poisoning of the cathode.
At the minimum control current, breakdown of the anode gap occurs for all tubes at the minimum anode supply voltage.

3) With the minimum control capacity, breakdown of the anode gap will occur for all tubes at the minimum plate voltage.
For control capacities of more than 10 000 pF (e. g. in electronic timers) a limiting resistor of 1000 to 10 000 Ω must be inserted in the starter circuit.

4) Mean value arithmetical; measured with a DC instrument.

5) Generally, a DC relay of approximately 1600 Ω, with a short-circuited winding of 4 layers Ø 0,4-0,6 mm Cu is employed. For further details see information 3.04.

6) Positive peak value. U_{St} may be composed of a fixed bias voltage and the control voltage which must exceed a peak value of 20, better of 50 volts.

7) The internal shield W should be connected if the tube is mounted in an external shield or near metal parts, as well as if disturbing influences of external fields (e. g. spontaneous firing of the tube) are observed.

MOUNTING in any position

AMBIENT TEMPERATURE
-20° to +80° C

LIFE EXPECTANCY
Exceeding 25 000 working hours at normal current.

APPLICATIONS
Control by sensitive contacts or contacts of high resistance, control by photo-resistors. Electronic timers.

Glimmrelais GR 17
Triode für Wechselspannung

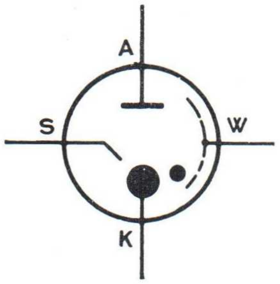
Relais électronique GR 17
Triode pour courant alternatif

Cold Cathode Relay Tube GR 17
AC-Triode

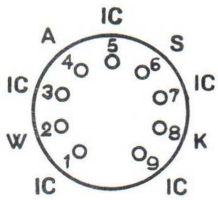
Relaisröhre mit kalter Molybdänkathode. Speisung des Anodenkreises mit 220 V~. Speisung des Starterkreises mit Gleich-, Wechsel- oder Tonfrequenzspannung. Die Röhre zündet bei positiver Anode und negativem Starter. Minimaler Steuerstrom 1–2 µA.

Triode à gaz à cathode froide en molybdène. Alimentation du circuit d'anode en 220 V alternatifs. Alimentation du starter en courant continu, alternatif ou basse fréquence. Le tube s'amorce avec anode positive et starter négatif. Courant de commande minimum de 1 à 2 µA.

Cold cathode relay tube with molybdenum cathode. Anode supply voltage 220 V AC. Starter voltage can be DC, AC or low frequency. The tube ignites with positive anode and negative starter. Minimum control current 1 to 2 µA.

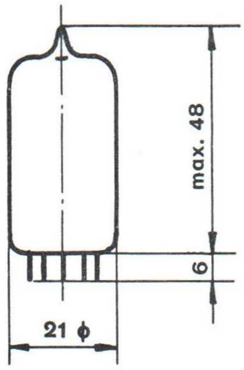


K: Kathode / Cathode
S: Starter
A: Anode
W: Wandkontakt / Blindage interne / Internal shield



Noval

IC: Interne Verbindung frei lassen / Connexion interne ne connectez pas / Internal connection do not connect



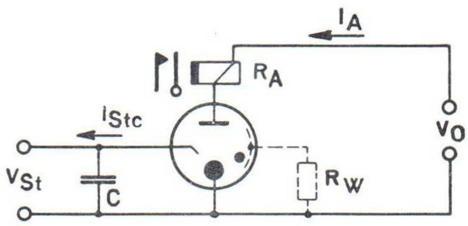
Kenndaten und Grenzbetriebsdaten / Caractéristiques et limites d'opération / Characteristics and limiting values

Deutsch	Français	English		min.	normal	max.	
Zündspannung A–K	Tension d'amorçage A–K	Breakdown voltage A–K	V_{ZA}	300 V~	370 V~	450 V~	
Zündspannung K–S (Starter negativ)	Tension d'amorçage K–S (Starter négatif)	Breakdown voltage K–S (Starter negative)	V_{ZS}	120 V=	130 V=	150 V=	
Brennspannung A–K (20 mA)	Tension d'entretien A–K (20 mA)	Sustaining voltage A–K (20 mA)	V_{BA}	108 V=	113 V=	118 V=	
Anodenstrom, Mittelwert	Courant anodique, valeur moyenne	Anode current, mean value	I_A	5 mA		40 mA	1)
Anoden-Speisespannung	Tension d'alimentation anodique	Anode supply voltage	V_O	180 V~		265 V~	
Starter-Steuerstrom für Direktsteuerung	Courant du starter pour commande directe	Starter current for direct control	I_{St}	50 µA		500 µA	5)
Starter-Steuerstrom für Kippsteuerung	Courant du starter pour commande par capacité	Starter current for capacity control	I_{Stc}	1–2 µA		500 µA	
Kippkapazität	Capacité de commande	Control capacity	C	100 pF		500 pF	6)

Typische Betriebsdaten

Conditions d'utilisation normales

Typical operation



V_O	220 V~	
I_A	15 mA	1)
R_A	4)	
V_{St}	180 V	2)
I_{Stc}	2–5 µA	
C	100 pF	
R_W	1 MΩ	3)

Montage in beliebiger Lage

Umgebungstemperatur
–20° bis +60 °C

Lebensdauer
Über 25000 Brennstunden bei Nennstrom

Montage en toute position

Température ambiante
–20° à +60 °C

Durée de service
Supérieure à 25000 heures de service continu dans les conditions normales

Mounting in any position

Ambient température
–20° to + 60 °C

Life expectancy
Exceeding 25000 working hours at normal current

Anwendungsbeispiele

Steuerung über empfindliche oder hochohmige Kontakte (Kontaktschutzrelais), durch Photozellen oder Photowiderstände (Lichtsteuerungen) oder durch eine Tonfrequenzspannung (Netzkommando-Empfänger).

Wechselstromgespeiste Schaltungen, in denen mit Gleichstrom gesteuert wird.

Applications

Commande de relais au moyen de contacts pour courants très faibles ou à résistance élevée, commandes par courants B.F., commandes par cellules photo-électriques ou des photo-résistances.

Circuits alimentés en courant alternatif, commandés par courant continu.

Applications

Control by very sensitive contacts or contacts of high resistance. Control by photo-cells or photo-resistors. Control by audio frequency signals superimposed on the line voltage.

DC-controlled AC-fed circuits.

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1) Die Röhre wirkt als Gleichrichter; mit Gleichstrominstrument messen. Kurzzeitige Spitzenströme bis zu einigen Ampere sind zulässig.

2) Negativer Spitzenwert bei positiver Anode. V_{St} kann auch aus einer festen Vorspannung und der Steuerspannung zusammengesetzt sein. Der Spitzenwert der Steuerspannung soll in der Regel nicht weniger als 60 V betragen.

3) Zur Abschirmung gegen starke äußere Felder sowie für besondere Anwendungen (Tonfrequenzsteuerung) kann der Wandbelag W, wenn nötig, über einen Widerstand von 1 MΩ mit der Kathode K verbunden werden.

4) Gleichstromrelais, mit Dämpfungswicklung oder Gleichrichter verzögert. Nähere Angaben siehe Anwendungshinweise 3. 04.

5) Der minimale Steuerstrom bewirkt bei beliebigen Röhren die Zündung der Hauptentladung bei der minimalen Anoden-Speisespannung.

6) Mit der minimalen Kippkapazität zünden beliebige Röhren bei der minimalen Anoden-Speisespannung auf die Anode durch, sobald im Starter die Zündspannung erreicht wird.

1) Le tube se comportant en redresseur, ce courant a été mesuré avec un instrument à courant continu. Des courtes pointes du courant jusqu'à quelques ampères sont admissibles.

2) Tension de crête négative pour une anode positive. V_{St} peut se composer d'une polarisation fixe, à laquelle vient s'ajouter la tension de commande. La tension de commande (valeur de crête) doit être 60 V au moins.

3) Pour éviter l'action de forts champs extérieurs et aussi pour certaines applications (commandes en B.F.) la broche W reliée au blindage peut être connectée à la cathode par l'intermédiaire d'une résistance de 1 MΩ.

4) Relais à courant continu avec retard à l'ouverture par enroulement de court circuit ou par un redresseur. Indications détaillées voir notice 3. 04.

5) Le courant de commande minimum amorce la décharge principale (anodique) à la tension minima d'alimentation anodique.

6) Avec la capacité de commande minima, tous les tubes s'amorcent à la tension minima d'alimentation anodique, dès que la tension du starter atteint sa tension d'amorçage.

1) Linear mean value, measured on DC-range. (Current is rectified by the tube.) Peak currents of several amps are admitted.

2) Negative peak value with positive anode. V_{St} may be composed of a fixed negative bias and the control voltage of at least 60 V peak.

3) To avoid an influence of external fields on the operation of the tube, the internal shield W may be connected to the cathode through a 1 MΩ resistor. This is especially important when the tube is controlled by an audio frequency voltage.

4) DC relay, retarded with short-circuited winding or parallel rectifier. For details see information no. 3. 04.

5) At the minimum control current, breakdown of the anode gap occurs for all tubes at the minimum plate supply voltage.

6) With the minimum control capacity, break-down of the anode gap will occur for all tubes at the minimum plate supply voltage when the control voltage reaches the starter firing voltage.

Glimmrelais GR 31
Triode für Gleichspannung

Relais électronique GR 31
Triode pour courant continu

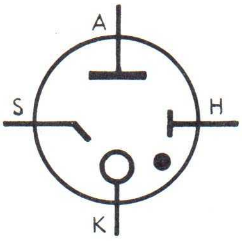
Cold Cathode Relay Tube GR 31
DC-Triode

Type	GR 31
Nr.	3.31
Ed. 10.65	Fol. 1

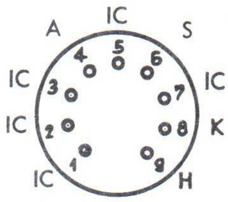
Relaisröhre mit kalter Molybdänkathode und geringer Tritiumvorionisierung. Novalausführung mit 1 Starter. Speisung des Anodenkreises mit Gleichspannung. Betrieb mit positivem Starter.
Die Röhrendaten sind von der Beleuchtung unabhängig.

Relais électronique à cathode froide en molybdène et faible préionisation au tritium. Exécution noval avec 1 starter. Alimentation du circuit anodique par courant continu. Opération avec starter positif.
Les caractéristiques du tube sont indépendantes de l'illumination.

Cold cathode relay tube with molybdenum cathode and low Tritium preionization. Noval base and 1 starter. DC anode voltage supply. Operation with positive starter.
Tube characteristics are independent of illumination.

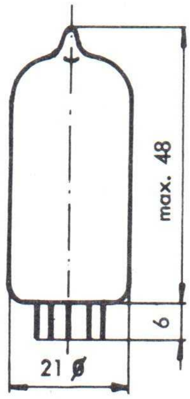


K : Kathode
Cathode
S : Starter
A : Anode
H : Hilfsanode
Anode auxiliaire
Keep alive anode



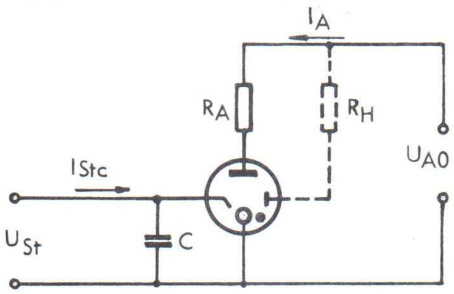
Noval

IC : Interne Verbindung frei lassen
Connection interne ne connectez pas
Internal connections do not connect



KENNDATEN UND GRENZBETRIEBSDATEN	CARACTERISTIQUES ET LIMITES D'OPERATION	CHARACTERISTICS AND LIMITING VALUES		min.	normal	max.	
Zündspannung A-K	Tension d'amorçage A-K	Breakdown voltage A-K	U_{ZA}	400 V	450 V		1)
Zündspannung S-K (Starter positiv)	Tension d'amorçage S-K (starter positif)	Breakdown voltage S-K (starter positive)	U_{ZS}	125 V	130 V	140 V	
Zündspannung H-K	Tension d'amorçage H-K	Breakdown voltage H-K	U_{ZH}	-	-	180 V	
Brennspannung A-K (15 mA)	Tension d'entretien A-K (15 mA)	Sustaining voltage A-K (15 mA)	U_{BA}	106 V	111 V	115 V	
Kathodenstrom Mittelwert	Courant cathodique valeur moyenne	Cathode current mean value	I_K	10 mA	-	40 mA	2)
Anoden-Speisespannung	Tension d'alimentation anodique	Anode supply voltage	U_{A0}	220 V	-	350 V	
Starterstrom für Direktsteuerung	Courant starter pour commande directe	Starter current for direct control	I_{St}	200 µA	-	40 mA	3)
Starterstrom für Kippsteuerung	Courant starter pour commande par capacité	Starter current for capacity control	I_{Stc}	10^{-3}µA	-	40 mA	4)
Kippkapazität	Capacité de commande	Control capacity	C	680 pF	-	10000pF	5)
Hilfsanodenstrom	Courant de l'anode auxiliaire	Keep alive anode current	I_H	-	-	20 µA	6)

TYPISCHE BETRIEBSDATEN
OPERATION TYPIQUE
TYPICAL OPERATION



U_{A0}	300 V	
I_A	15 mA	2)
R_A	12 kΩ	7)
U_{St}	160 V	8)
I_{Stc}	1-10 µA	
C	>680 pF	
R_H	10 MΩ	6)

1) Die angegebenen Grenzwerte gelten auch bei warmer Röhre (unmittelbar nach dem Abschalten).

2) Um eine gute Konstanz der Starterzündspannung zu gewährleisten darf der Minimalstrom nicht dauernd unterschritten werden.
Kurzzeitige Spitzenströme bis zu einigen Ampère sind zulässig.

1) Les valeurs limites sont également valables pour le tube chaud (immédiatement après extinction).

2) Le courant minimum doit être respecté pour assurer la stabilité de la tension d'amorçage du starter.
Des pointes de quelques ampères sont admissibles.

1) The limit values are equally valuable for the hot tube (immediately after extinction).

2) The tube must not be run permanently below the minimum current in order to secure a stable starter breakdown voltage.
Peak currents of several amps are admitted.

→

3) Für positive Starterzündung. Wesentlich höhere Spitzenwerte sind zulässig. Wird die Röhre so betrieben, dass auch negative Starterzündungen auftreten, muss der Steuerstrom auf 200 µA begrenzt werden.
Der minimale Steuerstrom bewirkt bei beliebigen Röhren die Zündung der Hauptentladung bei der minimalen Speisespannung.

4) Der Minimalwert gilt nur bei nicht angeschlossener Hilfsanode.

5) Mit der minimalen Kippkapazität zünden beliebige Röhren bei der minimalen Anodenspannung sicher auf die Anode durch.
Für Kippkapazitäten über 10 000 pF (z.B. in Zeitrelais) ist in den Starterkreis ein Begrenzungswiderstand von 1-10 kΩ zu schalten.

6) Die Hilfsanode H wird angeschlossen, wenn extrem kurze Aufbauzeiten der Entladung von Wichtigkeit sind (Grössenordnung Mikrosekunden).
Der Widerstand R_H soll unmittelbar am Röhrensockel angelötet werden.

7) In Steuergeräten tritt an Stelle von R_A oft ein Gleichstromrelais.

8) Positiver Spitzenwert. U_{St} kann aus einer festen Vorspannung und der Steuerspannung zusammengesetzt sein. Diese soll in der Regel nicht weniger als 20 V, besser 50 V (Spitzenwert) betragen.

MONTAGE in beliebiger Lage

UMGEBUNGSTEMPERATUR
-20° bis +80° C

LEBENSDAUER
über 25 000 Brennstunden bei Nennstrom

ANWENDUNGSBEISPIELE
Steuerung durch Photozellen und Photowiderstände, Ionisationskammern, empfindliche und hochohmige Kontakte, Induktionsspannungen, Elektronische Zeitschalter, Zählkreise, Programmsteuerungen.

3) Pour amorçage positif du starter. Des valeurs de pointe bien plus élevées sont admises. Lorsqu'il y a des amorçages négatifs du starter, le courant de commande doit être limité à 200 µA.
Le courant minimum de commande amorce la décharge principale (anodique) à la tension minima d'alimentation anodique.

4) La valeur minima est seulement valable si l'anode auxiliaire n'est pas connectée.

5) Avec la capacité de commande minima, tous les tubes s'amorcent à la tension minima d'alimentation.
Pour les capacités de commande supérieures à 10 000 pF (par exemple pour temporisateurs électroniques) on doit insérer une résistance de 1000 à 10000 Ω dans le circuit du starter.

6) L'anode auxiliaire est connectée si un temps d'ionisation très court (quelques microsecondes) est exigé.
La résistance R_H doit être soudée directement au socle du tube.

7) Dans les appareils de contrôle R_A est souvent remplacée par un relais.

8) Valeur de pointe positive. U_{St} peut être composée d'une tension fixe et de la tension de commande qui doit atteindre au moins 20 V, de préférence 50 V, de pointe.

MONTAGE en toute position

TEMPERATURE AMBIANTE
-20° à +80° C

DUREE DE SERVICE
au dessus de 25 000 heures de service continu au courant normal

APPLICATIONS
Commande par cellules et résistances photoélectriques, chambres de ionisation, contacts sensibles ou de résistance élevée, tensions d'induction. Temporisateurs électroniques, circuits compteurs, commandes automatiques.

3) For positive starter ignition. Considerably higher peak values are admitted. If the tube is operated in a way that also negative starter ignitions occur, the control current must not exceed 200 µA.
At the minimum control current, breakdown of the anode gap occurs for all tubes at the minimum supply voltage.

4) The minimum value is only valuable if the keep alive anode is not connected.

5) With the minimum control capacity, breakdown of the anode gap will occur for all tubes at the minimum plate supply voltage.
For control capacities of more than 10 000 pF (e.g. in electronic timers) a limiting resistor of 1000 to 10000 Ω must be inserted in the starter circuit.

6) The keep alive anode is connected if a very short ionisation time (some microseconds) is desired.
The resistor R_H must be soldered direct to the tube socket.

7) In control equipment, R_A is often replaced by a DC-Relay.

8) Positive peak value. U_{St} may be composed of a fixed prefiring voltage and the control voltage which must exceed a peak value of 20, better 50 volts.

MOUNTING in any position

AMBIENT TEMPERATURE
-20° to +80° C

LIFE EXPECTANCY
Exceeding 25 000 working hours at normal current

APPLICATIONS
Control by photoelectric cells and resistors, ionisation chambers, sensitive or high impedance contacts, induced voltages. Electronic timers, counting circuits, automatic switching.

Type **GR 44**

Nr. 3.44

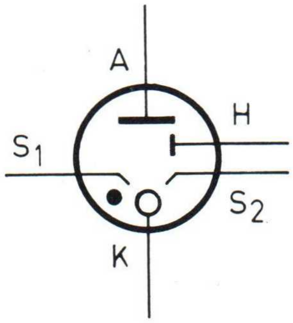
Ed. 10.65 | Fol. 1

Glimmrelais GR 44
Tube relais à cathode froide GR 44
Cold Cathode Relais Tube GR 44

Relaisröhre mit kalter Molybdänkathode und geringer Tritiumvorionisierung. Subminiaturausführung mit zwei Startern und freien Drahtenden zum Einlöten. Speisung des Anodenkreises mit Gleichspannung. Betrieb mit positivem Starter. Die Röhrendaten sind beleuchtungsunabhängig.

Tube relais à cathode froide en molybdène et faible préionisation au tritium. Exécution subminiature avec 2 starters et connexions par fils. Alimentation du circuit anodique par courant continu. Opération avec starter positif. Les caractéristiques du tube sont indépendantes de l'illumination.

Cold cathode relay tube with molybdenum cathode and low Tritium preionization. Subminiature type with two starters and flying leads. DC anode voltage supply. Operation with positive starter. Tube characteristics are independent of illumination.

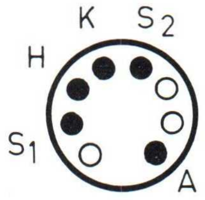


K : Kathode / Cathode

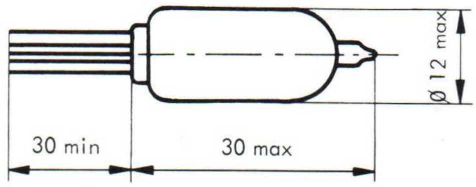
S_1: / S_2: Starter

A : Anode

H : Hilfsanode / Anode auxiliaire / Keep alive anode



Subminiatur



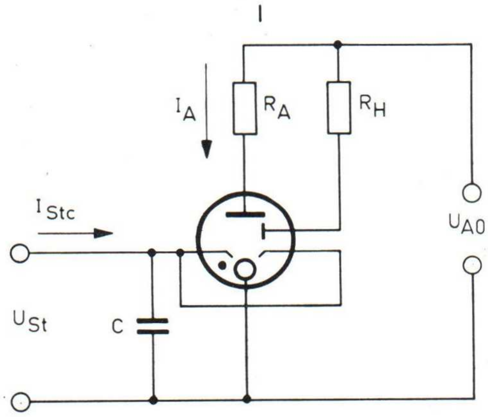
KENNDATEN; GRENZBETRIEBSDATEN	CARACTERISTIQUES; LIMITES D'OPERATION	CHARACTERISTICS; LIMITING VALUES		min.	normal	max.	
Zündspannung A-K	Tension d'amorçage A-K	Breakdown voltage A-K	U_{ZA}	400 V	-	-	1)
Zündspannung S-K (Starter positiv)	Tension d'amorçage S-K (Starter positif)	Breakdown voltage S-K (Starter positive)	U_{ZS}	120 V	130 V	140 V	
Zündspannung H-K	Tension d'amorçage H-K	Breakdown voltage H-K	U_{ZH}	-	-	180 V	
Brennspannung A-K (5,5 mA)	Tension d'entretien A-K (5,5 mA)	Sustaining voltage A-K (5.5 mA)	U_{BA}	105 V	110 V	117 V	
Kathodenstrom Mittelwert	Courant cathodique valeur moyenne	Cathode current mean value	I_K	5,5 mA	9 mA	12 mA	2)
Anoden-Speisespannung	Tension d'alimentation anodique	Anode supply voltage	U_{A0}	250 V	300 V	350 V	
Steuerstrom für Direktsteuerung	Courant de commande (commande directe)	Transfer current (direct control)	I_{St}	200 μA	-	12 mA	3)
Steuerstrom für Kippsteuerung	Courant de commande (par capacité)	Control current (capacity control)	I_{Stc}	10^{-3} μA	-	12 mA	3) 4)
Kippkapazität	Capacité de commande	Control capacity	C	200 pF	470 pF	5000 pF	4) 5)
Hilfsanodenstrom	Courant de l'anode auxiliaire	Keep alive anode current	I_H	-	-	20 μA	6)

TYPISCHE SCHALTUNGEN UND BETRIEBSDATEN

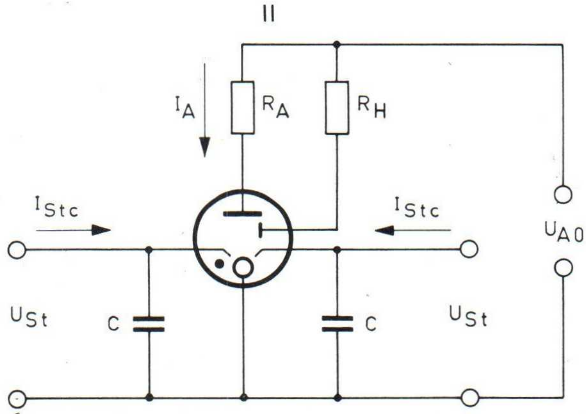
CIRCUITS ET CARACTERISTIQUES D'OPERATION TYPIQUES

TYPICAL CIRCUITS AND OPERATION DATA

I



II



U_{A0}	300 V	
I_A	9 mA	
R_A	18 kΩ	
U_{St}	160 V	7)
I_{Stc}	1-10 μA	
C	470 pF	
R_H	10 MΩ	6)

A. Wird die Hilfsanode nicht verwendet, dann soll sie mit der Kathode verbunden werden.

B. Statische Felder zwischen äusseren Metallteilen in unmittelbarer Nähe der Röhre (z.B. Montageklammer) und der Kathode können die Anodenzündspannung herabsetzen. Gegebenenfalls ist eine auf Kathodenpotential gelegte Abschirmung vorzusehen oder die Montageklammer auf Kathodenpotential zu legen.

1) Der angegebene Minimalwert gilt auch bei warmer Röhre (kurz nach dem Abschalten).

2) Kurzzeitige Spitzenströme bis zu einem Vielfachen des Maximalstromes sind zulässig.

3) Für positive Starterzündung. Wesentlich höhere Spitzenwerte sind zulässig.

4) Der Minimalwert gilt nur bei nicht brennender Hilfsentladung.

5) Für Kippkapazitäten über 5 000 pF (z.B. in Zeitrelais) ist in den Starterkreis ein Begrenzungswiderstand von 2 000 to 10 000 Ω zu schalten.

6) Die Hilfsanode H wird angeschlossen, wenn extrem kurze Aufbauzeiten der Entladung von Wichtigkeit sind.
Der Widerstand R_H soll unmittelbar bei der Röhre angelötet werden.

7) Positiver Spitzenwert. U_{St} kann aus einer festen Vorspannung von 60 V max. und der Steuerspannung zusammengesetzt sein.

MONTAGE in beliebiger Lage

UMGEBUNGSTEMPERATUR
-20° bis +80° C

LEBENSDAUER
Ueber 25 000 Brennstunden bei Nennstrom.

ANWENDUNGSBEISPIELE
Automatik- und Programmschaltungen, Zeitrelais, Zähler; Steuerung durch Impulse, Photozellen, Photowiderstände, hochohmige Kontakte, etc.

A. L'anode auxiliaire non utilisée doit être connectée à la cathode.

B. Des champs électrostatiques entre des pièces métalliques à proximité immédiate du tube (p.ex. clip de montage) et la cathode peuvent réduire la tension d'amorçage anodique. Eventuellement, un blindage du tube, porté au potentiel de la cathode, doit être prévu ou le clip de montage doit être porté au potentiel de la cathode.

1) La valeur min. est également valable pour le tube chaud (peu après extinction).

2) Des pointes qui atteignent un multiple du courant max. sont admises.

3) Pour amorçage positif du starter. Des valeurs de pointe bien plus élevées sont admises.

4) La valeur minima est seulement valable si l'anode auxiliaire n'est pas connectée.

5) Pour les capacités de commande supérieures à 5 000 pF (par exemple pour temporisateurs électroniques) on doit insérer une résistance de 2 000 à 10 000 Ω dans le circuit du starter.

6) L'anode auxiliaire est connectée si un temps d'ionisation très court est exigé.
La résistance R_H doit être soudée à proximité immédiate du tube.

7) Valeur de pointe positive. U_{St} peut être composée d'une tension fixe de 60 V max. et de la tension de commande.

MONTAGE en toute position

TEMPERATURE AMBIANTE
-20° à +80° C

DUREE DE SERVICE
Supérieure à 25 000 heures de service continu dans les conditions normales

APPLICATIONS
Circuits logiques, commandes automatiques, temporisateurs électroniques, compteurs; commande par impulsions, cellules photoélectriques, photorésistances, contacts à résistance élevée etc.

A. Connect not used auxiliary anode to cathode.

B. Electrostatic fields between external metal parts near the tube (e.g. a mounting clip) and the cathode may reduce the anode firing voltage. To avoid this, a shield at cathode potential must be inserted or the mounting clip must be connected to cathode potential.

1) The minimum value is equally valuable for the hot tube (shortly after extinction).

2) Peak currents of a multiple of the max. value are admitted.

3) For positive starter ignition. Considerably higher peak values are admitted.

4) The minimum value is only valuable if the keep alive anode is not connected.

5) For control capacities of more than 5 000 pF (e.g. in electronic timers) a limiting resistor of 2 000 to 10 000 Ω must be inserted in the starter circuit.

6) The keep alive anode is connected if a very short ionisation time is desired.
The resistor R_H must be soldered very close to the tube.

7) Positive peak value. U_{St} may be the sum of a fixed bias voltage of 60 V max. and the control voltage.

MOUNTING in any position

AMBIENT TEMPERATURE
-20° to +80° C

LIFE EXPECTANCY
Exceeding 25 000 working hours at normal current

APPLICATIONS
Logic circuits, automatic switching, electronic timers, counters; control by impulses, photoelectric cells, photoresistors, high impedance contacts etc.

Type	GR 46
Nr.	3.46 e
Ed.	6.70
Fol.	1

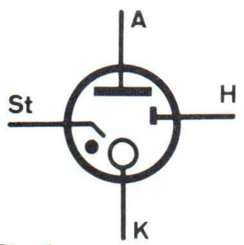
Cold Cathode Relay Tube GR 46

1. GENERAL

The GR 46 subminiature relay tube is the natural successor to the well-tried GR 44. Its simple design - only one starter - allowed for a specially attractive price. The electrical and mechanical characteristics are adapted to the GR 44. If only one starter is required, interchangeability between the GR 44 and the GR 46 is always ensured.

The main range of applications covers timing circuits and circuits for the industrial electronics. Because of its high anode breakdown voltage (over 400 V), the GR 46 tube may be connected directly and without a transformer to a rectified and smoothed 220 V a.c. supply. Other remarkable features of this tube are its excellent starter breakdown voltage stability (typically ± 1 %), minimal control current (less than 10^{-3} μ amp), unaffected by temperature fluctuations, and the wide temperature range in which it can operate. The GR 46 is so designed that the anode circuit can be supplied with direct voltage, and operation is assured with a positive starter. The starter striking voltage reaches its highest stability only if there is no negative starter current I_{St} (see Fig. 3 and 4).

Starter breakdown delays are largely prevented by an appropriate gas mixture. Should the starter voltage increase at a rate of more than 10 V/s, however, breakdown delays may exceed a permissible value. This is easily avoided by the ionising effect of a small current through the auxiliary anode (H, Fig. 1).



A: Anode
H: Auxiliary anode
St: Starter
K: Cathode

Fig.1

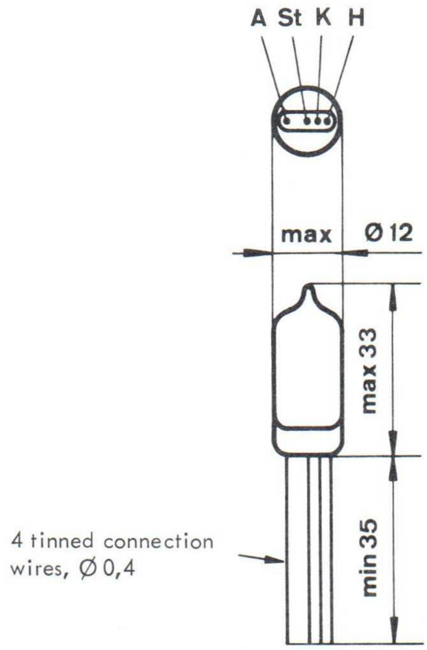


Fig.2

2. TECHNICAL DATA, OPERATIONAL RANGE

(d.c. values)			min.	normal	max.	
Breakdown voltage A-K	U_{ZA}	[V]	400			1)
Breakdown voltage S-K (positive starter)	U_{ZS}	[V]	120	130	145	
Breakdown voltage H-K	U_{ZH}	[V]			180	
Anode supply voltage	U_{AO}	[V]	250	300	350	
Maintaining voltage A-K (5,5 mA)	U_{BA}	[V]	105	110	117	
Cathode current (mean value)	I_K	[mA]	5,5	9	12	2)
Auxiliary anode current	I_H	[μA]			20	3)
Starter current for capacitance transfer (H combined with K)	I_{St}	[μA]	$1 \cdot 10^{-3}$		$12 \cdot 10^3$	2)
Starter current for capacitance transfer (I_H = 20 μA)	I_{StH}	[μA]	2		$12 \cdot 10^3$	2)
Trigger capacitor	C	[pF]	470		5000	4)
Ambient temperatures	T_a	[°C]	-20		+80	5)
Service life (with I_K = 9 mA)	L	[h]		25000		

1) The minimum value is also valid for warm tubes, i.e. shortly after switch-off.

2) Short peak currents several times the maximum value are admissible.

3) The auxiliary anode (H) is connected if extremely short ignition times are needed (Fig. 3).

4) Trigger capacitors of over 5.000 pF (e.g. in timer relays) need a current limiting resistor of 1 ... 10 kΩ in the starter circuit (Fig. 5).

5) The tubes may be operated as well as stored in the stated temperature range.

3. APPLICATION NOTES

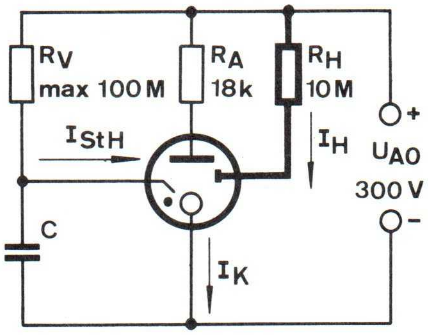


Fig. 3

Connect the auxiliary anode for rapid increase of the starter voltage U_{St} (> 10 V/s), e.g. for timer circuits with time delays of under 10 seconds.

Important: Shortest possible connexion between resistor R_H and auxiliary anode.

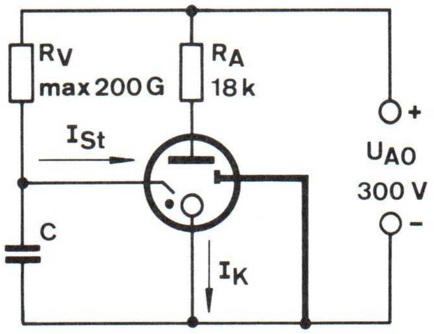


Fig. 4

Lay the auxiliary anode on cathode potential when the starter voltage U_{St} increase is slow (< 10 V/s), e.g. for timer circuits with a time delay of more than 10 seconds.

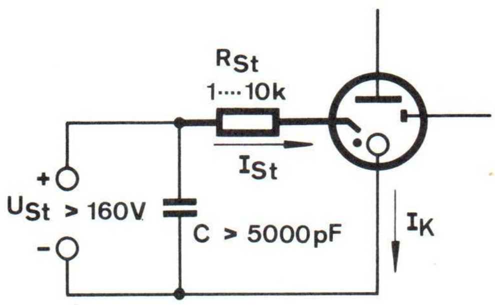


Fig. 5

Limit the starter peak current with a resistor R_{St} for trigger capacitor C of over 5.000 pF. No R_{St} is needed for C 470 to 5.000 pF.

4. MOUNTING ON PRINTED CIRCUITS

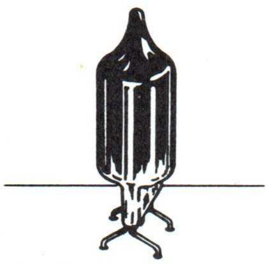


Fig. 6

For vertically mounted tubes straddle the leads to obtain good stability. If it lies at less than 2 cm distance from other metal parts and if these carry a.c. voltages several multiples of 10 V, the tube must be screened as shown in Fig. 7.

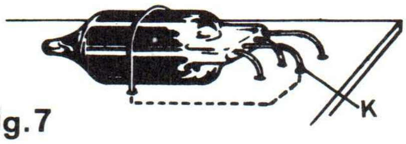


Fig. 7

By horizontally mounted tubes, a wire brace will hold and screen the tube (Fig. 7). If it lies at less than 2 cm distance from other metal parts and if these carry a.c. voltages several multiples of 10 V, the brace must be connected to the cathode potential.

4

CERBERUS

GLOW-THYRATRONS

Principle of Operation and general Application Notes

CONTENTS

1. INTRODUCTION

The glow-thyratron (patent pending) has been developed from the well known cold cathode relay tubes. These relay tubes, having pure metal cathodes, are well established as sturdy, reliable and long-life electronic switching elements.

The most salient property of the glow-thyratrons is their grid control characteristic which permits a tube to be fired with a signal of only 5 volts.

Other important properties are: the tubes are immediately ready for service when the anode supply voltage is switched on; stand-by power is very small and has negligible effect on life expectancy; they have very small electrical tolerances, high stability, high overload capability, are independent of temperature and give a good visual indication of their switching state.

Because of the low control voltage, glow-thyratrons can be controlled by transistor circuits.

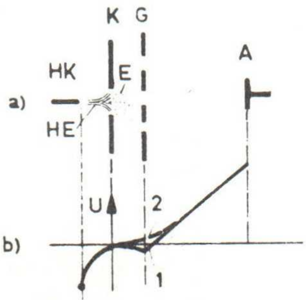


Fig. 1

2. PRINCIPLE OF OPERATION

A cold cathode tube is controlled by reducing the breakdown voltage of the main gap (cathode-anode) by introducing charge-carriers from a control discharge. In cold cathode relay tubes, this control discharge is obtained from the applied signal.

In the glow-thyratron the control discharge is a permanent auxiliary discharge, but its control effect on the main discharge is exercised by a grid. This control mechanism is illustrated in figure 1.

Figure 1 a) shows the electrode arrangement. The auxiliary discharge HE is maintained between the auxiliary cathode HK and the main cathode K. For this discharge, the cathode K forms the anode. Through an aperture in the cathode, electrons from the auxiliary discharge can reach the space between cathode and grid G. If the grid is sufficiently negative with respect to the cathode, these electrons enter a retarding field and they are returned to the cathode. Around the cathode aperture, an electron cloud E is formed. The grid-cathode field is a function of the grid potential and of the anode potential reaching through the grid openings. If the negative grid potential is reduced to a critical value, the electrons arrive in an accelerating field and are driven through the grid openings to the anode A. Then they ionize the gas in the grid-anode space. This forms a direct discharge between auxiliary cathode and anode which triggers the main discharge.

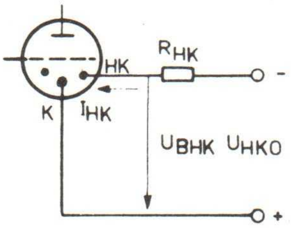
Figure 1 b) shows the field distribution along the axis of the unfired tube. Curve 1 corresponds to a grid voltage of -10 volts and a retarding field between grid and cathode. Curve 2 corresponds to a grid voltage of 0 volts and an accelerating field.

Since the anode voltage penetrates through the grid openings, it is evident that the critical grid voltage for firing the tube depends on the anode voltage. This relation is shown in the control characteristic described later.

3. ASSOCIATED CIRCUITS

3.1 Auxiliary discharge circuit

Auxiliary cathode HK and cathode K form the auxiliary discharge gap, the electrical characteristics of which are the firing voltage U_{ZHK} and the maintaining voltage U_{BHK}. Besides this auxiliary discharge gap, the auxiliary discharge circuit (see figure 2) contains the current limiting resistor R_{HK} and the auxiliary cathode supply voltage U_{HK0}.



$$R_{HK} = \frac{U_{HK0} - U_{BHK}}{I_{HK}}$$

U_{BHK} = ca 105 V

Fig. 2

If the anode gap of the tube is fired, the discharge from the auxiliary cathode no longer ends at the cathode, but at the anode, so that the auxiliary cathode assumes approximately cathode potential. This is accompanied by a corresponding increase of I_{HK}.

3.2 Grid circuit

Figure 3 shows the grid circuit. Its external elements are: the grid resistor R_G, the control voltage U_{St} and the grid bias voltage U_{G0}. The voltage between grid and cathode U_{G-K} is therefore composed of the grid bias voltage, the control voltage and the voltage drop across R_G.

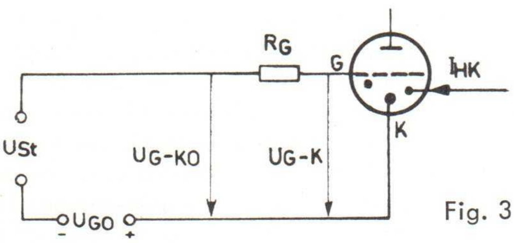


Fig. 3

In the tube the grid has mainly the function of an electrostatic diaphragm. Also it acts as a probe for the discharges maintained in the tube:

a) When the anode gap is not fired, the grid acts as a probe in the auxiliary discharge. The magnitude and direction of the probe current depend on the auxiliary cathode current and the voltage between grid and cathode as shown in figure 4.

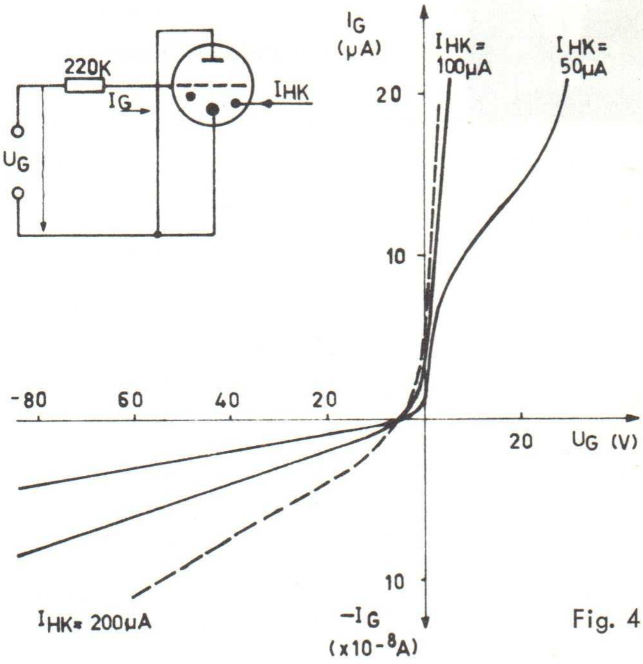


Fig. 4

b) When the anode gap is fired, the grid acts as a probe in the main discharge. The probe characteristic in figure 5 shows the relation between the voltage on the grid (U_{G-K}) and the grid current for two different values of the anode current (tube type GT 21).

Conditions change when a grid resistor is introduced. The voltage between grid and cathode U_{G-K} and the probe current I_G can be determined from the voltage U_{G-K0} before the grid resistor and the probe characteristic by introducing the load line R_G.

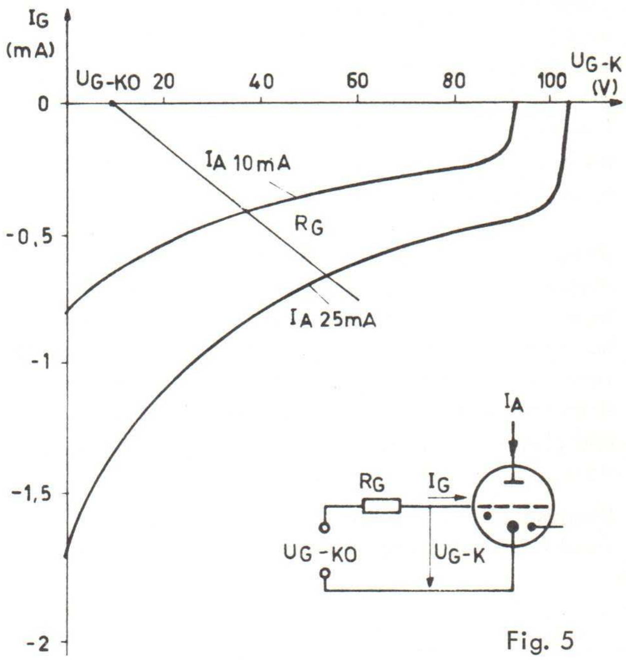


Fig. 5

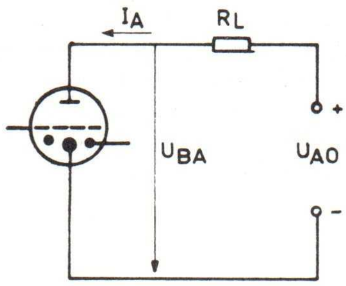
The probe action of the grid in the fired tube gives a feed-back voltage into the grid circuit. In most practical applications the grid-cathode gap can be considered as a voltage source (grid positive with respect to cathode) of approx. 100 volts with an internal resistance of approx. 0.1 MΩ.

3.3 Anode circuit

The anode circuit comprises the main cathode-anode gap, the load resistance R_L (which can be placed in the cathode or anode side or both) and the anode supply voltage U_{A0}. The magnitude of this voltage lies between the anode firing and maintaining voltages.

a) DC voltage supply

If the anode is fed by a DC voltage, the fired main discharge can only be extinguished by an interruption of the anode circuit or by reducing the anode voltage below the maintaining voltage for a sufficiently long time. The formula for calculating the load resistor is given with figure 6. Data sheets for the tube give limiting values of the anode current and the anode supply voltage.



$$R_L = \frac{U_{A0} - U_{BA}}{I_A}$$

$$P_{RL} = \frac{(U_{A0} - U_{BA})^2}{R_L}$$

Fig. 6

b) AC voltage supply

If the anode circuit is fed by an AC voltage, rectified half-waves or full-waves, the tube extinguishes automatically towards the end of each positive half-wave. It must be fired again during the following positive half-wave by the control signal. The load resistance is chosen in such a way that the mean value (measured with a DC instrument) of the cathode current is within the limits given on the data sheets. If the load resistor is replaced by a relay, it must be located in the anode side and must be retarded (see Relay sheet No 20.01).

4. CHARACTERISTICS

4.1 Firing characteristic

The firing characteristic shows the anode-cathode firing voltage as a function of the grid-cathode voltage. A typical characteristic for the type GT 21 is shown in figure 7. This figure also shows the points of the limit characteristic of particular significance:

A: minimum anode holding voltage at the maximum admissible negative grid voltage.

B: negative grid voltage to ensure cut-off at the minimum anode holding voltage.

C: critical grid voltage to ensure firing at the minimum anode supply voltage.

D: minimum inverse anode holding voltage at the maximum admissible positive grid voltage.

In general, control points of the limit characteristics or maximum values for anode and grid voltage are given instead of the firing characteristic.

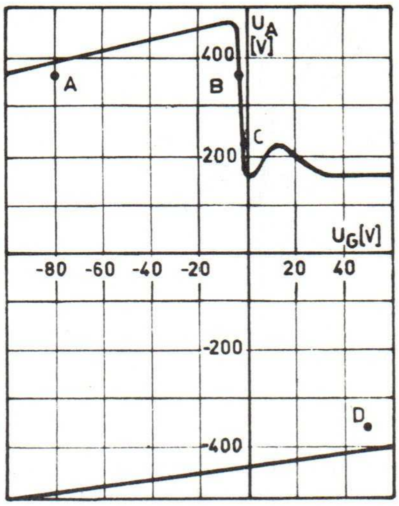


Fig. 7

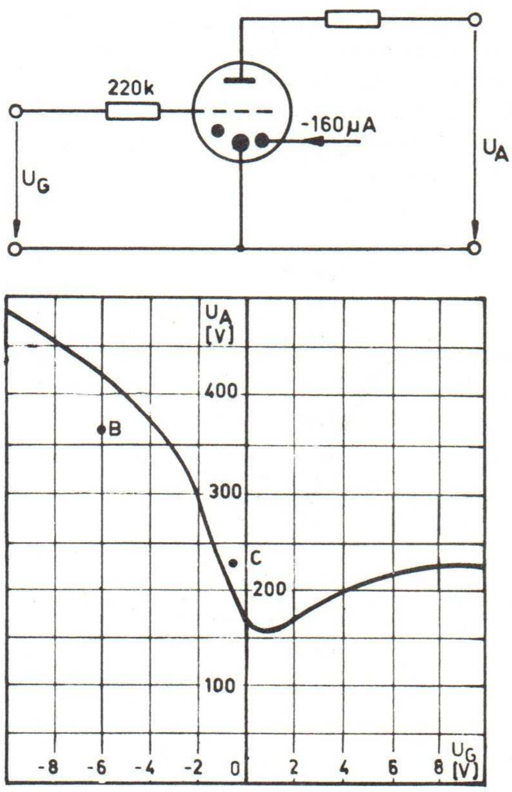


Fig. 8

4.2 Control characteristic

The control characteristic is an expanded section of the firing characteristic in the control range of the grid. The curve shown in figure 8 is typical for tube GT 21.

For practical purposes the voltage between cathode and the point before the grid resistor has been chosen as a variable instead of the voltage between grid and cathode. Because of the grid current, the control characteristic becomes dependent on the grid resistor, as shown in figure 9. There is little change for resistors between 50 kΩ and 0.5 MΩ.

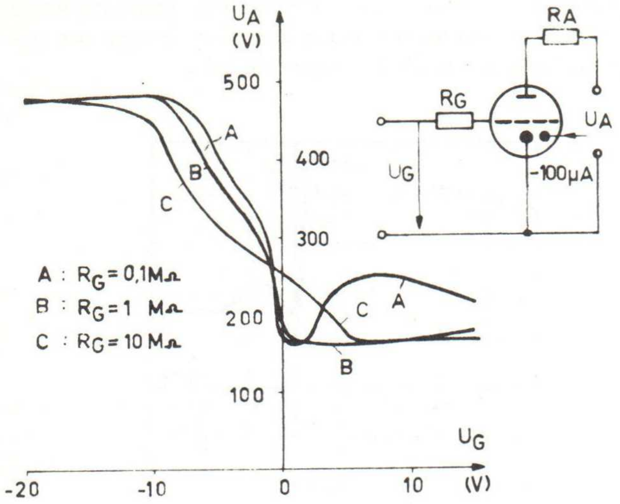


Fig. 9

The magnitude of the auxiliary cathode current has little effect on the control characteristic, as shown in figure 10.

Within the working limits of the tube, the influence of ambient temperature on the control characteristic is very small. In the temperature range from -30°C to $+90^{\circ}$C, the horizontal displacement of the control characteristic is between 0.1 and 0.5 volts, depending on the anode voltage.

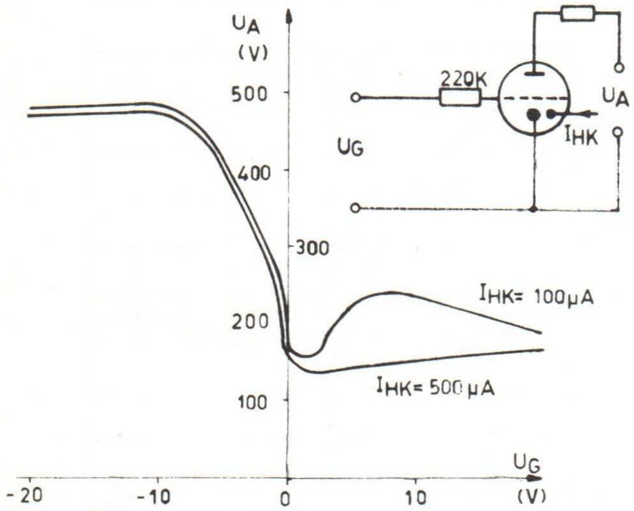


Fig. 10

The control characteristics of various tubes differ very little. According to present experience, the horizontal variation is considerably less than 1 volt.

5. DYNAMIC PROPERTIES

Although the construction and gas filling of glow-thyratrons are similar to relay tubes, there are two essential differences which influence the dynamic properties:

a) the permanently maintained auxiliary discharge shortens the ionization time

b) the grid divides the discharge gap in two parts, thus facilitating deionization and reducing deionization time.

5.1 Ionization time

The permanent control discharge of the glow-thyratron causes a reduction in response time compared to ordinary relay tubes since the firing delay of the starter discharge and its firing time are eliminated.

The ionization time depends primarily on the difference between the anode supply voltage and the anode firing voltage (corresponding to the grid voltage reached by the control pulse). It decreases as this difference increases. Because of this and because of the nature of the control characteristic it follows that, for each value of the anode supply voltage, the ionization time is at a minimum when the control pulse drives the grid to cathode potential. This case is illustrated in figure 11 and shows the ionization time as a function of the anode voltage for the tube GT 21.

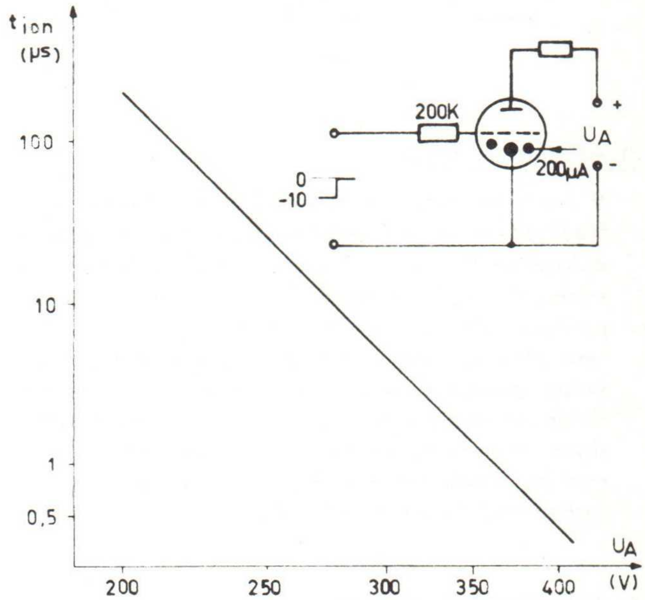


Fig. 11

5.2 Deionization time

The deionization time is the shortest time during which the anode voltage must be reduced below the maintaining voltage to ensure that the tube will not re-fire when the anode voltage is reapplied. It depends on the anode current before extinction, the value of the anode supply voltage and the value to which it is reduced during the deionization.

Figure 12 shows the deionization time for the glow-thyratron GT 21 as a function of the anode current for two different values of the anode voltage. (During deionization the anode voltage was reduced to cathode potential).

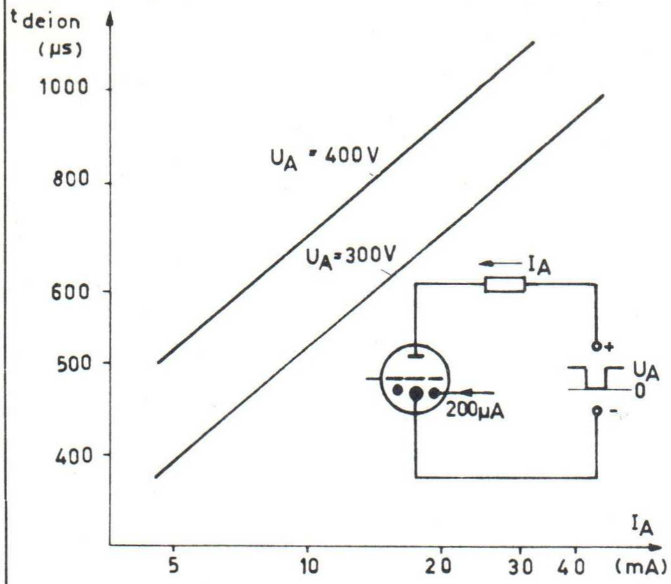


Fig. 12

6. GENERAL APPLICATION NOTES

6.1 High impedance elements

The high impedance components of the tube circuit (e.g. auxiliary cathode resistor, grid resistor) should be placed as near to the tube socket as possible. This avoids parasitic oscillations and the pick-up of stray signals.

The pins marked IC should not be used for any connections.

6.2 External influences, shielding

The operation of glow-thyratrons is not influenced by external light, magnetic field, or radioactive radiation and is almost independent of ambient temperatures. Strong electrostatic field may result in slight variations of the control characteristic. In most cases this can be suppressed as indicated in section 6.3.

Shielding of the tube is therefore unnecessary except for special cases. If a shield is used as a mechanical protection, it must be connected to cathode potential.

6.3 Avoiding stray signals in the grid circuit

Stray signals can reach the grid by capacitative pick up, especially when high grid resistors are used. This may be sufficient to cause unwanted firing of the tube. A condenser of approx. 200 pF between grid and cathode eliminates this effect.

6.4 Switching interval

By increasing the grid-cathode capacity to several 1000 pF (depending on the grid resistor), a switching interval is obtained. When the control circuit is fed by an AC voltage, a phase-lag is caused by the grid resistor and the grid capacitor. This may have to be corrected by a phase-lead network in the control circuit.

6.5 Radio interference

When the tube is supplied with an AC voltage, the anode gap is fired in every positive half-wave. The fast current build-up at firing may cause radio interference. This can be eliminated by a capacity of 0.1 to 0.2 μF parallel to the supply voltage or a capacity of approx. 5000 pF parallel to the anode-cathode gap of the tube.

6.6 Basic diagrams and applications

Basic diagrams and application examples are given on the application sheet 4.06 e.

GLOW-THYRATRONS

Basic Diagrams and Applications

CONTENTS

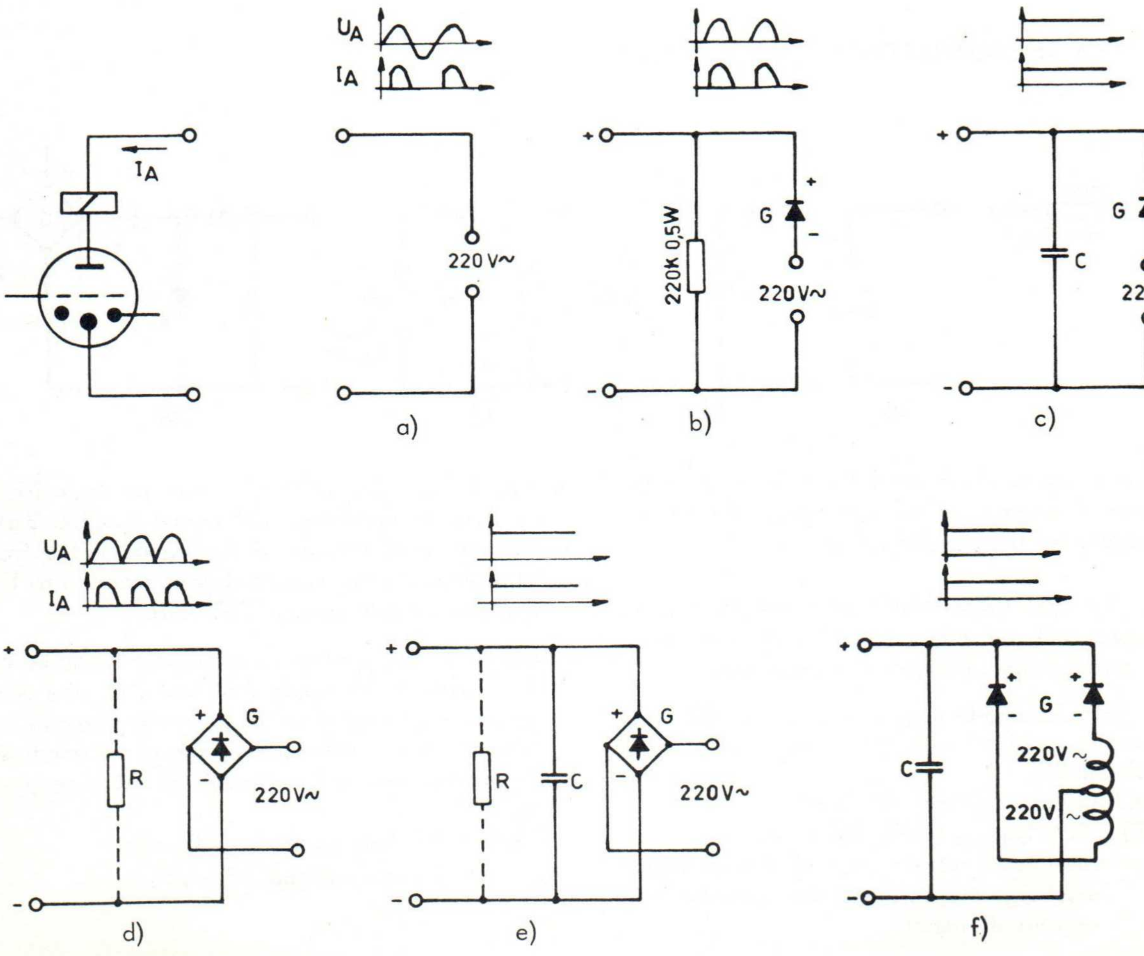
1. INTRODUCTION

The principle of operation of glow-thyratrons is explained and general application notes are given in information 2.21.04 E.

The following circuits apply basically to all types of glow-thyratrons; the numerical values and complete diagrams refer to type GT 21.

2. SUPPLY OF THE ANODE CIRCUIT

The voltage of 220 volts AC can be the mains supply voltage or it can be derived from a transformer. In the latter case the unloaded voltage of the transformer must not substantially exceed 220 volts. If a single tube is fed by a transformer it must be calculated for an unloaded voltage of 220 volts.



In the circuits a), b) and d), the tube is extinguished automatically when the control signal is removed.

In the circuits c), e) and f), the tube remains fired when the control signal is removed. It must be extinguished externally by interrupting the anode supply or by reducing the anode voltage below the maintaining voltage.

a) Supply with AC voltage.

b) Supply with half waves; this can be used with DC-tubes. In special cases it can also be used with AC-tubes (e.g. if a high positive grid voltage is expected during the negative anode half wave). Rectifier G has a peak inverse voltage of 350 volts.

c) Supply with DC voltage obtained from half wave rectifier.
G: peak inverse voltage 700 volts.
C: for 1 tube: 2 to 4 µF (depending on tube current), 350 volts.
C: for n tubes: $C\ (\mu F) = 0.9 \cdot I_{A\,tot}\ (mA)$.
($I_{A\,tot}$ = sum of the anode currents of all tubes that can be fired at the same time).
This supply is normally used in circuits having only one tube.

d) Supply with full waves: this supply gives a faster succession of tube firings than supplies a) and b), therefore a shorter maximum response time of the relay which also needs less retardation than in the other cases. Typical application would be for fast counting circuits. (With inductive load the extinction of the anode current can be made more difficult. If retarding of the magnetic field in the load is desired, it should be accomplished by a diode parallel to the load).
Resistor R must be inserted if the auxiliary discharge is fed according to diagram 3d).

$$R\ (k\Omega) = \frac{200}{I_{HK\,tot}\ (mA)}$$

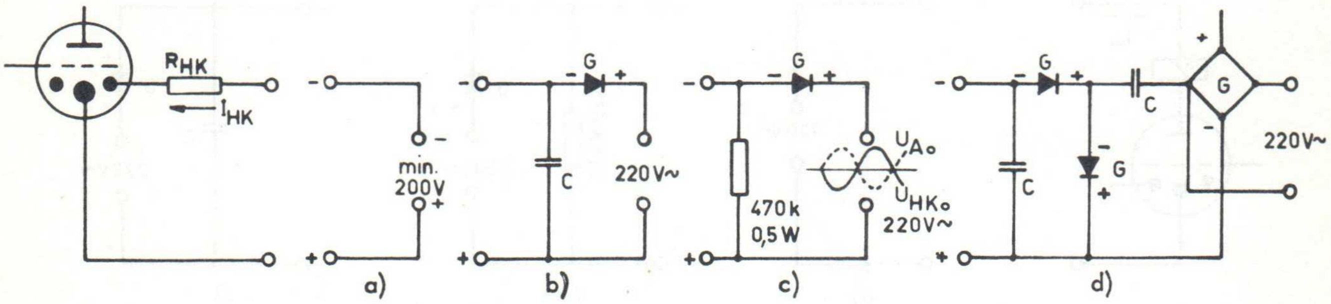
$I_{HK\,tot}$ = load current of the auxiliary discharge supply circuit.

e) Supply with DC voltage obtained from a bridge rectifier. In this DC voltage supply, a smaller condenser than in case c) can be used for the same current.
$C(\mu F) = 0.4 \cdot I_{A\,tot}\ (mA)$. R: as in d), 350 volts.
G: peak inverse voltage 350 volts.
This supply is generally used for circuits with several tubes.

f) DC-voltage supply obtained from a full wave rectifier.
C: as in case e).
G: peak inverse voltage 700 volts.
In this case, it is easier to derive the auxiliary discharge supply voltage than in case e).

If many tubes in the same circuit can be fired simultaneously the condenser necessary in the supplies e) and f) will have large capacities. In such a case it would be advisable to use a L-C circuit to reduce the ripple of the anode supply voltage to below 20 volts.

3. SUPPLY OF THE AUXILIARY DISCHARGE CIRCUIT



Any number of tubes which have their cathodes at the same potential when they are not fired, can have a common supply for the auxiliary discharge circuits.

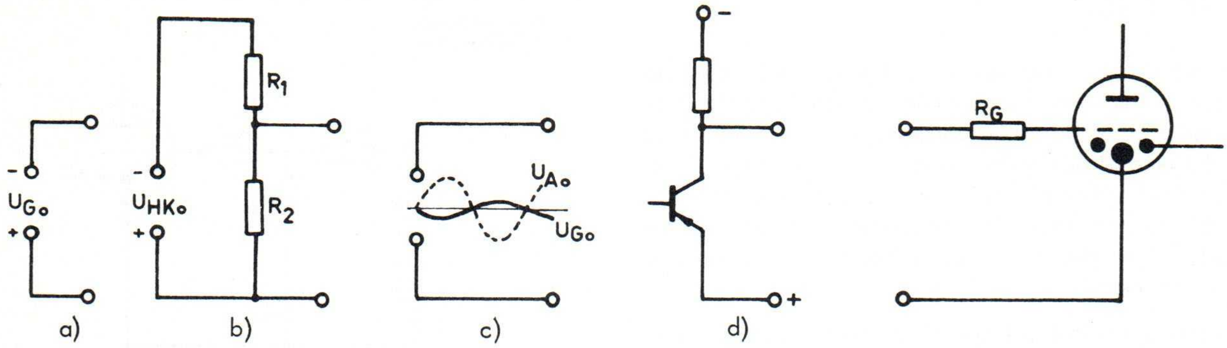
a) Supply from an independent DC voltage source. This supply can be combined with all the anode supply arrangements indicated in section 2.

b) Supply from the anode supply voltage of 220 volts AC, can be combined with the anode supplies 2 a), 2b), 2c) and 2f).
G: peak inverse voltage 700 volts.
C: $(\mu F) = 0.9 \cdot I_{HK\,tot}\ (mA)$, 350 volts.
$I_{HK\,tot}$ = total load current (sum of the auxiliary discharge currents and the currents of the voltage dividers).

c) Supply from 220 volts AC in phase opposition to U_{A0}, can be combined with anode-supplies 2 a) and 2 b) and is of interest if the anode is fed from a transformer. In this supply, R_{HK} is reduced to 1 MΩ.
G: peak inverse voltage 350 volts.

d) Supply from a voltage doubler, which can be combined with anode supply 2 d) and 2 e) (the auxiliary discharge supply voltage resulting from this circuit, referred to the negative end of the anode supply, equals the peak value of the AC supply voltage).
$C\ (\mu F) = 0.9 \cdot I_{HK\,tot}\ (mA)$, 350 volts.
G: peak inverse voltage 350 volts.

4. GRID BIAS VOLTAGE



Since the critical grid voltage for firing the tube depends on the anode voltage, it is desirable that the grid bias voltage varies with the anode voltage. Stabilization of the grid bias is only needed when the anode voltage is stabilized.

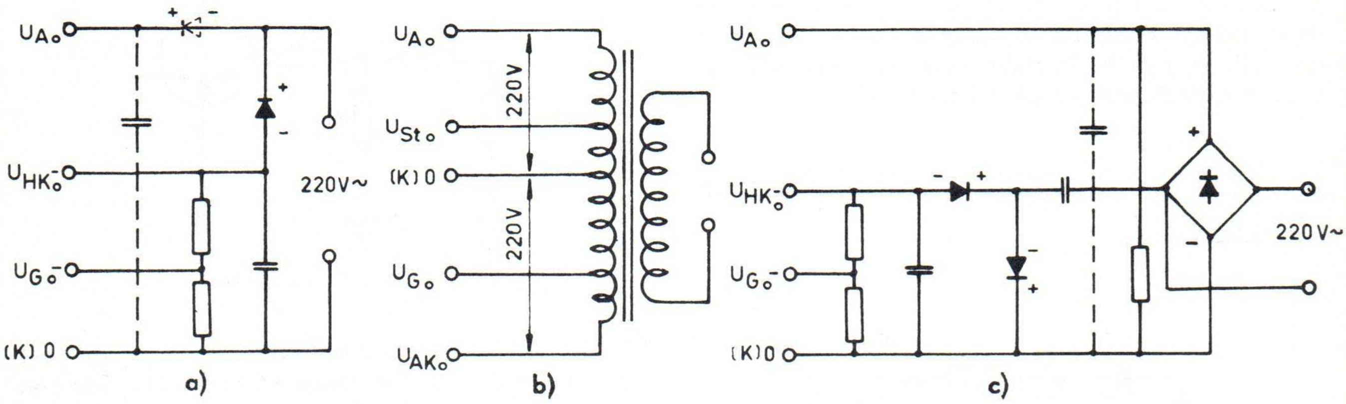
a) Independent DC voltage source; this can be combined with all the anode and auxiliary discharge supplies mentioned above.

b) The grid bias is derived from the auxiliary discharge supply voltage U_{HK0}. This method can be used for all auxiliary discharge supplies. The current in the voltage divider R1, R2 must be considered when calculating the auxiliary discharge supply. For most applications this method of obtaining the grid bias is the simplest and most useful.

c) AC voltage in phase opposition to the anode supply voltage, can be combined with anode supplies 2a) and 2b). This supply is useful when the anode is fed from a transformer e.g. in light beam devices.

d) When the tube is controlled from a transistor circuit, the grid bias is automatically obtained from this circuit. All anode and auxiliary discharge supplies can be used.

5. EXAMPLES FOR COMPLETE SUPPLIES



It will be seen from sections 2, 3 and 4 that a large variety of supply circuits are possible. The following examples show some selected combinations that are of special interest.

a) Normal supply when the tube is fed directly from the mains supply.

b) Supply with transformer, e.g. with light beam devices where the transformer is necessary for the lamp.

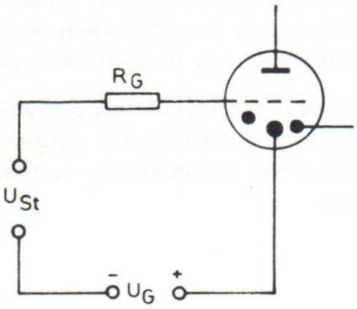
c) Normal circuit when the anode is supplied from a bridge rectifier.

6. COUPLING THE CONTROL SIGNAL TO THE GRID CIRCUIT

The control signal necessary for firing the tube is the difference between the grid bias voltage and the critical grid voltage. This voltage, and in most cases also the grid bias, depend on the supply voltage. Thus the critical value of the control signal also depends on the supply voltage. This dependency is reduced relatively when the grid bias voltage and the control signal are increased.

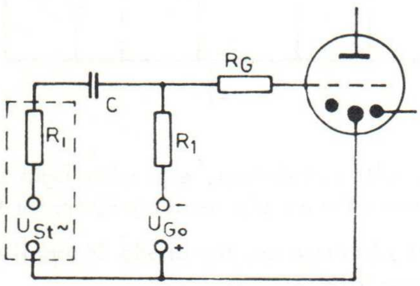
Normally a control voltage of at least 5 volts is needed. With more elaborate circuits this value can be reduced.

6.1 Control by a voltage that is independent of the anode-circuit



The control voltage can be DC or AC. For DC the positive voltage is applied to the grid. For AC, the control voltage must be in phase with the anode voltage or have a considerably higher frequency.

6.2 Control by a AC voltage connected to the anode circuit



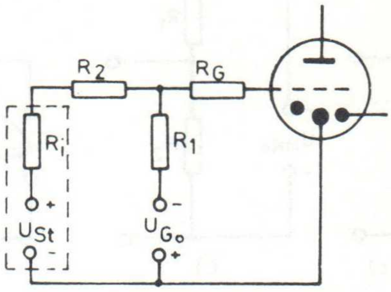
$C \cdot R_1$ must be large compared to the period of the control signal.

R_1 must be large compared with R_i.

R_G limits the feed-back from the grid of the fired tube to the control circuit and also the interval effect.

The control voltage U_{St} must be in phase with the anode voltage or have a considerably higher frequency.

6.3 Control by a DC voltage positive with respect to the cathode



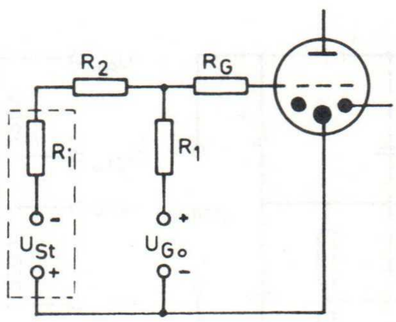
The effective voltage at the grid is the control voltage reduced by the factor $R_1 / (R_1 + R_2 + R_i)$.

The effective grid resistance is: R_G + [R_1 in parallel to $(R_2 + R_i)$].

Feed-back from the grid of the fired tube depends on the ratio $R_G : R_1$ and $R_2 : R_i$; it decreases when this ratio increases.

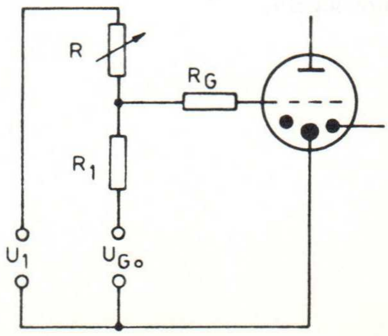
The conditions for small damping of the control voltage and small feed back are contradictory. For every application, the best compromise must be determined.

6.4 Control by a DC voltage negative with respect to the cathode



R_1, R_2 and U_{G0} are only necessary if the control voltage varies outside the range -6 to 0 volts. See also remarks made in section 6.3.

6.5 Control by a variable resistor



U_1 can be a DC-voltage (positive with respect to the cathode) or an AC-voltage in phase with the anode voltage. $\hat{U}_1$ and $\hat{U}_{G0}$ shall be symmetrical to -2.5 volts.

The critical grid voltage is reached when $R \approx R_1$.

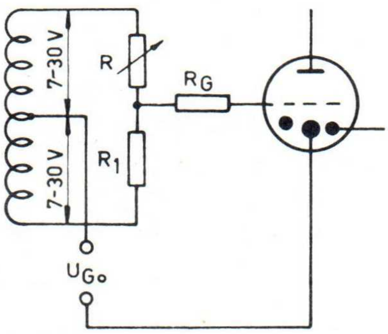
The percent variation of R necessary for firing and blocking the tube decreases as U_{G0} and U_1 are increased.

The resistor R_G can be omitted if the grid feed-back to the control circuit can be tolerated.

The internal reistance of the voltages U_{G0} and U_1 must be small compared to R_1.

The effective grid resistance is R_G + (R in parallel to R_1).

6.6 Control by a bridge circuit



Contrary to the other circuits, the grid bias U_{G0} does not have a value which cuts-off the tubes securely but is set at the critical value. (Approx. -2.5 volts). The critical grid voltage is reached when the bridge is balanced.

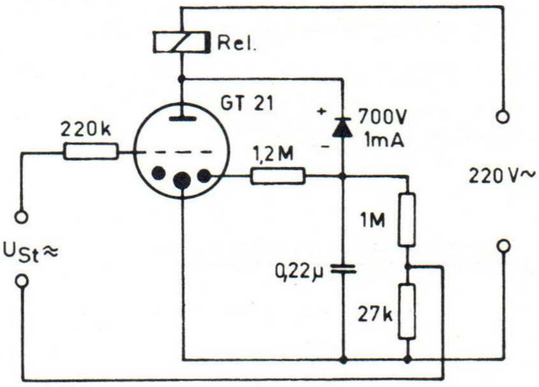
7. SWITCHING INTERVAL

The switching interval is the difference between the control voltage necessary for firing the tube and the control voltage at which the tube extinguishes in circuits supplied by AC, half wave or full wave. Also the quotient of these two voltages can be considered as the switching interval.

If the grid circuit contains a capacity from the grid to the cathode circuit, this capacity is charged, when the tube is fired because of the probe action of the grid. If the discharge time constant has a sufficiently high value, the capacity will still be charged to a small voltage at the next positive half wave, thus helping to refire the tube. Therefore the magnitude of the interval depends on the value of the capacitor, the charging conditions (when the tube is fired) and the discharging conditions (when the tube is extinguished).

8. COMPLETE DIAGRAMS FOR TUBE GT 21

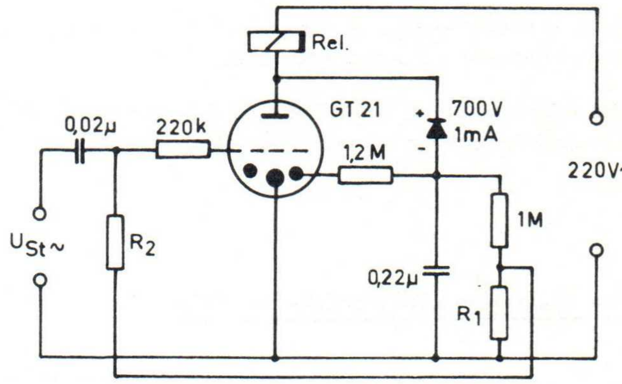
8.1 Control by audio- or high frequency signal



The tube fires at a control voltage of approx. 6 volts.

If the control voltage is connected to the supply voltage, it must be coupled to the grid circuit according to 6.2.

8.2 Supervising an AC voltage



U_{St} must be in phase with U_{A0}, $R_1 < 20$ kΩ. (for higher R_1 a higher control voltage is necessary in the same circuit).

a): R_1 = 27 kΩ, R_2 = 270 kΩ
the tube is fired if $U_{St} \geq$ ca. 5 volts rms.

b): R_1 = 270 kΩ, R_2 = 0
the tube is fired when $U_{St} \geq$ ca. 50 volts rms (maximum admissible: 80 volts rms).

Between a) and b) any intermediate values can be chosen. The precision of switching increases with U_{St}.

The capacitor of 0.02 µF gives in this diagram a switching interval (difference of U_{St} for firing and extinguishing the tube) of approx. 2 volts.

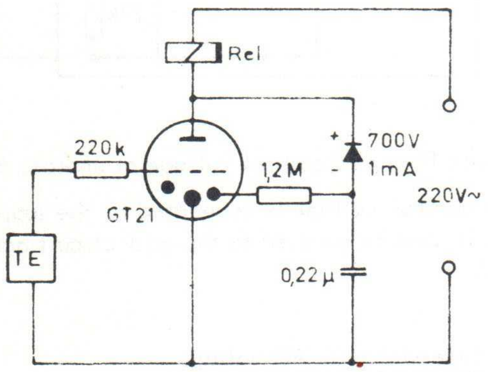
8.3 Supervising a DC voltage

Same diagram as 8.2 with R_3 instead of the capacitor 0.02 µF. U_{St}: minus connected to cathode.

a): $R_1 = 270$ kΩ, $R_2 = 1$ MΩ, $R_3 = 0.15$ MΩ $- R_i$
tube is fired, when $U_{St} \geq$ ca. 8 volts.

b): $R_1 = 270$ kΩ, $R_2 = 0.22$ MΩ, $R_3 = 0.47$ MΩ $- R_i$
tube is fired, when $U_{St} \geq$ ca. 65 volts (maximum admissible: 150 volts).

8.4 Control by a transistorized unit



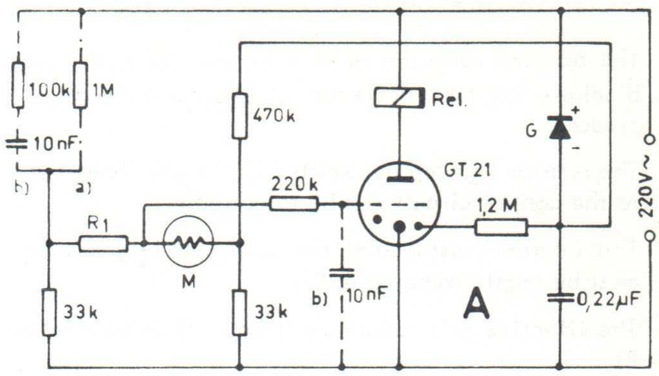
TE = transistorized unit, $R_i < 20$ kΩ

Tube is fired, when the out-put of the transistorized unit is between -0.5 and +50 volts.

The tube is cutt-off when the output of the transistorized unit is between -6 and -80 volts.

8.5 Control by a variable resistor M

(Photo-resistor, photo-diode, thermistor, contact, etc.)



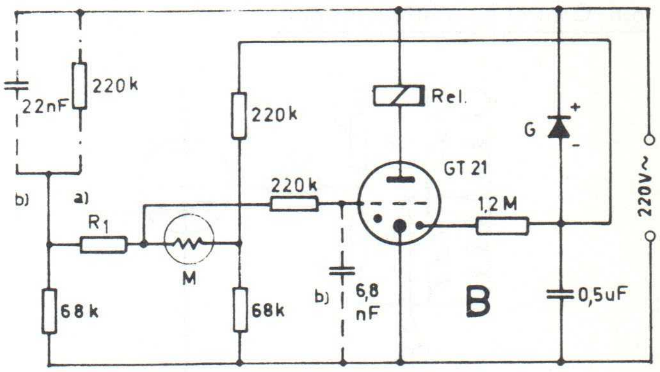
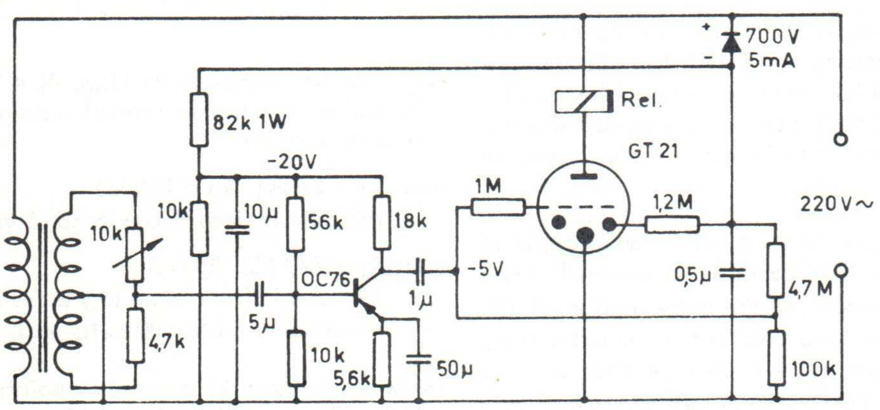


Diagram A is for low voltages on the measuring element. Diagram B is for high sensitivity. When the dash-dotted element is replaced by the dashed elements, a switching interval is obtained.
The switching function is inverted by exchanging R_1 and M.

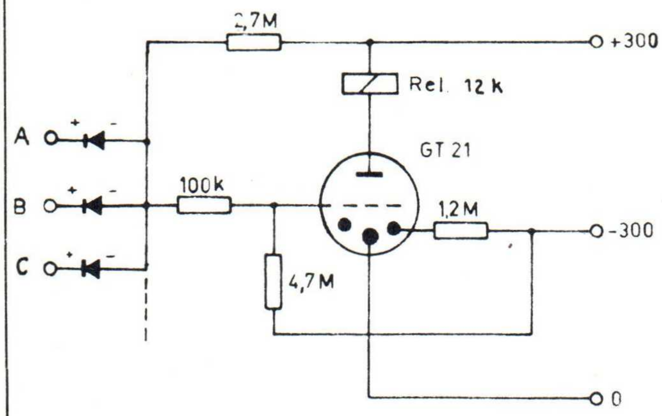
8.6 Operation with transistor amplifier



The control signal necessary at the input of the transistor amplifier is some tenths of a volt.

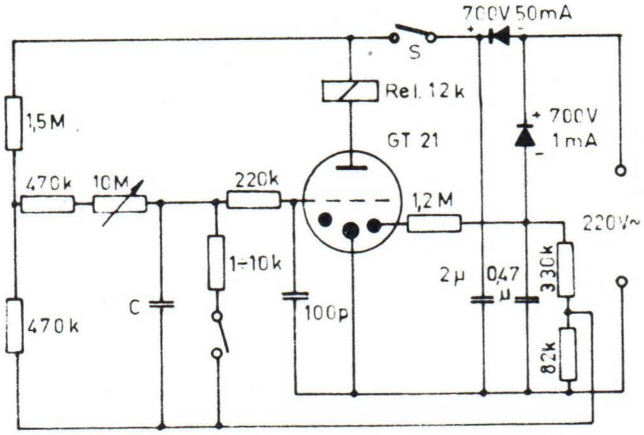
8.7 Coincident stage

(for example to ring-counters, counting tubes, etc)



A, B, C: input voltages, $R_i < 15$ kΩ.
Tube is cut off if at least one of the inputs is at 0 volts. Tube is fired if all inputs are at ≥ +6 volts (for higher control voltages a larger value of R_i is admitted). For the same amount of grid feed-back, the resistor of 100 kΩ must be increased proportionally.

8.8 Delay circuit



When the control contact S is closed, the attraction of the relay Rel is retarded. It releases without retardation when S is opended.
As the retarding condenser C is charged from a negative to a positive voltage (both voltages symmetrical to the critical grid voltage), the influence of variations of the supply voltage on the retarding time is small.

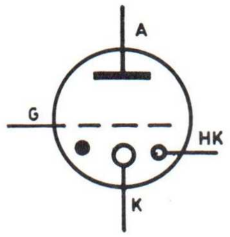
Glimm-Thyratron GT 21
Thyratron à effluve GT 21
Glow Thyratron GT 21

Type	GT 21
Nr.	4.21
Ed.	10.65
Fol.	1

Glimm-Thyratron mit kalter Molybdänkathode und geringer Tritiumvorionisierung. Steuerung durch Gitter, erforderliche Signalspannung ≤ 5 V. Speisung des Anodenkreises mit Gleich- oder Wechselspannung.

Thyratron à effluve à cathode froide en molybdène et faible préionisation au tritium. Commande par grille, tension de commande ≤ 5 V. Alimentation du circuit anodique par courant continu ou alternatif.

Glow thyratron with cold molybdenum cathode and low Tritium preionization. Grid control, needed signal voltage ≤ 5 Volts. DC or AC anode voltage supply.

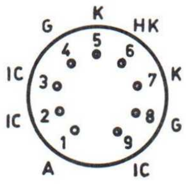


K: Kathode / Cathode

G: Gitter / Grille / Grid

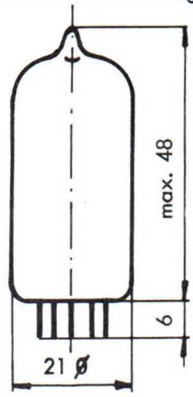
A: Anode

HK: Hilfskathode / Cathode auxiliaire / Auxiliary cathode



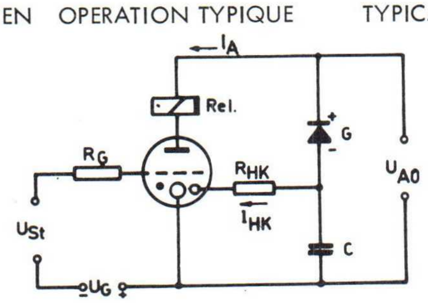
Noval

IC: Interne Verbindung frei lassen / Connexion interne ne connectez pas / Internal connections do not connect



KENNDATEN; GRENZBETRIEBSDATEN	CARACTERISTIQUES; LIMITES D'OPERATION	CHARACTERISTICS; LIMITING VALUES		min.	normal	max.
Zündspannung A-K (A+, U_G = -15 V)	Tension d'amorçage A-K (A+, U_G = -15 V)	Breakdown voltage A-K (A+, U_G = -15 V)	U_{ZA}	450 V	-	-
Zündspannung K-A (A-, U_G = 0)	Tension d'amorçage K-A (A-, U_G = 0)	Breakdown voltage K-A (A-, U_G = 0)	U_{ZA}	420 V	-	-
Zündspannung HK-K	Tension d'amorçage HK-K	Breakdown voltage HK-K	U_{ZHK}	-	-	-180 V
Brennspannung HK-K (I_{HK} = -100 µA)	Tension d'entretien HK-K (I_{HK} = -100 µA)	Sustaining voltage HK-K (I_{HK} = -100 µA)	U_{BH}	-	-	-110 V
Brennspannung A-K (I_A = 20 mA)	Tension d'entretien A-K (I_A = 20 mA)	Sustaining voltage A-K (I_A = 20 mA)	U_{BA}	-	115 V	-
Kathodenstrom Mittelwert	Courant cathodique valeur moyenne	Cathode current mean value	I_K	10 mA	-	40 mA
Anoden-Speisespannung	Tension d'alimentation anodique	Anode supply voltage	U_{A0}	180 V~ 250 V=	- -	250 V~ 350 V=
Gitterspannung für Sperrung der Röhre (U_A = U_{A0} max)	Tension de la grille pour blocage du tube (U_A = U_{A0} max)	Grid voltage for blocking the tube (U_A = U_{A0} max)	U_G	-6 V	-	-80 V
Gitterspannung für Freigabe der Röhre (U_A = U_{A0} min)	Tension de la grille pour libération du tube (U_A = U_{A0} min)	Grid voltage for release of the tube (U_A = U_{A0} min	U_G	-0,5 V	-	+50 V
Hilfskathodenstrom	Courant de la cathode auxiliaire	Auxiliary cathode current	I_{HK}	-100 µA	-	-250 µA

TYPISCHE BETRIEBSDATEN — OPERATION TYPIQUE — TYPICAL OPERATION



U_{A0}	220 V~ $^{+15}_{-20}$ %
R_A	Rel. ca 1,5 kΩ
I_A	15 mA
R_{HK}	1,2 MΩ, 1/2 W
I_{HK}	-160 µA
R_G	220 kΩ, 1/2 W
C	0,25 µF, 400 V=
G	700 V, 1 mA
U_G	7 V
U_{St}	5 V

MONTAGE in beliebiger Lage

MONTAGE en toute position

MOUNTING in any position

UMGEBUNGSTEMPERATUR
-30° bis +90° C

TEMPERATURE AMBIANTE
-30° à +90° C

AMBIENT TEMPERATURE
-30° to +90° C

LEBENSDAUER
Voraussichtlich über 25'000 Brennstunden bei Nennstrom.

DUREE DE SERVICE
Probablement plus de 25'000 heures de service continu dans les conditions normales.

LIFE EXPECTANCY
Presumably more than 25'000 working hours at normal current.

ZUENDKENNLINIE (A)

Dargestellt ist eine typische Zündkennlinie. Die Punkte A, B, C, D sind Kontrollpunkte der Grenzkennlinien.

A, B, D: alle Röhren sicher gesperrt.
C: alle Röhren sicher gezündet.

CARACTERISTIQUE D'AMORCAGE (A)

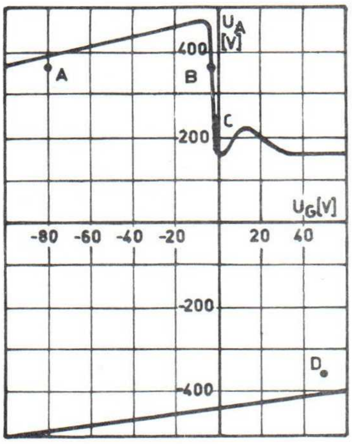
Une caractéristique typique est montrée. Les points A, B, C, D sont des points de contrôle des caractéristiques limites.

A, B, D: tous les tubes sûrement bloqués.
C: tous les tubes sûrement amorcés.

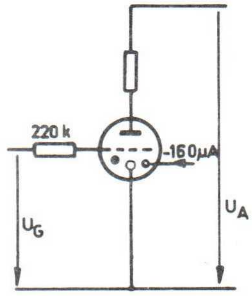
BREAKDOWN CHARACTERISTIC (A)

A typical characteristic is shown. The points A, B, C, D are control points of the limit characteristics.

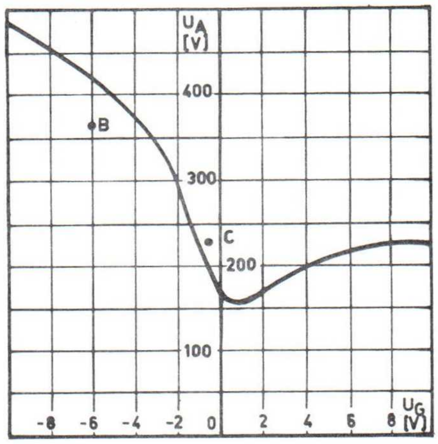
A, B, D: all tubes blocked securely.
C: all tubes fired securely.



A



B



STEUERKENNLINIE (B)

Die Steuerkennlinie zeigt einen Ausschnitt der Zündkennlinie in vergrössertem Masstab für U_G. Dargestellt ist eine typische Kennlinie. Die Punkte B und C sind Kontrollpunkte der Grenzkennlinien.

B: alle Röhren sicher gesperrt.
C: alle Röhren sicher gezündet.

CARACTERISTIQUE DE COMMANDE (B)

La caractéristique de commande montre une partie de la caractéristique d'amorçage en échelle agrandie pour U_G. Une caractéristique typique est montrée. Les points B et C sont des points de contrôle des caractéristiques limites.

B: tous les tubes sûrement bloqués.
C: tous les tubes sûrement amorcés.

CONTROL CHARACTERISTIC (B)

The characteristic shows a part of the breakdown characteristic in a larger scale for U_G. A typical curve is shown. The points B and C are control points of the limit characteristics.

B: all tubes blocked securely.
C: all tubes fired securely.

TYPISCHE SCHALTUNGEN

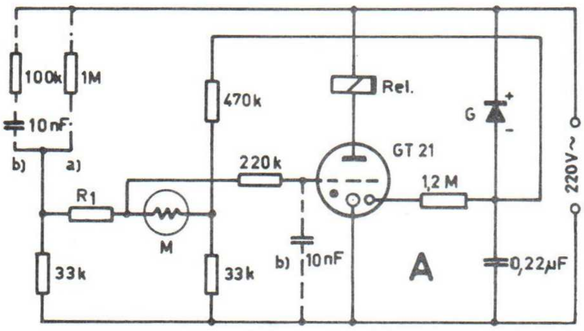
1) Steuerung durch Messelement M von veränderlichem Widerstand, z.B. Photowiderstand, Photodiode, Thermistor, Kontakt.

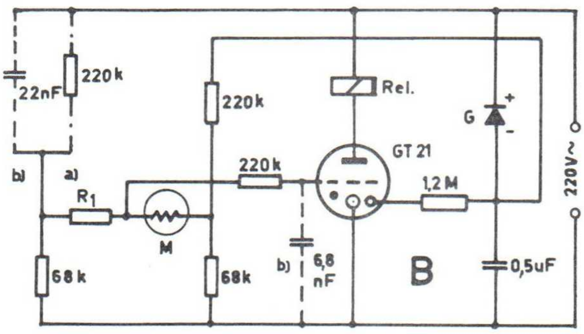
SCHEMAS TYPIQUES

1) Commande par élément de mesure M à résistance variable, p.ex. photo-résistance, photo-diode, thermistance, contact.

TYPICAL DIAGRAMS

1) Control by measuring element M with variable resistance, e.g. photoresistor, photodiode, thermistor, contact.





Schaltung A ist für kleine Spannungen am Messelement.
Schaltung B für hohe Schaltgenauigkeit.
Bei Einsetzen der gestrichelten Elemente anstelle der strichpunktierten wird ein Schaltintervall erhalten.
Durch Vertauschen von R_1 und M ergibt sich eine Umkehrung der Schaltfunktion.

Le schéma A est choisi si la tension sur l'élément M doit être petite.
Le schéma B est choisi si une grande sensibilité est exigée.
En remplacant les éléments -·-·-·- par les éléments pointillés, un intervalle est obtenu.
En interchangeant R_1 et M la fonction de commutation est inversée.

Diagram A is for low voltages on the measuring element.
Diagram B is for high sensitivity.
When the dash-dotted elements are replaced by the dotted elements a switching interval is obtained.
The switching function is inverted by exchanging R_1 and M.

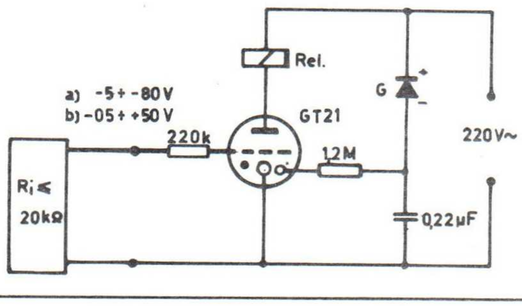
2) Steuerung durch transistorisierte Baugruppen.

2) Commande par des éléments transistorisés.

2) Control by transistorized elements.

a) Eingangsspannung für Sperrung der Röhre
Tension d'entrée pour bloquer le tube
Input voltage for blocking tube

b) Eingangsspannung für Zündung der Röhre
Tension d'entrée pour amorcer le tube
Input voltage for firing tube



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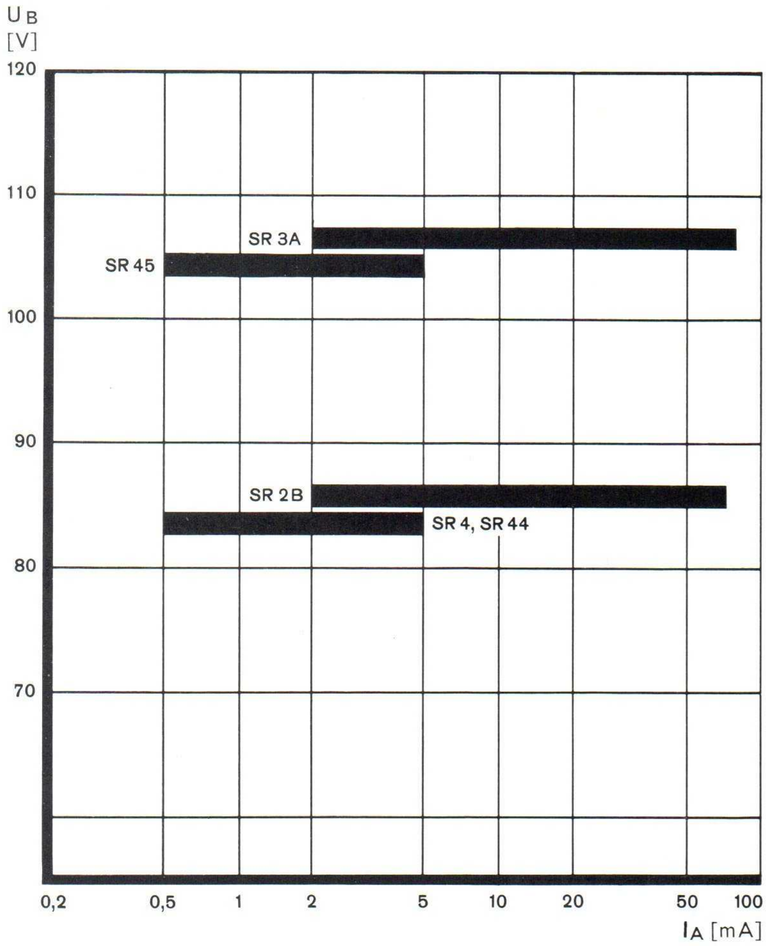
5

Spannungs-Stabilisierungsröhren
Tubes stabilisateurs
Voltage stabilizer tubes



Cerberus AG Werk für Elektronentechnik 8708 Männedorf/Schweiz Tel. 051-73 91 51 Telex 7 55 28

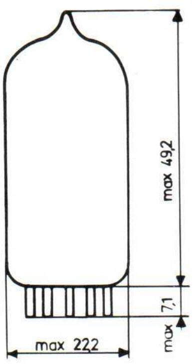
Nr. 5.01, Ed. 3.69

HAUPTDATEN			DONNEES PRINCIPALES			MAIN CHARACTERISTICS		
CERBERUS	Brennspannung Tension stabilisée Stabilized voltage U_B I V I	Arbeitsstrom Courant d'opération Operating current I_A I mA I	Max. Zündspannung Tension d'amorçage max. Max. breakdown voltage U_Z I V I	Innenwiderstand im normalen Strombereich Résistance interne dans la région du courant normal Internal resistance at normal current range R_i I Ω I	Aequivalente USA Röhre Tube USA équivalent Equivalent USA tube	Aequivalente Philips Röhre Tube Philips équivalent Equivalent Philips tube	Abmessungen Encombrement Dimensions Fig.	Sockelschaltung Brochage Base connections Fig.
SR 2 B	88	2-80	135	100			1	A
SR 3 A	107	2-80	155	200			1	A
SR 4 1)	85	0,5-5	110	200			4	
SR 44 1)	85	0,5-5	115	600		ZZ 1000 2)	5	
SR 45 1)	105	0,5-5	140	900			5	

1) Referenzröhre
Tube de référence
Reference tube

2) Kleine Unterschiede
Petites différences
Minor differencies

SOCKEL, ABMESSUNGEN — BROCHAGE, ENCOMBREMENT — BASE, DIMENSIONS



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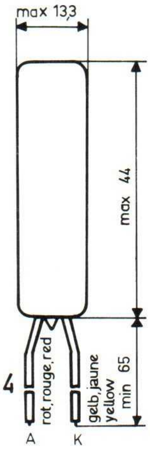

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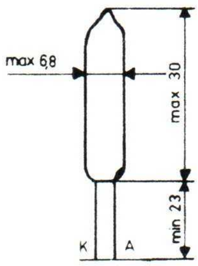
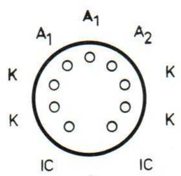


5

A, A_1, A_2: Anode

K : Katode
Cathode

IC : Interne Verbindung
Connexion interne
Internal connection



A

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Ask for our detailed information and data sheets.

VOLTAGE STABILIZERS

Principles of operation, characteristics and general application notes

Type	
Nr.	5.04e
Ed. 9.63	Fol. 1-2

CONTENTS

1. INTRODUCTION

The stabilizing effect of voltage stabilizer tubes (glow stabilizers) is based on the characteristic of a glow discharge in a rare gas. Voltage stabilizers are simple means of stabilizing voltages between 75 and some hundred volts at currents up to 100 mA. They compensate the variations of their supply voltage (stabilization) as well as variations of the load current (regulation).

During the past few years, a number of stabilizer tubes with close tolerances of the stabilized voltage has been developed. These tubes have been known as precision voltage stabilizers or voltage reference tubes.

2. PRINCIPLES OF OPERATION

A stabilizer tube is composed of several electrodes arranged in a glass bulb filled with rare gas: cathode K, anode A and sometimes a further anode, the firing anode A_Z. Figure 1 shows the symbolic representation of the tube in its circuit for measuring the current/voltage characteristic. When the supply voltage U_0 is in-

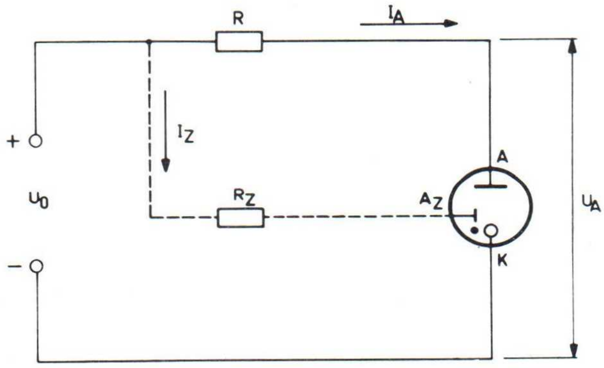


Fig. 1: Symbolic representation and measuring diagram for a stabilizer tube.

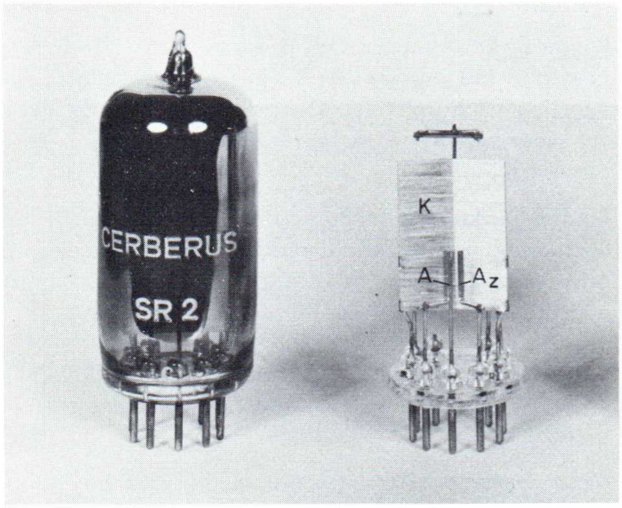


Photo: Precision stabilizer tube SR 2 with pure molybdenum cathode. U_B at 30 mA: 88 ± 2 V. Stabilizing range 2–80 mA. At the right: tube system: K = cathode, A = anode, A_Z = firing anode.

creased above the firing voltage U_Z, a glow discharge forms between cathode and anode. The anode current is limited by the resistor R. The voltage drop U_B across the tube is practically independent of the tube current. The current/voltage characteristic shown in figure 2 can be subdivised in three ranges that have a special meaning for the operation of the tube:

Point A: Beginning of the glow discharge. The corresponding voltage is known as the breakdown (firing, striking) voltage U_Z.

Range A–B: Subnormal glow discharge. The voltage drop is between the firing voltage U_Z and the stabilized voltage U_B. The discharge is not stable and the tube must not be run in this range.

Point B: Beginning of the normal glow discharge. The corresponding current is the minimum current required for correct operation of the tube (the corresponding

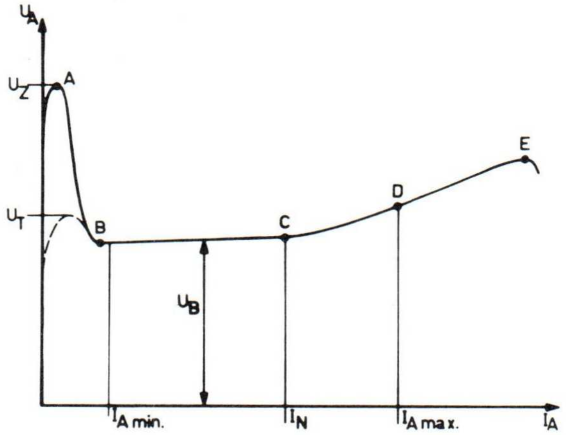


Fig. 2: Current/voltage characteristic. U_Z = firing voltage, U_B = stabilized voltage, I_{Amin} = minimum operating current, I_{Amax} = maximum operating current, other explanations see text.

value given in the data sheet, I_{Amin}, is chosen somewhat higher).

Range B-C: Normal glow discharge. With increasing current, the cathode is increasingly covered by the glow discharge.

Point C: The whole surface of the cathode is covered with glow. The corresponding current will be designated I_N.

Range C-E: Abnormal glow discharge. A further increase of the current results in an increase of current density at the cathode. The stabilized voltage increases more rapidly with increasing current than in the range B-C.

Point D: Maximum anode current I_{Amax}. This is not a particular point of the characteristic, it is chosen arbitrary considering the allowable heating of the tube and the life expectancy.

3. CHARACTERISTICS, CURVES AND THEIR DEPENDENCY ON EXTERNAL FACTORS. LIMITING VALUES

Most characteristics result from the current voltage characteristic and they will now be considered individually. Characteristics and curves are generally not fixed values and are affected by several external factors. The most important of these factors are enumerated under 3.1. When the different characteristics are discussed, their dependencies will be mentioned. Limiting values are arbitrary and are not influenced by these factors (exception: special working conditions).

3.1 Factors influencing characteristics and curves

a) production tolerances
b) ambient temperature
c) time (stocking, operation, time following switching on, breaks in operation, etc.)
d) history (e.g. overloads, repetitive firing, etc.)
e) spontaneous variations
f) frequency.

3.2 The breakdown voltage U_Z

For the breakdown voltage U_Z a maximum value is given which includes all possible factors. In complete darkness, the firing voltage of a tube may be higher, but most modern tubes are preionized with a radioactive material which cannot be detected outside the tube. By this means, the firing voltage becomes independent of illumination.

3.3 The transfer voltage U_T

When a firing current I_Z flows through the firing anode A_Z, the firing voltage of the main anode is reduced (dotted line in figure 2). The maximum firing voltage corresponding to a determined firing current I_Z is named transfer voltage U_T. For large firing currents I_Z, the transfer voltage can be reduced to the stabilized voltage U_B.

3.4 The stabilized voltage U_B

The stabilized voltage is a function of the anode current. The specification of a stabilized voltage must therefore be made with the anode current to which it refers.

The main factors influencing the stabilized voltage are: temperature, spontaneous variations, time, production tolerances.

3.4.1 The temperature coefficient

The temperature coefficient of the stabilized voltage indicates its change per °C of temperature change. It is of the order of some mV/°C.

3.4.2 Initial drift

For a short period after the switching on of the anode current, the stabilized voltage may vary until it reaches a stable value. This phenomenon is named initial drift and may occur over a period of minutes. The variation of the stabilized voltage will be between fractions of per cent and several percent.

3.4.3 Long term stability

The stabilized voltage can show a systematic change over long operation periods. In this case, the change is indicated as a percentage per 1000 hours.

3.5 The stabilizing range

The stabilizing range is defined by the currents I_{Amin} and I_{Amax} which are limiting values.

3.6 The starting current

When the stabilizer tube supplies a load with delayed current, a higher starting current flows through the stabilizer tube. In many cases the starting current (peak current) for a tube is indicated on its data sheet and in some instances its duration. The duration is generally longer, the lower the starting current.

3.7 Stabilizing characteristic

The stabilizing characteristic shows the current/voltage curve within the stabilizing range of the tube. The scale is chosen in such a manner that details are neatly visible (fig. 3). The stabilizing characteristic is subjected to the same influences as the stabilized voltage. The following phenomena will be observed.

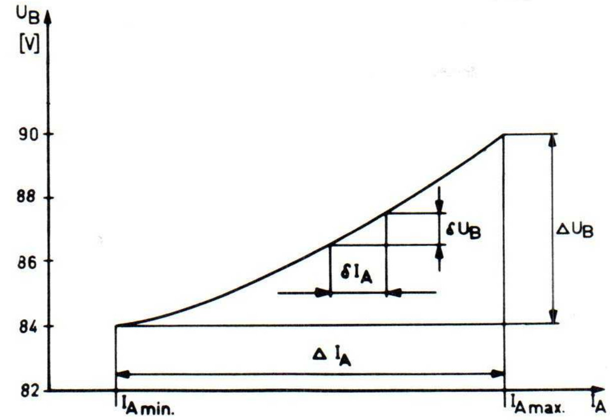


Fig. 3: Stabilizing characteristic.

3.7.1 Modification of the stabilizing characteristic

If a precision voltage stabilizer tube or a voltage reference tube with pure metal cathode is operated at an anode current below I_N, the stabilizing characteristic is modified because the non-operative part of the cathode becomes inactive. This is shown in figure 4. In a following operation period with an anode current above I_N, the characteristic is slowly returned to the original form.

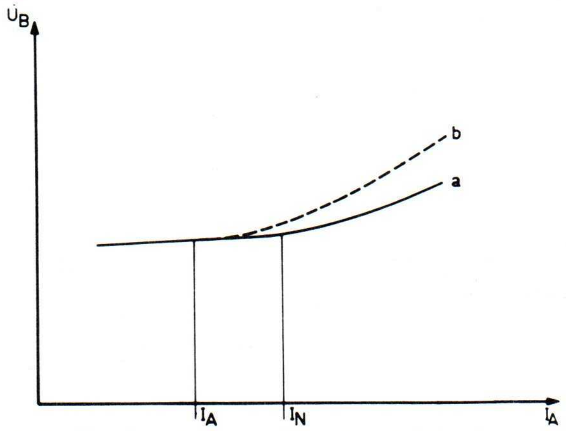


Fig. 4: Modification of the stabilizing characteristic of a precision voltage stabilizer tube operated at $I_A < I_N$. a: original characteristic, b: modified characteristic after a prolonged operating at $I_A < I_N$.

3.7.2 Voltage jumps

The stabilizing characteristic may show sudden variations of the stabilized voltage known as voltage jumps. Depending on the type of tube these voltage jumps can be of the order of mV up to several volts. Reference tubes that are operated in the range $I_A > I_N$ show practically no voltage jumps. An example for voltage jumps is given in figure 5.

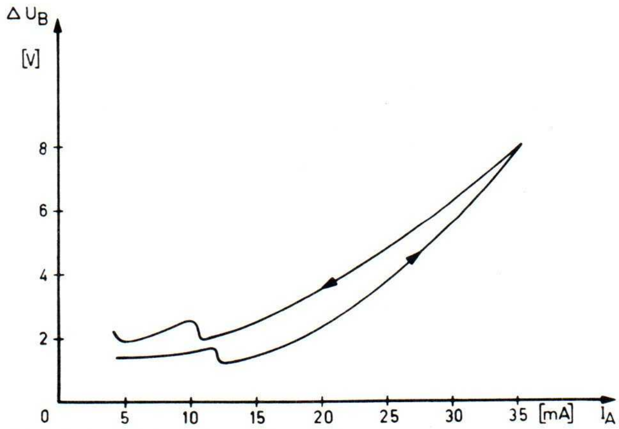


Fig. 5: Stabilizing characteristic with voltage jumps and hysteresis.

3.7.3 Hysteresis

When the stabilizing characteristic is measured with increasing current and afterwards with decreasing current a hysteresis phenomenon is present if these two characteristics are not identical (figure 5).

3.8 The internal resistance

The internal resistance (differential resistance) of a stabilizer tube is the differential resistance resulting from the stabilizing characteristic: $R_i = \frac{\delta U_B}{\delta I_A}$ (figure 3).

The figure shows that the internal resistance is not constant over the whole stabilizing range, but depends upon the current. For calculation purposes the mean value of the internal resistance is generally used.

The internal resistance shown by the stabilizing characteristic is valid for slow current changes. For fast changes it shows an ohmic and an inductive component which both vary with frequency (figure 6).

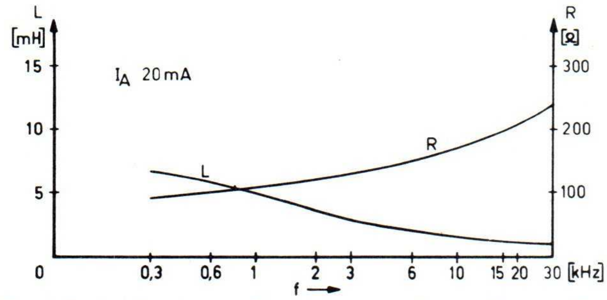


Fig. 6: Typical Impedance – Frequency curve of a precision stabilizer tube (Cerberus SR 2).

3.9 The regulation

Instead of the internal resistance the voltage variation between two determined current values (e.g. I_{Amin} and I_{Amax}, figure 3) is often given. This variation is named regulation and shows the following relation with the mean value of the internal resistance for the same current range: $\Delta U_B = \Delta I_A \cdot R_i$.

3.10 Noise

Every glow discharge has a noise output. This will vary between approx. 100 µV and several mV for typical stabilizer tubes.

The noise voltage depends on the tube current and it increases with decreasing tube current.

3.11 Life expectancy

The end of life is reached when definite characteristics (e.g. the stabilized voltage) pass determined limits. The life expectancy is mainly influenced by the tube current and is reduced with increasing tube currents.

4. CLASSIFICATION OF STABILIZER TUBES

As already mentioned, different classes of stabilizer tubes have been formed which differ in their characteristics and applications. It has to be borne in mind that the classification is not in all cases very consequent.

4.1 Stabilizer tubes

In a narrow sense, the term "stabilizer" applies to tubes with relatively large tolerances of the stabilized voltage and generally a large stabilizing range. Maximum anode current may be 15-80 mA. Generally indications on long term stability, voltage jumps, spontaneous variations, etc. are not given.

4.2 Precision voltage stabilizers

Precision voltage stabilizers are characterized by narrow tolerances and good stability of the stabilized voltage. Relatively large stabilizing range ($I_{Amin} : I_{Amax} = 1:4 \div 1:20$). The stabilizing range extends over the range of the normal and abnormal glow discharge (see paragraph 2). When the tube is run with $I_A < I_N$ the stabilizing characteristic may be modified as described in paragraph 3.7.1. Precision voltage stabilizers show practically no spontaneous variation of the stabilized voltage and voltage jumps are small.

4.3 Voltage reference tubes

Voltage reference tubes are precision voltage stabilizers that are operated in the range of the abnormal glow discharge (see paragraph 2).

Thus the modification of the stabilizing characteristic is avoided and voltage jumps are reduced to a negligible value. The stabilizing range is small (approx. 1:2) and the maximum anode current below 10 mA. Precision voltage stabilizers are sometimes referred to as reference tubes, but to be operated as reference tubes they must be used within a restricted range. On the other hand, voltage reference tubes can sometimes be operated in a wider stabilizing range as precision stabilizers.

5. GENERAL APPLICATION NOTES

5.1 Negative anode voltage

Cathode and anode must not be interchanged. Precautions have also to be taken that no inverse firing (anode negative) can occur. This would destroy the tube. In general, negative anode voltages that may occur during operation must not exceed the stabilized voltage. If the data sheet states a limit for the anode negative voltage, this must be respected.

5.2 Prefiring

For tubes with a firing anode it is an advantage to connect this firing anode. This avoids initial over-voltages on the load and, in many cases, the stabilizing range can be better utilized, especially for higher load currents.

In precision voltage stabilizers for low currents, the current in the firing anode can be used to improve the stabilizing characteristic in the range of the minimum current.

5.3 Operating current

When the operating current is chosen, the possible modification of the stabilizing characteristic (paragraph 3.7.1) has to be borne in mind for precision voltage stabilizers.

With large delayed load currents a higher initial current occurs in the stabilizer. If the data sheet gives no value for the maximum starting current, this can be chosen to be between 2 and 3 times the maximum tube current.

5.4 Parallel capacitors

For short-circuiting the impedance of the stabilizer tube at higher frequencies, parallel capacitors are used. As this may lead to relaxation oscillations, their value has to be kept as low as possible. In order to avoid an excessive peak current when the tube is fired, a series resistor of 100 to 1000 Ω in series with the capacitor must be used. This resistor is not necessary for tubes with correctly connected firing anodes.

Sometimes the data sheet gives the maximum value of the parallel capacitor and this must be respected.

5.5 Ambient temperature

If a tube is to be operated at temperatures outside the temperature range stated on the data sheet, the manufacturers should be consulted. The information on the data sheet refers to the ambient temperature when the tube is in operation.

The maximum storage temperature for the tubes may be lower than the maximum operating temperature for precision voltage stabilizers and reference tubes.

5.6 Magnetic effects

Strong alternating magnetic fields from transformers or inductors can cause a hum modulation on the stabilized voltage. If this modulation presents any difficulty, the stabilizer tubes must be mounted at a sufficient distance from the transformer or inductor.

5.7 Calculation of stabilizing circuits

The calculation of stabilizing circuits is treated, with examples, in document 5.07 e.

6. LITERATURE

More information about operating principles, characteristics and curves as well as a summary of literature is given in No 10 of the house paper "Cerberus Elektronik" (available in German and French).

STABILIZER TUBES

Design of stabilizing circuits

CONTENTS

1. GENERAL

The principle of operation of stabilizer tubes (glow stabilizers) is explained in Information sheet 5.04 e. This sheet also contains information on characteristics and their interpretation as well as general application notes.

A summary of Cerberus stabilizer tubes, their stabilized voltage and their operating range is given on the summary sheet 5.01. The present document contains full information for designing stabilizing circuits. In particular a general formula is given, the application of which is simplified by a graphic representation. The theory is completed with examples of calculation.

2. DESIGN PARAMETERS OF THE STABILIZING CIRCUITS

2.1 The unloaded stabilizing circuit

Figure 1 shows the basic stabilizing circuit: the supply voltage U_0 is connected to the stabilizer tube through the resistor R. Across the stabilizer tube, we find the stabilizing voltage U_1 which in this case is equal to the maintaining voltage U_B of the tube. The current I through the resistor is equal to the tube current I_A. Currents and voltages are represented graphically in figure 2. If the input voltage U_0 varies by the amount ΔU_0 this variation causes a variation ΔI_A of the tube current. As the maintaining voltage of the tube is not entirely independent of current, but increases with increasing tube current, the current variation causes a voltage variation ΔU_B. This, however, is substantially smaller than the original variation ΔU_0 of the supply voltage. The ratio of the relative variation of the input voltage to the relative variation of the output voltage is designated "stabilizing factor" S:

$$S = \frac{\Delta U_0}{U_0} \Big/ \frac{\Delta U_B}{U_B}$$

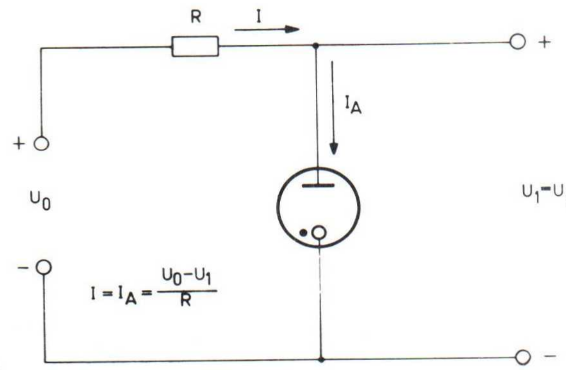


Fig. 1: Unloaded stabilizing circuit.

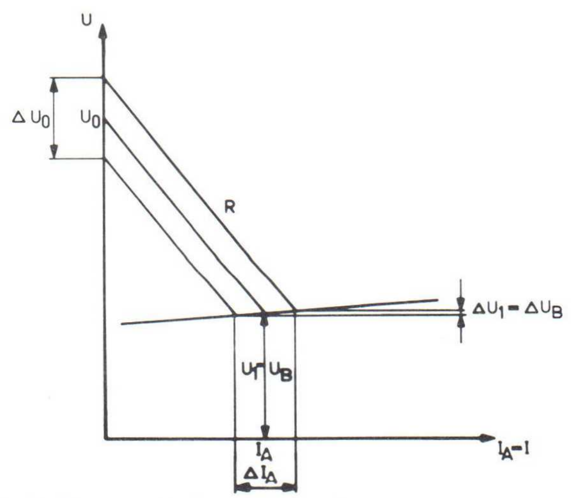


Fig. 2: Currents and voltages in the unloaded stabilizing circuit.

2.2 Effect of the load current

Naturally, it must be possible to draw a load current from the stabilized voltage. The load is represented in figure 3 by the load resistor R_V, the load current is I_V. Through the resistor R the sum of the tube current and the load current is flowing: $I = I_A + I_V$. The graphic representation chosen for figure 4 clearly shows this addition of the currents. [Here, as well as in the following discussions, the stabilized voltage U_B is assumed to be constant, which is admitted for all calculations with the exception of the calculation of the stabilizing factor.]

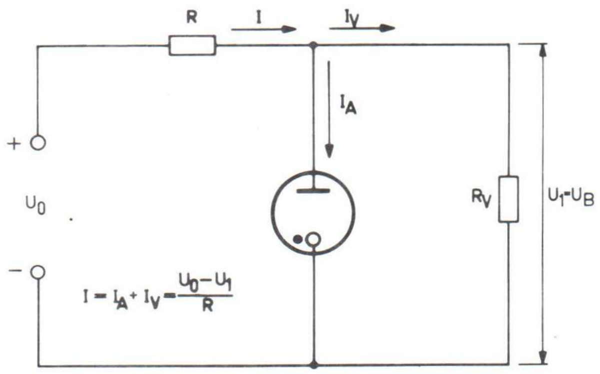


Fig. 3: Loaded stabilizing circuit.

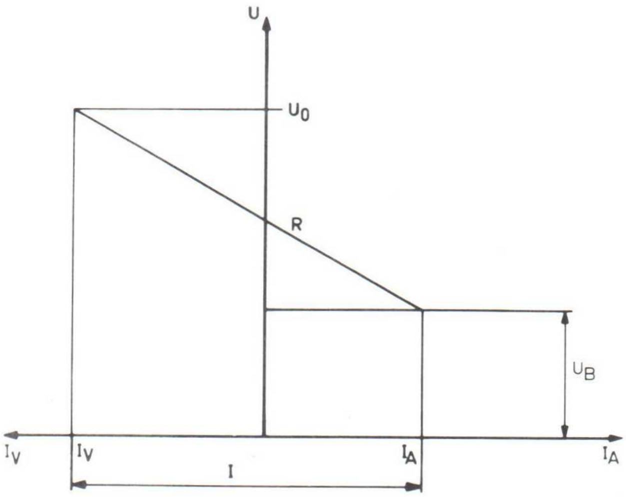


Fig. 4: Currents and voltages in the loaded stabilizing circuit.

Figure 5 shows the variation of the tube current with a constant load current and varying supply voltage U_0. For the same values of U_0, U_1 and I_A the resistance line representing R has a smaller slope than in figure 2 (the resistance is smaller): for a given variation of the supply voltage, the variation of the tube current will be higher with higher load current I_V.

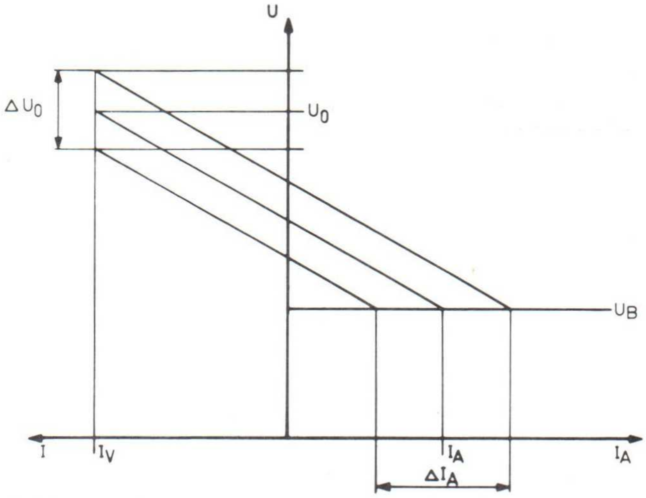


Fig. 5: I_V = constant, U_0 varies.

2.3 Variation of the load current

Figure 6 shows that the variation of the tube current ΔI_A is equal to the variation of the load current ΔI_V if the supply voltage U_0 is held constant.

Figure 7 shows the variation of the tube current that results from the variation of the load current and the variation of the supply voltage.

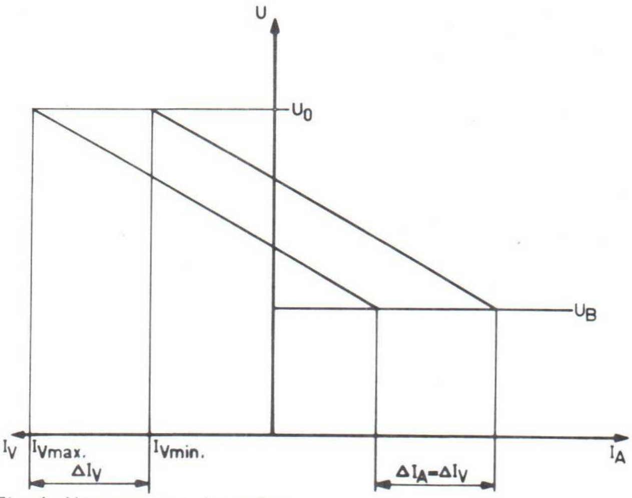


Fig. 6: U_0 = constant, I_V varies.

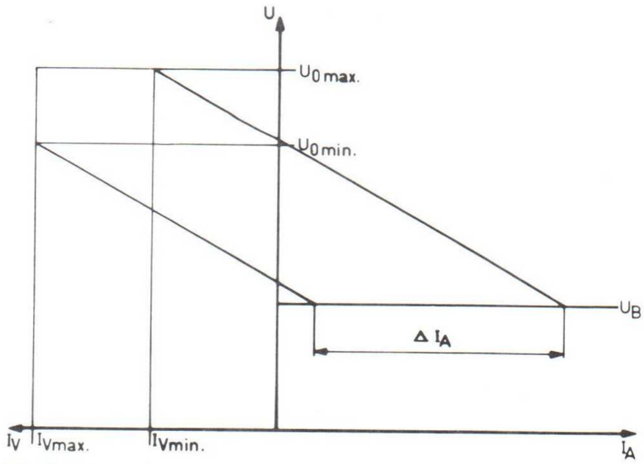


Fig. 7: U_0 and I_V vary.

2.4 Effect of the resistor tolerance

In a production equipment, the value of the resistor R must not be considered as being constant; it will vary from one piece of equipment to the other, resulting in different values of the tube current. This is shown in figure 8.

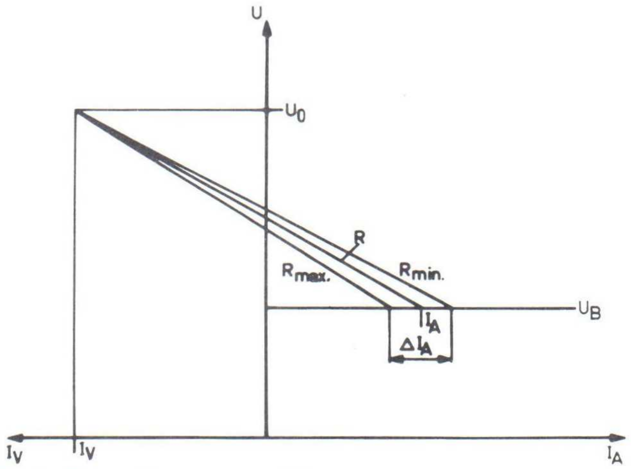


Fig. 8: Effect of the tolerance of R.

Figure 9 shows the combined effect of the variation of the supply voltage, the variation of the load current and the tolerance of the resistor R on the tube current. The stabilizing circuit should be designed in such a way that the resulting minimum and maximum values of the tube current will lie within the limits given by the data sheet.

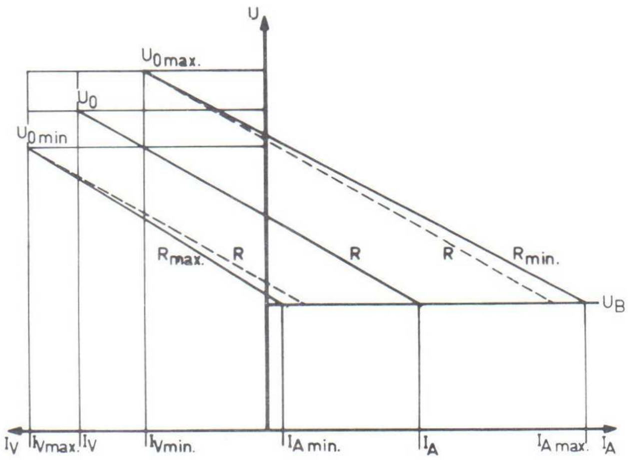


Fig. 9: Effect of all the circuit variations and tolerances: variations U_0, I_V, tolerance R.

2.5 Effect of the slope of the tube characteristic

In the preceeding considerations an ideal tube characteristic has been assumed (maintaining voltage independent of tube current). Generally, a maintaining voltage increases with increasing anode current. The differential resistance $\Delta U_B/\Delta I_A$ is designated as the internal resistance of the tube.

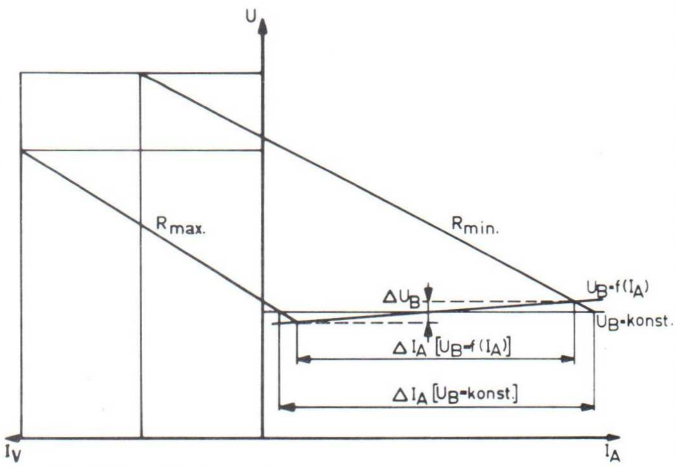


Fig. 10: Effect of the internal resistance.

Figure 10 shows that the total variation of the tube current becomes smaller when the internal resistance is considered and if the circuit parameters are held constant. However, the effect is small and will not be taken into account in the following calculations. This gives an additional safety margin.

2.6 Effect of tube tolerances

The maintaining voltage U_B varies from one tube to an other, it is subject to a tolerance. The effect of this tolerance on the variation of the tube current is shown in figure 11. For small tube tolerances the effect on the tube current is small and will compensate approximately the already neglected effect of the internal resistance. In special cases (e.g. large tolerance of U_B), it is necessary to take the tolerance into account by calculating with the maximum maintaining voltage U_{Bmax} instead of the mean maintaining voltage U_B.

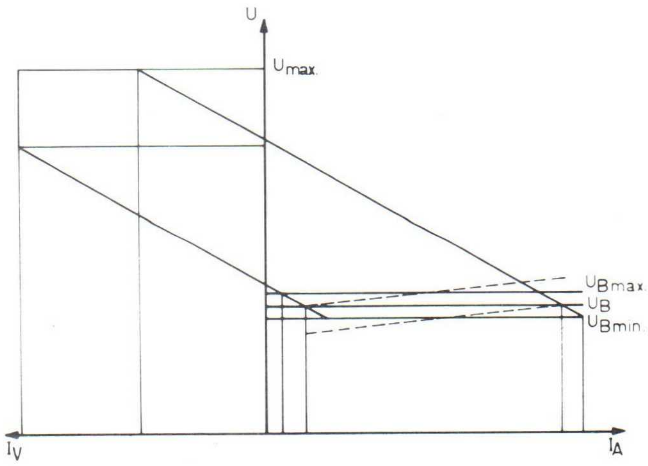


Fig. 11: Effect of the tube tolerance.

2.7 Starting current

If the load current or part thereof is delayed (e.g. when the load consists of heated switching tubes), the initial load on the stabilizer tube is higher as shown in figure 12. Usually the permitted initial current is indicated by the tube manufacturer. This current has to be respected when designing the circuit.

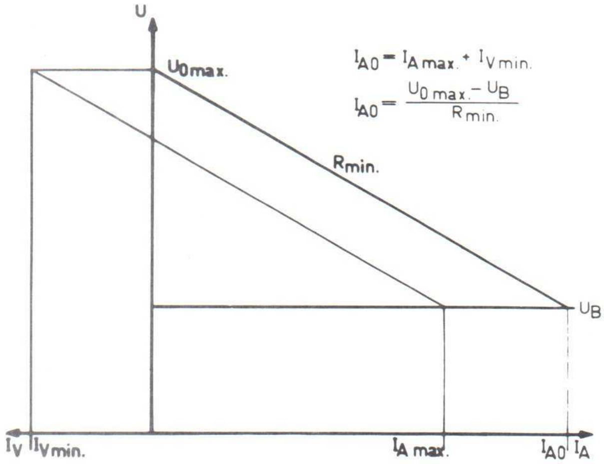


Fig. 12: Starting current.

2.8 Firing condition

Before the stabilizing action can take place, the tube must be fired. The breakdown voltage (firing voltage) U_Z of a tube is always higher than the maintaining voltage. If no load current is present when the supply voltage is switched on, the only condition is: $U_{0min} > U_Z$. If, however, a load current is initially present, the value of which shall be I_{V0max} (at $U_1 = U_Z$), the circuit must be designed in such a manner that the voltage across the tube exceeds U_Z. Figure 13 shows that the required minimum supply voltage U_{0min}, that secures correct firing of the tube, will be higher with

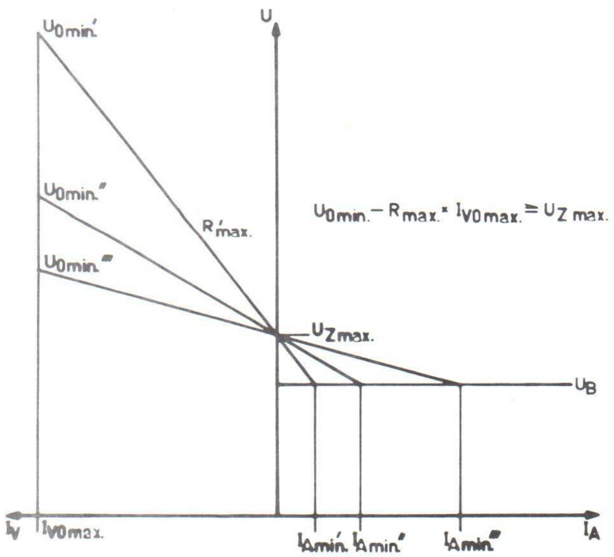


Fig. 13: Firing condition.

increasing firing voltage U_Z, increasing load current I_{V0max} and decreasing minimum anode current I_{Amin}.

Stabilizer tubes with a correctly connected firing anode fire with a few volts overvoltage. In this case, it is not necessary to consider the firing condition.

3. CONNECTIONS

3.1 Summary of the circuit parameters

The following summary of the circuit parameters is based on the preceeding figures:

3.1.1 Tube characteristics (from data sheet)

U_{Zmax}	maximum breakdown voltage
U_B	maintaining voltage (U_{Bmin}, U_{Bmax})
I_{Amin}	minimum anode current
I_{Amax}	maximum anode current
I_{A0max}	maximum initial current
ΔU_B	regulation

3.1.2 Circuit parameters

I_{Vmin}	minimum load current
I_{Vmax}	maximum load current
I_{V0max}	maximum initial load current, when $U_1 = U_{Zmax}$
U_0	supply voltage
q, r	relative variation of the supply voltage $\left(\frac{\text{percentual variation}}{100}\right)$ $U_{0min}^{max} = U_0\ (1 {}^{+q}_{-r})$
R	series resistor
p	relative tolerance of series resistor $\left(\frac{\text{percentual tolerance}}{100}\right)$ $R_{min}^{max} = R\ (1 \pm p)$

3.2 Formulas

3.2.1 Basic formulas

Figure 9, 12 and 13 show that four conditions must be fulfilled for correct operation of a stabilizer tube. These conditions are defined by the following expressions:

a) The tube current must be higher than the minimum anode current (figure 9).

Formula A: $\frac{U_{0min} - U_B}{R_{max}} - I_{Vmax} \geq I_{Amin}$

Instead of U_B, U_{Bmax} (I_{Amin}) ought to be introduced. However, the effect is negligible.

b) The maximum anode current must not be exceeded:

Formula B: $\frac{U_{0max} - U_B}{R_{min}} - I_{Vmin} \leq I_{Amax}$

Instead of U_B, U_{Bmin} (I_{Amax}) ought to be introduced. However, the effect is negligible.

c) The tube must fire when the supply voltage is switched on (firing condition, figure 13).

Formula C: $U_{0min} - R_{max} \cdot I_{V0max} \geq U_{Zmax}$

d) The maximum initial current must not be exceeded (figure 12).

Formula D: $\frac{U_{0max} - U_B}{R_{min}} \leq I_{A0max}$

Instead of U_B, U_{Bmin} (I_{A0max}) ought to be introduced.

By a suitable combination of the conditions, the general formula given in paragraph 3.2.2 is obtained. It gives the minimum value of U_0 at which the entire stabilizing range of the tube is used. The order of calculation given in paragraph 4 has proved to be the most suitable.

The formulas A–D as well as the following formulas are given for a single tube. In a series connection of several tubes (see paragraph 5.2) U_1 has to be introduced instead of U_B.

3.2.2 Calculating the supply voltage U_0

Formula 1 $$\frac{U_0}{U_B} \geq \frac{\alpha \cdot \beta - 1}{\alpha \cdot \beta\ (1 - r) - (1 + q)}$$

there is: $\alpha = \frac{I_{Vmin} + I_{Amax}}{I_{Vmax} + I_{Amin}}$; $\beta = \frac{1 - p}{1 + p}$

In figure 18 (appendix) the function U_0/U_B in function of α is given for several common values of p, q and r. In most cases these curves help to avoid calculation.

3.2.3 Calculating the series resistor

Formula 2 $$R = \frac{U_0\ (1 - r) - U_B}{(I_{Vmax} + I_{Amin})\ (1 + p)}$$

For I_{Vmax} and I_{Amin} in mA, R results in kΩ. R has to be rated for the power P_R:

Formula 2a $$P_R = \frac{[U_0\ (1 + q) - U_B]^2}{R\ (1 - p)}$$

3.2.4 Verification of the firing condition

Formula 3 $$U_{Zmax} \leq U_0\ (1 - r) - I_{V0max} \cdot R\ (1 + p)$$

If the firing condition is not satisfied, two ways are open:

a) Repeating the calculation with a value I_{Amin}' that is higher than I_{Amin} until the firing condition is satisfied.

b) Calculating U_0 with formula 4.

3.2.5 Calculating the supply voltage with respect to the firing condtions

Formula 4 $$\frac{U_0}{U_B} = \frac{\frac{U_Z}{U_B}\gamma \cdot \beta - 1}{\gamma \cdot \beta\ (1 - r) - (1 + q)}$$

there is: $\gamma = \frac{I_{Vmin} + I_{Amax}}{I_{V0max}}$; $\beta\ \frac{1 - p}{1 + p}$

Formula 4 may only be used if the firing condition is not satisfied when using formula 1. Again, R is determined by the formula 2. If the value is of interest, the resulting minimum tube current I_{Amin}' (which will be higher than the limiting value I_{Amin}) may be calculated with formula A.

3.2.6 Partial utilization of the stabilizing range

It may be desirable to use only part of the stabilizing range of the tube, e.g. if the variation of the output voltage has to be small. In this case, the lower current I_{Amax}' is introduced instead of I_{Amax} in formula 1, while the rest of the calculation is unchanged.

3.3 The stabilizing factor

The stabilizing factor (S) gives the reduction of the percent variation of the input voltage resulting from the stabilizing action.

$$S = \frac{\Delta U_0}{U_0} \Big/ \frac{\Delta U_B}{U_B}$$

In this formula ΔU_B is the variation of the maintaining voltage that results from a variation of the tube current ΔI_A, caused by the variation of the supply voltage.

$$S = S_{max} - \frac{S_{max} - 1}{\frac{U_0}{U_B}}$$; where $S_{max} = \frac{U_B}{R_i} \cdot \frac{1}{I_A + I_V}$ and $I_A + I_V = \frac{U_0 - U_B}{R}$

R and R_i in kΩ, $I_A + I_V$ in mA.

In most practical cases, the maximum variation of the stabilized voltage will be more important than the stabilizing factor. For some tubes the stabilizing factor as a function of U_0/U_B is given on the data sheet for different currents $I_A + I_V$.

4. DESIGN PROCEDURE

4.1 The supply voltage U_0 can be chosen

The stabilized voltage is determined by the load, also the minimum and the maximum load current. Consequently, the maintaining voltage of the tube is determined. As a rule the maximum tube current I_{Amax} is chosen at least 2 x I_{Vmax}, whereby the tube type is determined.

4.1.1 α is determined.
Then the value U_0/U_B is looked up in figure 18. If this value exceeds 3, it is necessary to reduce the tolerance of the series resistor R (extrem case: ± 0 = variable series resistor) or to chose a tube with a higher maximum current. Better stabilization will result if a higher value of U_0 than the calculated minimum value is chosen. At the same time, the stabilizing range of the tube will be only partially used.

4.1.2 Calculate the series resistor R with formula 2.

4.1.3 Verify the firing condition with formula 3 (this is not necessary when a tube with correctly connected firing anode is used). If this condition is not satisfied; proceed according to paragraph 3.2.4.

4.1.4 Verify the initial current (formula D).

4.1.5 If desired: calculate the stabilization factor according to paragraph 3.3.

4.2 The supply voltage U_0 is given

Determine the tube type as in paragraph 4.1.

4.2.1 Determine α from the tube characteristics and circuit parameters. Calculate U_0/U_B and verify from figure 18 if U_0 is sufficiently high for the required variation of U_0 (eventually a series resistor with closer tolerance may have to be chosen). If U_0 is too small, a tube with a larger stabilizing range has to be chosen. If U_0 is sufficiently high, then:

4.2.2 Calculate the series resistor R with formula 2.

4.2.3 Verify the firing condition with formula 3. If not satisfied: calculate the series resistor with respect to the firing condition:

Formula 5:
$$R = \frac{U_0\,(1 - r) - U_{Zmax}}{I_{V0max}\,(1 + p)}$$

I_{V0max} in mA gives R in kΩ.

4.2.4 Calculate the maximum tube current I_{Amax}'. If R has been calculated with formula 2, this value is automatically smaller than I_{Amax}. If R has been calculated with formula 5, it has to be verified if $I_{Amax}' < I_{Amax}$. (If desired: calculate I_{Amin} with formula A).

Formula 6:
$$I_{Amax}' = \frac{U_0\,(1 + q) - U_B}{R\,(1 - p)} - I_{Vmin} \leq I_{Amax}$$

I_{Amax}' results in mA if R is given in kΩ, U_0 and U_B in volts.

4.2.5 Verify the initial current with formula D.

4.2.6 If desired the stabilizing factor can be calculated according to paragraph 3.3.

4.3 The maximum variation of the stabilized voltage U_B is given

For the stabilized voltage U_1, distinction has to be made between the tolerance and the variation.

The tolerance is caused by the tolerance of the maintaining voltage U_B and the tolerance of the series resistor R. In a series production the tolerance is the variation between different pieces of equipment.

The variation is caused by the variation of the tube current, caused by the variation of the supply voltage and the load current. It depends on the variation of the tube current and on the stabilizing characteristic (internal resistance R_i or regulation ΔU_B). Furthermore, the tube may present short term or long term variations of the maintaining voltage.

In order to simplify the calculation, the tolerance of the series resistor is added to the variation.

4.3.1 Determine the tube type

4.3.2 Determine the permitted variation of the anode current (upper limit I_{Amax}'), that will keep ΔU_B within the required limits. The lower tube current limit is made to be equal I_{Amin}, if there are no reasons for choosing a higher minimum current. (In this case: I_{Amin}').

4.3.3 The order of calculation is the same as indicated in paragraph 4.1, whereby the current limits I_{Amin} (I_{Amin}') and I_{Amax}' are used in the formulas.

4.4 General considerations

4.4.1 The supply voltage U_0 must be chosen to be as high as possible. Generally it is between 1.5 and 3 times the stabilized voltage.

4.4.2 The maximum anode current of the tube is generally approximately twice the maximum load current.

4.4.3 For reference voltages, a cascade stabilization has to be used.

5. CIRCUITS

5.1 Prefiring

Tubes having a firing anode are connected according to figure 14. The resistor R_Z is chosen according to data sheet ($R_Z = \frac{U_0 - U_B}{I_Z}$), the minimum supply voltage U_{0min} must be higher than the firing voltage of the firing anode U_{ZZmax}. The prefiring avoids initial overvoltages at the load and a verification of the firing condition is not necessary.

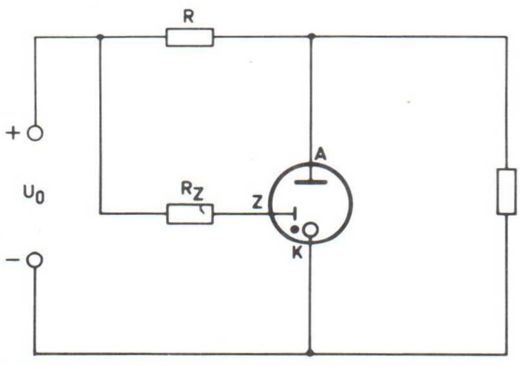


Fig. 14: Prefiring.

5.2 Series connection

Stabilizer tubes having the same or different maintaining voltages can be connected in series. The stabilized voltage is equal to the sum of all maintaining voltages: $U_1 = U_{B1} + U_{B2} + U_{B3} + \ldots$ If the tubes have different stabilizing ranges, only the stabilizing range common to all tubes is available in the series connection.

In order to keep the firing voltage of the series connection low, all tubes except one are bridged with the resistors R_1, R_2 etc., as indicated in figure 15. The firing voltage of the series connection is equal to the maximum firing voltage of the lowest tube plus the sum of the maintaining voltages of the other tubes. In most cases, the firing condition will not be critical. If the lowest tube has a firing anode, it ought to be connected.

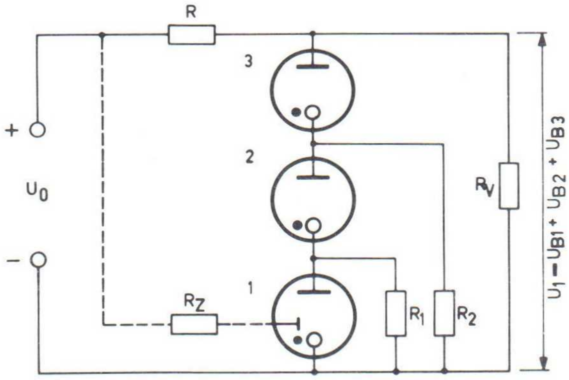


Fig. 15: Series connection.

5.3 Cascade connection

With cascade stabilization a specially low variation of the load voltage is obtained (figure 16): The supply voltage of the tube stabilizing the load voltage is pre-stabilized. The curves $U_0 \pm 5\%$ in figure 18 refer to this case. The total stabilizing factor is: $S = S_1 \cdot S_2$.

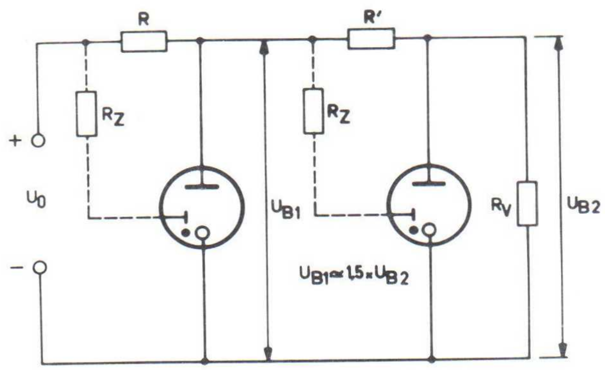


Fig. 16: Cascade connection.

5.4 Reference voltages

For obtaining stable reference voltages with no voltage jumps, the reference tubes have to be operated in a relatively small current range. In most cases, a cascade stabilization according to paragraph 5.3 is indicated.

5.5 Parallel connection

In general a parallel connection is not recommended as the tolerances of the maintaining voltages will result in an equal current sharing of the different tubes.

Tubes having a firing anode and close maintaining voltage tolerances can be connected in parallel. For two tubes, however, the permitted current is not doubled. In the case of SR 2 it may be 1.5 times the current of one tube.

5.6 Disconnecting the load

In many stabilizer tubes the anode and cathode connections are brought out to several pins. In this case, the supply voltage and the load may be connected to two different pins. The voltage on the load will be disconnected when the tube is taken out of its socket (figure 17).

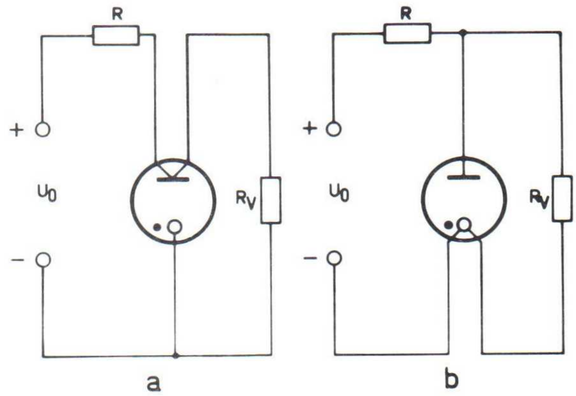


Fig. 17: Disconnection of the load when the tube is taken out.

6. EXAMPLES

6.1 Stabilizing 265 V, 10-40 mA

Given: $U_1 = 265$ V (= 3 x 88 V)
$I_{Vmin} = 10$ mA, $I_{Vmax} = 40$ mA.

The claim $I_{Amax} = 2 \cdot I_{Vmax}$ leads to $I_{Amax} = 80$ mA. The tube SR 2 has the right current range and the right maintaining voltage: 3 tubes type SR 2 are connected in series according to figure 15. $I_{Amin} = 2$ mA, $I_{Amax} = 80$ mA.

The variation of the supply voltage will be $^{+14}_{-18}$% corresponding to variation of the line voltage (220 V AC) between 180 V AC and 250 V AC. The tolerance of the series resistor should be ± 5 %. Therefore: p = 0.05, q = 0.14, r = 0.18.

Calculation (see paragraph 4.1):

$$\alpha = \frac{10 + 80}{2 + 40} = \frac{90}{42} = 2.14$$

The curve R = ± 5 %, U_0 $^{+14}_{-18}$% on figure 18 gives for $\alpha = 2.14$: $U_0/U_1 = 2.16 \rightarrow U_0 = 572$ V. Chosen value: $U_0 = 575$ V.

$$R \text{ (formula 2)} = \frac{575 \cdot 0.82 - 265}{(40 + 2) \cdot 1.05} = \frac{472 - 265}{42 \cdot 1.05}$$

R = 4.7 kΩ ± 5 %.

It is not necessary to verify the firing condition as the tubes have a firing anode. If the tubes had no firing anode, the firing voltage of the series connection would be according to paragraph 5.2: $U_{Zmax} + 2 \times U_B$ (U_{Zmax} for SR 2 = 135 V), therefore U_{Zmax} in formula 3: $135 + 2 \times 88 \simeq 310$ V.

According to formula 3:

$$U_0 (1 - r) - I_{V0max} \cdot R (1 + p) \geq U_{Zmax}$$
$$575 \cdot 0.82 - 40 \cdot 4.7 \cdot 1.05 = 471 - 197 = \underline{\underline{274}}$$

Without prefiring the firing condition would not be satisfied. (For $I_{V0max} = I_{Vmax}$: maximum load current is flowing when the supply voltage is switched on).

A higher initial current does not occur as the load current is initially present.

The stabilizing factor S is:

$$R_i = 100\ \Omega,\ I_A + I_V = \frac{U_0 - U_1}{R} = 67 \text{ mA}$$
$$S_{max} = \frac{88}{0.1} \cdot \frac{1}{67} = 13.1$$
$$\underline{\underline{S}} = 13.1 - \frac{13.1 - 1}{2.17} = \underline{\underline{7.5}}$$

This means: A 10 % variation of the supply voltage is reduced to a 1.3 % variation of the stabilized voltage.

6.2 Stabilizing the charging voltage in an electronic timer

A rectified line voltage is used as supply voltage: $U_0 = 300\ V^{+14}_{-18}\%$. The charging voltage will be 170 V (2 x SR 6). The charging resistor will be 470 kΩ minimum, therefore the maximum charging current (load current) is: $\frac{170}{470} = 0.35$ mA ($= I_{Vmax}$); $I_{Vmin} = 0$; $I_{Amin} = 0.5$ mA, $I_{Amax} = 5$ mA $\rightarrow \underline{\alpha} = \frac{5}{0.35 + 0.5} = \underline{5.9}$; $\frac{U_0}{\underline{U_1}} = \frac{300}{170} = \underline{1.76}$.

Figure 18 shows that a 10 % resistor R can be used. It shows further that the entire stabilizing range of the tube is not used.

R according to formula 2: $\underline{R} = \frac{300 \cdot 0.82 - 170}{0.85 \cdot 1.1} = 59$ kΩ,

the next smaller standard value is chosen: $\underline{R = 56 \text{ k}\Omega}$.

Firing condition: (The maximum load current can be present initially): (U_{Zmax} is: $U_{Zmax} + U_B$, as there are two tubes in series: $115 + 84 \simeq 200$ V).

$200 \text{ V} \leq 300 \cdot 0.82 - 0.35 \cdot 56 \cdot 1.1 = 246 - 26 = 220$ V. The firing condition is satisfied.

Calculation of the maximum anode current is not necessary.

6.3 Cascade stabilization

A reference voltage around 80 V at a load current of 1 mA is needed. The type SR 52 being the most accurate reference tube is selected. $U_B = 83$ V, $I_A = 4.5$ mA, $I_V = 1$ mA. The supply voltage of the SR 52 is prestabilized by an SR 57; the whole stabilizing range of this tube shall be used.

For the second cascade stage (SR 52), the following conditions are present, according to the data sheet SR 57: $U_0 = 150 \pm 7$ V (tolerance U_B + regulation ΔU_B).

Wanted: R, I_{Amin}', I_{Amax}',

$$R = \frac{U_0 - U_B}{I_A + I_V} = \frac{150 - 83}{5.5} = 12.2 \text{ k}\Omega, \text{ chosen value:}$$

$\underline{\underline{R = 12 \text{ k}\Omega + 5 \%}}$.

$$I_{Amin}' = \frac{U_{0min} - U_B}{R_{max}} - I_V = \frac{143 - 83}{12.6} - 1 = \underline{\underline{3.75 \text{ mA}}}$$
$$I_{Amax}' = \frac{U_{0max} - U_B}{R_{min}} - I_V = \frac{157 - 83}{11.4} - 1 = \underline{\underline{5.5 \text{ mA}}}$$

I_{Amin}' and I_{Amax}' lie within the range $I_{Amin} \div I_{Amax}$. Firing condition: $U_{0min} - R_{max} \cdot I_{V0max} \cdot \geq U_{Zmax}$. The load shall be a resistor; at $U_B = 83$ V a current of 1 mA is flowing; at $U_{Zmax} = 130$ V a current of $I_{V0max} = 1.57$ mA is flowing. Therefore: U_{Zmax} (130 V) $\leq 143 - 12.5 \cdot 1.57 = 124$. The firing condition is not satisfied even with a resistor R of closer tolerance. therefore the load current has to be reduced to 0.6 mA instead of 1 mA.

This gives: $R = 13$ kΩ $\pm$ 5 %

$I_{Amin}' = 3.8$ mA, $I_{Amax}' = 5.4$ mA, $I_{V0max} = 0.94$ mA. The firing condition: $130 \leq 143 - 13.7 \cdot 0.9 = 130$ is just satisfied. The example shows that the firing condition can be a nuisance.

The first cascade stage is calculated as the example 6.1: $I_{Amin} = 5$ mA, $I_{Amax} = 15$ mA, $I_{Vmin} = 3.8$ mA,

$$I_{Vmax} = 5.4 \text{ mA} \rightarrow \alpha = \frac{3.8 + 15}{5.4 + 5} = 1.8$$

Figure 18 furnishes for R $\pm$ 5 %, $U_0{}^{+14}_{-18}\%$:

$\frac{U_0}{U_B} = 3.15$ gives $U_0 = \underline{\underline{475 \text{ V}}}$,

from formula 2: $R = \underline{\underline{22 \text{ k}\Omega \pm 5 \%}}$

The firing condition is satisfied.

7. LITERATURE

A more complete presentation of the formulas and their derivation as well as further circuit examples are given in number 10 of the house paper "Cerberus Elektronik". This number also contains a bibliography.

TRANSLATION of the terms given in figure 18 (Anhang):
General calculation basis for stabilizing circuits:

U_0	Speisespannung	Supply voltage
U_1	stab. Spannung	Stabilized voltage
I_{V0max}	max. Verbraucherstrom beim Einschalten und wenn $U_1 = U_{Zmax}$	maximum initial load current, at $U_1 = U_{Zmax}$
-	Referenzröhren (mit Vorstab.)	Reference tubes (prestabilized)
-	Stabilisierungsröhren	Stabilizer tubes

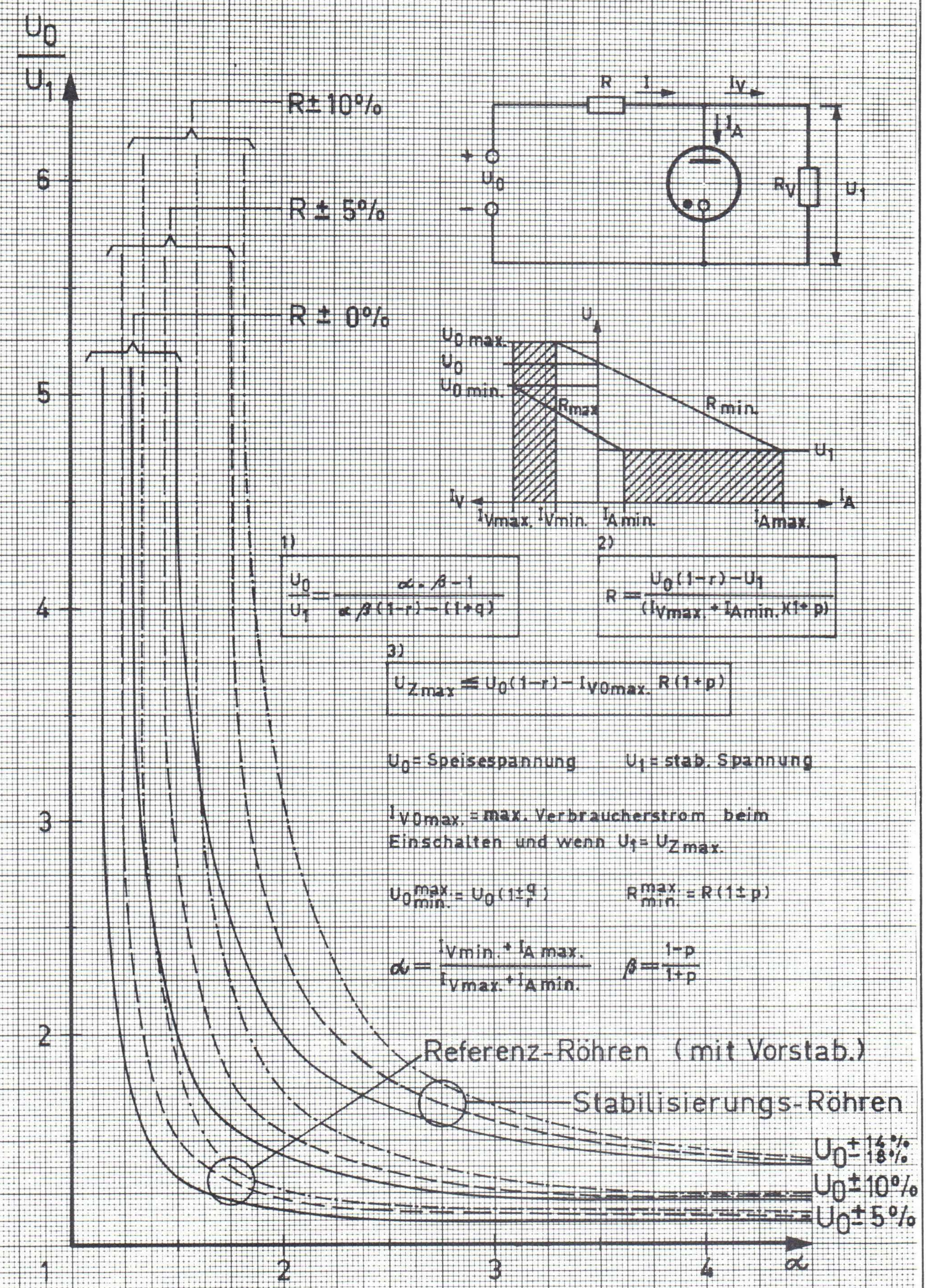


Fig. 18: Allg. Berechnungsunterlagen für Stabilisierungskreise.

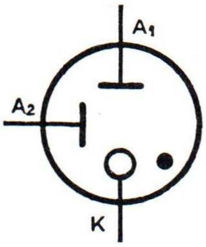
Präzisions-Stabilisierungsröhre SR 2 B
Tube stabilisateur de précision SR 2 B
Precision voltage stabilizer SR 2 B

Typ SR 2 B	
Nr. 5. 12	
Ausgabe 4.66	Blatt 1

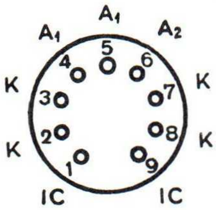
Präzisions-Stabilisierungsröhre (Spannungsreferenzröhre) mit Molybdänkathode von höchster Lebensdauer, Konstanz und Flackerfreiheit. Geringe Tritiumvorionisierung. Stabilisierungsbereich 2-80 mA.

Tube stabilisateur de précision (tube de référence de tension) avec cathode en molybdène pur de très longue durée de service, grande constance et absence de variations spontanées de la tension stabilisée. Faible préionisation au tritium. Gamme de stabilisation 2-80 mA.

Precision voltage stabilizer (voltage reference tube) with molybdenum cathode of extremely long life, high stability and freedom of flickering. Low Tritium preionization. Stabilizing range 2 to 80 mA.



A1: Anode
A2: Anode
K : Kathode
Cathode

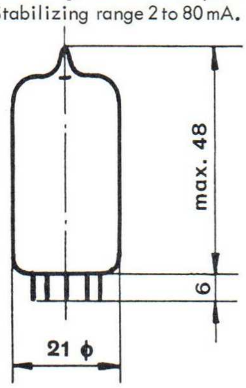


Noval

IC Interne Verbindung frei lassen

Connexion interne ne connectez pas

Internal connection do not connect



Kenndaten und Grenzbetriebsdaten	Caractéristiques et limites d'opération	Characteristics and limiting values		min.	normal	max.	
Zündspannung A-K	Tension d'amorçage A-K	Breakdown voltage A-K	U_Z			125 V	
Brennspannung (bei 30 mA)	Tension stabilisée (à 30 mA)	Stabilized voltage (at 30 mA)	U_B	84 V	86 V	88 V	
Arbeitsstrom	Courant d'opération	Operating current	I_A	2 mA	20-40 mA	80 mA	2)
Spannungsänderung (20–40 mA)	Variation de tension (20–40 mA)	Regulation (20–40 mA)			2 V		
Änderung der Brennspannung in 20000 Brennstunden	Variation de la tension stabilisée en 20000 heures	Variation of stabilized voltage during 20000 working hours				1 V	

Typische Betriebsdaten	Opération typique	Typical operation		A	B
A. als Spannungsreferenzröhre (Verbraucherstrom $I_V < 1$ mA)	**A.** Référence de tension (courant de charge $I_V < 1$ mA)	**A.** Voltage reference (load current $I_V < 1$ mA)	U_O	135 V	160 V
			I_A	5 mA	30 mA
			R_1	10 kΩ	1,2 kΩ
B. als Stabilisierungsröhre (Verbraucherstrom $I_V = 30$ mA)	**B.** Stabilisation (courant de charge $I_V = 30$ mA)	**B.** Stabilization (load current $I_V = 30$ mA)	R_2	0,2 MΩ	0,2 MΩ
			U_B	85 V	88 V

1) Die Anoden A_1 und A_2 der Röhre sind bezüglich der Stabilisierungscharakteristik gleichwertig. Anode A_2 kann als Zündanode verwendet werden, indem man über sie einen kleinen Vorstrom erzeugt; die Anode A_1 zündet, sobald die angelegte Spannung die Brennspannung unwesentlich überschreitet.

2) Siehe "Hinweise für die Anwendung" auf Informationsblatt 5.04.

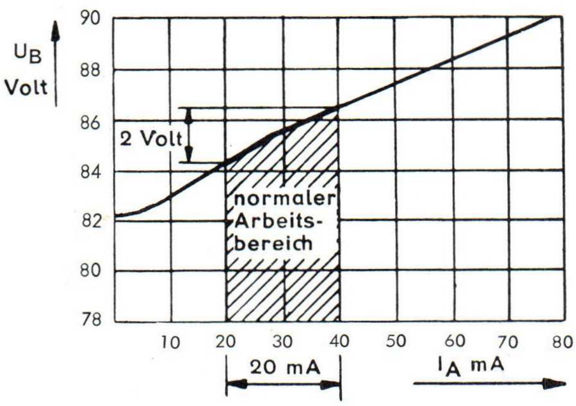
1) Les anodes A_1 et A_2 sont équivalentes en ce qui concerne la caractéristique de stabilisation. L'anode A_2 peut servir d'anode d'amorçage; un petit courant dans l'anode d'amorçage provoque l'amorçage de l'anode A_1 dès que la tension appliquée dépasse légèrement la tension d'entretien.

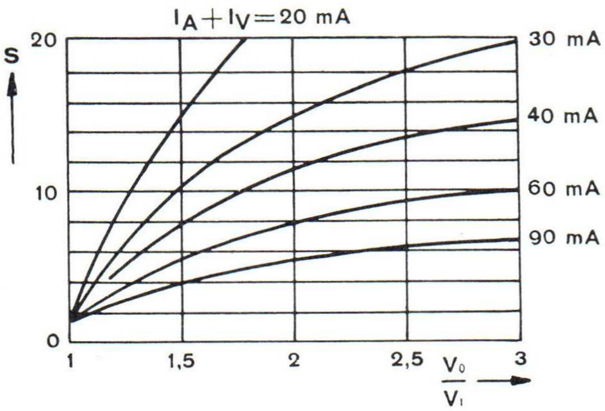
2) Voir "Opération" dans les informations 5.04.

1) The stabilizing characteristics of the anodes A_1 and A_2 are equivalent. Anode A_2 may be used as firing anode; a small current in this anode causes firing of the anode A_1 when the applied voltage exceeds the sustaining voltage by a small amount.

2) See "Operation" on Information sheet 5.04.

Stabilisierungscharakteristik **Caractéristique de stabilisation** **Stabilizing characteristic**





Montage in beliebiger Lage
Umgebungstemperatur –20 bis +80 °C
Lebensdauer
über 30000 Brennstunden
Berechnung von Stabilisierungskreisen
Siehe Informationsblatt 5.07

Montage en toute position
Température ambiante –20 à +80 °C
Dureé de service
au-dessus de 30000 heures
Calcul des circuits stabilisateurs
Voir informations 5.07

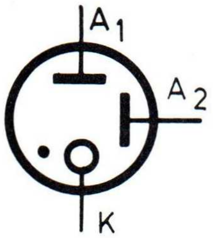
Mounting in any position
Ambient temperature –20 to +80 °C
Life expectancy
exceeding 30000 working hours
Design of stabilizing circuits
See information sheets 5.07

Präzisions-Stabilisierungsröhre SR 3A **Tube stabilisateur de précision SR 3A** **Precision voltage stabilizer SR 3A**	Type **SR 3A**	Nr. 5.13
	Ed. 4.66	Fol. 1

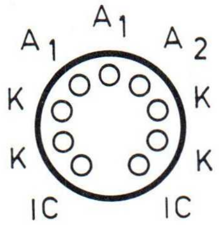
Präzisions-Stabilisierungsröhre (Spannungsreferenzröhre) mit Molybdänkathode von höchster Lebensdauer, Konstanz und Flackerfreiheit. Geringe Tritiumvorionisierung. Stabilisierungsbereich 2 - 80 mA.

Tube stabilisateur de précision (tube de référence de tension) avec cathode en molybdène pur de très longue durée de service, grande constance et absence de variations spontanées de la tension stabilisée. Faible préionisation au tritium. Gamme de stabilisation 2 à 80 mA.

Precision voltage stabilizer (voltage reference tube) with molybdenum cathode of extremely long life, high stability and freedom of flickering. Low Tritium preionization. Stabilizing range 2 to 80 mA.



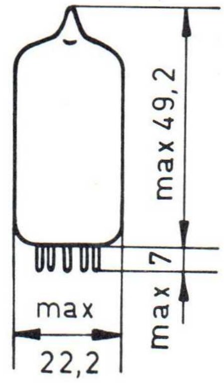
A_1: Anode
A_2: Anode
K : Kathode
Cathode



IC: Interne Verbindung freilassen

Connexion interne ne connectez pas

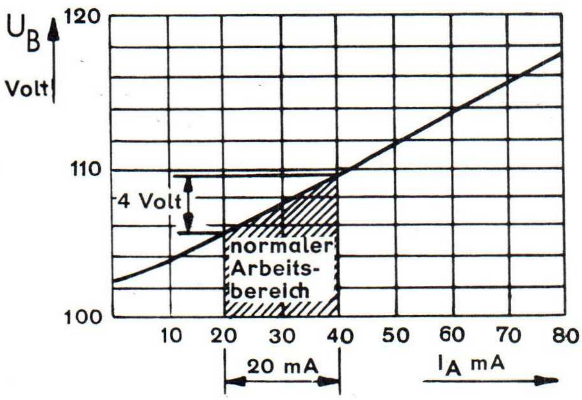
Internal connection do not connect

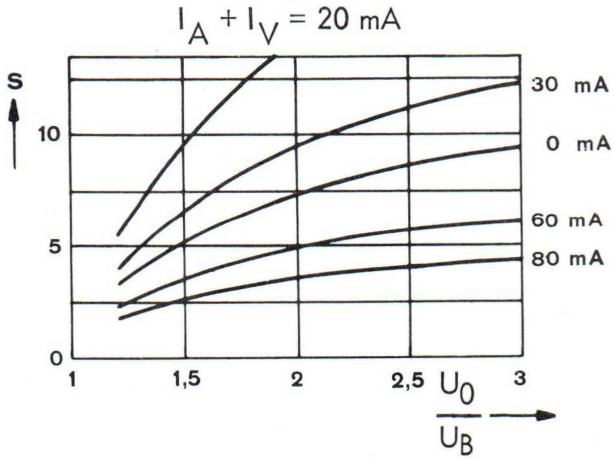


KENNDATEN UND GRENZBETRIEBSDATEN	CARACTERISTIQUES ET LIMITES D'OPERATION	CHARACTERISTICS AND LIMITING VALUES		min.	normal	max.
Zündspannung A-K	Tension d'amorçage A-K	Breakdown voltage A-K	U_Z			155 V 1)
Brennspannung (bei 30 mA)	Tension stabilisée (à 30 mA)	Stabilized voltage (at 30 mA)	U_B	102 V	105 V	107 V
Arbeitsstrom	Courant d'opération	Operating current	I_A	2 mA	20-40 mA	80 mA 2)
Spannungsänderung (20-40 mA)	Variation de tension (20-40 mA)	Regulation (20-40 mA)			4 V	
Aenderung der Brennspannung in 20'000 Betriebsstunden	Variation de la tension stabilisée en 20'000 heures	Variation of stabilized voltage during 20'000 working hours				1 V

TYPISCHE BETRIEBSDATEN	OPERATION TYPIQUE	TYPICAL OPERATION		A	B
A. als Spannungsreferenzröhre (Verbraucherstrom $I_V < 1$ mA)	A. Référence de tension (courant de charge $I_V < 1$ mA)	A. Voltage reference (load current $I_V < 1$ mA)	U_0	165 V	200 V
			I_A	5 mA	30 mA
			R_1	12 kΩ	1,5 kΩ
B. als Stabilisierungsröhre (Verbraucherstrom I_V = 30 mA)	B. Stabilisation (courant de charge I_V = 30 mA)	B. Stabilization (load current I_V = 30 mA)	R_2	0,2 MΩ	0,2 MΩ
			U_B	103 V	107 V

STABILISIERUNGSCHARAKTERISTIK CARACTERISTIQUE DE STABILISATION STABILIZING CHARACTERISTIC





MONTAGE in beliebiger Lage

UMGEBUNGSTEMPERATUR
-20 bis + 80° C

BERECHNUNG VON STABILISIERUNGSKREISEN
Siehe Informationsblatt 5.07 d

LEBENSDAUER
25'000 Betriebsstunden

1) Die Anoden A_1 und A_2 der Röhre sind bezüglich der Stabilisierungscharakteristik gleichwertig. Anode A_2 kann als Zündanode verwendet werden, indem man über sie einen kleinen Vorstrom erzeugt; die Anode A_1 zündet, sobald die angelegte Spannung die Brennspannung unwesentlich überschreitet.

2) Siehe "Hinweise für die Anwendung" auf Informationsblatt 5.04 d.

MONTAGE en toute position

TEMPERATURE AMBIANTE
-20 à + 80° C

CALCUL DES CIRCUITS STABILISATEURS
Voir informations 5.07 f.

DUREE DE SERVICE
25'000 heures

1) Les anodes A_1 et A_2 sont équivalentes en ce qui concerne la caractéristique de stabilisation. L'anode A_2 peut servir d'anode d'amorçage; un petit courant dans l'anode d'amorçage provoque l'amorçage de l'anode A_1. Dès que la tension appliquée dépasse légèrement la tension d'entretien.

2) Voir "Opération" dans les informations 5.04 f.

MOUNTING in any position

AMBIENT TEMPERATURE
-20 to + 80° C

DESIGN OF STABILIZING CIRCUITS
See Information sheets 5.07 e

LIFE EXPECTANCY
25'000 working hours

1) The stabilizing characteristics of the anodes A_1 and A_2 are equivalent. Anode A_2 may be used as firing anode; a small current in the anode causes firing of the anode A_1 when the applied voltage exceeds the sustaining voltage by a small amount.

2) See "Operation" on Information sheet 5.04 e.

Type	SR 44
Nr.	5.44
Ed. 5.72	Fol. 1

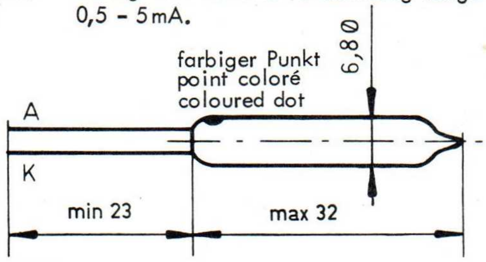
Spannungsreferenzröhre SR 44
Tube de référence de tension SR 44
Voltage reference tube SR 44

Spannungsreferenzröhre mit kalter Molybdänkathode und geringer Tritiumvorionisierung. Subminiaturausführung zum Einlöten. Stabilisierungsbereich 0,5 - 5 mA.

Tube de référence de tension avec cathode froide en molybdène et avec faible préionisation au tritium. Exécution subminiature avec connexions à souder. Gamme de stabilisation 0,5 - 5 mA.

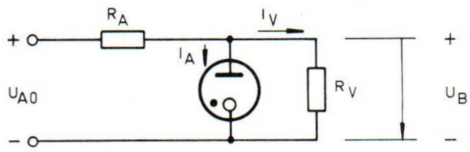
Voltage Reference Tube with cold molybdenum cathode and low Tritium preionization. Subminiature size with soldering connections. Stabilizing range 0,5 - 5 mA.

A: Anode
K: Kathode
Cathode



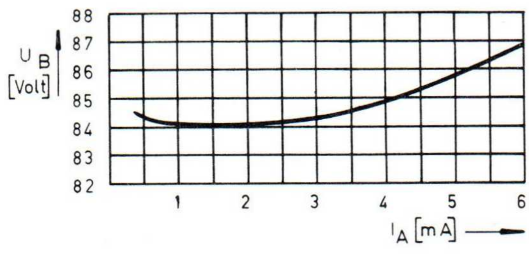
KENNDATEN UND GRENZBETRIEBSDATEN	CARACTERISTIQUES ET LIMITES D'OPERATION	CHARACTERISTICS AND LIMITING VALUES		min.	normal	max.	
Zündspannung A-K	Tension d'amorçage A-K	Breakdown voltage A-K	U_Z			115 V	1)
Brennspannung bei 1,5 mA	Tension stabilisée à 1,5 mA	Stabilized voltage at 1,5 mA	U_B	82 V	84 V	87 V	
Arbeitsstrom	Courant d'opération	Operating current	I_A	0,5 mA	1,5 mA	5 mA	
Spannungsänderung (1 - 3mA)	Variation de tension (1 - 3mA)	Voltage regulation (1 - 3mA)				1,5 V	
Strom für normale Glimmentladung	Courant pour décharge normale	Current for normal glow-discharge				4 mA	2)
Aenderung der Brennspannung in 20'000 h	Variation de la tension stabilisée en 20'000 h	Variation of stabilized voltage during 20'000 h				1 V	

TYPISCHE BETRIEBSDATEN — OPERATION TYPIQUE — TYPICAL OPERATION 2)



U_{A0} 160 V ± 15 %
I_A 1,7 mA
I_V ≤ 0,5 mA
R_A 33 kΩ ± 10 %

STABILISIERUNGSCHARAKTERISTIK — CARACTERISTIQUE DE STABILISATION — STABILIZING CHARACTERISTIC



MONTAGE in beliebiger Lage

UMGEBUNGSTEMPERATUR
-20 bis + 80° C

LEBENSDAUER
über 30'000 Brennstunden

MONTAGE en toute position

TEMPERATURE AMBIANTE
-20 à + 80° C

DUREE DE SERVICE
au dessus de 30'000 heures

MOUNTING in any position

AMBIENT TEMPERATURE
-20 to + 80° C

LIFE EXPECTANCY
exceeding 30'000 working houres

1) Die Zündspannung ist unabhängig von der Beleuchtung der Röhre, sie bleibt auch bei völliger Dunkelheit unverändert.

2) Ausführliche Angaben über Stabilisierungskreise und deren Berechnung in den Informationsblättern 5.04 und 5.07.

1) La tension d'amorçage n'est pas influencée par la lumière du tube, elle reste inchangée même en obscurité complète.

2) Indications complètes sur les circuits de stabilisation et les calculs y relatifs sur feuilles d'information 5.04 et 5.07.

1) The breakdown voltage is not influenced by light, it remains unchanged even in complete darkness.

2) Complete information on stabilizing circuits and theirs formula in information 5.04 and 5.07.

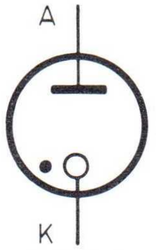
Type	SR 45
Nr.	5.45
Ed. 11.67	Fol. 1

Spannungsreferenzröhre SR 45
Tube de référence de tension SR 45
Voltage Reference Tube SR 45

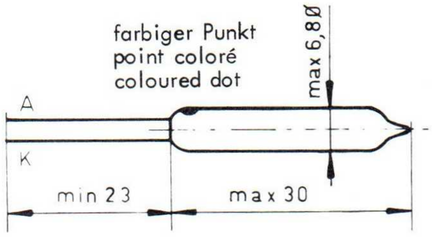
Spannungsreferenzröhre mit kalter Molybdänkatode und geringer Tritiumvorionisierung. Einlötbare Subminiaturausführung.
Stabilisierungsbereich 1 - 5 mA.

Tube de référence de tension avec cathode froide en molybdène et avec faible préionisation au tritium. Exécution subminiature soudable. Gamme de stabilisation 1 - 5 mA.

Voltage Reference Tube with cold molybdenum cathode and low Tritium preionization. Subminiature size with soldering connections. Stabilizing range 1 - 5 mA.



A: Anode
K: Katode
Cathode

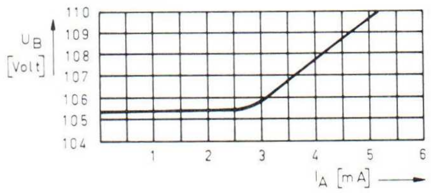


KENN- UND GRENZBETRIEBSDATEN / CARACTERISTIQUES ET LIMITES D'OPERATION / CHARACTERISTICS AND LIMITING VALUES

				min.	normal	max.	
Zündspannung A - K	Tension d'amorçage A - K	Breakdown voltage A - K	U_Z			140 V	1)
Brennspannung bei 1,5 mA	Tension stabilisée à 1,5 mA	Stabilized voltage at 1,5 mA	U_B	102 V	105 V	107 V	
Arbeitsstrom	Courant d'opération	Operating current	I_A	1 mA	2,5 mA	5 mA	
Spannungsänderung (1 - 4 mA)	Variation de tension (1 - 4 mA)	Voltage regulation (1 - 4 mA)				5 V	
Strom für Vollbedeckung	Courant pour pleine effluve	Current for full coverage of glow				3 mA	2)
Aenderung der Brennspannung in 20 000 h bei 1,5 mA	Variation de la tension stabilisée en 20 000 h à 1,5 mA	Variation of stabilized voltage during 20 000 h at 1,5 mA				5 V	

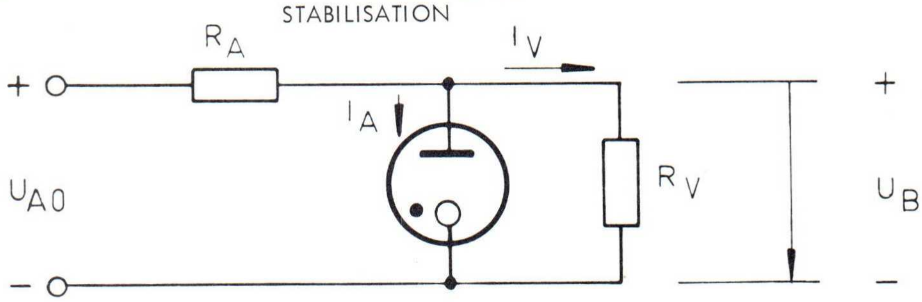
TYPISCHE BETRIEBSDATEN / OPERATION TYPIQUE / TYPICAL OPERATION

	min.	normal	max.
U_{A0}	-15 %	220 V	+15 %
I_A	2 mA	3,5 mA	5 mA
I_V		1,8 mA	
R_A		15k ± 5 %	



STABILISIERUNGSCHARAKTERISTIK

CARACTERISTIQUE DE STABILISATION



MONTAGE in beliebiger Lage

UMGEBUNGSTEMPERATUR
-20° C bis +80° C

LEBENSDAUER
über 30 000 Brennstunden

1) Die Zündspannung ist unabhängig von der Beleuchtung der Röhre, sie bleibt auch bei völliger Dunkelheit unverändert.

2) Ausführliche Angaben über Stabilisierungskreise und deren Berechnung geben die Informationsblätter 5.04 d und 5.07 d.

MONTAGE en toute position

TEMPERATURE AMBIANTE
-20° C à +80° C

DUREE DE SERVICE
au dessus de 30 000 heures

1) La tension d'amorçage n'est pas influencée par la lumière du tube, elle reste inchangée même en obscurité complète.

2) Indications complètes sur les circuits de stabilisation et leurs calculs sont données dans les feuilles 5.04 f et 5.07 f.

MOUNTING in any position

AMBIENT TEMPERATURE
-20° C to +80° C

LIFE EXPECTANCY
exceeding 30 000 working hours

1) The breakdown voltage is not influenced by light, it remains unchanged even in complete darkness.

2) Complete information on stabilizing circuits and theirs formula in information sheets 5.04 e and 5.07 e.

6

6

7

8

Type	G 11/155
Nr.	8.11
Ed. 12.65	Fol. 1

Schaltdiode G 11/155
Diode de commutation G 11/155
Switching diode G 11/155

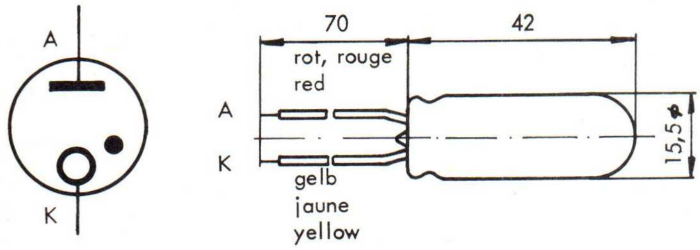
Schaltdiode mit Oxyd-Kaltkathode. Normale Zündspannung 155 V, Brennspannung um 60 V. Zünd-Brennspannungsdifferenz ca. 100 V. Dauerstrom max. 5 mA.

Diode de commutation avec cathode froide à oxydes. Tension d'amorçage normale 155 volts. Tension d'entretien autour de 60 volts. Différence entre tension d'amorçage et tension d'entretien env. 100 volts. Courant permanent admissible 5 mA.

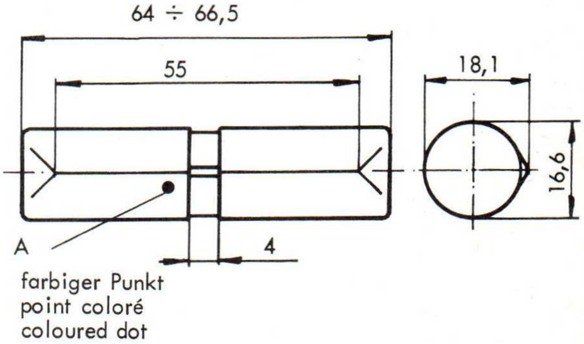
Switching diode with oxide cathode. Normal breakdown voltage 155 volts. Maintaining voltage around 60 volts. Difference between breakdown and maintaining voltage about 100 volts. Permanent current up to 5 mA.

AUSFUEHRUNGSFORMEN — EXECUTIONS — EXECUTIONS

Type G 11/155



Type GS 11/155

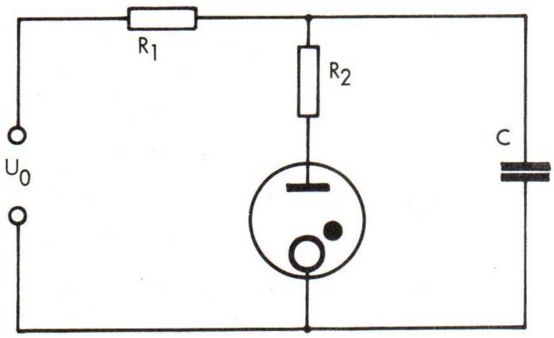


KENNDATEN UND GRENZBETRIEBSDATEN	CARACTERISTIQUES ET LIMITES D'OPERATION	CHARACTERISTICS AND LIMITING VALUES		min.	norm.	max.	
Zündspannung	Tension d'amorçage	Breakdown voltage	U_{ZA}	145	155	165 V	1)
Brennspannung bei I_A = 10 mA	Tension d'entretien à I_A = 10 mA	Maintaining voltage at I_A = 10 mA	U_{BA}	50	58	63 V	
Zünd-Brennspannungsdifferenz	Différence entre tension d'amorçage et tension d'entretien	Difference between breakdown and maintaining voltage	$U_{ZA}-U_{BA}$	85	97	115 V	
Anodenstrom	Courant anodique	Anode current	I_A	1	3-4	5 mA	2)

TYPISCHE BETRIEBSDATEN
für die Erzeugung von Kippschwingungen mit der G 11/155.

OPERATION TYPIQUE
d'un tube G 11/155 en oscillateur de relaxation.

TYPICAL OPERATION
of a G11/155 tube as relaxation oscillator.



U_0	ca. 300 V	3)
R_1	min. 0,5 MΩ	3)
R_2	20 kΩ	2)

An Stelle von R_2 tritt vielfach die Wicklung eines Relais.

L'enroulement d'un relais est souvent utilisé au lieu de R_2.

The coil of a relay often takes the place of R_2.

MONTAGE in beliebiger Lage

UMGEBUNGSTEMPERATUR
-30° bis + 80° C

LEBENSDAUER ca. 10'000 Stunden bei Nennstrom

MONTAGE en toute position

TEMPERATURE AMBIANTE
-30° à +80° C

DUREE DE SERVICE
Env. 10'000 heures sous courant normal.

MOUNTING in any position

AMBIENT TEMPERATURE
-30° to +80° C

LIFE EXPECTANCY
Approx. 10'000 hours at normal current.

ANWENDUNGSBEISPIELE

Erzeugung von Kippschwingungen. Zeitverzögerungskreise, Kreise, die beim Ueberschreiten einer bestimmten Spannung ansprechen.

1) Die angegebene Zündspannung ist im Dunkeln gemessen. Dank einer Vorionisierung der Röhre bleibt sie auch bei beliebig langer Lagerung im Dunkeln unverändert.

2) Eine Ueberschreitung des maximalen Anodenstromes (oder Verkleinerung von R_2) ist unter Umständen zulässig, verringert jedoch die Lebensdauer der Röhre stark. Gegebenenfalls ist die Zulässigkeit einer bestimmten Belastungsart durch einen Lebensdauerversuch abzuklären. Unter den folgenden Betriebsbedingungen übersteigt z.B. die Lebensdauer der Röhre $3,5 \times 10^6$ Schaltungen: C = 2 µF, R_2 = Relaiswicklung von 600 Ω; 1,3 Hy bei 1000 Hz.

3) Bei höherer Speisespannung U_0 muss der Widerstand R_1 entsprechend hinaufgesetzt werden, damit die Kippbedingung erhalten bleibt.

APPLICATIONS

Production des oscillations de relaxation, circuits de retardement, circuits qui répondent au dépassement d'une certaine tension.

1) La tension d'amorçage indiquée correspond au tube travaillant dans l'obscurité. Grâce à une préionisation du tube elle n'est pas influencée par le stockage à l'obscurité complète.

2) Le dépassement de la valeur maximum du courant anodique (ou diminution de la résistance R_2) peut être admis dans certaines conditions, mais la durée de vie du tube diminue notablement. L'essai seul peut déterminer la durée de vie du tube dans les conditions particulières. P. ex. dans les conditions suivantes: C = 2 µF, R_2 = enroulement de 600 Ω et de 1,3 Hy (à 1000 cps) d'un relais, la durée de vie du tube a dépassé $3,5 \times 10^6$ décharges.

3) Pour des tensions d'alimentation U_0 plus élevées, la valeur de R_1 doit être augmentée pour maintenir les conditions d'oscillation.

APPLICATIONS

Relaxation oscillators delay and timing circuits, circuits responding at a determined voltage.

1) The indicated breakdown voltage is measured in darkness. It is not influenced by idle periods in complete darkness as the tube is preionized.

2) Exceeding the maximum anode current (or reduction of R_2) is possible but lowers the useful life is of the tube. It is recommanded to test the tubes under the actual working conditions for a suitable period. E.g. under the following ones: C = 2 µF, R_2 = relay coil with 600 Ω and 1,3 Hy (at 1000cycles). The life of the tube exceeds $3,6 \times 10^6$ operations.

3) For higher supply voltages U_0 a higher value of R_1 must be chosen to keep the oscillation conditions fulfilled.

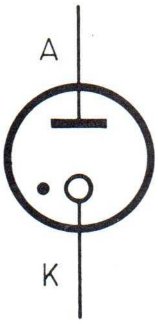
Schaltdiode G 42 Diode de commutation G 42 Switching Diode G 42	Type: **G 42** Nr. 8.42 Ed. 9.66 · Fol. 1

Schaltdiode G 42
Diode de commutation G 42
Switching Diode G 42

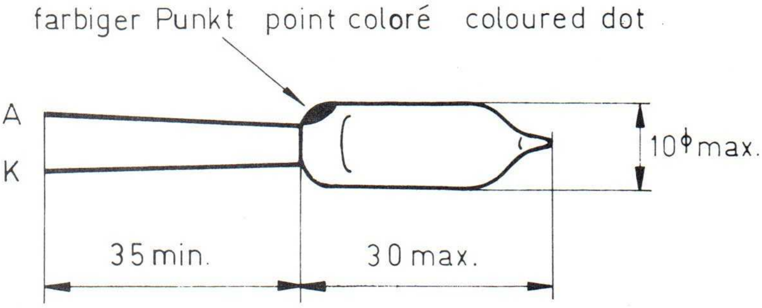
Schaltdiode für Gleichspannungsbetrieb mit zylindrischer Oxydkatode, konzentrisch angeordneter Anode und geringer Vorionisierung. Einlötbare Subminiaturausführung, schlag- und vibrationsfest.

Diode de commutation pour opération CC avec cathode oxydée cylindrique, anode au centre et faible préionisation. Exécution subminiature résistant aux chocs et vibrations, avec fils de connexion pour soudure.

Switching diode for DC operation with cylindrical, oxide coated cathode, concentric anode and slight preionisation. Flying leads, subminiature version, impact and vibration proof.



A: Anode
K: Katode
Cathode

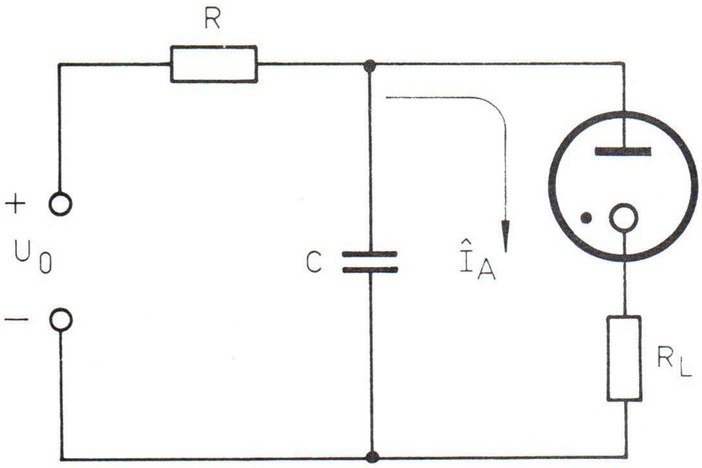


KENNWERTE UND GRENZBETRIEBSDATEN	CARACTERISTIQUES ET LIMITES D'OPERATION	CHARACTERISTICS AND LIMITING VALUES			min.	normal	max.	
Zündspannung A-K	Tension d'amorçage A-K	Breakdown voltage A-K	U_{ZAK}	[V]	145	155	165	1)2)
Zündspannung K-A	Tension d'amorçage K-A	Breakdown voltage K-A	U_{ZKA}	[V]	100			
Brennspannung bei I_A = 10 mA	Tension d'entretien avec I_A de 10 mA	Maintaining voltage at I_A = 10 mA	U_{BA}	[V]	50	58	65	2)
Differenz zwischen Zünd- und Brennspannung	Différence tensions d'amorçage et d'entretien	Difference between breakdown and maintaining voltage	ΔU	[V]	80	97	115	
Spitzenstrom in Kippschaltung (C = 4 µF)	Courant de crête pour oscill. à relaxation (C=4µF)	Peak current in relaxation oscillators (C=4µF)	$\hat{I}_A$	[mA]		35	100	3)
Temperatur-Koeffizient der Spannung U_{ZAK} zwischen -20°C/+80°C	Coéfficient de température de la tension U_{ZAK} entre -20°C/+80°C	Temperature coefficient of U_{ZAK} in the range -20°C/+80°C	TK	[%/°C]		± 0,015		

TYPISCHE BETRIEBSDATEN in selbstlöschender Kippschaltung

OPERATION TYPIQUE d'un oscillateur de relaxation

TYPICAL OPERATING DATA for relaxation oscillators



		min.	normal	max.	
U_0	[V]	250	300		
R	[MΩ]	0,47	10	100	4)
C	[µF]		4		
R_L	[kΩ]	1	3		3)

An Stelle von R_L tritt vielfach eine Relaiswicklung
R_L est souvent constitué par le bobinage d'un relais
A relay coil often takes the place of R_L

MONTAGE in beliebiger Lage. Bei Verwendung einer Metallbride zur Diodenbefestigung, ist diese auf Katodenpotential zu legen.

MONTAGE en toutes positions. Un clip métallique éventuel doit être relié au potentiel cathodique.

MOUNTING in any position. When a metal clip is used to hold the diode, it must be at cathode potential.

UMGEBUNGSTEMPERATUR für Betrieb und Lagerung -20° C bis + 80° C

TEMPERATURE AMBIANTE pour exploitation et stockage -20° C à +80° C

TEMPERATURE RANGE for operation and storage -20° C to +80° C

LEBENSDAUER

Bei mittlerem Strom ca. $50 \cdot 10^6$ Zündungen. Lebensende gekennzeichnet durch Erhöhung der Zünd- und Brennspannung um ca. 50 V.

ANWENDUNGSBEISPIELE

Zeitschalter, Verzögerungsschalter, Ueberwachungskreise, die bei einer bestimmten Spannung ansprechen (Netzkommandoempfänger), Erzeugung von Kippschwingungen.

1) Die angegebenen Zündspannungen sind im Dunkeln gemessen. Bei Tageslicht liegen sie um ca. 2 V tiefer.

2) Daten im Anlieferungszustand. Nach Inbetriebsetzung der Röhren beobachtet man einen Formierungseffekt. Er wird mit zunehmendem Spitzenstrom grösser. So bewirkt z.B. ein Spitzenstrom von 35 mA eine Erhöhung von U_{ZAK} um ca. 4 V und von U_{BA} um ca. 2 V. Nach ungefähr 1 000 Zündungen bleiben diese Werte bis zum Lebensende (ca. $50 \cdot 10^6$ Schaltzyklen) praktisch konstant.

3) Eine Ueberschreitung des maximalen Spitzenstromes ($\hat{I}_A$) verkürzt die Lebensdauer.

4) Der Maximalwert von $1 \cdot 10^8\,\Omega$ gilt bei belichteter Röhre. Arbeitet sie im Dunkeln, so sind Widerstandswerte bis max. $1 \cdot 10^9\,\Omega$ zulässig.

Die Katode der G 42 ist photoempfindlich. Je nach Belichtung wird ein gewisser Zündstrom benötigt, er nimmt mit grösser werdender Helligkeit zu. Vor allem beeinflusst der axiale Lichteintritt den Steuerstrom. Durch schwarze Lackierung der Röhre wird dieser Photoeffekt vermieden.

LONGEVITE

Sous courant moyen env. $50 \cdot 10^6$ amorçages. La durée de service aboutit à sa fin dès que les tensions d'amorçage et d'entretien s'élèvent d'env. 50 V.

EXEMPLES D'APPLICATION

Interrupteurs temporisateurs, interrupteurs de retardement, circuits de surveillance répondant à une certaine tension (récepteurs de télécommande par fréquence superposée au réseau), oscillateurs de relaxation.

1) Les tensions d'amorçage indiquées ont été mesurées dans l'obscurité. A la lumière du jour, elles sont inférieures d'env. 2 V.

2) Les données sont valables pour le tube neuf. On observera après sa mise en service un effet de formage, plus sensible avec un courant de crête supérieur. Ce dernier, étant p.ex. de 35 mA, augmente U_{ZAK} d'env. 4 V et U_{BA} d'env. 2 V. Après quelque 1 000 amorçages, ces valeurs restent pratiquement constantes jusqu'au bout de la durée de service (env. $50 \cdot 10^6$ cycles de commande).

3) La longévité est réduite dès que l'on dépasse le courant anodique ($\hat{I}_A$) maximum.

4) La valeur maximale de $1 \cdot 10^8\,\Omega$ se réfère au tube exposé à la lumière. Des résistances de $1 \cdot 10^9\,\Omega$ au max. sont admissibles lorsque le tube opère dans l'obscurité.

La cathode du tube G 42 a un certain caractère photo-électrique. Le courant d'amorçage requis augmente avec l'éclairage. Le courant de commande est surtout influencé par la lumière arrivant dans le sens axial. On peut y remédier en recouvrant le tube d'un vernis noir.

LIFE

Approx. $50 \cdot 10^6$ operations on normal current. At the end of life, the breakdown and maintaining voltages increase by about 50 volts.

EXAMPLES OF APPLICATION

Timer-relays, delay on-make relays, monitoring circuits responding to a certain voltage level (audio frequency control receiver), production of trigger pulses.

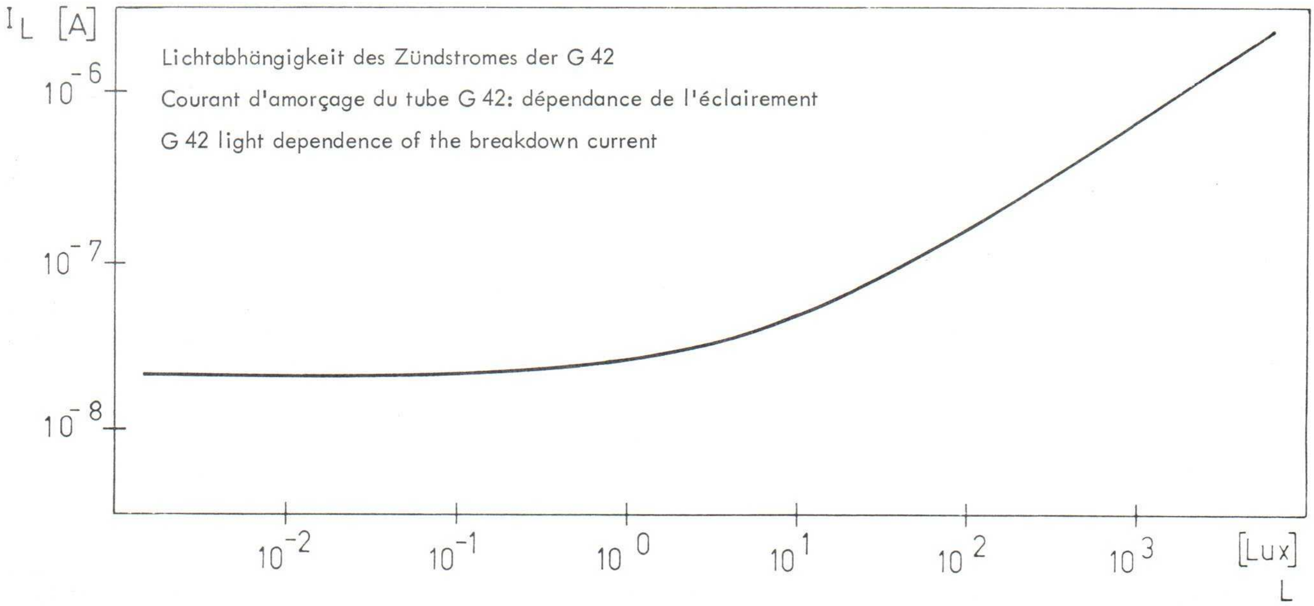
1) The breakdown voltages given are measured in darkness. They are about 2 volts less in daylight.

2) Data for tube as supplied. After putting into operation, a forming effect can be noticed. It increases with larger peak currents. Thus, for example, a peak current of 35 mA causes an increase of the breakdown voltage U_{ZAK} of about 4 volts and about 2 volts in maintaining voltage U_{BA}. After about 1 000 operations, these values remain practically constant for the remainder of the lifetime (approx. $50 \cdot 10^6$ operations).

3) The life will be shortened if the maximum peak current ($\hat{I}_A$) is exceeded.

4) The maximum value of $1 \cdot 10^8\,\Omega$ is valid for tubes in daylight. If they operate in the dark, resistors up to max. $1 \cdot 10^9\,\Omega$ are permissible.

The cathode of the G 42 is photo-sensitive. A definite breakdown current is required, dependent on the illumination, and it increases with increasing brightness. The breakdown current is primarily affected by light entering along the axis. This photo effect can be avoided by coating the tube black.



I_L: Leckstrom / courant de fuite / breakdown current

L: Beleuchtungsstärke mit angenäherter mittlerer Spektralverteilung
Intensité de l'éclairement avec répartition spectrale moyenne approx.
Strength of illumination with daylight spectral distribution

10

11

12

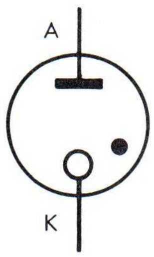
1

Hochstrom-Schaltdiode BD 22 **Diode de commutation à impulsions de forte intensité BD 22** **High current switching diode BD 22**	Type **BD 22** Nr. 12.22 Ed. 12.65 Fol. 1

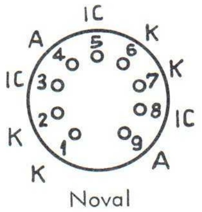
Edelgasgefüllte Diode mit kalter Kathode für impulsmässiges Schalten von einigen Ampères Spitzenstrom (Kondensatorenentladung über kleine Impedanz).

Diode à gaz à cathode froide pour la commutation par impulsions de courants de plusieurs ampères (p.ex. décharge d'une capacité à travers une faible impédance).

Rare-gas-filled cold cathode diode for pulsed switching of currents of several amperes (e.g. capacitor discharge through small impedance).



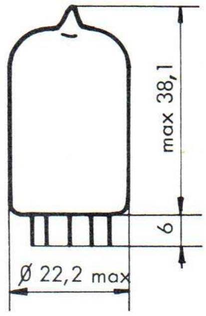
A: Anode
K: Kathode
Cathode



IC Interne Verbindung frei lassen

Connexion interne ne connectez pas

Internal connection do not connect

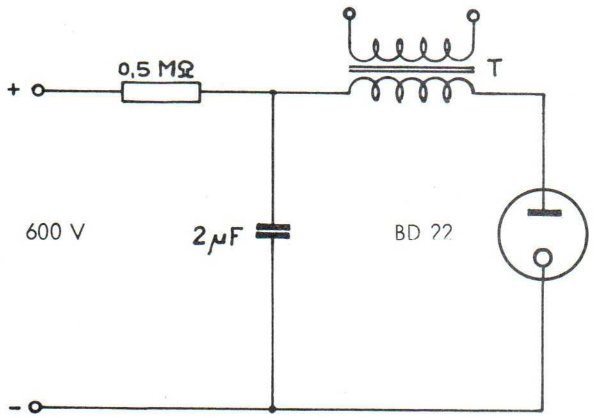


KENNDATEN UND GRENZBETRIEBSDATEN	CARACTERISTIQUES ET LIMITES D'OPERATION	CHARACTERISTICS AND LIMITING VALUES		min.	norm.	max.
Zündspannung	Tension d'amorçage	Breakdown voltage	U_{ZA}	360	400	440 V
Bogenspannung (für I ≥ 50 mA)	Tension d'arc (pour I ≥ 50 mA)	Arc voltage (for I ≥ 50 mA)	U_{arc}	-	15 V	-
max. Anodenstrom (Spitzenwert)	Courant anodique max. (valeur de pointe)	max. anode current (peak value)	I_{peak}	-	10 A	-
Energie pro Entladung	Energie par décharge	Discharge energy	W_A	-	5 Ws	-
Entladungs-Frequenz	Fréquence des décharges	Discharge frequency	f	-	2 Hz	-

TYPISCHE ANWENDUNG
Erzeugung von Hochspannungsimpulsen.

APPLICATION TYPIQUE
Génération d'impulsions de haute tension

TYPICAL APPLICATION
Generation of high-voltage pulses.



T = Impulstrafo (An Stelle dieses Trafos kann ein elektromagnetisches Element treten, das stossweise erregt werden soll.)

T = transformateur d'impulsions (Peut être remplacé par un élément électromagnétique à exciter par impulsions.)

T = pulse transformer (May be replaced by any electromagnetical element to be energized by pulses.)

MONTAGE in beliebiger Lage

MONTAGE en toute position

MOUNTING in any position

UMGEBUNGSTEMPERATUR
-20° bis +80° C

TEMPERATURE AMBIANTE
-20° à +80° C

AMBIENT TEMPERATURE
-20° to +80° C

ANWENDUNGEN
Schaltröhre für elektrische Weidezaungeräte, Hochspannungs-Zündvorrichtungen für Gasflammen.

APPLICATIONS
Tube de commutation pour des clôtures électriques, dispositifs à haute tension pour l'amorçage de flammes à gaz.

APPLICATIONS
Switching diode for electric fences, high tension ignition devices for gas flames.

LEBENSDAUER
Abhängig von Impulsfolgefrequenz, Entladungsenergie, Belastungsimpedanz. Für jeden Fall durch Dauerversuche zu ermitteln.

DUREE DE SERVICE
Dépend de la fréquence des décharges, de l'énergie de décharge de l'impédance dans le circuit. A déterminer par des essais de durée pour chaque application.

LIFE EXPECTANCY
Depends on discharge frequency, discharge energy and circuit impedance. To be determined for each case by life-tests.

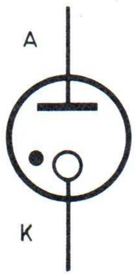
Hochstrom-Schaltdiode BD 31
Diode de commutation de forte intensité BD 31
High current switching diode BD 31

Type		BD 31
Nr.		12.31
Ed. 4.74	Fol. 1	

Edelgasgefüllte Diode mit kalter Kathode für impulsmässiges Schalten von einigen Ampères Spitzenstrom (Kondensatorenentladung über kleine Impedanz). Ausführung zum Einlöten, schlag- und vibrationsfest.

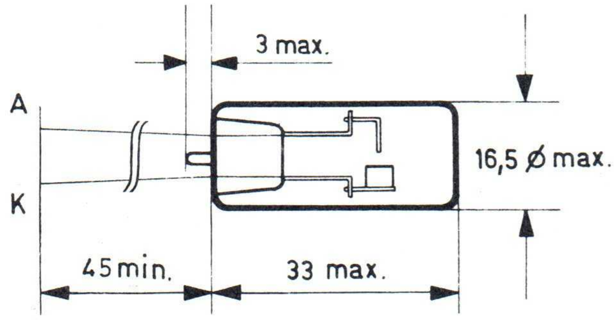
Diode à gaz à cathode froide pour la commutation par impulsions de courants de plusieurs ampères (par ex. décharge d'une capacité à travers une faible impédance). Exécution pour soudure, résistante aux chocs et vibrations.

Rare-gas-filled cold cathode diode for pulsed switching of currents of several amps (e.g. capacitor discharge through small impedance). Execution for soldering, resistant to shocks and vibrations.



A: Anode (gebogene Elektrode)
Anode (électrode recourbée)
Anode (shaped electrode)

K: Kathode (zylinderförmige Elektrode)
Cathode (électrode cylindrique)
Cathode (cylindrical electrode)



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KENNDATEN UND GRENZBETRIEBSDATEN	CARACTERISTIQUES ET LIMITES D'OPERATION	TECHNICAL DATA AND OPERATIONAL RANGE			min.	norm.	max.
Zündspannung A-K	Tension d'amorçage A-K	Breakdown voltage A-K	U_{ZAK}	(V)	180	200	220
Bogenspannung (für I > 50 mA)	Tension d'arc (pour I > 50 mA)	Arc voltage (for I > 50 mA)	U_{arc}	(V)		15	
Zulässiger Spitzenstrom in Kippschaltung	Courant de crête admissible dans bascule	Admissible peak current in trigger circuit	$\hat{I}_A$	(A)	5	10	
Energie je Entladung	Energie par décharge	Discharge energy	W_A	(Ws)		5	

UMGEBUNGSTEMPERATUR
-20° bis +80° C

TEMPERATURE AMBIANTE
-20° à +80° C

AMBIENT TEMPERATURE
-20° to +80° C

LEBENSDAUER
Abhängig von Impulsfolgefrequenz, Entladungsenergie, Belastungsimpedanz. Für jeden Fall durch Dauerversuche zu ermitteln.
Z.B. 100×10^6 Zündungen in Kippschaltung mit $\hat{I}_A$ = 10 A, Entladekapazität 4 µF bei ohmscher Last.

LONGEVITE
Dépend de la fréquence des décharges, de l'énergie de décharge, de l'impédance dans le circuit. A déterminer par des essais de durée pour chaque application.
Par ex. 100×10^6 amorçages dans bascule avec $\hat{I}_A$ = 10 A, capacité de décharge 4 µF pour charge ohmique.

LIFE EXPECTANCY
Depends on discharge frequency, discharge energy and circuit impedance. To be determined for each case by life-tests.
Will strike e.g. 100×10^6 times in trigger circuit, 10 A peak current, discharge capacity 4 µF with a resistive load.

ANWENDUNGSBEISPIELE
- Hochspannungs-Generatoren mit steilem Spannungsanstieg
- Hochspannungs-Zündvorrichtungen für Gasflammen
- Zündvorrichtungen für Natriumhochdrucklampen
- Schaltröhre für Weidezaungeräte

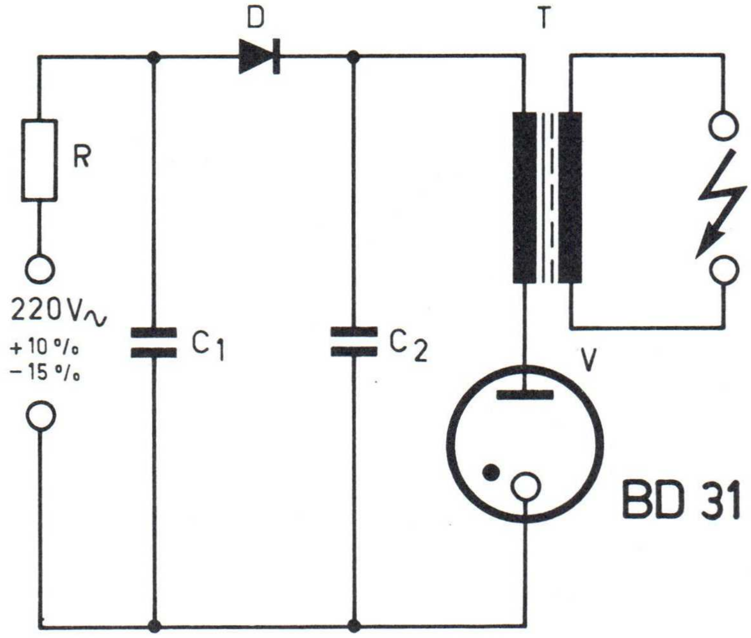
EXEMPLES D'APPLICATION
- Générateurs à haute tension avec une forte augmentation de tension
- Dispositifs à haute tension pour l'amorçage de flammes à gaz
- Dispositifs pour l'amorçage de lampes au sodiom
- Tube de commutation pour clôtures électriques

APPLICATION EXAMPLES
- High-voltage generators with significant voltage increase
- High-voltage ignition devices for gas flames
- Ignition devices for sodium lamps
- Switching diode for electric fences

TYPISCHE ANWENDUNG
Erzeugung von Hochspannungsimpulsen
(Beispiel eines Gasflammenzünders)

APPLICATION TYPIQUE
Génération d'impulsions de haute tension
(Exemple d'une allumage de flammes de gaz)

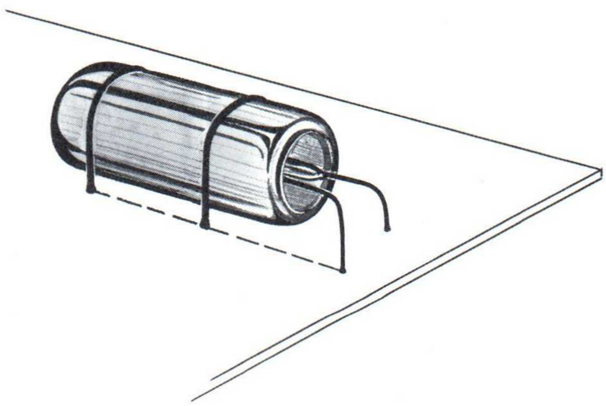
TYPICAL APPLICATION
Generation of high-voltage pulses
(Example of a gas flame igniter)



MONTAGE AUF PRINT-PLATTEN
Zwei Drahtbügel dienen als Halterung. Sie sind entweder potentialfrei zu halten oder mit der Kathode zu verbinden.

MONTAGE SUR CIRCUITS IMPRIMES
Deux ceintures métalliques servent à fixer le tube. Elles peuvent être exempte de potentiel ou reliées à la cathode.

MOUNTING ON PRINTED CIRCUITS
Two wire braces serve to support the tube. They can either be potential-free or connected to the cathode.



Type	BD 32
Nr.	12.32
Ed. 4.74	Fol. 1

Hochstrom-Schaltdiode BD 32
Diode de commutation de forte intensité BD 32
High current switching diode BD 32

Edelgasgefüllte Diode mit kalter Kathode für impulsmässiges Schalten von einigen Ampères Spitzenstrom (Kondensatorenentladung über kleine Impedanz). Ausführung zum Einlöten, schlag- und vibrationsfest.

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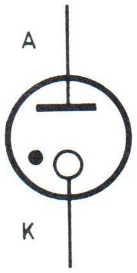
Rare-gas filled cold cathode diode for pulsed switching of currents of several amps (e.g. capacitor discharge through small impedance). Execution for soldering, resistant to shocks and vibrations.



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Anode (électrode recourbée)
Anode (shaped electrode)

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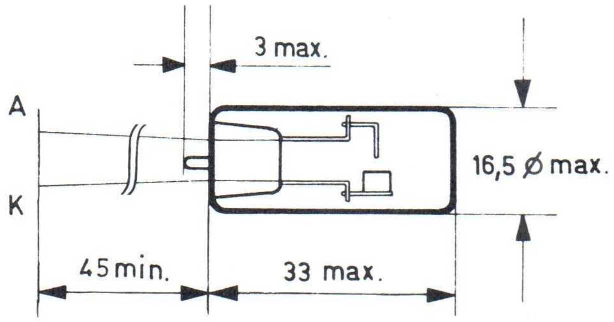
Cathode (électrode cylindrique)
Cathode (cylindrical electrode)



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KENNDATEN UND GRENZBETRIEBSDATEN	CARACTERISTIQUES ET LIMITES D'OPERATION	TECHNICAL DATA AND OPERATIONAL RANGE			min.	norm.	max.
Zündspannung A-K	Tension d'amorçage A-K	Breakdown voltage A-K	U_{ZAK}	(V)	360	400	440
Bogenspannung (für I > 50 mA)	Tension d'arc (pour I > 50 mA)	Arc voltage (for I > 50 mA)	U_{arc}	(V)		15	
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UMGEBUNGSTEMPERATUR
-20° bis +80° C

TEMPERATURE AMBIANTE
-20° à +80° C

AMBIENT TEMPERATURE
-20° to +80° C

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Abhängig von Impulsfolgefrequenz, Entladungsenergie, Belastungsimpedanz. Für jeden Fall durch Dauerversuche zu ermitteln.
Z.B. 100×10^6 Zündungen in Kippschaltung mit $\hat{I}_A$ = 10 A, Entladekapazität 4 µF bei ohmscher Last.

LONGEVITE
Dépend de la fréquence des décharges, de l'énergie de décharge, de l'impédance dans le circuit. A déterminer par des essais de durée pour chaque application.
Par ex. 100×10^6 amorçages dans bascule avec $\hat{I}_A$ = 10 A, capacité de décharge 4 µF pour charge ohmique.

LIFE EXPECTANCY
Depends on discharge frequency, discharge energy and circuit impedance. To be determined for each case by life-tests.
Will strike e.g. 100×10^6 times in trigger circuit, 10 A peak current, discharge capacity 4 µF with a resistive load.

ANWENDUNGSBEISPIELE
- Hochspannungs-Generatoren mit steilem Spannungsanstieg
- Hochspannungs-Zündvorrichtungen für Gasflammen
- Zündvorrichtungen für Natriumhochdrucklampen
- Schaltröhre für Weidezaungeräte

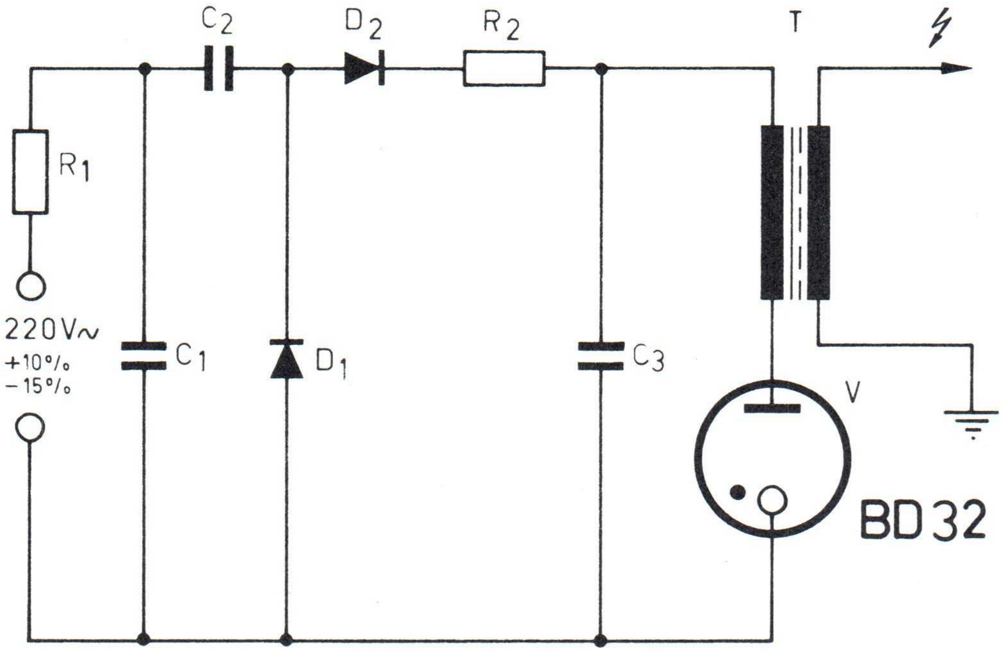
EXEMPLES D'APPLICATION
- Générateurs à haute tension avec une forte augmentation de tension
- Dispositifs à haute tension pour l'amorçage de flammes à gaz
- Dispositifs pour l'amorçage de lampes au sodiom
- Tube de commutation pour clôtures électriques

APPLICATION EXAMPLES
- High-voltage generators with significant voltage increase
- High-voltage ignition devices for gas flames
- Ignition devices for sodium lamps
- Switching diode for electric fences

TYPISCHE ANWENDUNG
Erzeugung von Hochspannungsimpulsen
(Beispiel eines Weidezaungerätes)

APPLICATION TYPIQUE
Génération d'impulsions de haute tension
(Exemple d'un appareil pour clôtures électriques)

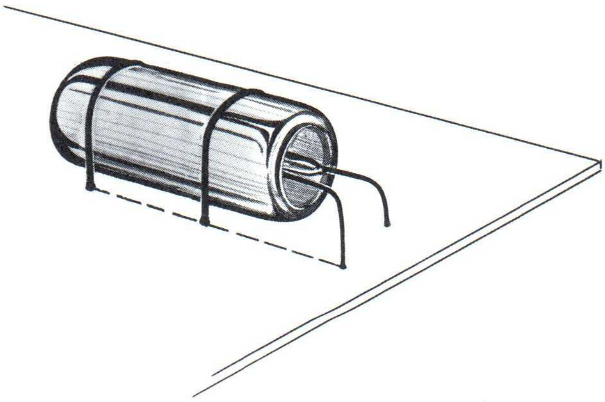
TYPICAL APPLICATION
Generation of high-voltage pulses
(Example of an electrical fence device)



MONTAGE AUF PRINT-PLATTEN
Zwei Drahtbügel dienen als Halterung. Sie sind entweder potentialfrei zu halten oder mit der Kathode zu verbinden.

MONTAGE SUR CIRCUITS IMPRIMES
Deux ceintures métalliques servent à fixer le tube. Elles peuvent être exempte de potentiel ou reliées à la cathode.

MOUNTING ON PRINTED CIRCUITS
Two wire braces serve to support the tube. They can either be potential-free or connected to the cathode.



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Überspannungsableiter UA 12, UA 12 U
Parasurtensions UA 12, UA 12 U
Surge Arrester UA 12, UA 12 U

Type: **UA 12**
Nr. 13.12
Ed. 1.70 | Fol. 1

ALLGEMEINES

Der Ueberspannungsableiter Typ UA 12 dient zum Schutz von Fernmelde- und Signalanlagen, von Freileitungen und Kabeln gegen Ueberspannungen, verursacht durch Blitzeinschläge oder atmosphärische Aufladungen. Der edelgasgefüllte Ableiter ist für eine Betriebsgleichspannung von max. 80 V oder eine Wechselspannung von max. 55 V ausgelegt. Dank seiner robusten Konstruktion und der sehr wirksamen β-Strahlen-Vorionisierung zeichnet er sich durch ein hohes Ableitungsvermögen und kleine Ansprechspannungen aus. Geringe Ströme (ca. 200 mA) gewährleisten bereits eine sichere Bogenentladung.

GENERALITES

Il incombe au parasurtension UA 12 de protéger des installations de télécommunication et de signalisation, des lignes aériennes et des câbles contre les surtensions provoquées par la foudre ou les charges atmosphériques. Le tube à gaz raréfié est conçu pour une tension de service continue de 80 V au max. ou alternative de 55 V au max. Sa construction robuste et une ionisation par la radiation β très efficace lui attribuent un grand pouvoir de décharge et de petites tensions d'amorçage. Les courants faibles d'environ 200 mA déjà suffisent pour garantir une décharge à arc.

INTRODUCTION

The surge arrester Type UA 12 serves to protect telephone and signalling installations, overhead lines and cables from overvoltages caused by lightning flashes and atmospheric charges. The inert gas filled device is designed for an operating DC voltage of 80 V or an AC voltage of maximum 55 V. As a result of its robust design and the very effective β-ray pre-ionization employed, the arrester has a high shunting capacity and a low response voltage. Small currents (approx. 200 mA) already ensure a reliable arc discharge.

FUNKTIONSWEISE

Die Zündeigenschaften des Ueberspannungsableiters UA 12 sind in Fig. 1 "Typische Ansprechcharakteristik" dargestellt. Die Ansprechspannung ist eine Funktion der Frontsteilheit der Stossspannung, sie nimmt mit zunehmender Steilheit leicht zu.

Sobald der Ueberspannungsableiter durch eine Stoss-Spannung gezündet ist, wird sein Verhalten durch die "Spannungs-Stromcharakteristik" (Fig. 2) beschrieben. Bei geringen Strömen durch den Ableiter entsteht eine Glimmentladung, die bei Strömen grösser als ca. 200 mA in eine Bogenentladung übergeht. Wird darauf der Strom auf 30 mA oder weniger reduziert, löscht die Bogenentladung und es entsteht wieder eine Glimmentladung. Nach Abklingen der Ueberspannung löscht der Ableiter und ist darauf zur nächsten Zündung bereit.

FONCTIONNEMENT

Le graphique "Caractéristique de réponse typique" selon fig. 2 renseigne sur les propriétés d'amorçage du parasurtension UA 12. La tension d'amorçage dépend de la pente du front de la tension de choc et s'élève légèrement si la pente devient plus forte.

Une fois amorcé par une tension de choc, le parasurtension se comporte comme décrit par la fig. 2 "Caractéristique tension-courant". De faibles courants à travers le tube produisent une décharge à effluve; des courants dépassant environ 200 mA la transforme en décharge à arc. Celle-ci s'éteint et se transforme en décharge à effluve dès que le courant est réduit à 30 mA ou une valeur inférieure. Une fois la surtension disparue, le tube s'éteint, prêt à un nouvel amorçage.

MODE OF OPERATION

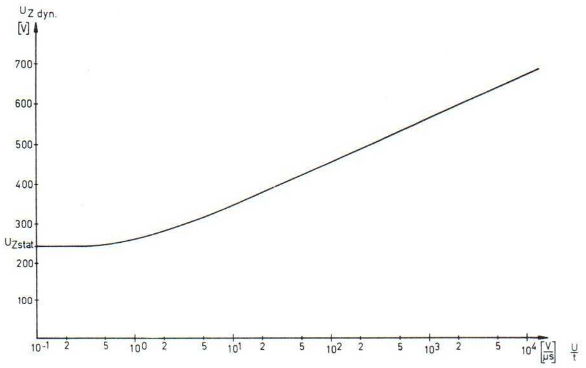
The ignition characteristics of the surge arrester Type UA 12 are given in Fig. 1, "Typical Operating Characteristic". The response or striking voltage is a function of the steepness of the wave front of the surge voltage - it increases slightly with increasing steepness.

As soon as the surge arrester is ignited by a surge voltage, its behaviour is described by the "Voltage-Current Characteristic" (Fig. 2). A glow discharge occurs if the current flowing through the arrester is small. This changes to an arc discharge when the current becomes larger than about 200 mA. If the current is reduced to 30 mA or less, the arc discharge is extinguished and a glow discharge again takes place. When the overvoltage dies out, the arrester is extinguished and is then ready for the next ignition.

Fig. 1
Typische Ansprechcharakteristik

Fig. 1
Caractéristique de réponse typique

Fig. 1
Typical Operating Characteristic



U_Z stat.: Ansprechgleichspannung
U_Z dyn.: Ansprechstoss-Spannung
$\frac{U}{t}$: Frontsteilheit der Stoss-Spannung

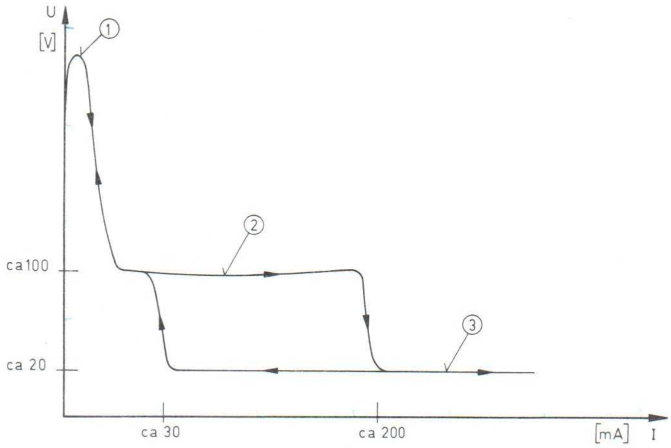
U_Z stat.: Tension d'amorçage continue
U_Z dyn.: Tension d'amorçage au choc
$\frac{U}{t}$: Pente du front de la tension de choc

U_Z stat.: Striking direct voltage
U_Z dyn.: Striking step voltage
$\frac{U}{t}$: Step voltage wave front slope

Fig. 2
Typische Spannungs-Stromcharakteristik

Fig. 2
Caractéristique tension-courant typique

Fig. 2
Typical Voltage-Current Characteristic



① Ansprechspannung
② Gebiet der Glimmentladung
③ Gebiet der Bogenentladung

① Tension d'amorçage
② Zone de la décharge à effluve
③ Zone de la décharge à arc

① Striking voltage
② Glow discharge region
③ Arc discharge region

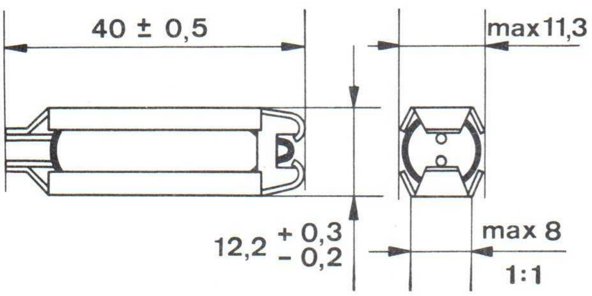
Für das Löschen von Ueberspannungsableitern parallel zu Gleichspannungsanlagen ist noch zusätzlich zu fordern, dass diese Spannungsquelle max. 80 V und 30 mA liefern darf. Beim Wechselspannungsbetrieb entfällt die Strombegrenzung, da der Ableiter automatisch beim Stromnulldurchgang löscht.

L'extinction de parasurtension connectés en parallèle à des installations à tension continue exige que cette source de tension puisse débiter 80 V et 30 mA au max. Cette restriction ne s'impose pas pour le service par tension alternative car le parasurtension s'éteint automatiquement lors du passage du courant par le point zéro.

For extinguishing surge arresters connected in parallel to DC voltage installations a further requirement is that the voltage source should not supply more than 80 V and 30 mA. There is no current limitation when operating with alternating voltages since the arrester automatically extinguishes when the current passes through zero.

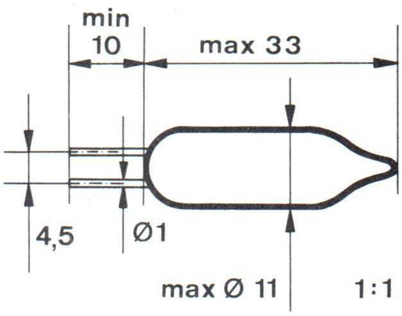
a. UA 12

(zum Einstecken in Halter UA 12)
(pour enfichage dans l'embase UA 12)
(to be put into holder UA 12)



b. UA 12 U

(mit verzinnten Drahtenden zum Einlöten)
(avec fil étamé pour soudure)
(with tinned wire ends for soldering)



KENNDATEN UND GRENZBETRIEBSDATEN	CARACTERISTIQUES ET LIMITES D'OPERATION	CHARACTERISTICS AND LIMITING VALUES				min.	normal	max.
Ansprech-Gleichspannung	Tension d'amorçage continue	Striking direct voltage	$U_{Z\,stat}$	(U_{ag})	[V]	220	245	270
(Spannungsanstieg ≤10^{-1} V/µs)	(Elévation de tension ≤10^{-1} V/µs)	(Step voltage ≤10^{-1} V/µs)						
Ansprech-Stossspannung (Stoss 2 kV - 1/50)	Tension d'amorçage au choc (choc 2 kV - 1/50)	Striking step voltage (pulse 2 kV - 1/50)	$U_{Z\,dyn}$	(u_{as})	[V]		600	800
Glimm-Brennspannung bei 10 mA	Tension d'entretien (à effluve) à 10 mA	Glow sustaining voltage at 10 mA	U_B	(U_{gl})	[V]	100	115	
Bogen-Brennspannung	Tension d'entretien à arc	Arc sustaining voltage	U_{Arc}	(U_{bo})	[V]		25	
Ableit-Wechselstrom (1 s, 50 Hz)	Courant de dérivation alternatif (1 s, 50 c/s)	Shunting alternating current (1 s, 50 c/s)	I_{50}	(I_w)	[A]	20		
Ableit-Stossstrom (Stoss 15/50)	Choc du courant de dérivation (choc 15/50)	Shunting current pulse (pulse 15/50)	I_S	(i_s)	[kA]	10		
Isolationswiderstand bei 100 V	Isolement à 100 V	Insulation at 100 V	R_{is}		[Ω]	10^{10}		
Eigenkapazität	Capacité propre	Capacitance	C		[pF]			4

Überspannungsableiter UA 230
Parasurtensions UA 230
Surge Arrester UA 230

Type	UA 230
Nr.	13.23
Ed. 4.71	Fol. 1

1. ALLGEMEINES

Der Ueberspannungsableiter UA 230 ist für eine Nennzündspannung von 255 V ausgelegt. Er dient dem Schutz von Fernmelde- und Signalanlagen gegen Ueberspannungen, verursacht durch Blitzeinschläge oder Erdrückströme bei fehlerhaften Schaltzuständen in benachbarten Hochspannungsnetzen. Der Ueberspannungsableiter ist mit Edelgas gefüllt. Wegen der wirksamen Vorionisierung zündet er praktisch verzugsfrei und unabhängig davon, welche Belastungen zuvor erfolgten. Die elektrischen Kennwerte bleiben auch nach langer Lagerzeit oder intensiver Stromleitung weitgehend erhalten.

1. GENERALITE

Le parasurtension UA 230 est conçu pour une tension d'amorçage nominale de 255 V. Il sert à la protection des installations de télécommunication et de signalisation contre des surtensions, provoquées par la foudre ou des courants de retour par la terre en cas de conditions de commutation défectueuses à proximité de circuits haute tension. Le parasurtension est rempli d'un gaz rare. Sa ionisation par radiation très efficace lui confère un amorçage pratiquement sans retard, indépendamment des charges auxquelles il a été soumis auparavant. Les valeurs caractéristiques restent maintenues même après un long stockage ou une circulation de courant intensive.

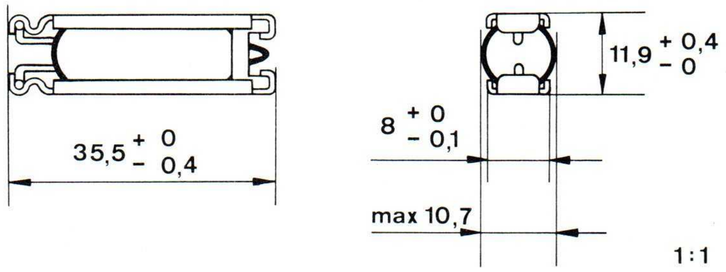
1. INTRODUCTION

The UA 230 surge arrester is designed for a nominal breakdown voltage of 255 V. It serves to protect telecommunication systems and signal installations from overvoltages caused by lightning or earth return currents on faulty switch conditions in neighbouring high voltage lines. The surge arrester is filled with inert gas. Because of its effective pre-ionization it strikes practically without delay, regardless of the charges to which it was submitted before. Its electrical caracteristics are maintained even after a long storage or a sustained, strong flow of current.

2. ABMESSUNGEN

2. ENCOMBREMENT

2. DIMENSIONS



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3. KENNDATEN, GRENZBETRIEBSDATEN

3. CARACTERISTIQUES, LIMITES D'OPERATION

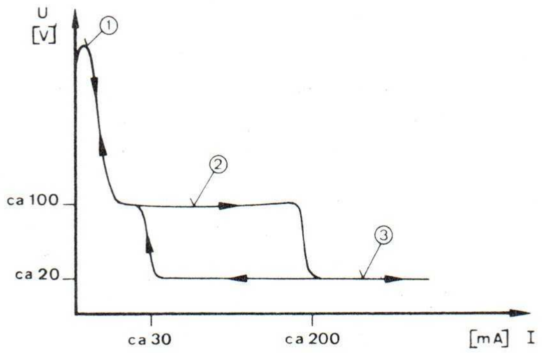
3. CHARACTERISTICS, LIMITING VALUES

					min.	normal	max.
Ansprech-Gleichspannung	Tension d'amorçage continue	Breakdown voltage	$U_{Z\,stat}$ (U_{ag})	[V]	220	255	290
Ansprech-Stossspannung (Stoss 2 kV - 1/50)	Tension d'amorçage au choc (choc 2 kV - 1/50)	Dynamic breakdown voltage (shape 2 kV - 1/50)	$U_{Z\,dyn}$ (u_{as})	[V]		600	800
Glimm-Brennspannung	Tension d'entretien	Glow sustaining voltage	U_B (U_{gl})	[V]		110	
Bogen-Brennspannung	Tension d'entretien à arc	Arc sustaining voltage	U_{Arc} (U_{bo})	[V]		25	
Ableit-Wechselstrom (1 s, 50 Hz)	Courant de dérivation alternatif (1 s, 50 c/s)	A.C. current r.m.s. (50 c/s, 1 s)	I_{50} (I_w)	[A]	20		
Ableit-Stossstrom (Stoss 15/50)	Choc du courant de dérivation (choc 15/50)	Surge current (shape 15/50)	I_S (i_s)	[kA]	10		
Isolationswiderstand bei 100 V	Isolement à 100 V	Insulation at 100 V	R_{is}	[Ω]	10^{10}		
Eigenkapazität	Capacité propre	Capacitance	C	[pF]			4

4. TYPISCHE SPANNUNGS-STROMCHARAKTERISTIK

4. CARACTERISTIQUE TENSION-COURANT TYPIQUE

4. TYPICAL VOLTAGE-CURRENT CHARACTERISTIC



① Ansprechspannung
② Gebiet der Glimmentladung
③ Gebiet der Bogenentladung

① Tension d'amorçage
② Zone de la décharge à effluve
③ Zone de la décharge à arc

① Striking voltage
② Glow discharge region
③ Arc discharge region

Überspannungsableiter UAM 120
Parasurtension UAM 120
Surge Arrester UAM 120

Type	UAM 120
Nr.	13.06
Ed. 4.71	Fol. 1

1. ALLGEMEINES

Der Ueberspannungsableiter UAM 120 dient zum Schutze von Fernmelde- und Signalanlagen gegen Ueberspannungen geringer Energie, verursacht durch Blitzeinschläge, atmosphärische Aufladungen oder Abschalten induktiver Verbraucher. Der Ableiter ist besonders preisgünstig, in Subminiaturausführung mit einlötbaren Drahtenden. Er ist für eine Betriebsgleichspannung von maximal 80 V oder eine Wechselspannung von maximal 55 V ausgelegt.

1. GENERALITE

Le parasurtension UAM 120 sert à la protection des installations de télécommunication et de signalisation contre des surtensions de faible énergie, provoquées par la foudre, des charges atmosphériques ou l'arrêt de consommateurs inductifs. Le parasurtension est particulièrement bon marché dans son exécution subminiature avec fils à souder. Il est conçu pour une tension d'exploitation continue de 80 V au max. ou alternative de 55 V au max.

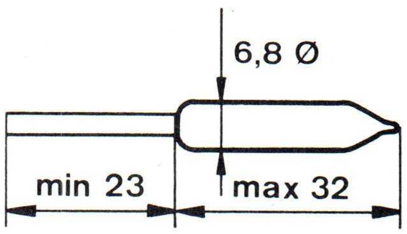
1. INTRODUCTION

The UAM 120 surge arrester serves to protect telecommunication systems and signalling installations against low-energy surge voltages caused by lightning strokes, atmospheric charges or by switch-off transients from inductive loads. This surge arrester is marketed at an attractively low price and obtainable in subminiature form with flying leads. It is designed for a working voltage of maximum 80 V d.c. or 55 V a.c.

2. ABMESSUNGEN

2. ENCOMBREMENT

2. DIMENSIONS



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3. KENNDATEN, GRENZBETRIEBSDATEN

3. CARACTERISTIQUES, LIMITES D'OPERATION

3. CHARACTERISTICS, LIMITING VALUES

						min.	normal	max.
Ansprech-Gleichspannung	Tension d'amorçage continue	Breakdown voltage	$U_{Z\,stat}$	(U_{ag})	[V]	90	120	160
Ansprech-Stossspannung (Stoss 2 kV - 1/50)	Tension d'amorçage au choc (choc 2 kV - 1/50)	Dynamic breakdown voltage (shape 2 kV - 1/50)	$U_{Z\,dyn}$	(u_{as})	[V]		800	1500
Glimm-Brennspannung	Tension d'entretien	Glow sustaining voltage	U_B	(U_{gl})	[V]	80		
Ableit-Wechselstrom (1 s, 50 Hz)	Courant de dérivation alternatif (1 s, 50 c/s)	A.C. current r.m.s. (1 s, 50 c/s)	I_{50}	(I_w)	[A]	1		
Ableit-Stossstrom (Stoss 15/50)	Choc du courant de dérivation (choc 15/50)	Surge current (shape 15/50)	I_S	(i_s)	[kA]	1		
Eigenkapazität	Capacité propre	Capacitance	C		[pF]			4

Überspannungsableiter UAM 470
Parasurtension UAM 470
Surge Arrester UAM 470

Type	UAM 470
Nr.	13.08
Ed. 8.73	Fol. 1

1. ALLGEMEINES

Der Ueberspannungsableiter UAM 470 ist für eine Nennzündspannung von 470 Volt ausgelegt. Er wird allgemein dort eingesetzt, wo kurzzeitige Ueberspannungen geringer Energie auftreten, verursacht durch atmosphärische Entladungen, Abschalten von Induktivitäten etc. Der Ableiter ist besonders preisgünstig, in Subminiaturausführung mit einlötbaren Drahtenden.

1. GENERALITE

Le parasurtension UAM 470 est conçu pour une tension d'amorçage nominale de 470 V. Il lui incombe de protéger contre des surtensions de courte durée et de faible énergie, provoquées par des décharges atmosphériques, l'arrêt de consommateurs inductifs etc. Le parasurtension est particulièrement bon marché dans son exécution subminiature avec fils libres.

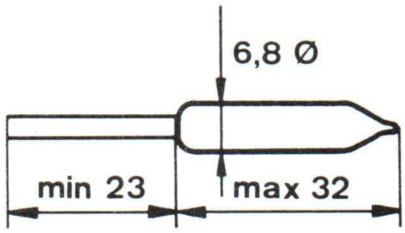
1. INTRODUCTION

The surge arrester type UAM 470 is designed for a nominal breakdown voltage of 470 V. It is generally installed to protect against momentary low-energy surge voltages caused by atmospheric discharges, switch-off transients from inductive loads etc. This surge arrester is marketed at an attractive low price and is obtainable in subminiature form with flying leads.

2. ABMESSUNGEN

2. ENCOMBREMENT

2. DIMENSIONS



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3. KENNDATEN GRENZBETRIEBSDATEN

3. CARACTERISTIQUES, LIMITES D'OPERATION

3. CHARACTERISTICS, LIMITING VALUES

						min.	normal	max.
* Ansprech-Gleichspannung	Tension continue d'amorçage	Breakdown voltage	$U_{Z\,stat}$	(U_{ag})	[V]	400	470	540
Ansprech-Stossspannung (Stoss 2 kV - 1/50)	Tension d'amorçage au choc (choc 2 kV - 1/50)	Dynamic breakdown voltage (shape 2 kV - 1/50)	$U_{Z\,dyn}$	(u_{as})	[V]		1100	1600
Glimm-Brennspannung	Tension d'entretien	Glow sustaining voltage	U_B	(U_{gl})	[V]		180	
Ableit-Wechselstrom (1 s, 50 Hz)	Courant de dérivation alternatif (1 s, 50 c/s)	A.C. current r.m.s. (1s, 50 c/s)	I_{50}	(I_w)	[A]	1		
Ableit-Stossstrom (Stoss 15/50)	Choc du courant de dérivation (choc 15/50)	Surge current (shape 15/50)	I_S	(i_s)	[kA]	1		
Eigenkapazität	Capacité propre	Capacitance	C		[pF]			4

* Belastungen können je nach Ausmass ein Absinken der Ansprech-Gleichspannung bewirken.
La tension continue d'amorçage peut être réduite selon l'importance des charges.
The breakdown voltage may be reduced by loads according to their amount.

Überspannungsableiter UAM 600
Parasurtension UAM 600
Surge Arrester UAM 600

Type	UAM 600
Nr.	13.09
Ed. 2.73	Fol. 1

1. ALLGEMEINES

Der Ueberspannungsableiter UAM 600 ist für eine Nennzündspannung von 670 Volt ausgelegt und dient als Primärschutz für 220 V~ Geräte. Er wird allgemein dort eingesetzt, wo kurzzeitige Ueberspannungen geringer Energie auftreten, verursacht durch atmosphärische Entladungen, Abschalten von Induktivitäten etc. Der Ableiter ist besonders preisgünstig, in Subminiaturausführung mit einlötbaren Drahtenden.

1. GENERALITE

Le parasurtension UAM 600 est conçu pour une tension d'amorçage nominale de 670 V et sert comme protection primaire pour des appareils de 220 V a.c. Il lui incombe de les protéger contre des surtensions de faible énergie, provoquées par des charges atmosphériques, l'arrêt de consommateurs inductifs etc. Le parasurtension est particulièrement bon marché dans son exécution subminiature avec fils libres.

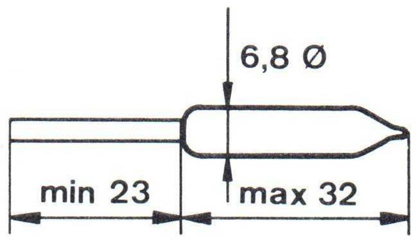
1. INTRODUCTION

The surge arrester type UAM 600 is designed for a nominal breakdown voltage of 670 V and serves as primary protection for 220 V a.c. apparatus. It is generally installed to protect them against low-energy surge voltages caused by atmospheric charges or by switch-off transients from inductive loads. This surge arrester is marketed at an attractive low price and is obtainable in subminiature form with flying leads.

2. ABMESSUNGEN

2. ENCOMBREMENT

2. DIMENSIONS



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3. KENNDATEN, GRENZBETRIEBSDATEN

3. CARACTERISTIQUES, LIMITES D'OPERATION

3. CHARACTERISTICS, LIMITING VALUES

						min.	normal	max.
* Ansprech-Gleichspannung	Tension continue d'amorçage	Breakdown voltage	UZ stat	(U_{ag})	[V]	600	670	740
Ansprech-Stossspannung (Stoss 2 kV - 1/50)	Tension d'amorçage au choc (choc 2 kV - 1/50)	Dynamic breakdown voltage (shape 2 kV - 1/50)	UZ dyn	(u_{as})	[V]		1100	1600
Glimm-Brennspannung	Tension d'entretien	Glow sustaining voltage	U_B	(U_{gl})	[V]		180	
Ableit-Wechselstrom (1 s, 50 Hz)	Courant de dérivation alternatif (1 s, 50 c/s)	A.C. current r.m.s. (1 s, 50 c/s)	I_{50}	(I_w)	[A]	1		
Ableit-Stossstrom (Stoss 15/50)	Choc du courant de dérivation (choc 15/50)	Surge current (shape 15/50)	I_S	(i_s)	[kA]	1		
Eigenkapazität	Capacité propre	Capacitance	C		[pF]			4

* Belastungen können ein Absinken der Ansprech-Gleichspannung bewirken.
Des charges peuvent réduire la tension continue d'amorçage.
Loads can cause a reduction in the breakdown voltage.

Type
YS 245
Nr. 13.24
Ed. 5.69 — Fol. 1

Überspannungsableiter YS 245
Parasurtensions YS 245
Surge Arrester YS 245

1. ALLGEMEINES

Der Ueberspannungsableiter YS 245 ist für eine Nennzündspannung von 245 V ausgelegt. Er dient dem Schutz von Fernmelde- und Signalanlagen gegen Ueberspannungen, verursacht durch Blitzeinschläge oder Erdrückströme bei fehlerhaften Schaltzuständen in benachbarten Hochspannungsnetzen. Der Ueberspannungsableiter ist mit Edelgas gefüllt. Wegen der wirksamen Vorionisierung zündet er praktisch verzugsfrei und unabhängig davon, welche Belastungen zuvor erfolgten. Die elektrischen Kennwerte bleiben auch nach langer Lagerzeit oder intensiver Stromleitung weitgehend erhalten.

1. GENERALITE

Le parasurtension YS 245 est conçu pour une tension d'amorçage nominale de 245 V. Il sert à la protection des installations de télécommunication et de signalisation contre des surtensions, provoquées par la foudre ou des courants de retour par la terre en cas de conditions de commutation défectueuses à proximité de circuits haute tension. Le parasurtension est rempli d'un gaz rare. Sa ionisation par radiation très efficace lui confère un amorçage pratiquement sans retard, indépendamment des charges auxquelles il a été soumis auparavant. Les valeurs caractéristiques restent maintenues même après un long stockage ou une circulation de courant intensive.

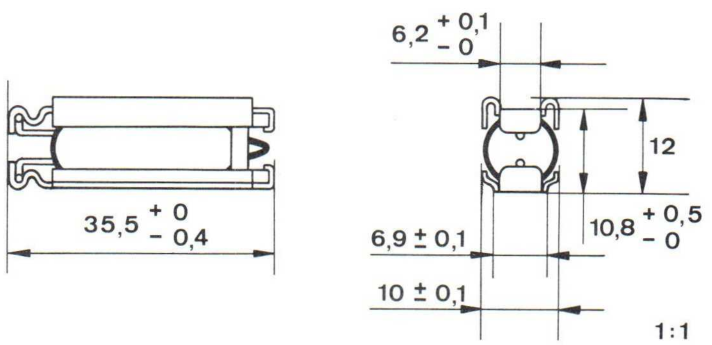
1. INTRODUCTION

The YS 245 surge arrester is designed for a nominal striking voltage of 245 V. It serves to protect telecommunication systems and signal installations from overvoltages caused by lightning or earth return currents on faulty switch conditions in neighbouring high voltage lines. The surge arrester is filled with inert gas. Because of its effective pre-ionization it strikes practically without delay, regardless of the charges to which it was submitted before. Its electrical caracteristics are maintained even after a long storing time or a sustained, strong flow of current.

2. ABMESSUNGEN

2. EMCOMBREMENT

2. DIMENSIONS



3. KENNDATEN, GRENZBETRIEBSDATEN
3. CARACTERISTIQUES, LIMITES D'OPERATION
3. CHARACTERISTICS, LIMITING VALUES

						min.	normal	max.
Ansprech-Gleichspannung	Tension d'amorçage continue	Striking direct voltage	$U_{Z\,stat}$	(U_{ag})	[V]	215	245	275
Ansprech-Stossspannung (Stoss 2 kV − 1/50)	Tension d'amorçage au choc (choc 2 kV − 1/50)	Striking step voltage (pulse 2 kV − 1/50)	$U_{Z\,dyn}$	(u_{as})	[V]		600	800
Glimm-Brennspannung	Tension d'entretien	Glow sustaining voltage	U_B	(U_{gl})	[V]		110	
Bogen-Brennspannung	Tension d'entretien à arc	Arc sustaining voltage	U_{Arc}	(U_{bo})	[V]		25	
Ableit-Wechselstrom (1 s, 50 Hz)	Courant de dérivation alternatif (1 s, 50 c/s)	Shunting alternating current (1 s, 50 c/s)	I_{50}	(I_w)	[A]	20		
Ableit-Stossstrom (Stoss 15/50)	Choc du courant de dérivation (choc 15/50)	Shunting current pulse (pulse 15/50)	I_S	(i_s)	[kA]	10		
Isolationswiderstand bei 100 V	Isolement à 100 V	Insulation at 100 V	R_{is}		[Ω]	10^{10}		
Eigenkapazität	Capacité propre	Capacitance	C		[pF]			4

Type	UA 245 A
Nr.	13.25
Ed. 8.70	Fol. 1

Überspannungsableiter UA 245 A
Parasurtension UA 245 A
Surge Arrester UA 245 A

1. ALLGEMEINES

Der Ueberspannungsableiter UA 245 A ist für eine Nennzündspannung von 245 V ausgelegt. Er dient dem Schutz von Fernmelde- und Signalanlagen gegen Ueberspannungen, verursacht durch Blitzeinschläge oder Erdrückströme bei fehlerhaften Schaltzuständen in benachbarten Hochspannungsnetzen. Der Ueberspannungsableiter ist mit Edelgas gefüllt. Wegen der wirksamen Vorionisierung zündet er praktisch verzugsfrei und unabhängig davon, welche Belastungen zuvor erfolgten. Die elektrischen Kennwerte bleiben auch nach langer Lagerzeit oder intensiver Stromleitung weitgehend erhalten.

1. GENERALITE

Le parasurtension UA 245 A est conçu pour une tension d'amorçage nominale de 255 V. Il sert à la protection des installations de télécommunication et de signalisation contre des surtensions, provoquées par la foudre ou des courants de retour par la terre en cas de conditions de commutation défectueuses à proximité de circuits haute tension. Le parasurtension est rempli d'un gaz rare. Sa ionisation par radiation très efficace lui confère un amorçage pratiquement sans retard, indépendamment des charges auxquelles il a été soumis auparavant. Les valeurs caractéristiques restent maintenues même après un long stockage ou une circulation de courant intensive.

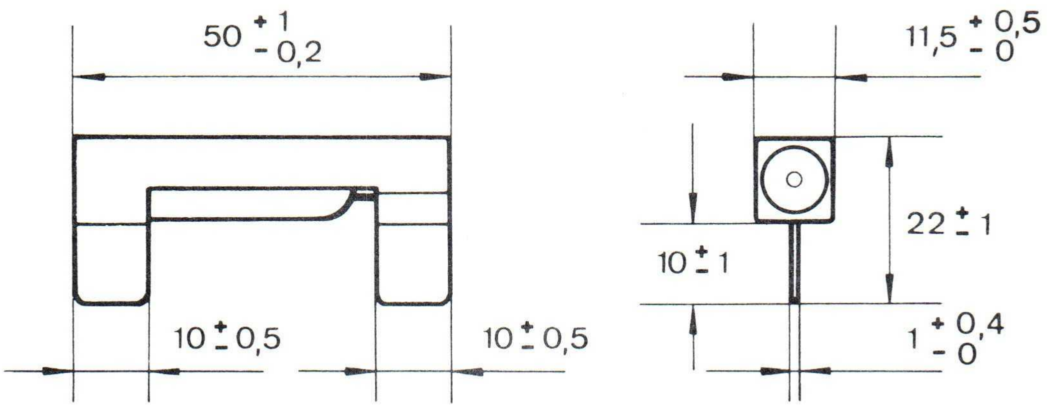
1. INTRODUCTION

The UA 245 A surge arrester is designed for a nominal striking voltage of 245 V. It serves to protect telecommunication systems and signal installations from over-voltages caused by lightning or earth return currents on faulty switch conditions in neighbouring high voltage lines. The surge arrester is filled with inert gas. Because of its effective pre-ionization it strikes practically without delay, regardless of the charges to which it was submitted before. Its electrical caracteristics are maintained even after a long storing time or a sustained, strong flow of current.

2. ABMESSUNGEN

2. ENCOMBREMENT

2. DIMENSIONS



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3. KENNDATEN, GRENZBETRIEBSDATEN

3. CARACTERISTIQUES, LIMITES D'OPERATION

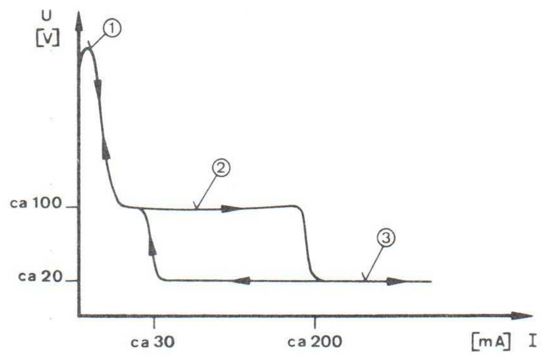
3. CHARACTERISTICS, LIMITING VALUES

						min.	normal	max.
Ansprech-Gleichspannung	Tension d'amorçage continue	Striking direct voltage	$U_{Z\,stat}$	(U_{ag})	[V]	215	245	275
Ansprech-Stossspannung (Stoss 2 kV - 1/50)	Tension d'amorçage au choc (choc 2 kV - 1/50)	Striking step voltage (pulse 2 kV - 1/50)	$U_{Z\,dyn}$	(u_{as})	[V]		600	800
Glimm-Brennspannung	Tension d'entretien	Glow sustaining voltage	U_B	(U_{gl})	[V]		110	
Bogen-Brennspannung	Tension d'entretien à arc	Arc sustaining voltage	U_{Arc}	(U_{bo})	[V]		25	
Ableit-Wechselstrom (1 s, 50 Hz)	Courant de dérivation alternatif (1 s, 50 c/s)	Shunting alternating current (1 s, 50 c/s)	I_{50}	(I_w)	[A]	20		
Ableit-Stossstrom (Stoss 15/50)	Choc du courant de dérivation (choc 15/50)	Shunting current pulse (pulse 15/50)	I_S	(i_s)	[kA]	10		
Isolationswiderstand bei 100 V	Isolement à 100 V	Insulation at 100 V	R_{is}		[Ω]	10^{10}		
Eigenkapazität	Capacité propre	Capacitance	C		[pF]			4

4. TYPISCHE SPANNUNGS-STROMCHARAKTERISTIK

4. CARACTERISTIQUE TENSION-COURANT TYPIQUE

4. TYPICAL VOLTAGE-CURRENT CHARACTERISTIC



① Ansprechspannung
② Gebiet der Glimmentladung
③ Gebiet der Bogenentladung

① Tension d'amorçage
② Zone de la décharge à effluve
③ Zone de la décharge à arc

① Striking voltage
② Glow discharge region
③ Arc discharge region

Überspannungsableiter UA 245 B Parasurtension UA 245 B Surge Arrester UA 245 B	Type UA 245 B	
	Nr. 13.26	
	Ed. 8.70	Fol. 1

Überspannungsableiter UA 245 B
Parasurtension UA 245 B
Surge Arrester UA 245 B

1. ALLGEMEINES

Der Ueberspannungsableiter UA 245 B ist für eine Nennzündspannung von 245 V ausgelegt. Er dient dem Schutz von Fernmelde- und Signalanlagen gegen Ueberspannungen, verursacht durch Blitzeinschläge oder Erdrückströme bei fehlerhaften Schaltzuständen in benachbarten Hochspannungsnetzen. Der Ueberspannungsableiter ist mit Edelgas gefüllt. Wegen der wirksamen Vorionisierung zündet er praktisch verzugsfrei und unabhängig davon, welche Belastungen zuvor erfolgten. Die elektrischen Kennwerte bleiben auch nach langer Lagerzeit oder intensiver Stromleitung weitgehend erhalten.

1. GENERALITE

Le parasurtension UA 245 B est conçu pour une tension d'amorçage nominale de 255 V. Il sert à la protection des installations de télécommunication et de signalisation contre des surtensions, provoquées par la foudre ou des courants de retour par la terre en cas de conditions de commutation défectueuses à proximité de circuits haute tension. Le parasurtension est rempli d'un gaz rare. Sa ionisation par radiation très efficace lui confère un amorçage pratiquement sans retard, indépendamment des charges auxquelles il a été soumis auparavant. Les valeurs caractéristiques restent maintenues même après un long stockage ou une circulation de courant intensive.

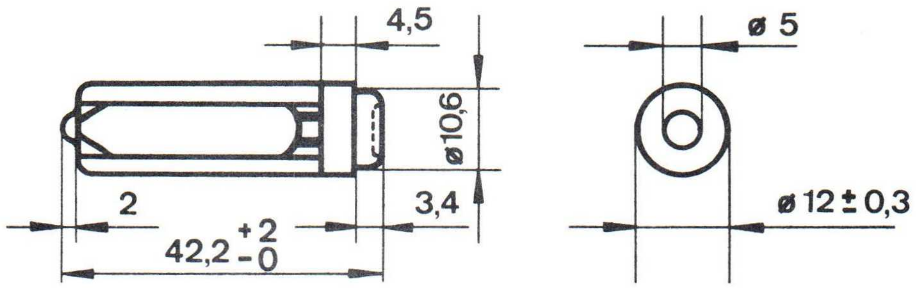
1. INTRODUCTION

The UA 245 B surge arrester is designed for a nominal striking voltage of 245 V. It serves to protect telecommunication systems and signal installations from over-voltages caused by lightning or earth return currents on faulty switch conditions in neighbouring high voltage lines. The surge arrester is filled with inert gas. Because of its effective pre-ionization it strikes practically without delay, regardless of the charges to which it was submitted before. Its electrical caracteristics are maintained even after a long storing time or a sustained, strong flow of current.

2. ABMESSUNGEN

2. ENCOMBREMENT

2. DIMENSIONS



1:1

3. KENNDATEN, GRENZBETRIEBSDATEN

3. CARACTERISTIQUES, LIMITES D'OPERATION

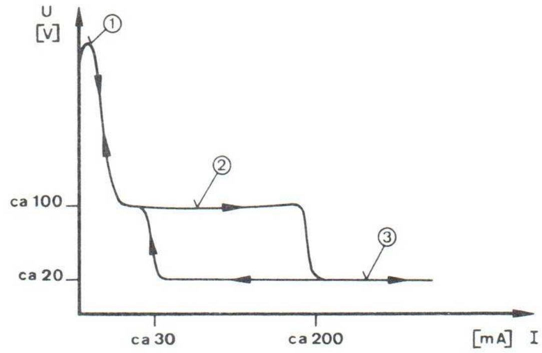
3. CHARACTERISTICS, LIMITING VALUES

						min.	normal	max.
Ansprech-Gleichspannung	Tension d'amorçage continue	Striking direct voltage	$U_{Z\,stat}$	(U_{ag})	[V]	215	245	275
Ansprech-Stossspannung (Stoss 2 kV - 1/50)	Tension d'amorçage au choc (choc 2 kV - 1/50)	Striking step voltage (pulse 2 kV - 1/50)	$U_{Z\,dyn}$	(u_{as})	[V]		600	800
Glimm-Brennspannung	Tension d'entretien	Glow sustaining voltage	U_B	(U_{gl})	[V]		110	
Bogen-Brennspannung	Tension d'entretien à arc	Arc sustaining voltage	U_{Arc}	(U_{bo})	[V]		25	
Ableit-Wechselstrom (1 s, 50 Hz)	Courant de dérivation alternatif (1 s, 50 c/s)	Shunting alternating current (1 s, 50 c/s)	I_{50}	(I_w)	[A]	20		
Ableit-Stossstrom (Stoss 15/50)	Choc du courant de dérivation (choc 15/50)	Shunting current pulse (pulse 15/50)	I_S	(i_s)	[kA]	10		
Isolationswiderstand bei 100 V	Isolement à 100 V	Insulation at 100 V	R_{is}		[Ω]	10^{10}		
Eigenkapazität	Capacité propre	Capacitance	C		[pF]			4

4. TYPISCHE SPANNUNGS-STROMCHARAKTERISTIK

4. CARACTERISTIQUE TENSION-COURANT TYPIQUE

4. TYPICAL VOLTAGE-CURRENT CHARACTERISTIC



① Ansprechspannung
② Gebiet der Glimmentladung
③ Gebiet der Bogenentladung

① Tension d'amorçage
② Zone de la décharge à effluve
③ Zone de la décharge à arc

① Striking voltage
② Glow discharge region
③ Arc discharge region

Überspannungsableiter, UA 350, UA 350 U, YS 350 Parasurtensions UA 350, UA 350 U, YS 350 Surge Arrester UA 350, UA 350 U YS 350	Type UA 350	
	Nr. 13.35	
	Ed. 3.71	Fol. 1

1. ALLGEMEINES

Die Ueberspannungsableiter UA 350 und YS 350 sind für eine Nennzündspannung von 350 V ausgelegt. Sie unterscheiden sich durch verschiedene Fassungen. Die Ableiter dienen dem Schutz von Fernmelde- und Signalanlagen gegen Ueberspannungen, verursacht durch Blitzeinschläge oder Erdrückströme bei fehlerhaften Schaltzuständen in benachbarten Hochspannungsnetzen. Die Ueberspannungsableiter sind mit Edelgas gefüllt. Sie zünden wegen der wirksamen Vorionisierung praktisch verzugsfrei und unabhängig davon, welche Belastungen zuvor erfolgten. Die elektrischen Kennwerte bleiben auch nach langer Lagerzeit oder intensiver Stromleitung weitgehend erhalten.

1. GENERALITE

Les parasurtensions UA 350 et YS 350 sont conçus pour une tension d'amorçage nominale de 350 V. Ils se distinguent par des douilles différentes. Les parasurtensions servent à la protection des installations de télécommunication et de signalisation contre des surtensions, provoquées par la foudre ou des courants de retour par la terre en cas de conditions de commutation défectueuses à proximité de circuits haute tension. Les parasurtensions sont remplis d'un gaz rare. Sa ionisation par radiation très efficace leurs confèrent un amorçage pratiquement sans retard, indépendamment des charges auxquelles ils ont été soumis auparavant. Les valeurs caractéristiques restent maintenues même après un long stockage ou une circulation de courant intensive.

1. INTRODUCTION

The UA 350 and YS 350 surge arresters are designed for a nominal breakdown voltage of 350 V. They are distinguished by different holders. The surge arresters serve to protect telecommunication systems and signal installations from overvoltages caused by lightning or earth return currents on faulty switch conditions in neighbouring high voltage lines. The surge arresters are filled with inert gas. Because of its effective pre-ionization they strike practically without delay, regardless of the charges to which they were submitted before. Their electrical caracteristics are maintained even after a long storage or a sustained, strong flow of current.

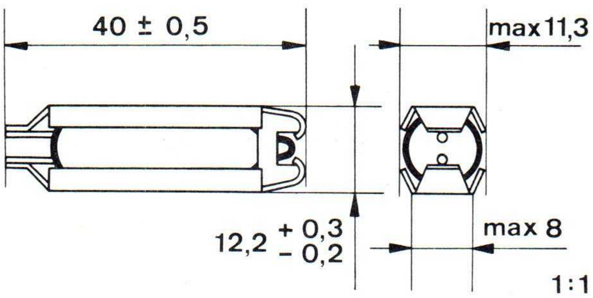
2. ABMESSUNGEN

2. ENCOMBREMENT

2. DIMENSIONS

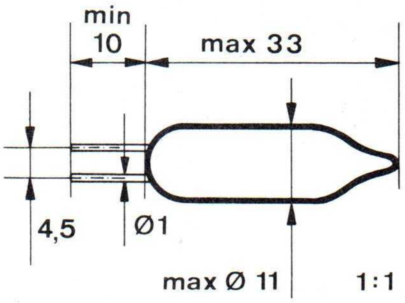
a. UA 350

(zum Einstecken in Halter Nr. 175 197)
(pour enfichage dans l'embase no. 175 197)
(to be put into holder no. 175 197)

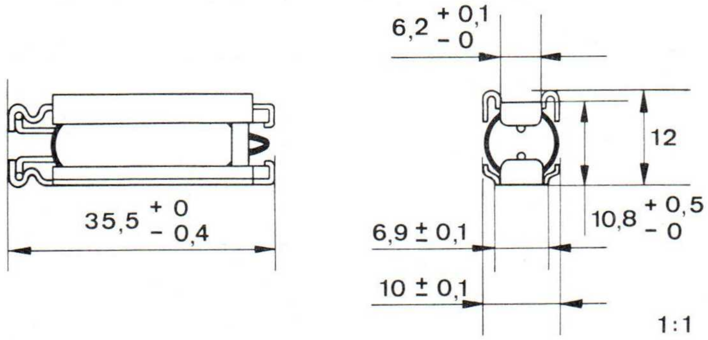


b. UA 350 U

(mit verzinnten Drahtenden zum Einlöten)
(avec fil étamé pour soudure)
(with tinned wire ends for soldering)



c. YS 350

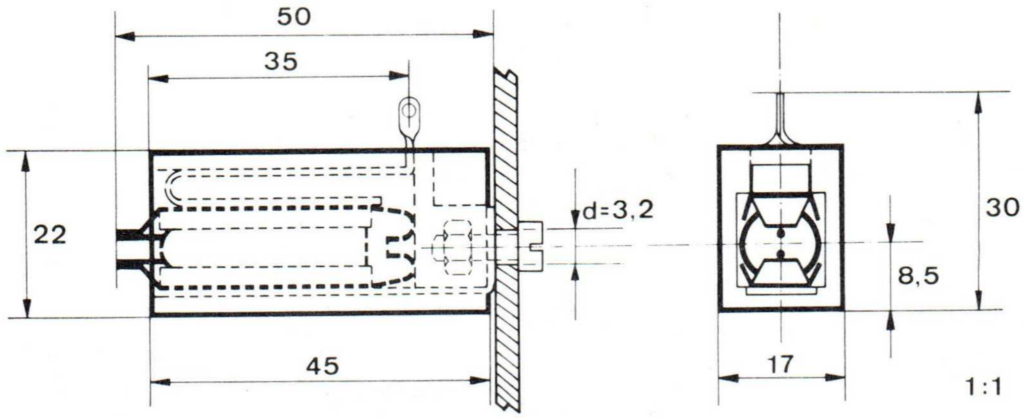


3. KENNDATEN, GRENZBETRIEBSDATEN	3. CARACTERISTIQUES, LIMITES D'OPERATION	3. CHARACTERISTICS, LIMITING VALUES				min.	normal	max.
Ansprech-Gleichspannung	Tension d'amorçage continue	Breakdown voltage	$U_{Z\,stat}$	(U_{ag})	[V]	315	350	385
Ansprech-Stossspannung (Stoss 2 kV - 1/50)	Tension d'amorçage au choc (choc 2 kV - 1/50)	Dynamic breakdown voltage (shape 2 kV - 1/50)	$U_{Z\,dyn}$	(u_{as})	[V]		700	1000
Glimm-Brennspannung	Tension d'entretien	Glow sustaining voltage	U_B	(U_{gl})	[V]		130	
Bogen-Brennspannung	Tension d'entretien à arc	Arc sustaining voltage	U_{Arc}	(U_{bo})	[V]		25	
Ableit-Wechselstrom (1 s, 50 Hz)	Courant de dérivation alternatif (1 s, 50 c/s)	A.C. current r.m.s. (1 s, 50 c/s)	I_{50}	(I_w)	[A]	20		
Ableit-Stossstrom (Stoss 15/50)	Choc du courant de dérivation (choc 15/50)	Surge current (shape 15/50)	I_S	(i_s)	[kA]	10		
Isolationswiderstand bei 100 V	Isolement à 100 V	Insulation at 100 V	R_{is}		[Ω]	10^{10}		
Eigenkapazität	Capacité propre	Capacitance	C		[pF]			4

4. HALTER NR. 175 197
PASSEND FUER UA 350
(Material H. POP)

4. EMBASE NO. 175 197
CADRANT AVEC UA 350
(Matériel H.POP)

4. HOLDER NO. 175 197
SUITABLE FOR UA 350
(Material H. POP)



d: Montageloch / Trou de montage / Mounting hole

Überspannungsableiter UA 350 B Parasurtension UA 350 B Surge Arrester UA 350 B	Type	UA 350 B
	Nr.	13.36
	Ed. 8.70	Fol. 1

1. ALLGEMEINES

Der Ueberspannungsableiter UA 350 B ist für eine Nennzündspannung von 350 V ausgelegt. Er dient dem Schutz von Fernmelde- und Signalanlagen gegen Ueberspannungen, verursacht durch Blitzeinschläge oder Erdrückströme bei fehlerhaften Schaltzuständen in benachbarten Hochspannungsnetzen. Der Ueberspannungsableiter ist mit Edelgas gefüllt. Wegen der wirksamen Vorionisierung zündet er praktisch verzugsfrei und unabhängig davon, welche Belastungen zuvor erfolgten. Die elektrischen Kennwerte bleiben auch nach langer Lagerzeit oder intensiver Stromleitung weitgehend erhalten.

1. GENERALITE

Le parasurtension UA 350 B est conçu pour une tension d'amorçage nominale de 350 V. Il sert à la protection des installations de télécommunication et de signalisation contre des surtensions, provoquées par la foudre ou des courants de retour par la terre en cas de conditions de commutation défectueuses à proximité de circuits haute tension. Le parasurtension est rempli d'un gaz rare. Sa ionisation par radiation très efficace lui confère un amorçage pratiquement sans retard, indépendamment des charges auxquelles il a été soumis auparavant. Les valeurs caractéristiques restent maintenues même après un long stockage ou une circulation de courant intensive.

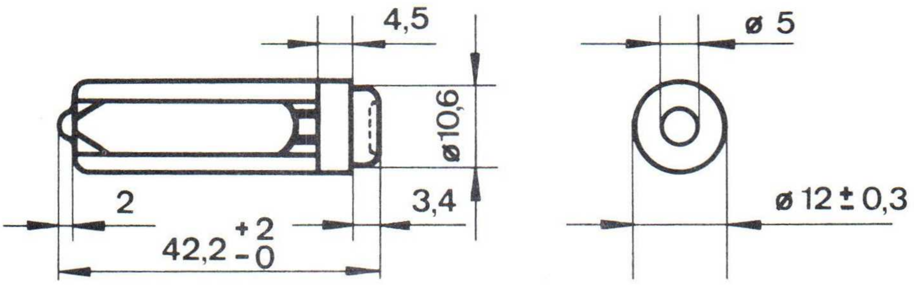
1. INTRODUCTION

The UA 350 B surge arrester is designed for a nominal striking voltage of 350 V. It serves to protect telecommunication systems and signal installations from over-voltages caused by lightning or earth return currents on faulty switch conditions in neighbouring high voltage lines. The surge arrester is filled with inert gas. Because of its effective pre-ionization it strikes practically without delay, regardless of the charges to which it was submitted before. Its electrical caracteristics are maintained even after a long storing time or a sustained, strong flow of current.

2. ABMESSUNGEN

2. ENCOMBREMENT

2. DIMENSIONS



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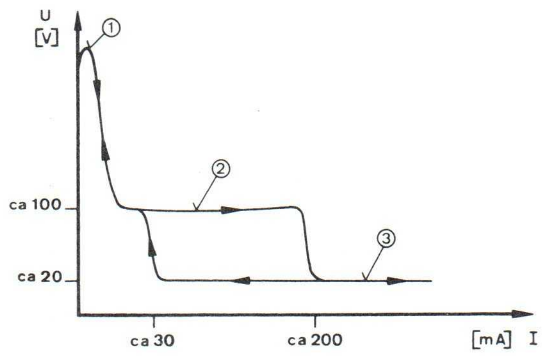
3. KENNDATEN, GRENZBETRIEBSDATEN

3. CARACTERISTIQUES, LIMITES D'OPERATION

3. CHARACTERISTICS, LIMITING VALUES

						min.	normal	max.
Ansprech-Gleichspannung	Tension d'amorçage continue	Striking direct voltage	$U_{Z\,stat}$	(U_{ag})	[V]	315	350	385
Ansprech-Stossspannung (Stoss 2 kV - 1/50)	Tension d'amorçage au choc (choc 2 kV - 1/50)	Striking step voltage (pulse 2 kV - 1/50)	$U_{Z\,dyn}$	(u_{as})	[V]		700	1000
Glimm-Brennspannung	Tension d'entretien	Glow sustaining voltage	U_B	(U_{gl})	[V]		130	
Bogen-Brennspannung	Tension d'entretien à arc	Arc sustaining voltage	U_{Arc}	(U_{bo})	[V]		25	
Ableit-Wechselstrom (1 s, 50 Hz)	Courant de dérivation alternatif (1 s, 50 c/s)	Shunting alternating current (1 s, 50 c/s)	I_{50}	(I_w)	[A]	20		
Ableit-Stossstrom (Stoss 15/50)	Choc du courant de dérivation (choc 15/50)	Shunting current pulse (pulse 15/50)	I_S	(i_s)	[kA]	10		
Isolationswiderstand bei 100 V	Isolement à 100 V	Insulation at 100 V	R_{is}		[Ω]	10^{10}		
Eigenkapazität	Capacité propre	Capacitance	C		[pF]			4

4. TYPISCHE SPANNUNGS-STROMCHARAKTERISTIK	4. CARACTERISTIQUE TENSION-COURANT TYPIQUE	4. TYPICAL VOLTAGE-CURRENT CHARACTERISTIC



① Ansprechspannung	① Tension d'amorçage	① Striking voltage
② Gebiet der Glimmentladung	② Zone de la décharge à effluve	② Glow discharge region
③ Gebiet der Bogenentladung	③ Zone de la décharge à arc	③ Arc discharge region

CERBERUS	**Überspannungsableiter UA 600, UA 600 U** **Parasurtensions UA 600, UA 600 U** **Surge Arrester UA 600, UA 600 U**	Type **UA 600** Nr. 13.60 Ed. 4.71 Fol. 1

1. ALLGEMEINES

Der Ueberspannungsableiter UA 600 ist für eine Nennzündspannung von 600 V ausgelegt. Er dient zum Schutz von Koaxialkabelverstärkern gegen Ueberspannungen, verursacht durch Blitzeinschläge oder Erdrückströme bei fehlerhaften Schaltzuständen in benachbarten Hochspannungsnetzen. Der Ableiter ist mit Edelgas gefüllt. Wegen seiner wirksamen Vorionisierung zündet der UA 600 praktisch verzugsfrei, unabhängig davon, welchen Belastungen er zuvor unterzogen wurde. Die elektrischen Kennwerte bleiben auch nach langer Lagerzeit oder intensiver Stromleitung weitgehend erhalten.

1. GENERALITE

Le parasurtension UA 600 est conçu pour une tension d'amorçage nominale de 600 V. Il sert à la protection d'amplificateurs de cables coaxiaux contre des surtensions, provoquées par la foudre ou des courants de retour par la terre en cas de conditions de commutation défectueuses à proximité de circuits haute tension. Le parasurtension est rempli d'un gaz rare. Sa ionisation par radiation très efficace lui confère un amorçage pratiquement sans retard, indépendamment des charges auxquelles il a été soumis auparavant. Les valeurs caractéristiques électriques restent maintenues même après un long stockage ou une circulation de courant intensive.

1. INTRODUCTION

The UA 600 surge arrester is designed for a nominal breakdown voltage of 600 V. It serves to protect coaxial cable amplifiers from overvoltages caused by lightning or earth return currents on faulty switch conditions in neighbouring high voltage lines. The surge arrester is filled with inert gas. Because of its effective pre-ionization, the UA 600 strikes practically without delay, regardless of the charges to which it was submitted before. Its electrical caracteristics are maintained even after a long storage or a sustained, strong flow of current

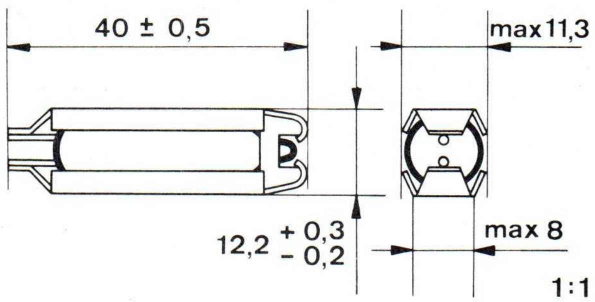
2. ABMESSUNGEN

2. ENCOMBREMENT

2. DIMENSIONS

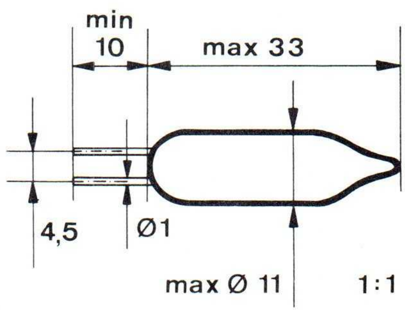
a. UA 600

(zum Einstecken in Halter Nr. 175.197)
(pour enfichage dans l'embase no. 175.197)
(to be put into holder no. 175.197)



b. UA 600 U

(mit verzinnten Drahtenden zum Einlöten)
(avec fil étamé pour soudure)
(with tinned wire ends for soldering)



3. KENNDATEN, GRENZBETRIEBSDATEN	3. CARACTERISTIQUES, LIMITES D'OPERATION	3. CHARACTERISTICS, LIMITING VALUES				min.	normal	max.
Ansprech-Gleichspannung	Tension d'amorçage continue	Breakdown voltage	$U_{Z\ stat}$	(U_{ag})	[V]	540	600	660
Ansprech-Stossspannung (Stoss 2 kV - 1/50)	Tension d'amorçage au choc (choc kV - 1/50)	Dynamic breakdown voltage (shape 2 kV - 1/50)	$U_{Z\ dyn}$	(u_{as})	[V]		900	1200
Glimm-Brennspannung	Tension d'entretien	Glow sustaining voltage	U_B	(U_{gl})	[V]		150	
Bogen-Brennspannung	Tension d'entretien à arc	Arc sustaining voltage	U_{Arc}	(U_{bo})	[V]		25	
Ableit-Wechselstrom (50 Hz, 1 s)	Courant de dérivation alternatif (50 c/s, 1 s)	A.C. current r.m.s. (50 c/s, 1 s)	I_{50}	(I_w)	[A]	20		
Ableit-Stossstrom (Stoss 15/50)	Choc du courant de dérivation (choc 15/50)	Surge current (shape 15/50)	I_S	(i_s)	[kA]	10		
Isolationswiderstand bei 100 V	Isolement à 100 V	Insulation at 100 V	R_{is}		[Ω]	10^{10}		
Eigenkapazität	Capacité propre	Capacitance	C		[pF]			4

4. HALTER NR. 175.197
PASSEND FUER UA 600

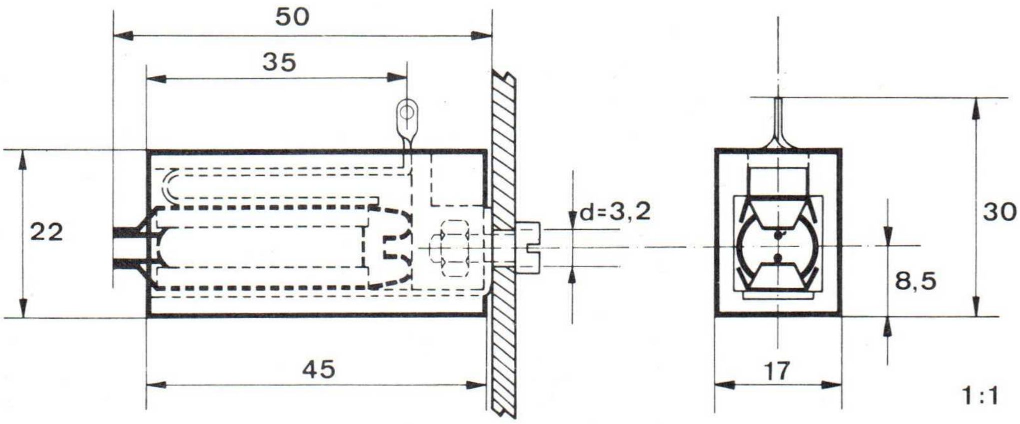
(Material H. POP)

4. EMBASE NO. 175.197
CADRANT AVEC UA 600

(Matériel H. POP)

4. HOLDER NO. 175.197
SUITABLE FOR UA 600

(Material H. POP)



d: Montageloch / Trou de montage / Mounting hole

14

1

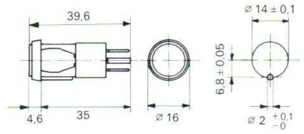
16

Cerberus Glow Lamps for Flush-mounting

SGF 14

Voltage	115 (100–130) V ~	220 (200–250) V ~
Current	1 mA	2 mA
Life expectancy appr.	25 000 hours	25 000 hours
Colour of lens	clear, yellow, red	clear, yellow, red, opal, green
Holder	black	black or white

Dimensions/ Mounting hole



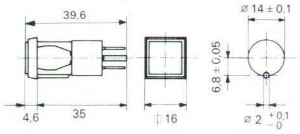
For mounting holes without positioning slot the lateral node on the lamp can be easily removed with a knife.

Type of connection: soldered or plug-in (AMP 6.3 mm)

SGFQ 14

Voltage	115 (100–130) V ~	220 (200–250) V ~
Current	1 mA	2 mA
Life expectancy appr.	25 000 hours	25 000 hours
Colour of lens	clear, yellow, red	clear, yellow, red, opal, green
Holder	black	black or white

Dimensions/ Mounting hole



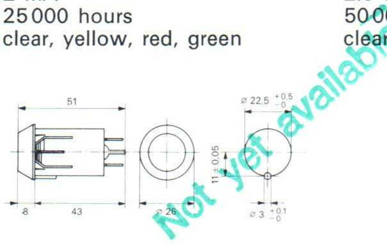
For mounting holes without positioning slot the lateral node on the lamp can be easily removed with a knife.

Type of connection: soldered or plug-in (AMP 6.3 mm)

SGF 22

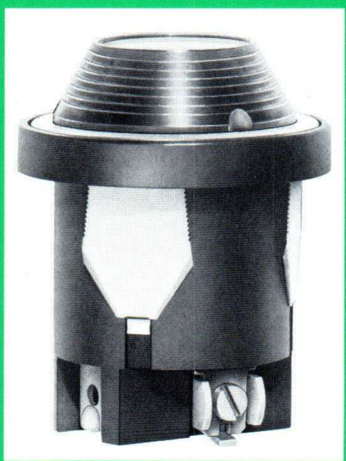
Voltage	115 (100–130) V ~	220 (200–250) V ~
Current	2 mA	2.5 mA
Life expectancy appr.	25 000 hours	50 000 hours
Colour of lens	clear, yellow, red, green	clear, yellow, red, green

Dimensions/ Mounting hole



For mounting holes without positioning slot the lateral node on the lamp can be easily removed with a knife.

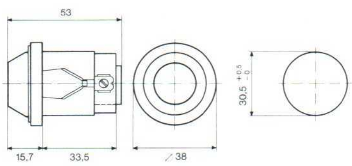
Type of connection: screw, soldered, plug-in (AMP 6.3 mm)



SGF 30

Voltage	220 (200–250) V ~	380 (340–420), 500* (450–550) V ~
Current	10 mA	10 mA
Life expectancy appr.	25 000 hours	25 000 hours
Colour of lens	clear, yellow, red, green, blue	clear, yellow, red, green, blue
Holder	black	black

Dimensions/ Mounting hole



Type of connection: screw, soldered, plug-in (AMP 6.3 mm)
* with separate ballast resistor 39 kΩ/6 W

Scale 1:1

How to order Cerberus glow lamps

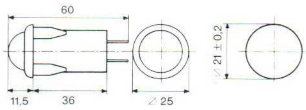
2 examples:

Item	Model	Voltage	Holder supplied in black unless marked **W** (white)
glow lamp	SGFQ 20	220	W
glow lamp	SGF 14	115	

SGF 20

Voltage	115 (100–130) V ~	220 (200–250) V ~
Current	2 mA	2.5 mA
Life expectancy appr.	25 000 hours	50 000 hours
Colour of lens	clear, yellow, red, green	clear, yellow, red, green, opal, blue
Holder	black	black or white

Dimensions/ Mounting hole

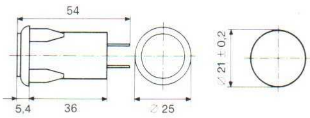


Type of connection screw, soldered, plug-in (AMP 6.3 mm)

SGFF 20

Voltage	115 (100–130) V ~	220 (200–250) V ~
Current	2 mA	2.5 mA
Life expectancy appr.	25 000 hours	50 000 hours
Colour of lens	clear, yellow, red, green	clear, yellow, red, green, opal, blue
Holder	black	black or white

Dimensions/ Mounting hole

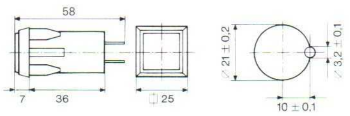


Type of connection screw, soldered, plug-in (AMP 6.3 mm)

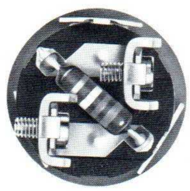
SGFQ 20

Voltage	115 (100–130) V ~	220 (200–250) V ~
Current	2 mA	2.5 mA
Life expectancy appr.	25 000 hours	50 000 hours
Colour of lens	clear, yellow, red, green	clear, yellow, red, green, opal, blue
Holder	black	black or white

Dimensions/ Mounting hole



Type of connection screw, soldered, plug-in (AMP 6.3 mm)



Quenching resistor 150 kΩ / ½ W

With long leads cable capacity can cause glow lamps to continue to shine even after the current has been switched off.
A quenching resistor in parallel to the terminals guarantees clear differentation between "on" and "off". Models SGF 20, SGFF 20 and SGFQ 20 are all available with quenching resistor.
It is also possible to add a quenching resistor at a later date.

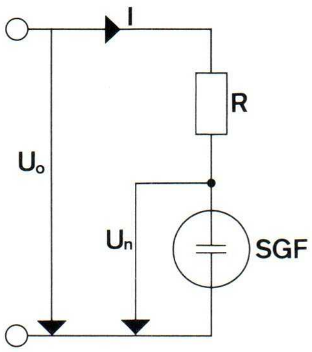
Scale 1:1

Quenching resistor if required mark: **P**	**Screw connection supplied unless marked:** plug-in, soldered: **AMP**	**Colour of lens**
P	AMP	RED
		YELLOW

Order

SGFQ 20.220 WP. AMP. RED
SGF 14.115 YELLOW

Calculating the additional resistance for a higher connection voltage



SGF: Cerberus glow lamps for flush-mounting
U_o: Connection voltage
U_n: Rated voltage of glow lamps
I: Glow lamp current
R: Additional resistance for higher connection voltage
P: Wattage of additional resistance

$R = \frac{U_o - U_n}{I}$ (U in volts, I in mA gives R in kΩ)

$P = I^2R$ (I in mA, R in kΩ gives P in mW)

Example: an SGF 22.220 has to be operated on 380 V∼

$R = \frac{380-220}{2.5} = 64$ kΩ (nearest standard value 68 kΩ)

$P = 2.5^2 \cdot 64 = 400$ mW (nearest standard value ½ W)

CERBERUS

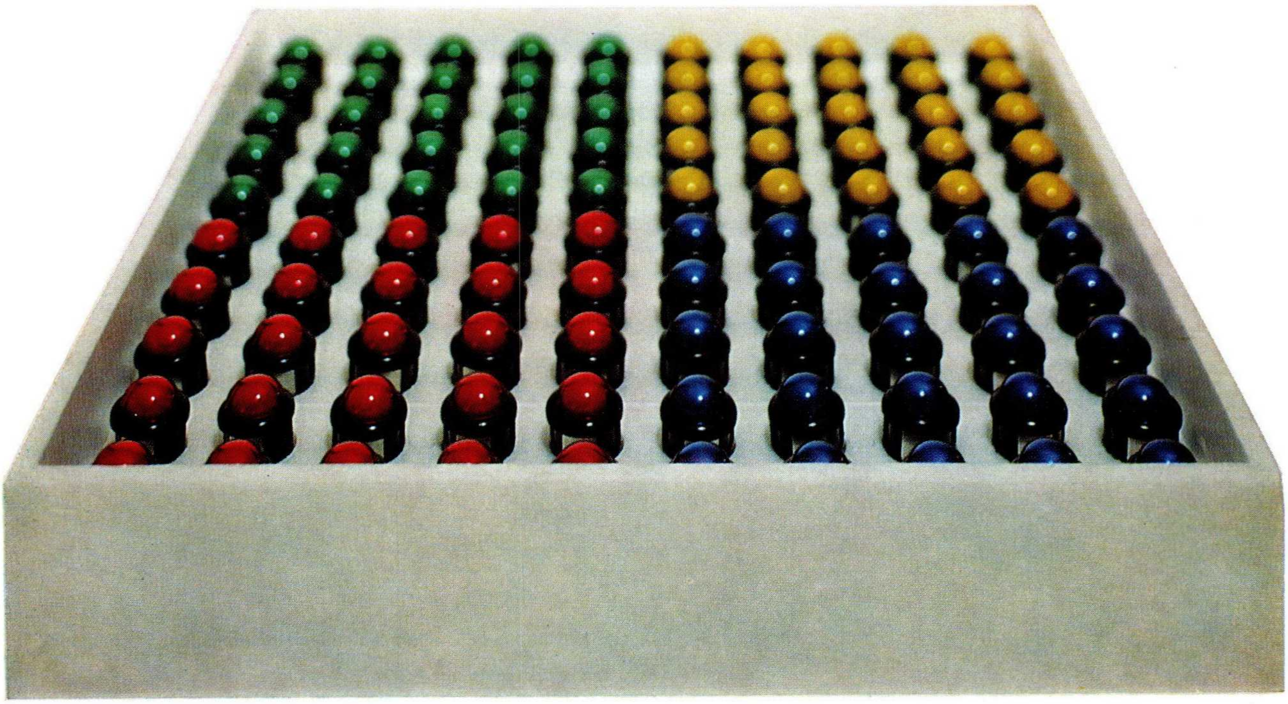
Gas Discharge Electronics
Fire Alarm and Extinguishing Systems
Security Systems

CH-8708 Männedorf
Telephone 01/73 91 51
Telex 75 528

RP 112 e D VN

Cerberus Glow Lamps

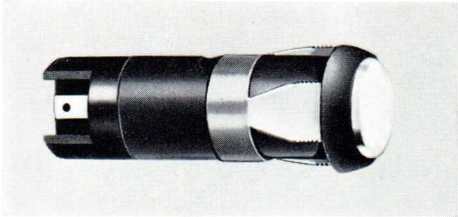
Cerberus Ltd
Manufacturers of Electronic Equipment
CH-8708 Männedorf
Tel. 051 - 739151



Cerberus glow lamps stand out for their :

- ***long life (up to 50 000 hours)***
- ***high light intensity***
- ***good perceptibility***
- ***several luminous colours***
- ***low power consumption***
- ***resistance to vibrations***
- ***insensitivity to voltage fluctuations***
- ***application in ambient temperatures of up to 125°C***
- ***easy installation of the holder versions***

Cerberus glow lamps are economic, rugged and reliable



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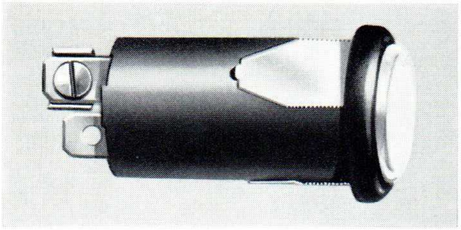

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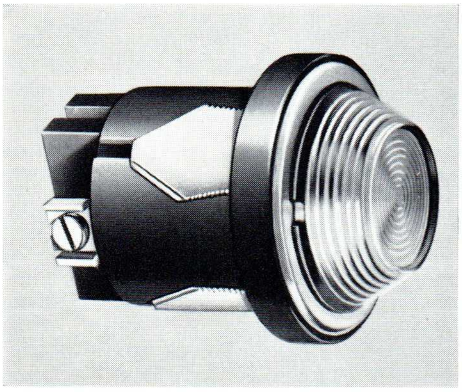

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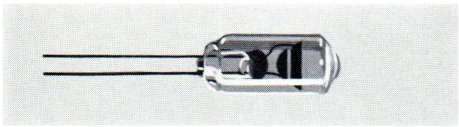

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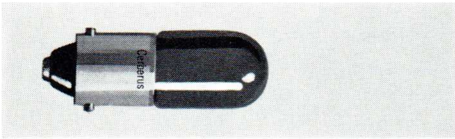

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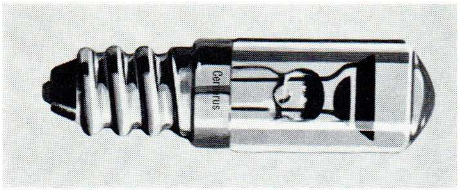
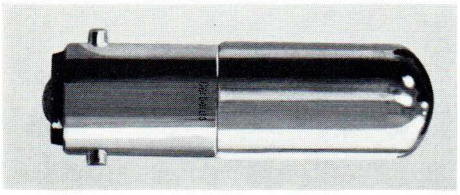
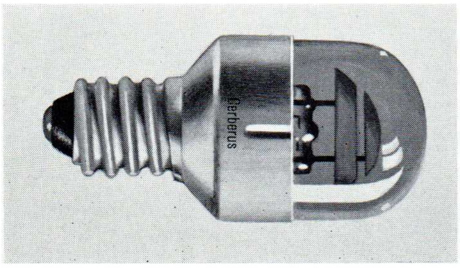


page 10



page 11



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Contents

General Description

The glow lamp reference number is followed by the nominal voltage, e.g., SGF 13.220 is suitable for use with a 220 V a.c. supply. Glow lamps referenced in this manner contain the correct ballast resistor fitted into the holder or cap. Lamps supplied without a ballast resistor are marked with an '0' in place of the nominal voltage, and in addition are also marked with 'connect resistor in series'.

The required colour of the front lens should be quoted from the following: – clear, blue, yellow, green, opal, red.

Normally lamp holders are supplied in black but when a white lamp holder is required add 'w' to the part number e.g., SGFw 13.220.

Special requirements are subject to minimum orders.

SGF glow lamps with holder

They are differentiated by the approximate diameter of the holder. A capital letter specifies the lens type as follows:

SGF = glow lamps with holder and domed circular lens.
SGFF = glow lamps with holder and flat circular lens.
SGFQ = glow lamps with holder and flat square lens.

Example:
SGFQw 13.220 yellow = glow lamps with holder, 13 mm ∅, with flat, square, yellow lens, with holder, 220 V~.

SG lamps with caps

Lamps with caps are differentiated by the bulb diameter. The additional letter 'B' or 'E' signifies either a Bayonet cap or Edison screw cap.

SG 10 (10 mm ∅ bulb)	BA9s
	EX10
SG 16 (16 mm ∅ bulb)	B15d
	E14
SG 25 (25 mm ∅ bulb)	B15d (29 x 26)
	E14 (36 x 26)

The additional letter 'N' indicates higher light output. These lamps are available in either clear, red or yellow.

Standard lamps are fitted with fluorescent-coated bulbs.

Examples:
SGEN 10.220 clear = clear glow lamp, 10 mm ∅, Edison screw cap, high luminosity, 220 V~
SGB 25.0 green = green glow lamp, 25 mm ∅, bayonet-cap B15d 29x26, fluorescent-coated bulb, without ballast resistor

GL glow lamp without caps

Glow lamps without caps (flying leads units) are distinguishable by the approximate bulb diameter. The only exceptions are the international standard types NE2 and NE2H.

The following letters indicate further options:

R = spherical bulb
L = bulb with front lens
s = with activated electrodes for use 150 V or less
g = green fluorescent-coated bulbs for green lenses; spherical bulbs only

Glow lamps with tinned terminals are available.

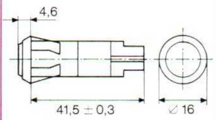
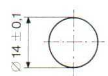
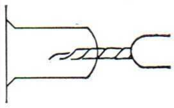
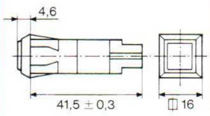
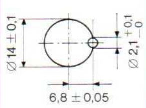
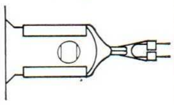
All lamps of this series must be provided with the recommended ballast resistor.

Example:
GL6Ls = clear glow lamp 6 mm ∅, bulb with front lens and activated electrodes for 150 V~.

Fig. 1

Fig. 2

13mm ⌀ glow lamps with holder — *SGF 13*

Type	Colour of holder	Voltage[1] V~	Colour of lens	Fig.	Dimensions mm	Mounting hole mm	Type of connection
SGF 13	black	115 (100–130) 220 (200–250)	clear, yellow red opal (only 220 V) green (only 220 V)	1			soldering 
SGFw 13	white	220 (200–250)					
SGFQ 13	black	115 (100–130) 220 (200–250)	clear, yellow red opal (only 220 V) green (only 220 V)	2			plug-in 
SGFQw 13	white	220 (200–250)					

Standard supply: box of 10 units

Types of connection:	soldered, plug (3 mm AMP)
Ambient temperature:	maximum 125 °C
Expected life:	25000 operation hours
Working current:	2 mA (220 V lamp) 1 mA (115 V lamp)

When ordering state: type, voltage and lens colour
eg: SGFw 13.220 red

[1]) For supply voltages over 250 V with separate additional resistor see technical data on page 15.

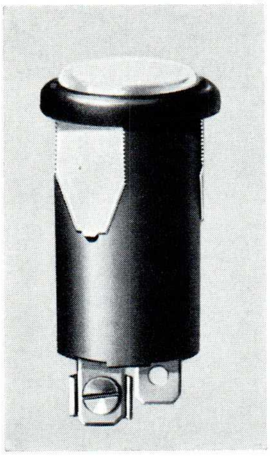


Fig. 1

Fig. 2

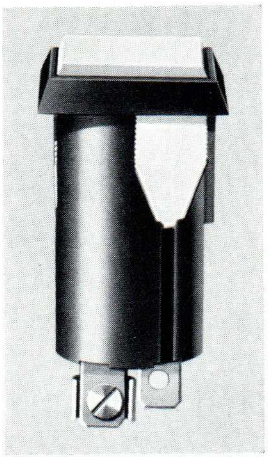
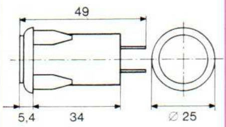
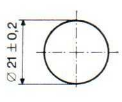
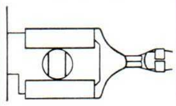
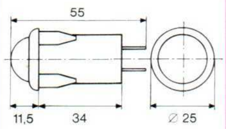
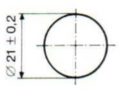
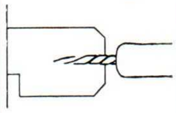
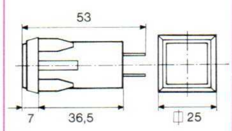
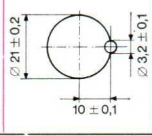
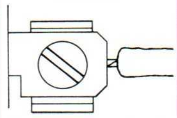


Fig. 3

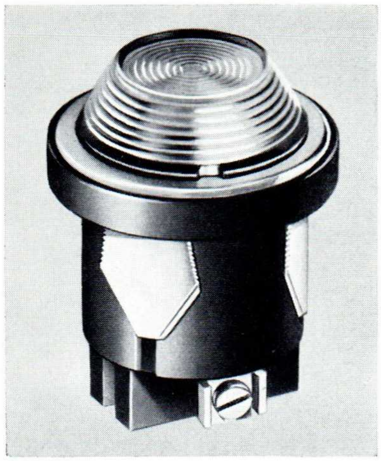
20 mm ⌀ glow lamps with holder — *SGF 20*

Type	Colour of holder	Voltages[1)] V~	Colour of lens	Fig.	Dimensions mm	Mounting hole mm	Type of connection
SGFF 20	black	115 (100–130) 220 (200–250)	clear, yellow, green, red, opal (only 220 V) blue (only220 V)	1			plug-in 
SGFFw 20	white	220 (200–250)					
SGF 20	black	115 (100–130) 220 (200–250)	clear, yellow, green, red, opal (only 220 V) blue (only 220 V)	2			soldering 
SGFw 20	white	220 (200–250)					
SGFQ 20	black	115 (100–130) 220 (200–250)	clear, yellow, green, red, opal (only 220 V) blue (only 220 V)	3			screw 
SGFQw 20	white	220 (200–250)					

Standard supply: box of 10 units

Types of connection:	soldered, plug (6,3 mm AMP)
Ambient temperature:	maximum 125 °C
Expected life:	25 000 operation hours
Working current:	2 mA (220 V lamp) 1 mA (115 V lamp)
When ordering state:	type, voltage and lens colour eg: SGFw 20.220 red

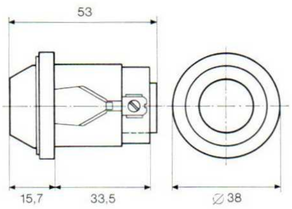
1) For voltages over 250 V with separate additional resistor see technical data on page 15.



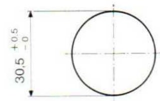
30 mm ⌀ glow lamps with holder **SGF 30**

Type	Colour of holder	Ballast resistor Working voltage			Colour of lens
		220 V~ kΩ/W	380 V~ kΩ/W	500 V~ kΩ/W	
SGF 30.0	black	10/2	27/4	39/8	clear red yellow green blue
SGF 30.220	black	externally soldered resistor[1])			clear red yellow green blue
SGF 30.380	black		externally soldered resistor[1]		clear red yellow green blue
SGF 30.500	black			separate plug-in resistor[2]	clear red yellow green blue

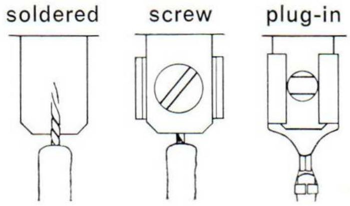
Dimensions in mm



Mounting hole in mm



Types of connections[3]



Standard supply: box of 10 units

Types of connection:	soldered, plug-in (6,3 mm AMP)
Ambient temperature:	maximum 125 °C
Expected life:	25000 operation hours
Working current:	10 mA with appropriate ballast resistor
When ordering state:	type, voltage and lens colour eg.: SGF 30.220 clear

[1] Ballast resistor can also be delivered separately.
[2] Ballast resistor is clamped on to the base of the pilot-light (see connection drawing).
[3] The connection drawing is shown on the label glued on the pilot-light.

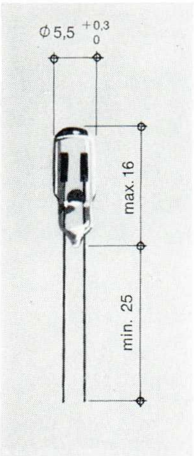


Fig. 1

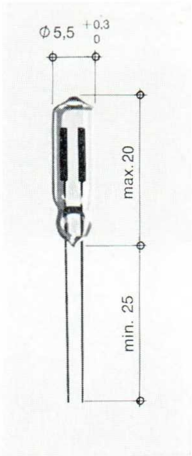


Fig. 2

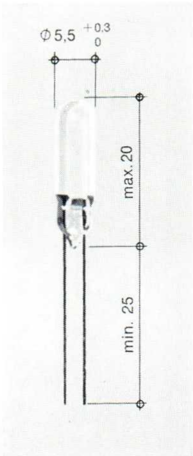


Fig. 3

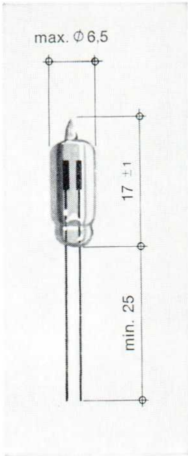


Fig. 4

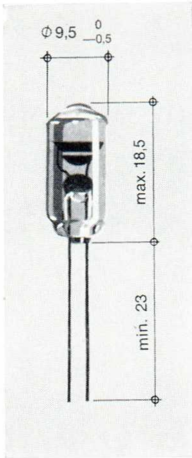


Fig. 5

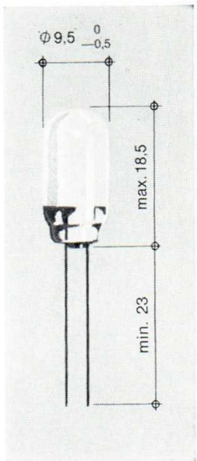


Fig. 6

Glow lamps without caps — GL

Order ref. No.	Colour	Fig.	Ballast resistor Working voltage			Typical striking voltage	Typical maintaining voltage	Working current	Typical life expectancy
			110 V∼ kΩ/W	220 V∼ kΩ/W	380 V∼ kΩ/W	V=	V=	mA_{rms}	h
GL6.1 Ls	clear	1	180/⅛	560/⅛	1000/¼	70	55	0,3	25 000
GL6 Ls	clear	2	100/⅛	330/⅛	680/¼	70	55	0,5	25 000
GL6 Lsg	green	3	56/¼	150/½	270/1	120	50	1,2	25 000
NE 2 [1]	clear	4	82/⅛	270/¼	560/½	70	50	0,6	25 000
NE 2 H [1]	clear	4	27/¼	82/½	150/1	100	55	2,0	5 000
GL10 L	clear	5	—	47/¼	120/1	160	125	2,0	25 000
GL10 Rg	green	6	—	68/¼	180/1	180	110	1,6	15 000

Standard supply: box of 10 units

[1] International type reference

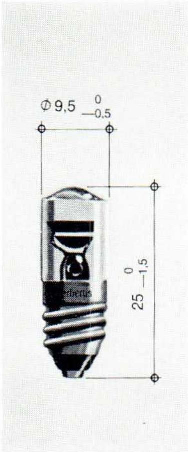


Fig. 1
Cap:
Edison EX10

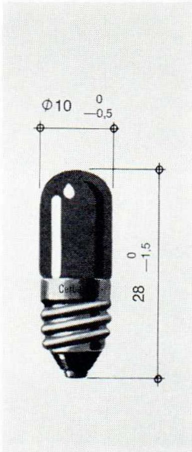


Fig. 2
Cap:
Edison EX10

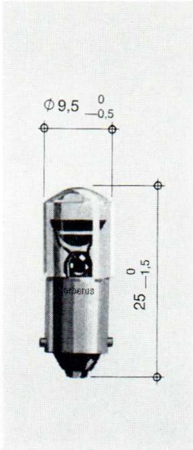


Fig. 3
Cap:
Bayonet
BA9s

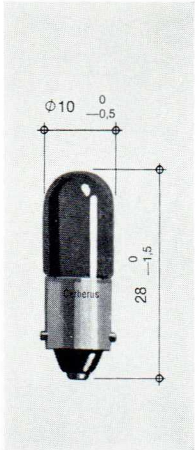


Fig. 4
Cap:
Bayonet
BA9s

10 mm ⌀ glow lamps with caps — *SG10*

Order ref. No.		Fig.	Working voltage[1]	Typical striking voltage	Typical maintaining voltage	Working current	Typical life expectancy
Type	**Colour**		V~	V=	V=	mA_{rms}	h
SGEN 10.110	**clear red yellow**	1	110	90	55	0,9	10 000
SGEN 10.220	**clear red yellow**	1	220	160	125	2,0	25 000
SGE 10.220	**green**	2	220	180	110	1,6	15 000
SGBN 10.110	**clear red yellow**	3	110	90	55	0,9	10 000
SGBN 10.220	**clear red yellow**	3	220	160	125	2,0	25 000
SGB 10.220	**green**	4	220	180	110	1,6	15 000

Standard supply: box of 10 units

[1] Cap with built-in ballast resistor

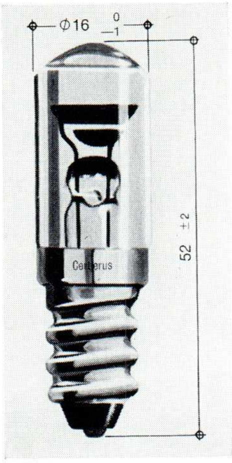


Fig. 1
Cap:
Edison E14

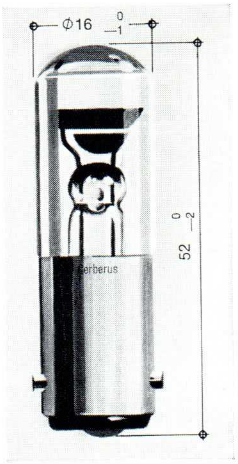


Fig. 2
Cap:
Bayonet B15d

16 mm ⌀ glow lamps with caps *higher light intensity* — ***SGN 16***

Order ref. No.		Fig.	Working voltage	Typical striking voltage	Typical maintaining voltage	Working current	Typical life expectancy
Type	Colour		V~	V=	V=	mA_{rms}	h
SGEN 16.0	clear red yellow	1	without ballast resistor	220	120	3,2[1]	15 000[1]
SGEN 16.110	clear red yellow	1	110[2]	80	55	1,7	15 000
SGEN 16.220	clear red yellow	1	220[2]	220	120	3,2	15 000
SGEN 16.380	clear red yellow	1	380[2]	220	120	3,2	15 000
SGBN 16.0	clear red yellow	2	without ballast resistor	220	120	3,2[1]	15 000[1]
SGBN 16.110	clear red yellow	2	110[2]	80	55	1,7	15 000
SGBN 16.220	clear red yellow	2	220[2]	220	130	3,2	15 000
SGBN 16.380	clear red yellow	2	380[2]	220	130	3,2	15 000

Standard supply: box of 10 units

[1] With appropriate ballast resistor
[2] Cap with built-in ballast resistor: see technical data on page 15.

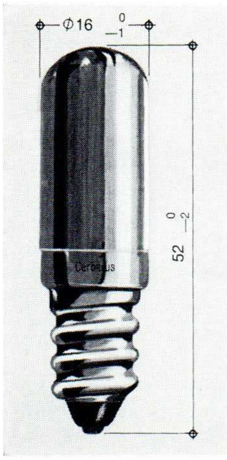


Fig. 1
Cap:
Edison E14

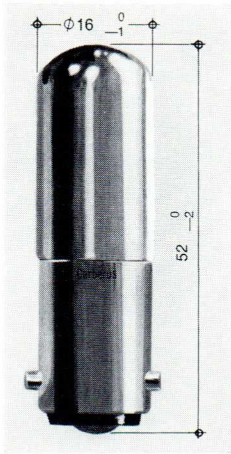


Fig. 2
Cap:
Bayonet B15d

16 mm ⌀ glow lamps with caps *coloured fluorescent coating* — ***SG 16***

Order ref. No.		Fig.	Working voltage	Typical striking voltage	Typical maintaining voltage	Working current	Typical life expectancy
Type	Colour		V~	V=	V=	mA_{rms}	h
SGE 16.0	opal red yellow green blue	1	without ballast resistor	170	120	2,5 1)	10 000 1)
SGE 16.220	opal red yellow green blue	1	220 2)	170	120	2,5	10 000
SGE 16.380	opal red yellow green blue	1	380 2)	170	120	2,5	10 000
SGB 16.0	opal red yellow green blue	2	without ballast resistor	170	120	2,5 1)	10 000 1)
SGB 16.220	opal red yellow green blue	2	220 2)	170	120	2,5	10 000
SGB 16.380	opal red yellow green blue	2	380 2)	170	120	2,5	10 000

Standard supply: box of 10 units

1) With appropriate ballast resistor
2) Cap with built-in ballast resistor: see technical data on page 15.

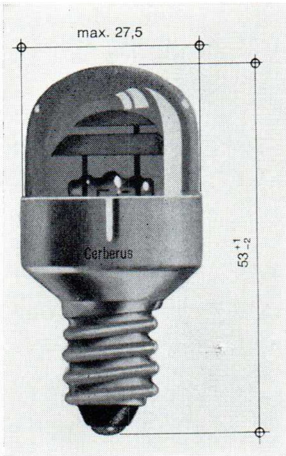


Fig. 1
Cap: Edison E14

Fig. 2
Cap: Edison E14

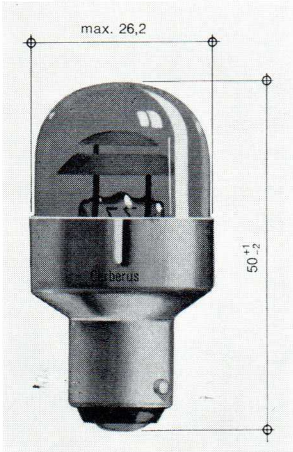


Fig. 3
Cap: Bayonet B15d

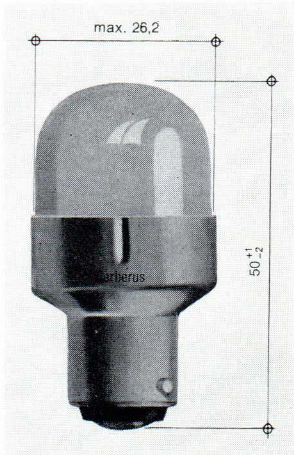


Fig. 4
Cap: Bayonet B15d

25 mm ⌀ glow lamps with caps — *SG 25*

Order ref. No.		Fig.	Typical striking voltage	Typical maintaining voltage	Working current	Ballast resistor[1] Working voltage			Typical life expectancy
Type	Colour		V=	V=	mA_{rms}	220 V~ kΩ/W	380 V~ kΩ/W	500 V~ kΩ/W	h
SGE 25.0	clear red yellow	1	240	120	10	10/2	27/4	39/8	25 000
	green	2	190	120	10				
SGB 25.0	clear red yellow	3	240	120	10	10/2	27/4	39/8	25 000
	green	4	190	120	10				

Standard supply: box of 10 units

[1] Appropriate ballast resistor is supplied on request only.

Technical data

Cerberus glow lamps give visual information on the operational state of any type of electrical apparatus.

They afford increased safety for:
- domestic appliances (irons, electric cookers, refrigerators, boilers, etc.)
- electronic and telephonic equipment
- industrial installations
- light and mains switches

Working principle

The glow lamp consists of two electrically equivalent electrodes fitted into a discharge tube containing inert gas. Inert gases are normally good electrical insulators and only become conductive after ignition. The passage of current ionizes the gas and the lamp emits the characteristic line spectrum (glow light).

The light intensity corresponds roughly to the rms value of the current. The efficiency depends on the type of gas filling, the electrode geometry and other factors.

Electrical characteristics

The voltage igniting the glow lamp is the ignition voltage (U_Z). After ignition the maintaining voltage (U_B) exists between the electrodes.

To achieve the instantaneous ignition of a gas discharge lamp, slight pre-ionisation of the filling gas is necessary. Usually exposure to ordinary light gives sufficient pre-ionisation. Prolonged storage of the glow lamp in the dark may prevent sufficient pre-ionisation taking place. This may cause ignition delays of up to one second. Instantaneous ignition can be obtained at all times by introducing a small quantity of radioactive matter into the glow lamp. Cerberus glow lamps do not usually contain a radioactive emitter.

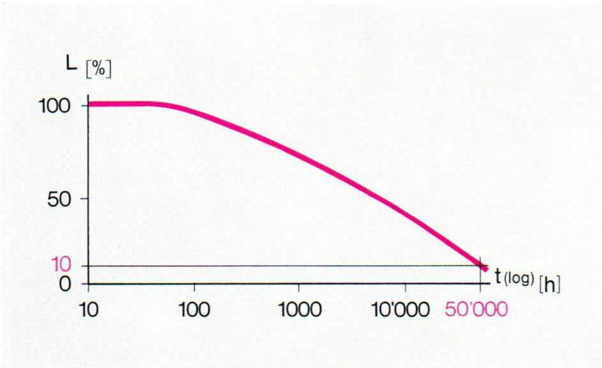
Glow lamps consume very little current. The tables describing the various types of glow lamps show the typical current values ensuring the optimum light output and service life.

Life expectancy

Cerberus glow lamps have a long life expectancy.

Contrary to many other electronic components the end of the service life of glow lamps is not due to complete failure. The electrical characteristics of the glow lamps remain constant throughout its service life. Instead, the electrode sputtering blackens the bulbs decreasing the light emission.

Consequently, the glow lamp has neither a complete breakdown nor a definite service life. A luminosity reduction to 10% of the original value, however, is defined as the end of the glow lamp's life. Fig. 2 shows the light emission deterioration characteristics of a glow lamp in continuous operation.



Typical light emission characteristic of a glow lamp: the luminous flux L at the end of the service life (for most Cerberus glow lamps after some 50000 hours operation) is 10% of the original value.

Since the human eye perceives the light changes more or less logarithmically, the 90% loss of luminosity is seen as an apparent reduction of only 50%. The glow is still clearly visible.

The life expectancy of glow lamps is inversely proportional to 3.5^4 of the peak current. This must be taken into account when operating conditions differ from our recommendations. All the quoted life durations apply to lamps used on an a.c. supply of 50 cycles per second. If direct current is used, equivalent in value to the r.m.s. value of the alternating current, the life expectancy will be halved and only one electrode of the cathode will glow.

Lower working voltages are possible and these will prolong the life expectancy of the glow lamp. At present it is possible for currents in the order of tens of microamps to produce a clear glow although not over the complete electrodes.

Ballast resistors

We have already said that the glow lamp's current must be limited. Most Cerberus glow lamps with caps and holders which are supplied with an adequate built-in current limiting ballast resistor. It provides a means of dropping the supply voltage to the maintaining voltage of the lamp. The power dissipated in the ballast resistor, must of course be within the resistor's power rating at a given ambient temperature.

The diagrams on page 15 give the resistor value and its power rating for the various supply voltages of each type group of Cerberus glow lamps. The top diagram is valid for lamps without ballast resistors and enables the correct series resistor to be calculated.

If lamps already fitted with a ballast resistor are required to work off a supply voltage in excess of that marked on the lamp then an additional series resistor will be required. The value of this resistor may be found from the formula

$$R = \frac{Vl - Vs}{I} \text{ K. ohms.}$$

Where R = the additional series resistor required
Vl = the line voltage
Vs = the lamp supply voltage
I = the lamp working current in mA (see the data on the lamp type concerned).

The required power rating of this resistor may be calculated from $P = I^2 R$.

Where P is in mW, I in mA and R in K. ohm.

Examples of the additional resistor requirements for 220 V lamps are given in the lower diagram on page 15.

Optical characteristics

Cerberus glow lamps with clear bulbs stand out for their intensive light. This is increased even more by a lens effect inside the bulbs. The N-series bulbs are also available to special order with a red or yellow coating.

The glow lamp's light intensity is proportional to the current passing through the lamp.

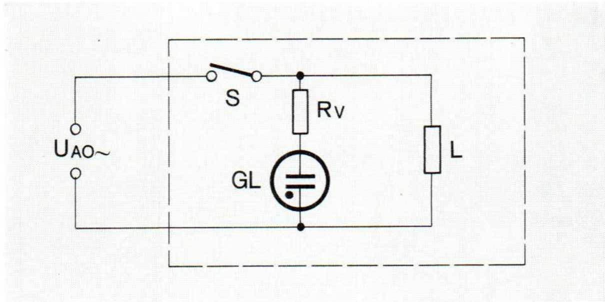
Working currents greater than those recommended will increase the emission of light but will shorten the life of the lamps. The clear-bulb lamps emit light in the orange-red range of the visible spectrum (i.e. 6500 Ängströms approximately).

Application of a fluorescent coating on the internal wall of the bulb can change the red light emitted by the "clear" bulbs. The required colour is obtained through the fluorescence of the ultraviolet spectrum of the light emission. Blue, yellow, green, opal and red are easily produced with this simple process, though the varying colour spectrum sensitivity of the human eye will register them in unequal intensities.

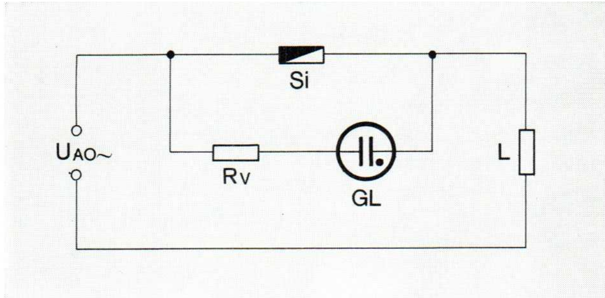
Glow lamp circuits

Glow lamps normally need high supply voltages, for lower voltages 6–48 V special circuits are necessary.

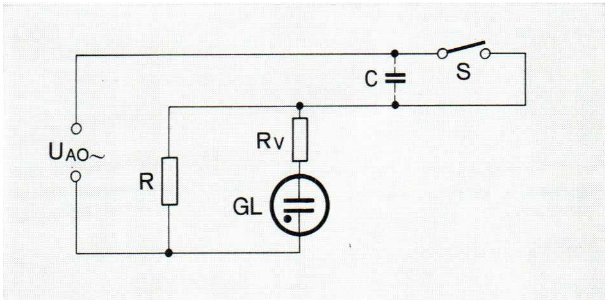
Examples of the main uses of glow lamps are given in the circuits below (our experts will be pleased to advise on customers special requirements).



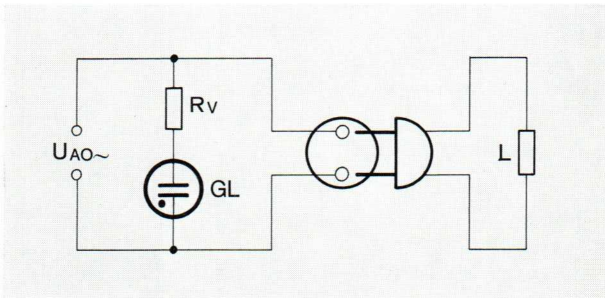
GL glow lamp (eg. SGF, SGFF or SGFQ types with built-in ballast resistor R_V) indicating (by GL glowing) that, when switch S is closed, the mains voltage U_{AO} is present across the load, L.



Glow lamp monitoring of a fuse, Si. When the fuse (Si) burns through, the lamp GL lights up (e.g. SGF, SGFF, SGFQ lamps with built-in ballast resistor R_V).



Capacitive coupling between cables (as depicted by C above) often causes glow lamps to light even when the switch S is open. This can be prevented by the addition of a resistor R as shown. The value of R varies between 100 K. ohm und 1 M. ohm depending on the supply voltage and the magnitude of C.



The glow lamp is connected in parallel with the plug point and lights up when voltage is applied to it. Eventual defects in the mains or connected object can immediately be located.

Diagram showing ballast resistor's values

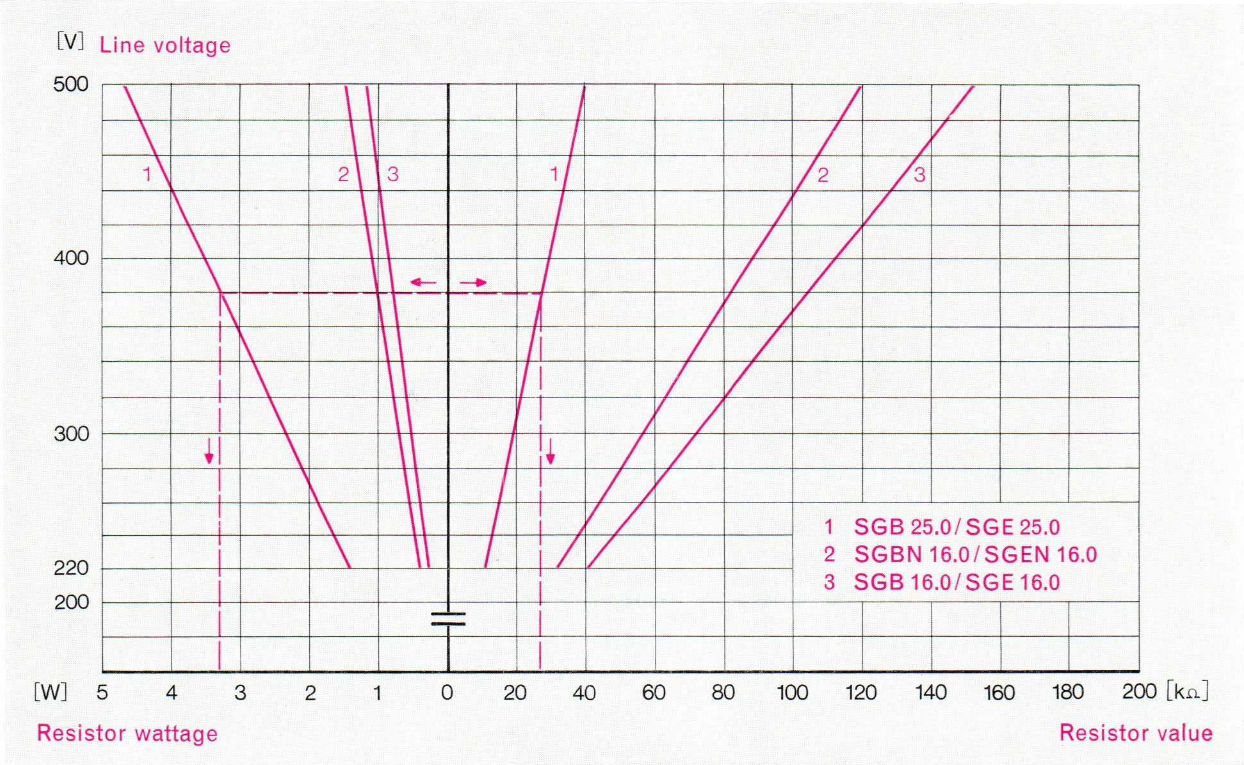
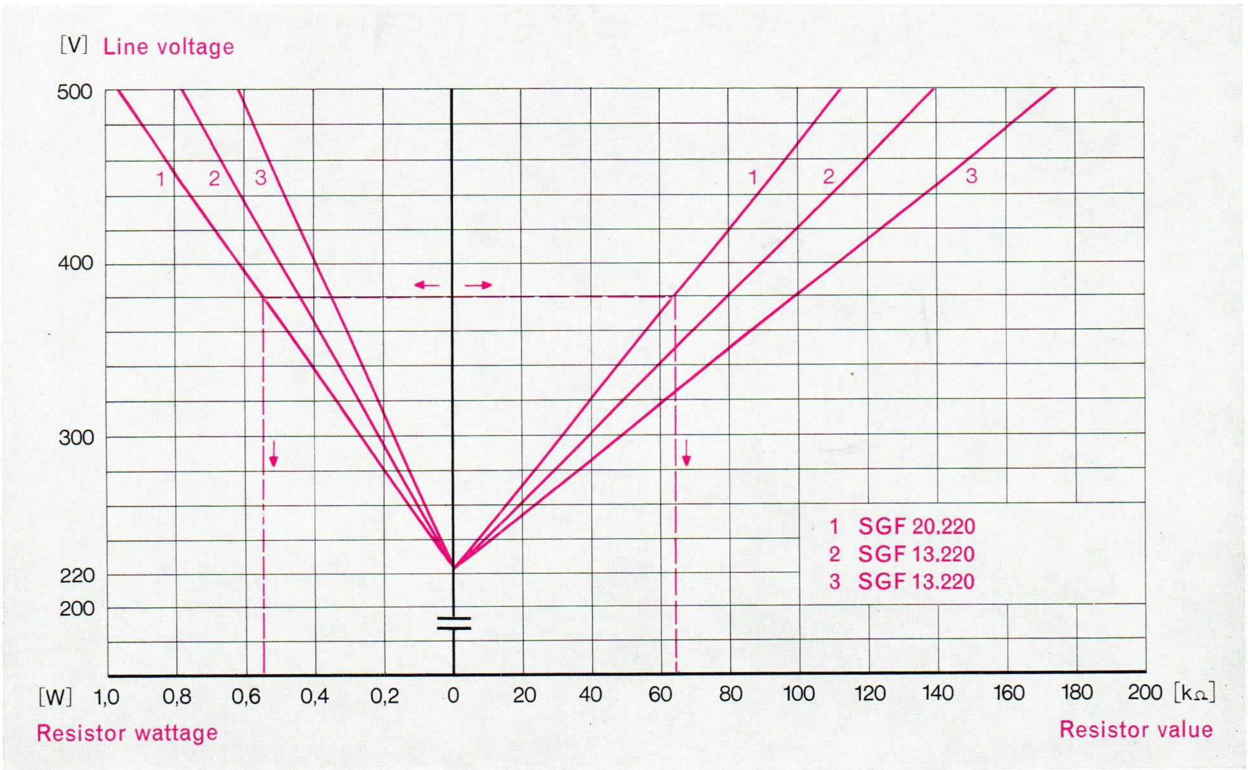


Diagram showing additional resistor's values



Note:

- Take line voltage
- Follow direction of arrows
- Then choose nominal value for power and resistor value.

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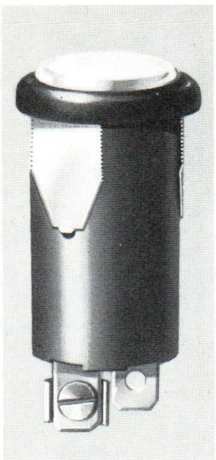
Cerberus glow lamps with bright colours

The long life pilot light for
electric and electronic equipment,
industrial installations, switches etc.

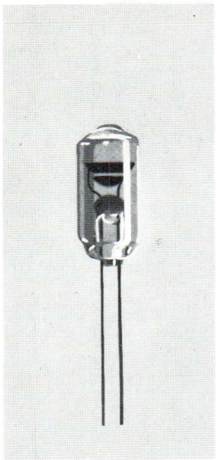
Cerberus glow lamps are built for
all common a-c voltages, namely
110/115, 220, 380 and 500 V.

SGF 30

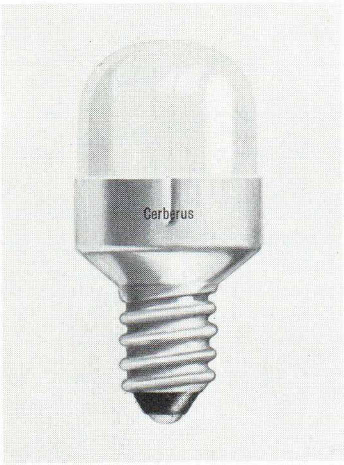


SGF 20

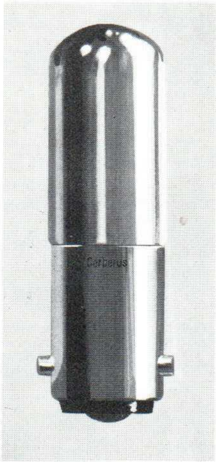
SGF 13



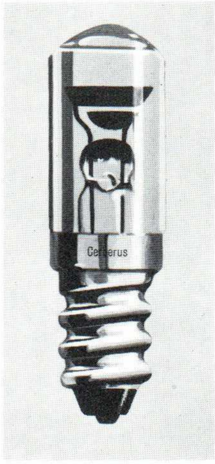
GL



SG 25



SG 16



SGN 16

SG 10

Our manufacturing program:

SGF 30 snap-in glow lamps, 30 mm ∅
SGF 20 snap-in glow lamps, 20 mm ∅
SGF 13 snap-in glow lamps, 13 mm ∅
GL glow lamps with wire terminals
SG 25 glow lamps with socket, 25 mm ∅
SG 16 glow lamps with socket, 16 mm ∅
with coloured fluorescent coating
SGN 16 glow lamps with socket, 16 mm ∅
higher light intensity
SG 10 glow lamps with socket, 10 mm ∅

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CERBERUS

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17

1P

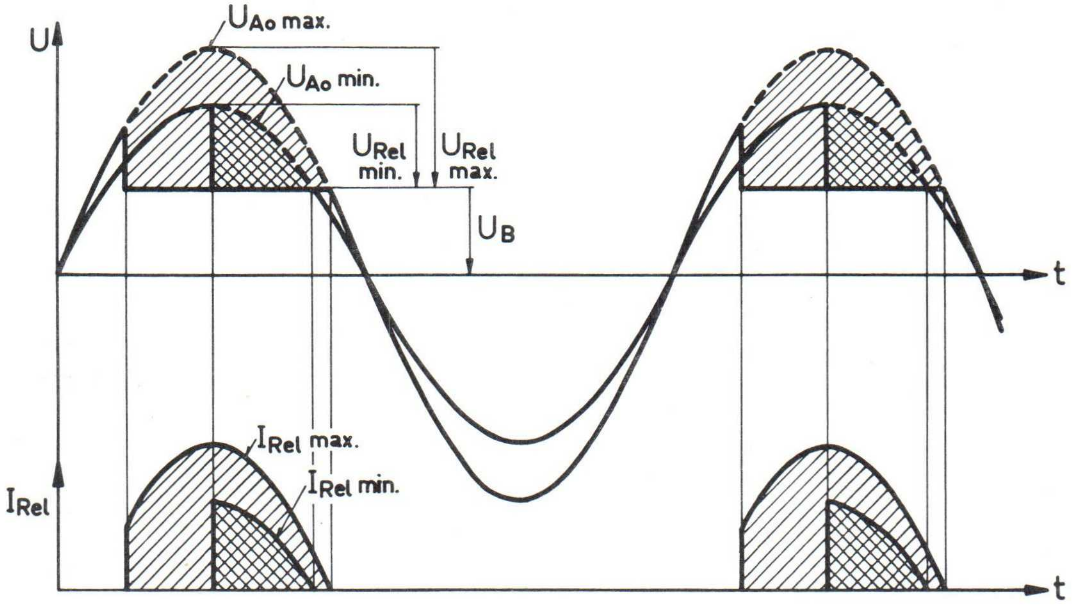
1

CERBERUS	RELAIS ZU KALTKATHODENROEHREN IM WECHSELSTROMBETRIEB RELAIS POUR TUBES A CATHODE FROIDE AU REGIME CA RELAYS FOR COLD CATHODE TUBES SUPPLIED BY AC	Type Nr. **18.01** Ed. 9.67 Fol. 1-2

Kaltkathodenröhren, die für den Betrieb an Wechselspannung gebaut sind, arbeiten wie gesteuerte Gleichrichter. Sie leiten (bei Ansteuerung) in jeder positiven Halbwelle. Dabei tritt an ihnen ein Spannungsabfall (Brennspannung U_B) von etwa 110 V auf. So entsteht ein pulsierender Gleichstrom.

Les tubes à cathode froide conçus pour courant alternatif fonctionnent comme des redresseurs contrôlés. Amorcés, ils laissent passer chaque alternance positive. La chute de tension (tension d'entretien U_B) du tube est de 110 V environ. Ainsi un courant pulsant se produit,

Cold cathode tubes suitable for AC-operation work like controlled rectifiers. If triggered they conduct during each positive portion of the supply voltage. The voltage drop across the tube (sustaining voltage U_B) is approximately 110 V. This generates DC current pulses and



Mit ihm können Gleichstromrelais betrieben werden, welche mit einer Abfallverzögerung von mindestens 20 ms versehen sind. Diese wird entweder durch einen Parallelgleichrichter oder - unter bestimmten Bedingungen - durch einen Parallelkondensator erreicht.

et on peut se servir d'un relais pour courant continu, muni d'un dispositif de retard pour 20 ms au moins: soit enroulement court-circuité, soit redresseur en parallèle, soit - sous certaines conditions - condensateur en parallèle.

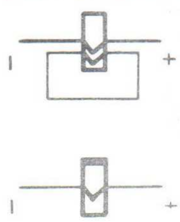
a DC-relay, delayed by at least 20 ms, must be used. Such delays are provided either by a short-circuit winding, or a parallel rectifier or - under certain conditions - a parallel capacitor.

Relais mit Kurzschlusswicklung und solche mit Parallelgleichrichter und Schutzwiderstand (siehe b) erzeugen beim Glimmthyratron GT 21 und wenn sie bei der GR 16 in der Kathodenzuleitung liegen ein Schaltintervall. Das heisst, dass für das Einschalten eine höhere Steuerspannung benötigt wird als für das Ausschalten. Dies ist vor allem dann erwünscht, wenn die Steuerspannung nur langsam ändert.

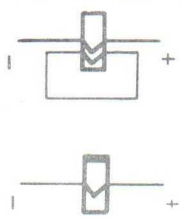
Les relais à enroulement court-circuité ou à redresseur parallèle et résistance de protection (voir b) créent un intervalle de commutation lorsqu'ils sont utilisés avec le thyratron à effluve GT 21 ou dans le circuit cathodique du tube relais GR 16. C'est-à-dire que pour l'enclenchement on a besoin d'une tension de commande plus élevée que pour le déclenchement. Ceci est utile, surtout au cas que la tension de commande ne change que lentement.

Relays with a short-circuit winding, or with a parallel rectifier and protecting resistor (see b), will produce a switching interval when used with the glow thyratron GT 21 or in the cathode circuit of the relay tube GR 16. I.e. to switch the tube on, a higher signal level is needed than to turn it off. The switching interval is very useful, especially with slowly varying control voltages.

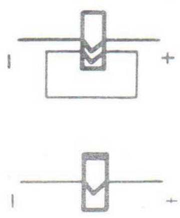
a) Am einfachsten ist das Anbringen einer Kurzschlusswicklung oder eines Kurzschlussringes mit einem Volumen, das 25-30% des Wickelraumes einnimmt. Die Arbeitswicklung muss dann den ganzen restlichen Raum füllen und ihre Drahtstärke ist so zu wählen, dass der Wicklungswiderstand 1000-2000 Ω beträgt. Die genaue Dimensionierung ist für jede Bauart experimentell zu bestimmen.



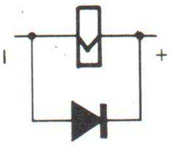
a) Le plus simple est de se servir d'un enroulement court-circuité ou d'une bague de cuivre, dont le volume atteint 25 à 30% du volume d'enroulement total. Le bobinage d'operation doit alors remplir l'espace restant et la section du fil être choisie telle qu'il en résultera une résistance d'enroulement de 1000 à 2000 ohms. C'est l'essais qui devra déterminer les valeurs exactes pour chaque genre de relais.



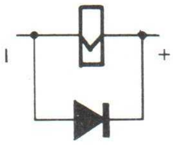
a) The simplest method is given by a short-circuit winding or a short-circuit ring using about 25-30% of the window area. The coil has to fill the remaining window area, whilst the resistance has to be about 1000 to 2000 Ω. Exact data for each relay type are only found empirically.



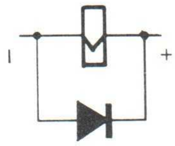
b) Mit Hilfe des Parallelgleichrichters (Sperrspannung 250 V, Strom 15 mA, z.B. E125C60) wird die Arbeitswicklung auch für die Abfallverzögerung verwendet. Der gesamte Wickelraum kann deshalb für sie ausgenützt werden. Das erlaubt oft die Verwendung von Relais, welche nach a) nicht mehr dimensioniert werden können. Der Wicklungswiderstand soll etwa 1000–2000 Ω betragen. Meist schaltet man einen Schutzwiderstand von 500–2000 Ω in Serie zum Gleichrichter, um bei einem Durchschlag die Röhre zu schonen. Das Schaltintervall wird durch die Grösse des Widerstandes mitbestimmt.



b) A l'aide d'un redresseur en parallèle (250 volts PIV, 15 mA, p. ex. E 125 C60) l'enroulement d'opération est utilisé aussi pour le retardement du relais. Ainsi peut-il remplir le volume total de la bobine, et permet quelquefois d'employer des relais ne pouvant être réalisés d'après a). La résistance d'enroulement doit comporter 1000 à 2000 ohms. Pour protéger le tube au cas d'un claquage du redresseur, on le mettra en série avec une résistance de 500 à 2000 ohms. L'intervalle de commutation sera déterminé par la valeur de cette résistance.



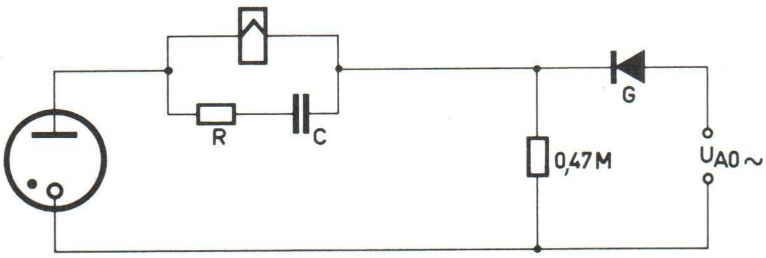
b) If a parallel rectifier is applied (250 V PIV, 15 mA, e.g. E125C60) the operating coil is also acting as delay coil. All the window area may therefore be used for the coil. This often enables the use of relays which can not be realised by method a). The coil resistance has to be about 1000 to 2000 Ω. To protect the tube against rectifier failure, a series resistor of approximately 500 to 2000 Ω is often used in the rectifier path. This will influence the value of the switching interval.



c) Der Parallelkondensator ermöglicht auch Verzögerungen von viel mehr als 20 ms und die Verwendung von Relais, bei denen eine magnetische Verzögerung nicht möglich ist. Die Anwendung dieser Methode setzt aber voraus, dass in Serie zur Röhre ein Gleichrichter G (350 V, 50 mA, z. B. E 125 C60) und in Serie zum Kondensator C ein Strombegrenzungswiderstand von 500 Ω bis zu einigen kΩ geschaltet wird. Der Wicklungswiderstand kann für lange Zeiten sehr hoch gewählt werden, er soll mindestens 1000 Ω betragen.

c) Le condensateur en parallèle permet de réaliser des retardements de chute beaucoup plus grands que 20 ms et l'utilisation de relais dont le retardement magnétique est impossible. Condition pour son emploi est l'insertion d'un redresseur en série G (pour 350 volts, 50 mA, p.ex. E125C60) et d'une résistance de limitation de courant R (entre 500 ohms et quelques kiloohms). La résistance d'enroulement peut, pour les retards importants être très grande, sa valeur minima est 1000 ohms.

c) With a parallel capacitor delay times of much more than 20 ms can be obtained and a relay may be used, which cannot be delayed magnetically. This method requires the insertion of a rectifier G (350 V, 50 mA, e.g. E125C60) in series to the tube and a limiting resistor R (500 Ω to several kΩ) in series to the capacitor. To obtain long delay times, the coil resistance may have very high values. The minimum resistance is 1000 Ω.



Die Verwendbarkeit eines Relais mit den Röhren GR 16 oder GT 21 wird durch folgende Bedingungen geprüft:

1) Bei der minimal zu erwartenden Speisespannung U_{A0} (meist 180 V eff.) und betriebswarmem Relais dreht man den Abgriff des Potentiometers 1 MΩ von A gegen B, bis die Röhre eben zündet. Dann soll das Relais einwandfrei anziehen und ein Strom von ⩾ 10 mA (lin. Mittelwert) fliessen.

2) Bei der maximal zu erwartenden Speisespannung U_{A0} (meist 250 V eff.) und Potentiometerabgriff bei B soll das Relais nicht zu heiss werden und der Strom I_A 40 mA nicht übersteigen.

Les relais ayant passés par l'examen suivant peuvent être utilisés avec les tubes GR 16 et GT 21:

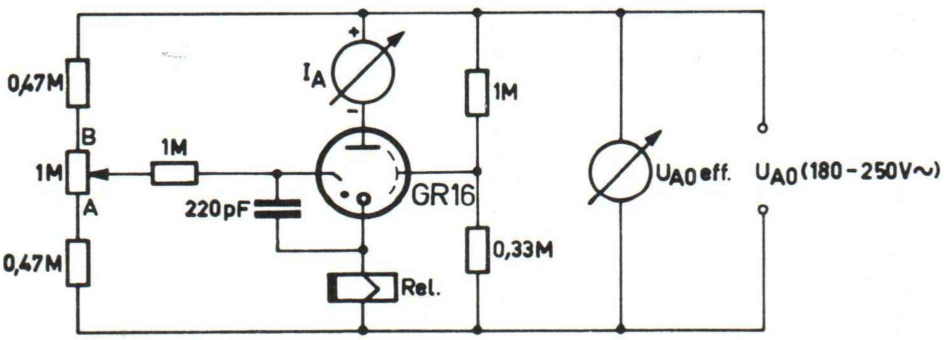
1) Avec la tension d'alimentation minima (le plus souvent 180 volts eff.) et le relais étant chauffé à sa température de service on tourne la prise du potentiomètre 1 MΩ de A vers B jusqu'à ce-que le tube entre en fonction. Le relais doit alors attirer nettement et le courant I_A (moyenne linéaire) être de 10 mA ou davantage.

2) Avec la tension d'alimentation maxima (le plus souvent 250 volts eff.) et le potentiomètre 1 MΩ mis sur B, le relais ne doit pas surchauffer et le courant ne pas dépasser 40 mA.

The relays meeting below check conditions can be used with the tubes GR 16 and GT 21:

1) Applying the minimum supply voltage to be expected (mostly 180 V rms) and the relay at working temperature, the tap of potentiometer 1 MΩ is turned from A to B until the tube fires. Then the relay has to pull in properly and to allow a current I_A of 10 mA minimum (linear average value).

2) Applying the maximum supply voltage to be expected (mostly 250 V rms) and potentiometer tap at B the relay may not heat excessively and the current I_A must not exceed 40 mA.



Die folgende Liste zählt verschiedene im Handel erhältliche Relais auf, deren Wicklung speziell den Kaltkathoden - röhren GR 16, GR 17 und GT 21 im Wechselstrombetrieb angepasst wurde.

La liste suivante indique différents relais courants, dont la bobine a été spécialement adaptée aux tubes à cathode froide GR 16, GR 17 et GT 21 alimentés par une tension alternative.

The following list shows commercially available relays suitable for use with the cold cathode tubes GR 16, GR 17 and GT 21 supplied by AC.

Hersteller / Fabricant / Manufacturer	Relaisbezeichnung / Dénomination du relais / Relay designation	Normale Kontaktbestückung / Disposition de contacts standard / Normal contact arrangement 1)	Spulenwiderstand / Résistance de la bobine / Coil resistance [Ω]	Zusatzwiderstand / Résistance supplémentaire / Additional resistor [Ω]	Verzögerungsart / Moyen de retardement / Delaying mode 2)
Badische Telefonbau, Renchen (D)	K 220 W / BV 220/32	2 WK	1600		K
Eberle & Co., Elektro GmbH, Oedenbergstr. 55, Nürnberg - 30 (D)	403/ BV 403.165 (Industrierel.)	2 WK	600		K
Erni & Co., Elektro-Industrie, Brüttisellen/ZH (CH)	60 R (Industrierelais) zu GR 16	2 WK	1000		K
W. Gruner KG, 7209 Wehingen (D)	C 1 A zu GR 16 (Industrierelais) 26 (grosses Rundrelais) zu GR 16	2 WK 2 WK	1600 2350		K
E. Haller & Co., 7209 Wehingen (D)	551 zu GR 16 (Kleinrelais) 26 (grosses Rundrelais) zu GR 16	2 WK 2 WK	1600 2350		K + G K
Jucker, Relaisbau, Seefeldstr. 94a, Zürich (CH)	J 56/W 1 (Industrierelais)	2 WK	1700		K
J.W. Kühnel, Werk für industrielle Elektronik, Untere Donaustrasse 27, Wien II (A)	B 401 / 220 W GR	2 WK	900		K
Kuhnke, Elektrotechnische Fabrik GmbH, 2427 Malente (D)	1 - H(V) - W - K (Kleinrelais) 2 - H(V) - W - K (Kleinrelais) N - 4(6) - II - W - K (Normal) U - 3 - A - W - K (Universal)	1 WK 2 WK 4(6) WK 3 WK		750 Serie	K + G G G
Mansfeld-Apparatebau GmbH, Am Tiergarten 14, Frankfurt a.M. (D)	J 56 zu GR 16 (Industrierelais)	2 WK	2000		K
W. Moser-Baer, Sumiswald (CH)	RGB / BV 689 (Industrierelais)	2 WK	580	560 Serie	G
Rapa, Rausch & Pausch, Elektrotechn. Spezialfabrik, 8672 Selb/Oberfranken (D)	R 16 / 21-33 R 16 / 21-3	2 WK 1 WK			G K
E. Schrack, Elektrizitäts AG, Pottendorferstr. 25, Wien XII (A)	RN 215 901	2 WK	2350	5000 parallel	K
Siemens & Halske AG (D)	Trls6a / TBV 62020/10c	1 AK 1 RK			G
W. Sihn, JR. KG., 7532 Niefern/Pforzheim (D)	R 10 (Industrierelais)	2 WK	1500		K
Alois Zettler, Elektrotechn. Fabrik GmbH, Holzstr. 28-30, 8000 München (D) oder Zettler, Elektroapparatebau Weesen, Blütenstrasse 18, Zürich (CH)	AZ 17-259-1 (grosses Rundrelais) AZ 37-115-1 (kleines Rundrelais)	2 WK 2 WK	1300 1200		K K

1) Alle Kontakte sind Starkstromkontakte.
AK = Arbeitskontakt
RK = Ruhekontakt
WK = Wechselkontakt

2) K = Kurzschlusswicklung, Kupferring oder - Mantel
G = Parallelgleichrichter

1) Tous les contacts sont pour courant fort.
AK = contact de travail
RK = contact de repos
WK = contact de commutation

2) K = enroulement court-circuité, bague de cuivre
G = redresseur en parallèle

1) All contacts are heavy duty contacts.
AK = make contact
RK = break contact
WK = changeover contact

2) K = shortened winding, copper ring,
G = parallel rectifier

RELAIS ZU KALTKATHODENROEHREN IM GLEICHSTROMBETRIEB
RELAIS POUR TUBES A CATHODE FROIDE AU REGIME CC
RELAY FOR COLD CATHODE TUBES SUPPLIED BY DC

Wird eine Kaltkathoden-Relaisröhre mit Gleichspannung gespeist, kann ihr Anodenstrom zur Betätigung eines normalen Gleichstromrelais ausgenutzt werden. Die Verhältnisse, die sich dabei für das Relais ergeben, sind in Fig. 1 verdeutlicht. Dabei ist:

- $U_{A0\,min}^{max}$: die Anodenspeisespannung (mit Schwankung zwischen Min.- und Max.-Wert)
- $U_{B\,min}^{max}$: die Brennspannung der Röhre (mit Streuung zwischen Min.- und Max.-Wert)
- I_K: der Röhrenstrom (= Relaisstrom)
- R_{min}^{max}: Widerstand der Relaisspule (mit Streuung zwischen Min.- und Max.-Wert)

Neben dem Spulenwiderstand ist eine bestimmte Relaistype durch 2 Grössen charakterisiert:

- P_{min}: die Ansprechleistung, d.h. die zum sicheren Anzug erforderliche Erregungsleistung
- P_{max}: die zulässige Dauerleistung, bei der keine unzulässig hohe Uebertemperatur des Relais auftritt.

Von der Röhre her sind die folgenden Grenzen gegeben:

- I_{Kmin}: minimal erforderlicher Kathodenstrom
- I_{Kmax}: maximal zulässiger Kathodenstrom
- U_{Amin}: minimal erforderliche Anodenspannung
- U_{Amax}: maximal zulässige Anodenspannung

Die Schwankung der Speisespannung wirkt sich auf den Relaisstrom überproportional aus, da die Brennspannung U_B praktisch konstant ist. Die Schwankung des Relaisstromes ist umso kleiner, je höher die Speisespannung gewählt wird. Die Streuung des Relaiswiderstandes ist zu berücksichtigen.
Allgemein gilt:

Die für die Erregung des Relais zur Verfügung stehende Leistung ist:

Für eine bestimmte Röhrentype und gegebene Speisespannung ist das Relais so-

Le courant anodique d'un tube relais peut actionner un relais électro-mécanique pour c.c. Les conditions d'opération sont illustrées dans la figure 1. Les symboles signifient:

- $U_{A0\,min}^{max}$: la tension d'alimentation anodique (variant entre les valeurs min. et max.)
- $U_{B\,min}^{max}$: la chute de tension du tube (avec une dispersion entre les valeurs min. et max.)
- I_K: le courant du tube (= courant du relais)
- R_{min}^{max}: la résistance de la bobine du relais (dispersion entre les valeurs min. et max.)

A part la résistance de la bobine, un relais déterminé est caractérisé par deux grandeurs:

- P_{min}: la puissance d'attraction, c.à.d. la puissance min. requise pour l'excitation sure du relais
- P_{max}: la puissance admissible (sans trop d'échauffement du relais)

Du côté tube, les limites suivantes sont à respecter:

- I_{Kmin}: courant cathodique minimum
- I_{Kmax}: courant cathodique maximum
- U_{Amin}: tension anodique minimum
- U_{Amax}: tension anodique maximum

Les variations de la tension d'alimentation ont une influence plus que proportionnelle sur le courant du relais, car la chute de tension du tube est pratiquement constante. La variation du courant du relais est plus petite pour les tensions d'alimentation plus élevées. La dispersion de la résistance du relais doit être considerée.

Les formules de base:

$$I_K = \frac{U_{A0} - U_B}{R} \qquad R = \frac{U_{A0} - U_B}{I_K}$$

La puissance disponible pour l'excitation du relais est:

$$P_{Rel} = \frac{(U_{A0} - U_B)^2}{R} \quad \text{oder / ou / or} \quad P_{Rel} = (U_{A0} - U_B) \cdot I_K$$

Pour un tube et une tension d'alimentation déterminés, le relais doit attirer avec cer-

The anode current of a relay tube supplied by DC can be used to operate a normal DC relay. The working conditions for this relay are shown in figure 1. The symbols are:

- $U_{A0\,min}^{max}$: the anode supply voltage (varying between a min. and a max. value)
- $U_{B\,min}^{max}$: the maintaining voltage of the tube (with tolerances between the min. and the max. value)
- I_K: the tube current (=relay current)
- R_{min}^{max}: resistance of relay coil (with tolerances between a min. and a max. value).

Besides the coil resistance, a given relay type is characterized by two values:

- P_{min}: the sensitivity (minimum power for secure operation)
- P_{max}: the dissipation (maximum admitted power without excessive heating of the relay)

From the tube side, the following limits are given:

- I_{Kmin}: minimum required anode voltage
- I_{Kmax}: maximum admitted cathode current
- U_{Amin}: minimum required anode voltage
- U_{Amax}: maximum admitted anode voltage

The influence of the variations of the supply voltage on the relay current is more than proportional, as maintaining voltage U_B is practically constant. The variation of the relay current is the smaller the higher the supply voltage is chosen. The tolerances of the relay coil resistance must be considered.
The general formulas are:

The excitation power of the relay is:

For a given tube type and a given supply voltage, a relay must be chosen that

Fig.1

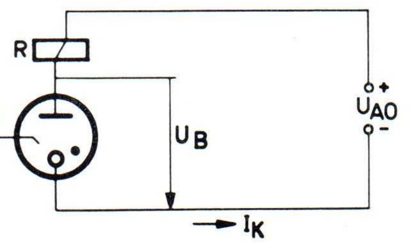
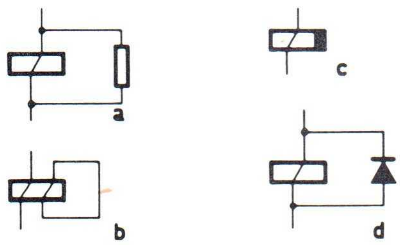


Fig.2



auszuwählen, dass es bei der minimal zu erwartenden Speisespannung sicher anzieht und sich bei der maximal vorkommenden Speisespannung nicht unzulässig erwärmt.

Fall 1:
Soll die maximal mögliche Erregerleistung erzielt werden, wählt man $U_{A01max} = U_{Amax}$. Relaiswiderstand, Dauerleistung und Ansprechleistung sind:

$$R_{1min} = \frac{U_{A01max} - U_{Bmin}}{I_{Kmax}}$$

Fall 2:
Soll das Relais eine möglichst kleine Erregerleistung erhalten, wählt man $U_{A02min} = U_{Amin}$ und erhält:

$$R_{2max} = \frac{U_{A02min} - U_{Bmax}}{I_{Kmin}}$$

Für die Anpassung bestehender Relais an eine bestimmte Röhre können Serie- und Parallelwiderstände verwendet werden, die verfügbare Erregerleistung wird allerdings dadurch reduziert.

Für die Speisung mit der normalen Speisespannung (Schwankung : $^{+14}_{-18}$ %) und Betrieb der Röhren mit Nennstrom sind die erforderlichen Relaiswerte in der untenstehenden Tabelle zusammengestellt. Sie gelten für eine gut gesiebte Speisespannung, bei schlechter Siebung ist eine kleinere Ansprechleistung und ein kleinerer Relaiswiderstand erforderlich.

Beim Löschen der Röhre tritt über der Relaiswicklung eine Spannungsspitze auf, die zu einer unerwünschten Wiederzündung führen kann, insbesondere in Zählschaltungen und Flip-Flop-Schaltungen. Diese Spannungsspitzen können durch die in Fig. 2 dargestellten Mittel vermindert oder unterdrückt werden: a) Parallelwiderstand, b) Kurzschlusswicklung, c) Kurzschlussring, d) Parallelgleichrichter. Am wirksamsten ist die Methode d).

Lit.: "Cerberus Elektronik" Nr. 5, Nr. 9.

titude à la tension d'alimentation min. et ne pas trop se chauffer à la tension d'alimentation max.

Cas 1:
Pour obtenir le maximum de puissance d'excitation, on choisit $U_{A01max} = U_{Amax}$. La résistance de la bobine, la puissance admissible et la puissance d'attraction sont alors:

$$P_{1max} = (U_{A01max} - U_{Bmin})\, I_{Kmax}$$

Cas 2:
Pour obtenir le minimum possible de la puissance d'excitation, on choisit $U_{A02} = U_{Amin}$ et obtient:

$$P_{2max} = \frac{(U_{A02max} - U_{Bmin})^2}{R_{2min}}$$

Pour adapter des relais existants à un tube déterminé, la résistance correcte peut être obtenue par des résistances en série ou en parallèle avec la bobine. Ces mesures réduisent cependant la puissance disponible pour le relais.

Pour les tubes alimentés avec leur tension normale (variation $^{+14}_{-18}$%) et fonctionnant avec leur courant normal, les valeurs des relais correspondants sont données dans la tabelle ci-dessous. Les valeurs se réfèrent à une tension d'alimentation bien filtrée; avec un mauvais filtrage, la résistance de la bobine et la puissance d'attraction doivent être diminuées.

Quand le tube s'éteint, une pointe de tension se développe aux bornes de la bobine, ce qui peut causer un réamorçage du tube, tout spécialement dans les circuits compteurs et les bascules. Cette pointe peut être réduite ou éliminée par l'une des mesures suivantes: a) résistance en parallèle, b) enroulement court-circuité, c) bague de cuivre, d) redresseur en parallèle. La mesure d) est la plus efficace.

Lit.: "Cerberus Elektronik" No 5, No 9.

will operate securely with the minimum supply voltage and show no excessive heating at the maximum supply voltage.

Case 1:
The maximum excitation power for the relay is obtained if $U_{A01max} = U_{Amax}$. Coil resistance, dissipation and sensitivity are:

$$P_{1min} = \frac{(U_{A01min} - U_{Bmax})^2}{R_{1max}}$$

Case 2:
The minimum excitation power for the relay is obtained if $U_{A02min} = U_{Amin}$. This gives:

$$P_{2min} = (U_{A02min} - U_{Bmax})\, I_{Kmin}$$

For adapting an existing relay to a determined tube, series or parallel resistors can be added to the relay coil, however, the available excitation power for the relay is reduced.

For tubes supplied with their normal voltage (variation $^{+14}_{-18}$%) and operating at their normal current, the required relay data are given in the table below. These values are valid for a well filtered supply voltage. For a badly filtered supply voltage, a better sensitivity and a lower coil resistance are required.

When the tube is extinguished, a voltage peak develops on the relay coil, which may lead to unwanted refiring of the tube, especially in counting and flip-flop circuits. This voltage peak can be reduced or eliminated by one of the following methodes: a) parallel resistors, b) short-circuited winding, c) copper ring, d) parallel rectifier. Methode d) is the most efficient.

Lit.: "Cerberus Elektronik" No 5, No 9.

Röhrentype Tube Tube type	Speisespannung Tension d'alimentation Supply voltage U_{A0} (V=)	Relaiswiderstand Résistance du relais Relay coil resistance R (kΩ)	Ansprechleistung Puissance d'attraction Sensitivity P_{min} (mW)	Dauerleistung Puissance admissible Dissipation P_{max} (W)
GR 15	220	8	600	2,5
GR 16	300	6,5	3000	9
GR 20	220	15	300	1,5
GR 31	300	12	1400	4,5
GR 43	220	33	150	0,7
	spec.	12	50	0,25
GR 44	300	18	800	3
GK 11	220 ± 5 %	12	1200	2
	200	10	400	2,5
	spec.	6,5	400	2
	spec.	6,5	250	1,2

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Nachbestückungstypen
Types de rechange
Maintenance types

Der folgende Typ soll für Neuentwicklungen nicht mehr verwendet werden. Seine Nachlieferung für laufende Herstellung und Nachbestückung bestehender Geräte ist jedoch gewährleistet.

Le type suivant n'est plus recommandé pour des développements nouveaux. Cependant, son livraison est assurée pour des productions courantes et pour des remplacements.

The following type is not recommended for new designs. It is delivered, however, for current productions and for replacements.

Hochstrom-Schaltdiode BD 22

Diode de commutation à impulsions de forte itensité BD 22

High current switching diode BD 22

Datenblatt dieser Röhre ist auf Wunsch erhältlich.

Notice de ce tube sur demande.

Data sheet for this tube is available at request.

Nachbestückungstypen
Types de rechange
Maintenance types

Type	
Nr.	19.01
Ed. 4. 72	Fol. 1

Die folgenden Typen sollen für Neuentwicklungen nicht mehr verwendet werden. Ihre Nachlieferung für laufende Herstellung und Nachbestückung bestehender Geräte ist jedoch gewährleistet.

Glimmrelais	GR 18 GR 20 GR 44
Spannungsreferenzröhre	SR 4
Schaltdioden	G 11/220 GS 11/220
Hochstromschaltröhre	BR 11
Hochstromschaltdioden	BD 21 BD 23

Datenblätter dieser Röhren sind auf Wunsch erhältlich.

Les types suivants ne sont plus recommandés pour des développements nouveaux. Cependant, leur livraison est assurée pour des productions courantes et pour des remplacements.

Relais électroniques	GR 18 GR 20 GR 44
Tube de référence de tension	SR 4
Diodes de commutation	G 11/220 GS 11/220
Tubes pour courant élevé	BR 11
Diodes de commutation à impulsions de forte intensité	BD 21 BD 23

Notices de ces tubes sur demande.

The following types are not **recommended** for new designs. They are delivered, however, for current productions and for replacements.

Trigger tubes	GR 18 GR 20 GR 44
Voltage reference tube	SR 4
Switching diodes	G 11/220 GS 11/220
High current switching tube	BR 11
High current switching diodes	BD 21 BD 23

Data sheets for these tubes are available at request.

~~20~~
50

CERBERUS

SPEISUNG VON KALTKATHODEN-RELAISROEHREN AUS DEM 115 V~ NETZ
ALIMENTATION DE TUBES RELAIS PAR LE RESEAU DE 115 VOLTS CA
OPERATION OF COLD CATHODE RELAY TUBES FROM A 115 VOLTS AC LINE

Type	
Nr.	50.11
Ed. 8.63	Fol. 1

Die Kaltkathodenröhren GR 16 und GR 17 sind für den Betrieb aus dem 220 V~ Netz ausgelegt. Für die Speisung dieser Röhren aus dem 115 V~ Netz können die unten angeführten Schaltungen angewendet werden.

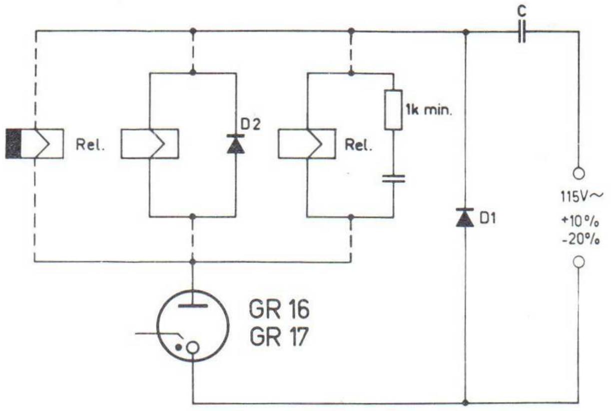
Les tubes relais GR 16 et GR 17 sont normalement alimentés par le réseau de 220 volts CA. Pour alimenter ces tubes par un réseau de 115 volts CA, les circuits suivants peuvent être utilisés.

The cold-cathode relay tubes GR 16 and GR 17 are designed to be operated from a 220 Volts AC line. To feed these tubes from a 115 Volts AC line the circuits given below can be used.

1. Schaltung mit Spannungsverdoppler.

1. Circuit avec doubleur de tension.

1. Circuit with voltage-doubler.

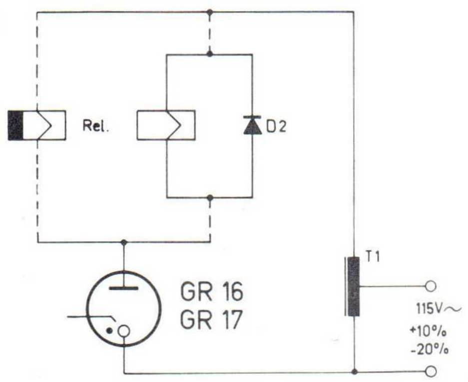


2. Schaltungen mit Netztransformator.

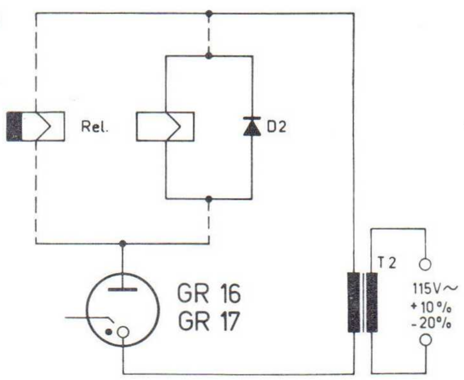
2. Circuits avec transformateur.

2. Circuits with linevoltage transformer.

A



B



Rel	Relais, siehe Blatt 20.01 "Relais zu Kaltkathoden-Relaisröhren" Relais, voir feuille 20.01 "Relais pour tubes à cathode froide" Relay, see sheet 20.01 "Relays for cold cathode tubes"
C	Kondensator: min. 4 µF, 400 V=, max. Welligkeitsstrom: 100 mA Condensateur: min. 4 µF, 400 V=, Composante alternative superposée max.: 100 mA Capacitor: min. 4 µF, 400 V=, max. AC ripple current: 100 mA
D1	Diode, 400 V Spitzensperrspannung, 50 mA Diode, 400 V Tension inverse de pointe, 50 mA Diode, 400 V Peak inverse voltage, 50 mA
D2	Diode, 300 V Spitzensperrspannung, 25 mA Diode, 300 V Tension inverse de pointe, 25 mA Diode, 300 V Peak inverse voltage, 25 mA
T1, T2	Netztransformator 8 VA, sekundäre Leerlaufspannung: 220 V Transformateur 8 VA, tension secondaire à vide: 220 V Line voltage transformer 8 VA, secondary open circuit voltage: 220 V

PROTECTION OF POWER SUPPLIES AGAINST VOLTAGE- AND SWITCH-ON TRANSIENTS

Type	
Nr.	**50.12 e**
Ed. 7.67	Fol. 1

1. INTRODUCTION

The majority of all breakdowns in mains operated units can be attributed to destruction of their power supplies. The causes are voltage transients superimposed on the mains voltage. The danger of destruction is particularly great when the units are connected in parallel with inductors, e.g. with transformers switched on the primary side, magnetic switches, contactors, relays, etc. (Fig. 1). An additional source of danger are high inrush currents such as occur when capacitors charge (Fig. 2).

These disturbing influences are specially of danger for units containing any kind of semiconductors. However, the addition of simple circuits to the power supply ensure safe operation by reducting any occuring effect, as described before, to a reasonable value.

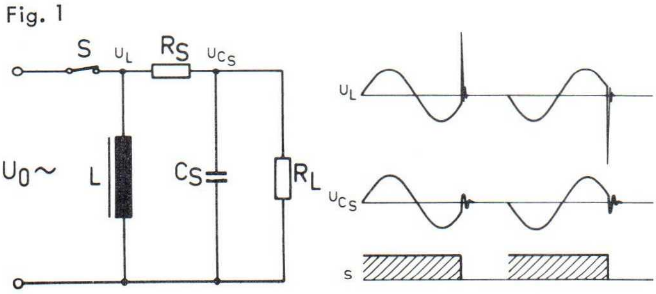
2. INFLUENCE OF OVERVOLTAGES AND OVERCURRENTS ON SEMI-CONDUCTOR ELEMENTS

With semiconductor elements, in particular rectifier diodes, the peak value and rise time are the important parameters of the transient voltage. If this overvoltage is in the forward direction of the diode, the peak current must be limited to a safe value. In the reverse direction the amplitude of the transient voltage must not exceed the permissible peak reverse voltage. (It is to be noted with half-wave rectification and subsequent smoothing that the diode already blocks twice the peak value of the supply voltage.) Furthermore, the diode reverse current at the moment of nonconduction (carrier recombination delay) must be limited to a safe value by increasing transient voltage's rise time.

2.1 Limitation of voltage surges (Fig. 1)

Voltage surges can occur as a result of external influences on the power line or by switch-off of inductivities connected in parallel with load R_L. It is found from experience that breaking voltages rise to approx. 2 kV on magnetic switches and contactors, and to approx. 1 kV on industrial relays.

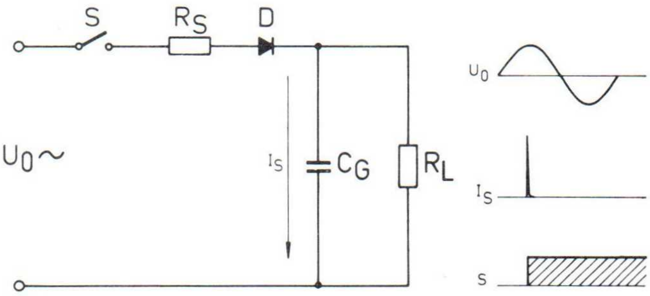
Fig. 1



2.2 Limitation of inrush currents (Fig. 2)

Charging of the smoothing capacitor C_G via protective resistor R_S and recifier diode D results in high inrush currents. R_S must be rated so that in the least favourable case (switch-on at peak value of the positive half-cycle with max. supply voltage U_0) the permissible forward peak current I_S stated by the diode's manufacturer is not exceeded. The dielectric strength of R_S should also be borne in mind.

Fig. 2



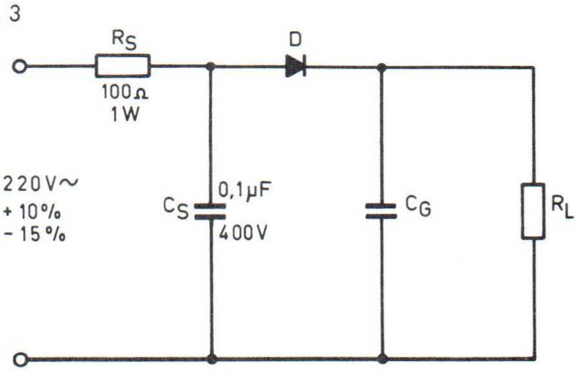
3. PRECAUTIONS AGAINST VOLTAGE TRANSIENTS AND PEAK CURRENTS

Voltage transients can be neutralized in the simplest possible way by using a low-pass filtre consisting of components R_S and C_S. Peak currents are also limited to a reasonable value by R_S.

3.1 Power supplies with half-wave rectification (Fig. 3)

Protective circuit in a power supply for switching diodes and trigger tubes with smoothed d.c. voltage: Positive and negative voltage transients are reduced by the diode and $R_S C_S$ network. Positive voltage transients are additionally damped by the smoothing capacitor C_G. R_S acts as a limiter of the inrush current at the same time.

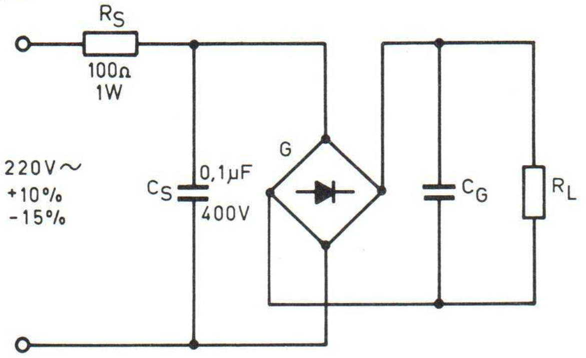
Fig. 3



3.2 Power supplies with full-wave rectification (Fig. 4)

Protective circuit in a power supply with full-wave rectification for switching diodes and trigger tubes with smoothed d.c. voltage: C_S and C_G smooth overvoltage peaks of both polarities. The R_SC_S network also increases the rise time of voltage pulses. R_S finally limits the inrush current as well.

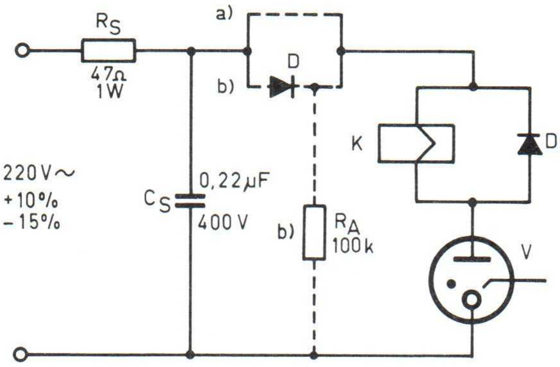
Fig. 4



3.3 Power supplies for a.c. full-wave or half-wave voltage (Fig. 5)

Protective circuit in a power supply for a trigger tube with a.c. voltage (case a) or half-wave voltage supply (case b). The R_SC_S network smooths voltage peaks of both polarities. Forward or reverse conduction in the trigger tube is thereby avoided. This is particularly necessary when a relay K has its release-delay by diode D_V. Reverse conduction in the trigger tube would destroy both the diode D_V and the tube itself, because the current is limited by the resistor R_S only.

Fig. 5



In the circuit-variant b, the resistor R_A bypasses the reverse diode current during the negative period.

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5

KONTAKTSCHUTZRELAIS FUER NIEDERE KONTAKTSPANNUNG RELAIS PROTEGE-CONTACT A FAIBLE TENSION DE CONTACT CONTACT OPERATED ELECTRONIC RELAY WITH LOW CONTACT VOLTAGE	Type	
	Nr. 51.12	
	Ed. 10.63	Fol. 1

Die Schaltungen eignen sich als Schaltverstärker: die Ansteuerung erfolgt über einen empfindlichen, schwach belastbaren Kontakt. Am Ausgang liegt ein robustes Relais mit Starkstromkontakten.
Besondere Eigenschaften sind:
- kleine Spannung über dem geöffneten Kontakt (keine Funkenbildung, kleine statische Anziehung der Pole).
- kleiner Strom im geschlossenen Kontakt (geringe Abnützung).
- auf der Zuleitung zum Steuerkontakt liegt Gleichspannung (Kapazität resp. Länge der Zuleitung unkritisch).
- Isolationswiderstand der Steuerleitung braucht nicht besonders hoch zu sein.
- auch Kontakte mit Uebergangswiderstand von einigen kΩ sind noch verwendbar.
- Explosionssicherheit des Steuerkontaktes ist in den meisten Fällen gewährleistet (je nach Aufbau des Apparates und nach Vorschriften).

ANWENDUNGEN
- Temperaturregelung mit Kontaktthermometer
- Mikrometerabtastung
- Zeigerabtastung an Messinstrumenten

A. ARBEITSSTROM-STEUERUNG
Das Relais zieht an, wenn der Steuerkontakt schliesst.

Les circuits fonctionnent en amplificateur de contact: La commande, effectuée par un contact sensible, agit par l'intermédiaire du tube sur un relais muni de contacts robustes pour courant fort.
Les qualités spécifiques sont:
- petite tension sur le contact de commande ouvert (pas d'étincelle, attraction électrostatique négligeable des pôles).
- petit courant dans le contact de commande fermé (faible usure).
- la ligne de commande fait partie d'un circuit à courant continu (capacité ou longueur peu critique).
- la résistance d'isolement de la ligne de commande ne doit pas être extrème.
- la résistance du contact fermé peut atteindre quelques kΩ.
- dans la plupart des applications les circuits sont anti-déflagrants (suivant le montage et les prescriptions y respectives).

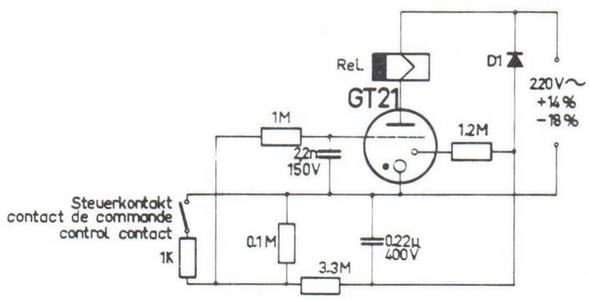
APPLICATIONS
- Réglage de température au moyen d'un thermomètre à contact
- Palpage de micromètre
- Palpage de l'aiguille d'instruments de mesure

A. CIRCUIT DE TRAVAIL
Le relais attire quand le contact de commande est fermé.

The circuits are suitable as switching amplifiers: a very sensitive contact controls a tube that operates a robust relay equipped with heavy duty contacts.
Special features:
- low voltage across the open control contact (no sparks and low electrostatic attraction of poles).
- low control current (negligible wear of contacts).
- DC-voltage on control line (capacity or length of line is therefore not critical).
- no extreme contact insulation resistance required.
- contacts with a resistance as high as several kΩ may be used.
- in most applications the circuits are explosion-proof (depending on the mode of mounting and regulations).

APPLICATIONS
- temperature supervision by means of a contact thermometer
- micrometer sensing
- sensing the pointer position in instruments

A. MAKE CONTACT CIRCUIT
The relay is energized when the control contact is closed.



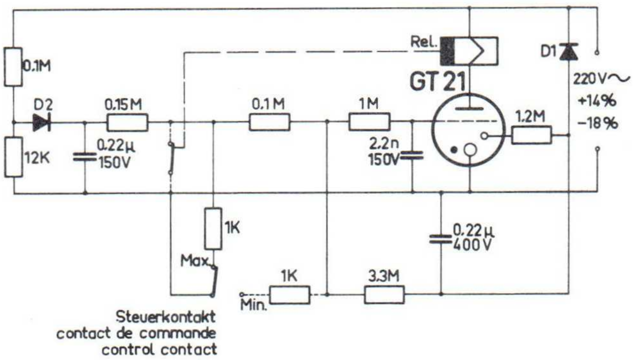
Steuerkreisdaten*	Caractéristiques de commande*	Control circuit data*	
Spannung über dem geöffneten Steuerkontakt	Tension sur le contact de commande ouvert	Voltage across the open control contact	9 V (max. 13 V)
Strom durch den Steuerkontakt	Courant dans le contact de commande	Current through the control contact	70 μA (max. 100 μA)
Geforderter Isolationswiderstand des geöffneten Steuerkontaktes	Résistance d'isolement exigée du contact de commande ouvert	Required insulating resistance of open contact	0,5 MΩ min.
Zulässiger Uebergangswiderstand des geschlossenen Steuerkontaktes	Résistance admissible du contact de commande fermé	Admitted resistance of closed contact	5 kΩ max.
Zulässige Kapazität der Steuerleitung	Capacité admissible de la ligne de commande	Admitted capacity of the control line	0,05 μF max.

→

B. RUHESTROM-STEUERUNG
Das Relais zieht an, wenn der Steuerkontakt öffnet. Die gestrichelt gezeichneten Elemente entfallen.

B. CIRCUIT DE REPOS
Le relais attire quand le contact de commande est ouvert. Les éléments en pointillé seront omis.

B. BREAK CONTACT CIRCUIT
The relay is energized when the control contact is opened. The elements drawn in dotted lines have to be omitted.



Steuerkreisdaten*	Caractéristiques de commande*	Control circuit data*	
Spannung über dem geöffneten Steuerkontakt	Tension sur le contact de commande ouvert	Voltage across the open control contact	19 V (max. 31 V)
Strom durch den Steuerkontakt	Courant dans le contact de commande	Current through the control contact	130 µA (max. 240 µA)
Geforderter Isolationswiderstand des geöffneten Steuerkontaktes	Résistance d'isolement exigée du contact de commande ouvert	Required insulating resistance of open contact	0,7 MΩ min.
Zulässiger Uebergangswiderstand des geschlossenen Steuerkontaktes	Résistance admissible du contact de commande fermé	Admitted resistance of closed contact	10 kΩ max.
Zulässige Kapazität der Steuerleitung	Capacité admissible de la ligne de commande	Admitted capacity of the control line	5 nF max.

C. MINIMAL-MAXIMAL-STEUERUNG
Das Relais zieht an, wenn der Minimalkontakt schliesst, es fällt erst wieder ab, wenn der Maximalkontakt schliesst. Schaltung wie B einschliesslich die gestrichelt gezeichneten Teile.

Steuerkreisdaten*
für den Max-Kontakt gleich wie für B
für den Min-Kontakt gleich wie für A

C. CIRCUIT MINIMUM-MAXIMUM
Le relais attire quand le contact Minimum est fermé. Il ne relâche que lorsque le contact Maximum est fermé.
Schéma suivant B, les éléments en pointillé inclus.

Caractéristiques de commande*
pour le contact Max égales à celles du circuit B
pour le contact Min égales à celles du circuit A

C. MINIMUM-MAXIMUM CIRCUIT
The relay is energized when the Minimum-contact is closed. It is de-energized only after the Maximum-contact is closed.
Circuit as in B, including the parts drawn in dotted lines.

Control circuit data*
of Max-contact same as for B
of Min-contact same as for A

D_1 = Diode, 700 V Spitzensperrspannung, 5 mA (z.B. SD 98: International Rectifiers; BY 100: Philips)

D_2 = Diode, 100 V Spitzensperrspannung, 1 mA (z.B. 1S132: Texas Instruments; OA202: Philips)

Relais: siehe Blatt 20.01

Widerstände: ± 10%, 0,5 W

Kondensatoren: ± 10%

D_1 = Diode, 700 V Tension inverse de pointe, 5 mA (p.ex. SD 98: International Rectifiers; BY 100: Philips)

D_2 = Diode, 100 V Tension inverse de pointe, 1 mA (p.ex. 1S132: Texas Instruments; OA202: Philips)

Relais: voir feuille 20.01

Résistances: ± 10%, 0,5 Watts

Condensateurs: ± 10%

D_1 = Diode, 700 V Peak inverse voltage, 5 mA (e.g. SD 98: International Rectifiers; BY 100: Philips)

D_2 = Diode: 100 V Peak inverse voltage, 1 mA (e.g. 1S132: Texas Instruments; OA202: Philips)

Relay: see sheet 20.01

Resistors: ± 10%, 0,5 Watts

Capacitors: ± 10%

* Steuerkreisdaten
Kontaktstrom und -spannung sind als Nennwerte angegeben. Die Angaben von max.- und min.-Werten beziehen sich auf die ungünstigste Kombination von Toleranzen der Komponenten und Schwankungen der Speisespannung.

* Caractéristiques de commande
Le courant et la tension du contact sont indiqués comme valeurs nominales. Les valeurs maxima et minima se réfèrent toujours à la combinaison la plus défavorable des tolérances des composants et des variations du secteur.

* Control circuit data
Contact voltage and current are indicated as nominal values. The maximum and minimum values are calculated for the worst case condition (components and line voltage tolerances).

Die Schaltung eignet sich zur Steuerung von Leistungen bis zu einigen Kilowatt mittels empfindlichen, schwach belastbaren Kontakten (Kontaktthermometer, Hygrometer, etc.).

Der Kontakt K, in allen Fällen mit nur max. 7 mW belastet, steuert die einlötbare Subminiaturröhre GR 44. Diese liefert am Anfang jeder positiven Halbwelle stromstarke Impulse, welche den gesteuerten Gleichrichter (SCR 1) zünden. (Master)

Bei der Antiparallel-Schaltung leitet der gesteuerte Gleichrichter SCR 2 (Slave) während der negativen Halbwelle. Die Zündung durch die zugeordnete GR 44 erfolgt automatisch, nachdem die Last L in der positiven Halbwelle eingeschaltet war.

Le circuit permet de commander des puissances de quelques kilowatts par des contacts sensibles tels que thermomètres à contact, hygromètres, etc.

Le contact K, dont la charge ne dépasse jamais 7 mW, commande le tube subminiature soudable GR 44. Celui-ci émet, au début de chaque alternance positive, des impulsions de forte intensité qui amorcent le redresseur commandé SCR 1 (circuit Master).

Dans le couplage antiparallèle, le redresseur commandé SCR 2 (circuit Slave) est conducteur pendant l'alternance négative. Le tube GR 44 correspondant amorce automatiquement une fois que la charge a été enclenchée au cours de l'alternance positive.

The circuit is suitable for controlling powers up to a few kilowatts with sensitive, low-power contacts (contact thermometer, hygrometer, etc.).

The contact K, which in all cases should not be loaded with more than 7 mW, controls the soldered-in subminiature tube GR 44. The latter generate powerful current impulses at the beginning of each positive half-wave, these impulses trigger the controlled rectifier SCR 1 (Master).

In the AC static switch circuit the semiconductor SCR 2 (Slave) conducts in the negative half-wave. This is caused by the corresponding GR 44 tube automatically after positive ignition has occurred.

A. STEUERUNG MIT ARBEITSKONTAKT

Fig. 1

Bei geschlossenem Kontakt K ist der gesteuerte Gleichrichter SCR 1 in jeder positiven Halbwelle leitend. Durch die Last L fliesst pulsierender Gleichstrom.

A. COMMANDE PAR CONTACT DE TRAVAIL

Fig. 1

Une fois le contact K fermé, le redresseur commandé SCR 1 est conducteur pendant chaque alternance positive. Un courant continu pulsatoire s'écoule à travers la charge L.

A. CONTROL WITH MAKE CONTACT

Fig. 1

If contact K is closed, the controlled rectifier SCR 1 conducts during every positive half-wave. Pulsating direct current flows through the load L.

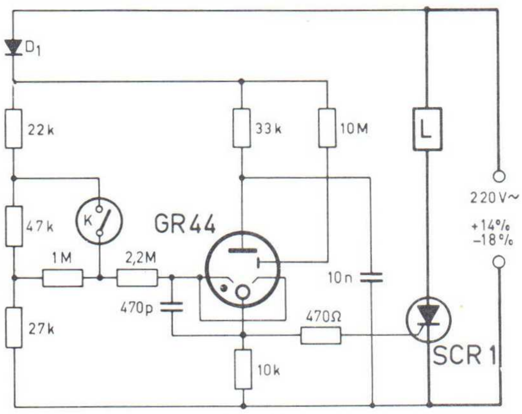


Fig. 1

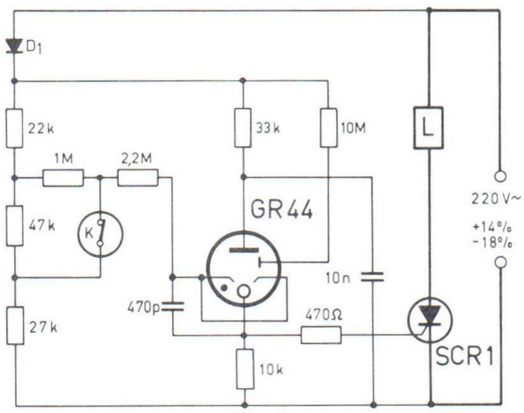


Fig. 2

B. STEUERUNG MIT RUHEKONTAKT

Fig. 2

Bei geöffnetem Kontakt K ist der gesteuerte Gleichrichter SCR 1 in jeder positiven Halbwelle leitend. Durch die Last L fliesst pulsierender Gleichstrom.

B. COMMANDE PAR CONTACT DE REPOS

Fig. 2

Une fois le contact K ouvert, le redresseur commandé SCR 2 est conducteur pendant chaque alternance positive. Un courant continu pulsatoire s'écoule à travers la charge L.

B. CONTROL WITH BREAK CONTACT

Fig. 2

When the contact K is opened, the controlled rectifier SCR 1 conducts during every positive half-wave. Pulsating direct current flows through the load L.

C. ANTIPARALLEL-SCHALTUNG

Fig. 3

Als Master kann zur Steuerung sowohl Schaltung A als auch B verwendet werden. Durch die Last L fliesst ein Wechselstrom, wobei der Zündwinkel in beiden Halbwellen praktisch gleich gross ist.

C. COUPLAGE ANTIPARALLELE

Fig. 3

Les schémas A et B peuvent l'un ou l'autre servir à la commande en circuit Master. La charge L est traversée par un courant alternatif, l'angle d'amorçage étant pratiquement le même pour les deux alternances.

C. AC STATIC SWITCH CIRCUIT

Fig. 3

Both circuit A and circuit B can be used as master. Alternating current flows through the load L, the firing angle is practically equal in both half-waves.

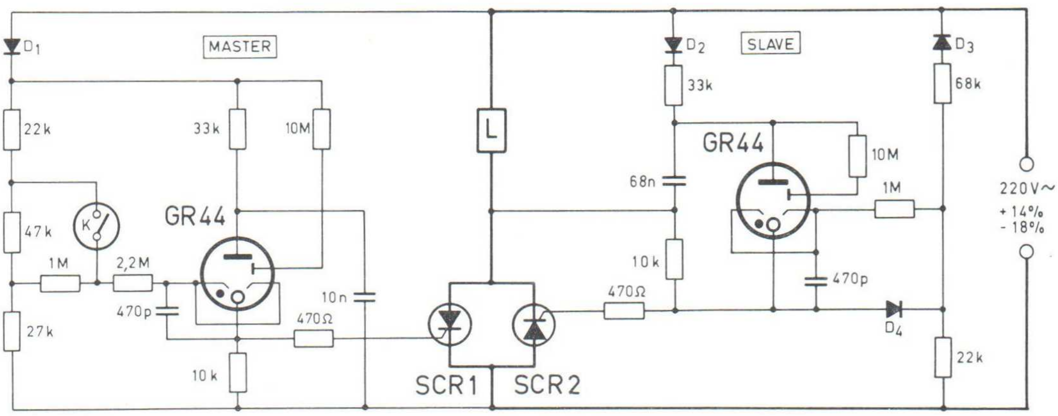


Fig. 3

ELEKTRISCHE DATEN / DONNEES ELECTRIQUES / ELECTRICAL DATA

	Schaltung / Circuit / Circuit Fig. 1	Fig. 2
– Max. Kontaktstrom / Courant max. sur contact Max. contact current	70 µA	55 µA
– Spannung über dem geöffneten Kontakt / Tension sur contact ouvert / Voltage over the open contact	90 V	70 V
– Max. Kabelkapazität der Steuerleitung / Capacité max. de la ligne de commande / Max. cable capacity of the control line	4700 pF	3300 pF
– Min. Isolationswiderstand über dem geöffneten Kontakt Résistance d'isolement min. pour contact ouvert Min. insulation resistance over the open contact	1 MΩ	1 MΩ
– Max. Uebergangswiderstand des geschlossenen Kontaktes Résistance max. du contact fermé / Max. resistance of the closed contact	100 kΩ	100 kΩ

– Dioden, 5 mA Sperrspannung
  Diodes, 5 mA tension inverse de crête
  Diodes, 5 mA inverse voltage
) D1, D2 >680 V / D3, D4 >350 V

– SCR 1, SCR 2, gesteuerte Gleichrichter (max. Steuerstrom 120 mA, Sperrspannung 400 V) z.B. TI 3014 (Texas Instruments)
  redresseurs commandés (courant de commande 120 mA au max., tension inverse 400 V) p.ex. TI 3014 (Texas Instruments)
  controlled rectifiers (max. control current 120 mA, inverse voltage 400 V) e.g. type TI 3014 (Texas Instruments)

– Kondensatoren / Condensateurs / Capacitors ± 10%, 400 V

– Widerstände / Résistances / Resistors 1/2 W ± 10 %

1. INTRODUCTION

Simple circuits for controlling the level of electrically conducting substances (liquids or loose materials) can be built with the GR 16 cold-cathode tube. Measurement is based on the conductivity of the filling material between the measuring electrodes M and the counter-electrode G. In the following circuits the maximum voltage between the electrodes is 170 V, and the control current is limited to 100 µA.

A metal rod at least 3 mm thick is used as measuring electrode. The grounded counter-electrode consists either of a further measuring electrode or of the filling material container, if the latter is of metal.

WORKING DIAGRAMS FOR CIRCUITS SHOWN IN FIGS. 1 TO 6			
CONTROLLER TYPES	BAISSED-OFF CIRCUIT	BAISSED-ON CIRCUIT	TYPICAL APPLICATION EXAMPLES
ON-OFF CONTROLLER (see 3.1)	Rel A, on, off, level 1, level 2 — see 3.1.1	Rel A, on, off, level 1, level 2 — see 3.1.2	- Limiting value controller - Limiting value signalling unit
ON-OFF CONTROLLER WITH SWITCHING HYSTERESIS (see 3.2)	Rel A, on, off, level 1, level 2 — see 3.2.1	Rel A, on, off, level 1, level 2 — see 3.2.2	- Limiting value controller with dead zone - Monitoring undulating filling levels
THREE-POSITION CONTROLLER (see 3.3)	Rel A, on, off, on, Rel B, level 1, level 2 — see 3.3.1	Rel A, on, off, on, Rel B, level 1, level 2 — see 3.3.2	- Limiting value signalling unit, e.g. controlling mixing devices and dosing device

Depending on the application, the filling level is controlled or monitored. In the case of control, a certain level is kept constant, whereas during monitoring a signal is given (e.g. actuation of an alarm) as soon as a predetermined level is reached or surpassed. The following circuits are suitable both for control and monitoring of filling levels.

There are three different types of control, namely: on-off control, on-off control with switching hysteresis, and three-position control.

The main characteristics of these three control types are summarized in the annexed diagrams.

2. ELECTRICAL DATA (see also Fig. 1)

M:	Measuring electrode	
G:	Counter-electrode or grounded metal container	
R_{is}:	Min. insulation resistance between measuring and counter-electrode	10 MΩ
C:	Max. electrode and load capacity (e.g. thermosplastic insulated of max. 5 m length)	1000 pF
R_u:	Max. Resistance of filling material between the electrodes	100 kΩ
Rel:	Relay 1,5 kΩ, short-circuit winding filling about 25 % of winding space	
Resistors:	1/2 W ± 10 %	
Capacitors:	200 V~ ± 20 %	
Transformer:	Power about 8 VA, in the case of Fig. 6 about 16 VA	

3. DESCRIPTION OF THE CIRCUITS

3.1 On-off controller

3.1.1 Baissed-off circuit, Fig. 1

When there is no filling material the tube is extinguished and the relay is de-energized. When the material being monitored reaches the upper electrode (level 2), the starter ignition voltage is exceeded, the tube fires and the relay operates.

3.1.2 Baissed-on circuit, Fig. 2

The circuit operates in a manner exactly opposite to that of Fig. 1.

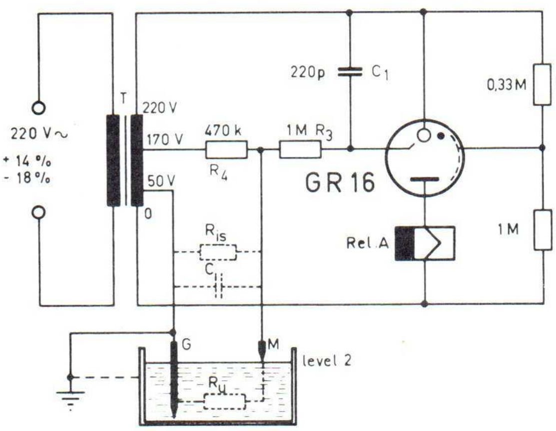


Fig. 1

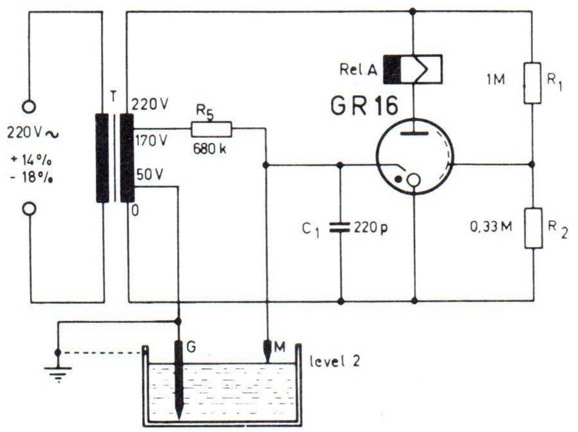


Fig. 2

3.2 On-off controller with switching hysteresis

3.2.1 Baissed-off circuit, Fig. 3

When the filling material lies below level 1, the relay is de-energized (tube extinguished). When the upper most electrode (level 2) is reached, the tube fires and the relay operates. This causes contact a to close which in turn causes the filling material to fall until the relay is again de-energized. (Difference between levels 2 and 1: switching hysteresis or dead zone.)

3.2.2 Baissed-on circuits, Fig. 4

The circuit operates in a manner exactly opposite to that of Fig.3.

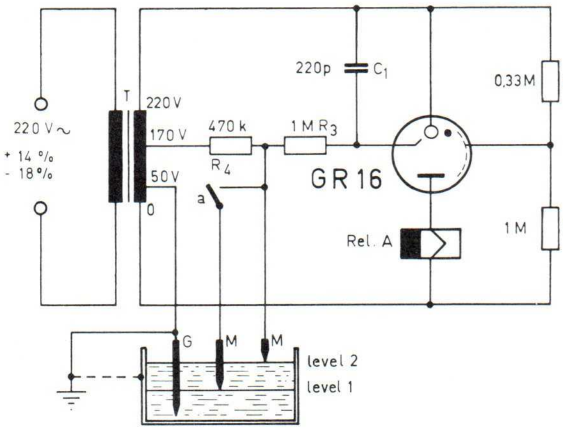


Fig. 3

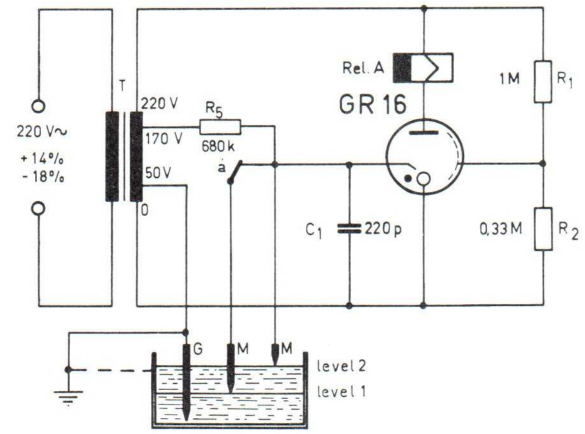


Fig. 4

3.3 Three-position controller

3.3.1 Baissed-off circuit, Fig. 5

Without filling material tube Rö 1 is extinguished and relay Rel A de-energized; tube Rö 2 is fired and the corresponding relay Rel B energized. When the filling material reaches level 1, relay Rel B falls; relay Rel A remains in the rest position. When level 2 is reached, Rel A operates whereas relay Rel B remains in the rest position. When the filling material falls, relay Rel A is disconnected at level 2 and relay Rel B operates again at level 1.

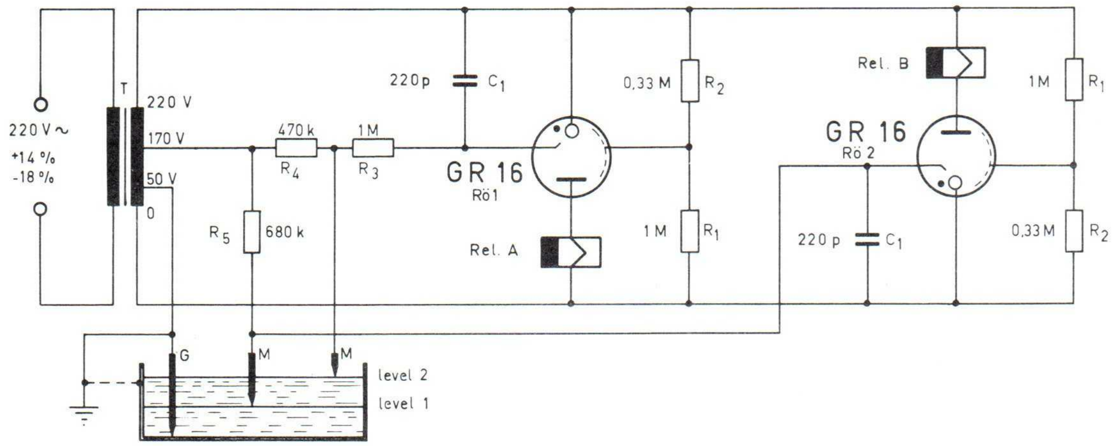


Fig. 5

3.3.2 Baissed-on circuit, Fig. 6

The circuit operates in a manner exactly opposite to that of Fig.5.

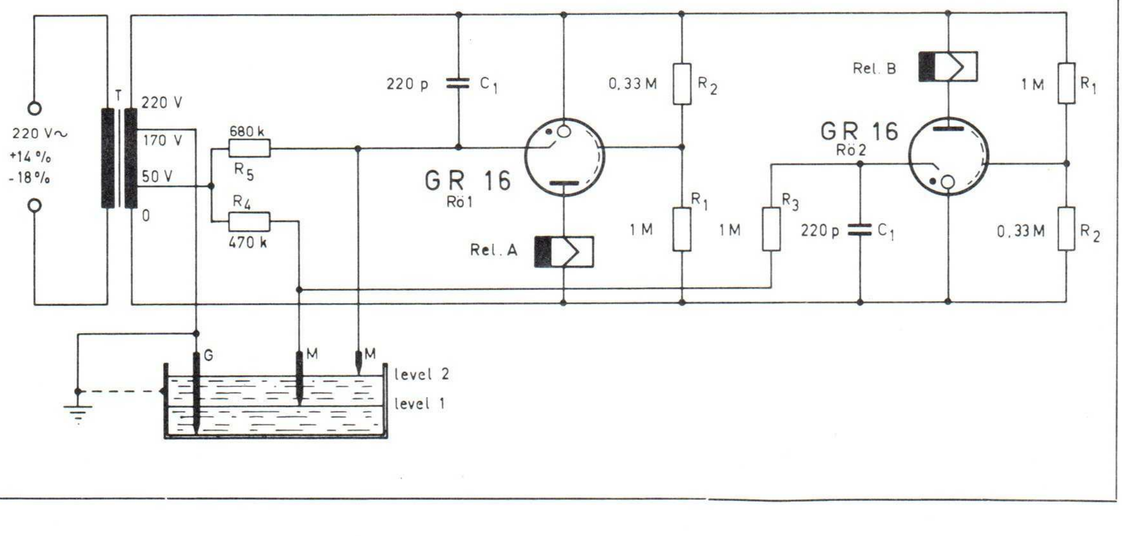


Fig. 6

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FLAMMENUEBERWACHUNG MIT KURZSCHLUSSICHERER SONDE

SURVEILLANCE DE FLAMMES PAR SONDE PROTEGEE CONTRE LES COURTS-CIRCUITS

FLAME MONITORING WITH SHORT-CIRCUIT PROOF PROBE

Die Sonde zur Ueberwachung von Oelflammen besteht aus der Serieschaltung eines Photowiderstandes mit einer Diode.

Diese Massnahme wurde getroffen, um bei einem eventuellen Kurzschluss in der Sondenzuleitung keine Flamme vorzutäuschen.

Der beim normalen Betrieb durch den Photowiderstand fliessende Gleichstrom wird zur Steuerung der Röhre verwendet. Tritt in der Sondenzuleitung ein Kurzschluss auf, so fliesst Wechselstrom, welcher durch den Kondensator C_1 abgeleitet wird, damit keine Zündung der Röhre erfolgen kann.

La sonde pour la surveillance de flammes à mazout se compose d'une résistance photo-électrique et d'une diode connectées en série.

Il a fallu avoir recours à cette solution pour éviter la signalisation d'une flamme lors d'un court-circuit éventuel dans la conduite menant à la sonde.

Le courant continu qui s'écoule à travers la résistance photo-électrique à l'état de service normal sert à commander le tube. Dès qu'un court-circuit survient dans la conduite reliant la sonde, le courant alternatif qui en résulte est dérivé par le condensateur C_1; le tube ne peut donc pas amorcer.

The probe for monitoring oil flames consists of photo-resistor (photoconductive cell) connected in series with a diode.

This arrangement was selected in order not to simulate the presence of a flame in the case of a short-circuit in the probe leads.

The direct current flowing through the photo-resistor during normal operation is used to control the tube. If a short-circuit occurs in the probe leads, an alternating current flows. This current is bypassed through capacitor C_1, thus preventing the tube from firing.

A. HELLSCHALTUNGEN

Bei belichtetem Photowiderstand ist das Relais Rel angezogen (Fig. 1 und 2).

Für sehr lange Lebensdauer wird die Schaltung gemäss Fig. 2 empfohlen.

A. CIRCUITS DE TRAVAIL

Le relais Rel est excité tant que la lumière agit sur la résistance photo-électrique (fig. 1 et 2).

Le circuit selon fig. 2 est indiqué si l'on exige une longévité particulière.

A. LIGHT CIRCUITS

When the photo-resistor is illuminated, relay Rel is energized (Fig. 1 and 2).

To obtain the atmost of the life expectancy, the circuit shown in Fig. 2 is to use.

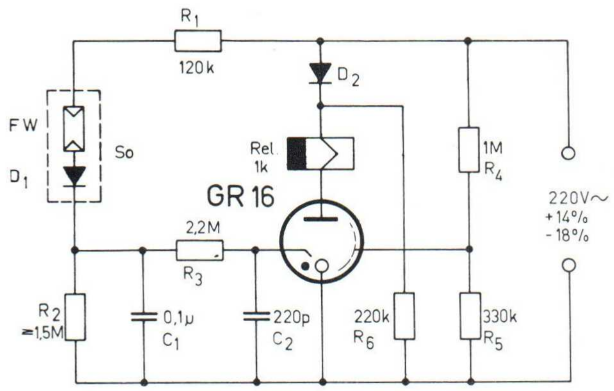


Fig. 1

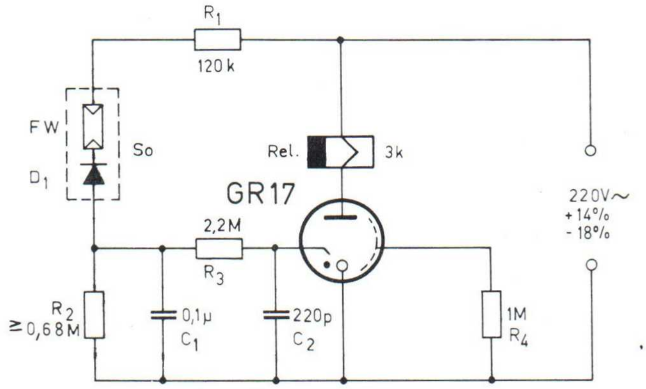


Fig. 2

B. DUNKELSCHALTUNG

Bei belichtetem Photowiderstand ist das Relais Rel abgefallen (Fig. 3).

B. CIRCUIT DE REPOS

Le relais Rel n'est pas excité tant que la lumière agit sur la résistance photo-électrique (fig. 3).

B. DARK CIRCUIT

When the photo-resistor is illuminated, relay Rel is de-energized (Fig. 3).

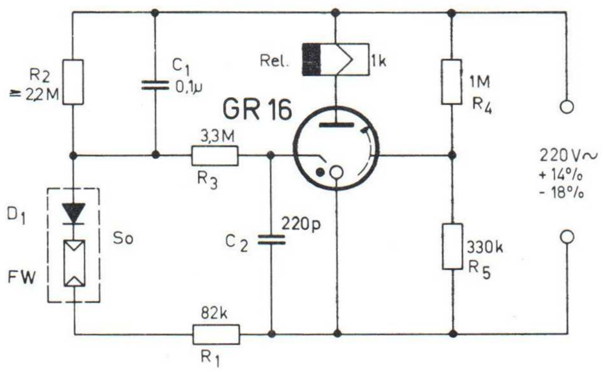
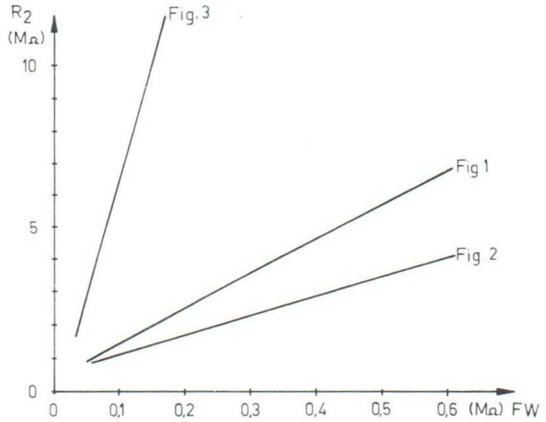


Fig. 3

NOMOGRAMM zur Bestimmung des Seriewiderstandes R_2 als Funktion des max. Hellwertes des Photowiderstandes (FW).

NOMOGRAMME servant à déterminer la résistance en série R_2 en fonction de la valeur max. de la résistance photo-électrique FW à l'état éclairé.

NOMOGRAM for determining the series resistances R_2 as a function of the max. light value of the photoresistor (FW).



ELEKTRISCHE DATEN / DONNEES ELECTRIQUES / ELECTRICAL DATA

- FW:	Photowiderstand 300 V=, 30 mW (min.), z.B. Photorésistance 300 V CC, 30 mW (min.), p.ex. Photoresistor 300 V DC, 30 mW (min.), e.g.		Clairex: CL 402, CL 406 Philips: ORP 60, ORP 61, ORP 62 PTW: L1, L2, L3
- D_1, D_2:	Dioden, Sperrspannung Diodes, tension inverse Diodes, inverse voltage	))	700 V (BYX 10 Philips, SD 98 Int. Rect.)
-	Widerstände Résistances Resistors	))	$\pm$ 10 %, 1/2 W
-	Kondensatoren Condensateurs Capacitors	))	$\pm$ 10 %, 400 V

Schaltungen mit Schaltintervall zur Ueberwachung von langsam ändernden Helligkeitswerten. Das Schaltintervall ist vom Relais und der Netzspannung abhängig.

A. HELLSCHALTUNG
Das Relais zieht bei einem bestimmten Lichtstrom durch die Photodiode an und fällt bei einem kleineren Lichtstrom wieder ab.

B. DUNKELSCHALTUNG
Das Relais fällt bei einem bestimmten Lichtstrom durch die Photodiode ab und zieht bei einem kleineren Lichtstrom wieder an.

Relais photoélectrique à intervalle, propre spécialement au contrôle d'éclairement changeant lentement. L'intervalle de commutation dépend du relais et de la tension du réseau.

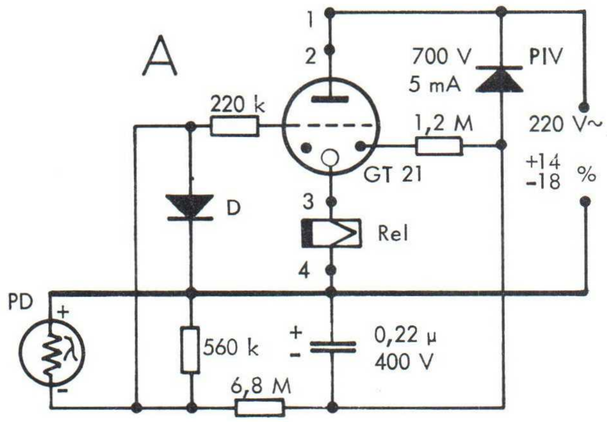
A. CIRCUIT DE TRAVAIL
Le relais est attiré quand le flux lumineux atteint une certaine valeur et il relâche à une limite inférieure.

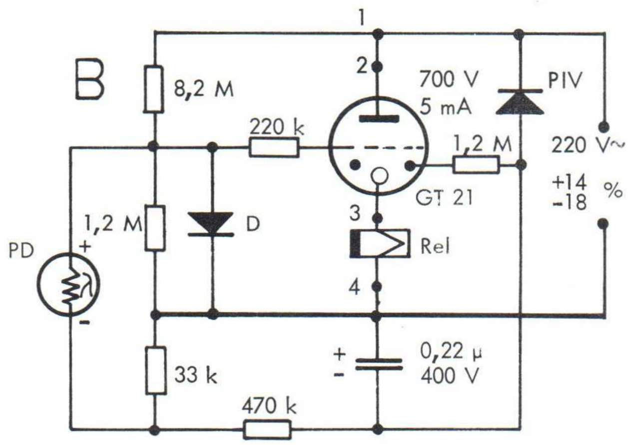
B. CIRCUIT DE REPOS
Le relais est desexcité à un certain flux lumineux et est attiré à une limite inférieure.

Circuits with switching interval for supervision of slowly changing light intensities. The switching interval depends on the relay and the line voltage.

A. LIGHT-CIRCUIT
The relay is energized at a given light current through the photodiode and de-energized at a smaller light current.

B. DARK-CIRCUIT
The relay is de-energized at a given light-current through the photodiode and energized at a smaller light current.





Widerstände Résistances Resistors	±10 %, 1/2 Watt
PD	Photodiode, min. Betriebsspannung 30 V; max. Dunkelstrom 25 µA*; min. Photostrom ca. 50 µA Photodiode, tension de service min. 30 V; courant d'obscurité max. 25 µA*; courant photoélectrique min. env. 50 µA Photodiode, min. bias voltage 30 V; max. dark current 25 µA*; min light current approx. 50 µA Z.B. / p.ex. / e.g.: H11 (Texas Instruments), TP 51 II (Siemens)
D	Diode, Sperrspannung (PIV) 50 V; Durchlasstrom 1 mA; max. Sperrstrom 5 µA* Diode, tension inverse (PIV) 50 V; courant de conduction 1 mA; courant inverse max. 5 µA* Diode, peak inverse voltage (PIV) 50 V; average forward current 1 mA; max. reverse current 5 µA* Z.B. / p.ex. / e.g.: 1 S 130 (Texas Instruments), O A 200 (Philips)
Rel	Relais, siehe Blatt "Relais zu Kaltkathoden-Relaisröhren" Relais, voir feuille "Relais pour tubes à cathode froide" Relay, see sheet "Relays for cold cathode tubes"
*	Werte bei max. Umgebungstemperatur Valeurs pour température ambiante maximale Values at max. ambient operating temperature

Für rasch ändernde Helligkeitswerte kann das Schaltintervall entfallen: Relais zwischen Punkten 1 und 2 (3 und 4 kurzgeschlossen).

Für Schaltpunkte bei grösseren Lichtwerten, die Widerstände 6,8 MΩ und 560 kΩ (A) resp. 8,2 MΩ und 1,2 MΩ (B) proportional verkleinern.

Pour des changements rapides d'éclairement, l'intervalle de commutation peut être omis: relais entre les points 1 et 2, (3 et 4 court-circuités).

Pour un flux lumineux plus élevé, on peut varier le point de réponse en réduisant proportionnellement les résistances 6,8 MΩ et 560 kΩ (A) respectivement 8,2 MΩ et 1,2 MΩ (B).

For fast changing light intensities the switching interval can be omitted: relay between points 1 and 2 (short circuit between 3 and 4).

For switching at higher light levels reduce proportionally resistors 6,8 MΩ and 560 kΩ (A) resp. 8,2 MΩ and 1,2 MΩ (B).

Schaltung zur Ueberwachung von langsam ändernden Helligkeitswerten. Durch Auseinandersetzen der Ein- und Ausschaltpunkte wird ein sauberes Schalten beim kritischen Lichtwert erreicht. Der Unterschied der Steuerspannung zwischen Ein- und Ausschalten wird als Intervallspannung bezeichnet.

Relais photoélectrique, propre spécialement à la surveillance d'intensités de lumière changeant lentement. En séparant les points d'enclenchement et de déclenchement on atteint un fonctionnement très propre quand la lumière arrive à sa valeur critique. La différence entre la tension de commande à l'enclenchement et au déclenchement sera appelé tension d'intervalle.

The circuit is especially suitable for the supervision of slowly changing light intensities. By the difference of the switching-on and -off value of the photoresistor, well defined switching of the tube is obtained when the light reaches the critical value. The difference between the "on" and the "off" control voltage is named interval voltage.

A. HELLSCHALTUNG

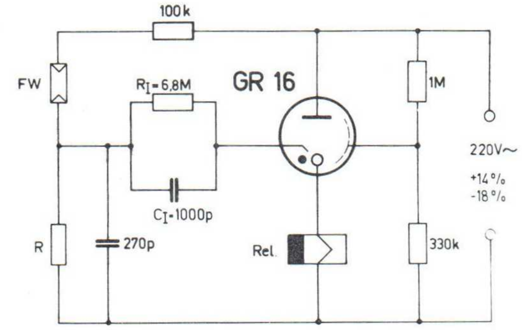
Das Relais zieht bei einem bestimmten Lichtstrom durch den Photowiderstand an und fällt bei einem kleineren Lichtstrom wieder ab.

A. CIRCUIT DE TRAVAIL

Le relais est attiré quand le flux lumineux atteint une certaine valeur et il relâche à une limite inférieure.

A. LIGHT CIRCUIT

The relay is energized at a given light current through the photoresistor and de-energized at a smaller light current.



B. DUNKELSCHALTUNG

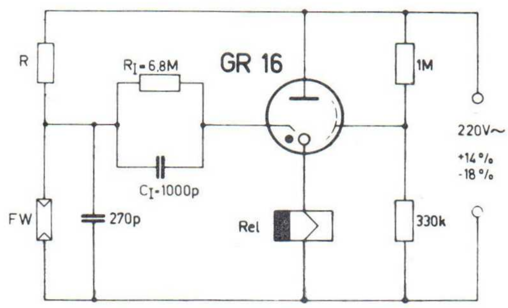
Das Relais fällt bei einem bestimmten Lichtstrom durch den Photowiderstand ab und zieht bei einem kleineren Lichtstrom wieder an.

B. CIRCUIT DE REPOS

Le relais est desexcité à un certain flux lumineux et est attiré à une limite inférieure.

B. DARK-CIRCUIT

The relay is de-energized at a given light-current through the photoresistor and energized at a smaller light current.



FW	Photowiderstand 220 V~, 30 mW (min.), z.B. Photorésistance 220 V CA, 30 mW (min.), p.ex. Photoresistor 220 V AC, 30 mW (min.), e.g.	Clairex: CL 402, CL 406 Philips: ORP 60, ORP 61, ORP 62 PTW: L1, L2, L3
R	Arbeitswiderstand, ca. 0,47 bis 2,7 MΩ, je nach Photowiderstand und gewünschter Empfindlichkeit Résistance de charge, environ 0,47 à 2,7 MΩ, suivant le type de photo-résistance et la sensibilité requise Load resistor, approx. 0,47 to 2,7 MΩ, depending on photo-resistor type and wanted sensitivity	
Rel.	Relais, siehe Blatt 20.01 "Relais zu Kaltkathoden-Relaisröhren" Relais, voir feuille 20.01 "Relais pour tubes à cathode froide" Relay, see sheet 20.01 "Relays for cold cathode tubes"	

Kondensatoren	± 10%, 400 V	Widerstände	± 10%, 1/2 Watt
Condensateurs	± 10%, 400 V	Résistances	± 10%, 1/2 Watt
Capacitors	± 10%, 400 V	Resistors	± 10%, 1/2 Watt

→

KURVEN ZUR BESTIMMUNG DES SCHALTINTERVALLS

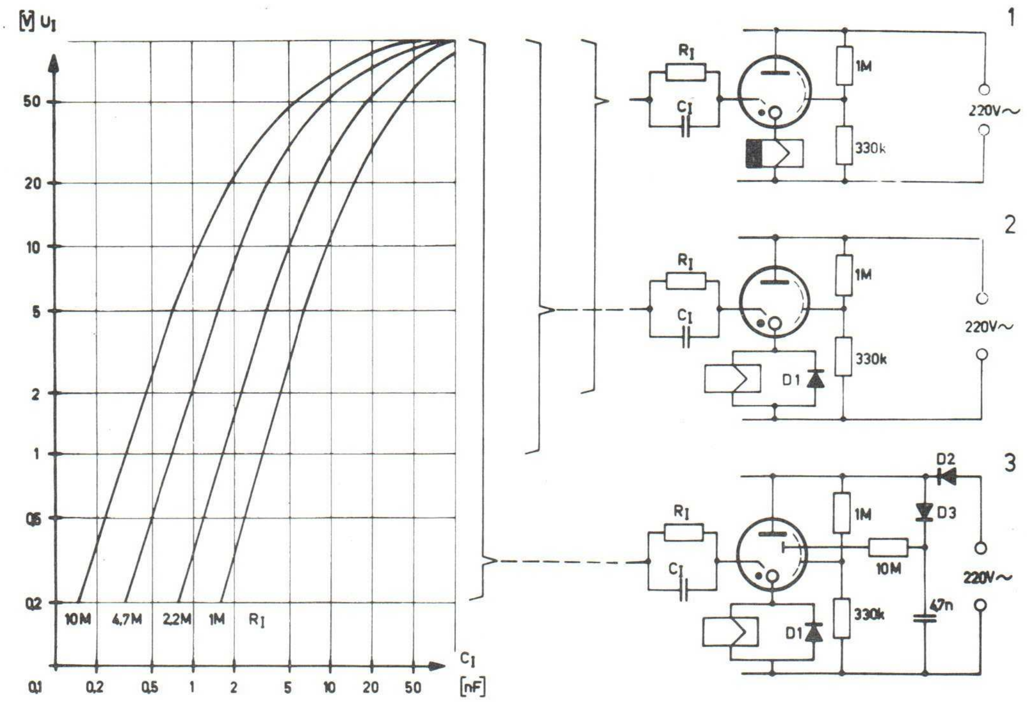
Je nach der gewünschten minimalen Intervallspannung wird eine der unten angegebenen Schaltungen (1, 2 oder 3) ausgewählt.

COURBES POUR LA DETERMINATION DE L'INTERVALLE

Le choix du circuit (1,2 ou 3) est déterminé par l'intervalle minimum désiré.

SWITCHING INTERVAL-COURVES

The application of the circuits given below (1,2 or 3) depends on the minimum interval voltage wanted.



D1	Diode, 300 V PIV*, 25 mA (2E4: Internat. Rectifiers)
D2	Diode, 400 V PIV*, 50 mA (2E4: Internat. Rectifiers)
D3	Diode, 400 V PIV*, 1 mA (2E4: Internat. Rectifiers)

* PIV: Spitzensperrspannung / Tension inverse de pointe / Peak inverse voltage

Kondensatoren	± 10%, 400 V	Widerstände	± 10%, 1/2 Watt
Condensateurs	± 10%, 400 V	Résistances	± 10%, 1/2 Watt
Capacitors	± 10%, 400 V	Resistors	± 10%, 1/2 Watt

Schaltung 1

Intervallspannungsbereich ca. 7-70 V - Die Intervallspannung setzt sich aus 2 Teilen zusammen:

a) Der Spannung U_I gemäss Kurven durch das Produkt $R_I \cdot C_I$ bestimmt (2-70 V) und

b) den Intervallanteil des Relais (einige Volt)

Schaltung 2

Intervallspannungsbereich ca. 1-70 V - Die Intervallspannung U_I ist gemäss den Kurven durch das Produkt $R_I \cdot C_I$ bestimmt. Das Relais muss durch eine Diode (D1) abfallverzögert sein.

Schaltung 3

Intervallspannungsbereich ca. 0,2-70V Die Intervallspannung U_I ist gemäss Kurven durch das Produkt $R_I \cdot C_I$ bestimmt. Die Röhre ist mit angeschlossener Hilfsanode und Diode D1 parallel dem Relais zu betreiben.

Eine geringe Beeinflussung der Intervallspannung der obigen Schaltungen erfolgt durch die Netzspannung und das Relais.

Circuit 1

Tension d'intervalle env. 7 à 70 volts. La tension d'intervalle se compose de deux parties:

a) La tension U_I selon les courbes, déterminée par le produit $R_I \cdot C_I$ (2-70 volts) et

b) La partie causée par le relais (quelques volts).

Circuit 2

Tension d'intervalle env. 1 à 70 volts. La tension d'intervalle est déterminée par le produit $R_I \cdot C_I$ selon les courbes. Le relais doit être retardé par une diode (D1).

Circuit 3

Tension d'intervalle 0,2 à 70 volts. La tension d'intervalle est déterminée par le produit $R_I \cdot C_I$ selon les courbes. Le tube doit être opéré avec l'anode auxiliaire et une diode D1 en parallèle du relais.

La tension d'intervalle des trois circuits est légèrement influencée par la tension du réseau et par le relais.

Circuit 1

Interval voltage range approx. 7 to 70 V. The interval voltage consists of 2 parts:

a) The voltage U_I as shown by the curves determined by the product $R_I \cdot C_I$ (2-70 V) and

b) The interval portion of the relay (some volts)

Circuit 2

Interval voltage range approx. 1 to 70 V. The interval voltage is determined by the product $R_I \cdot C_I$ as shown by the curves. The relay has to be delayed by means of the diode D1.

Circuit 3

Interval voltage range approx. 0,2 to 70 V - The interval voltage is determined by the product $R_I \cdot C_I$ as shown by the curves. The tube has to be operated with auxiliary anode and diode D1 parallel to the relay.

In these circuits the line voltage and the relay have some influence on the interval voltage.

IONISATIONS-FLAMMENUEBERWACHUNG MIT GR 17G SURVEILLANCE IONIQUE DE FLAMMES AVEC GR 17G IONISATION FLAME MONITORING WITH GR 17G	Type	
	Nr. 52.23	
	Ed. 12.65	Fol. 1

1. EINLEITUNG

Zur Ueberwachung der Gasflammen von Brennern mit Gebläsemotoren sind sehr rasch arbeitende und empfindliche Schaltungen erforderlich. Zu diesem Zweck wurden mit der Kaltkathodenröhre GR 17G ausserordentlich betriebssichere und einfache Schaltungen entwickelt, welche die Gleichrichterwirkung von Gasflammen ausnutzen.

Werden in geeigneter Anordnung zwei Elektroden in eine Gasflamme gebracht, so fliesst beim Anlegen von Wechselspannung ein Gleichstrom (Sondenstrom), welcher zur Steuerung der Kaltkathodenröhre GR 17 G verwendet wird. Im vorliegenden Fall besteht die eine Elektrode (Ueberwachungselektrode) aus einem temperaturbeständigen Material (z.B. Kanthal) und befindet sich im grössten Ionisationsgebiet, während der Brennermund die Gegenelektrode bildet.

In der angegebenen Dimensionierung sind Betriebszeiten von mindestens 30'000 Stunden zu erwarten.

1. REMARQUES D'ORDRE GENERAL

La surveillance de flammes à gaz émanant de brûleurs alimentés par de l'air comprimé exige des circuits très rapides et fiables. A cet effet ont été développés, avec le tube à cathode froide GR 17 G, des circuits extrêmement simples et sûrs qui tirent profit de la propriété rectificatrice des flammes à gaz.

Si deux électrodes sont judicieusement aménagées dans une flamme à gaz, un courant continu (courant de sondage) s'écoule dès que l'on connecte une tension alternative et peut servir à la commande du tube à cathode froide GR 17 G. Dans le cas particulier, on a choisi pour l'électrode de surveillance, située dans la zone d'ionisation optimale, un matériau fortement résistant aux températures élevées (Kanthal p. ex.); la contre-électrode est constituée par le bec du brûleur.

En respectant les valeurs indiquées, on peut s'attendre à 30'000 heures de service au moins.

1. INTRODUCTION

Very rapidly operating and sensitive circuits are necessary for monitoring gas flames of burners fitted with blower motors. For this application exceptionally reliable and simple circuits have been developed with the GR 17 G cold-cathode tube, all utilizing the rectifying action of gas flames.

When two electrodes are suitably placed in a gas flame, a direct current (probe current) flows through this arrangement. This current can be utilized to drive a cold-cathode tube GR 17 G. In the present case one electrode (monitoring electrode) is of temperatur-resistant material (e.g. Kanthal) and is placed in the region of highest ionisation, the opposite electrode being formed by the burner opening.

The circuits given here are so dimensioned that operating life of at least 30'000 hours can be expected.

2. FUNKTIONSBESCHREIBUNG SCHALTUNGEN 1 und 2

Zur Ueberwachung grosser Flammen, wo ein relativ grosser Steuerstrom zur Verfügung steht (10µA und mehr), ist die Schaltung nach Fig. 1 geeignet.

2. DESCRIPTIF DU FONCTIONNEMENT SELON CIRCUITS 1 et 2

Le circuit selon fig. 1 est indiqué pour la surveillance de grandes flammes, donc si l'on dispose d'un courant de commande relativement élevé (10µA et davantage).

2. MODE OF OPERATION OF CIRCUITS 1 and 2

The circuit given in Fig. 1 is suitable for monitoring large flames which give rise to relatively large control currents of 10µA and more.

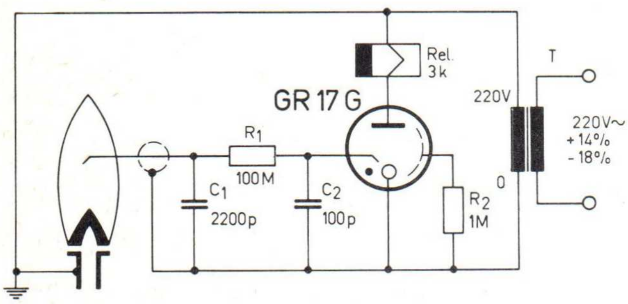


Fig. 1

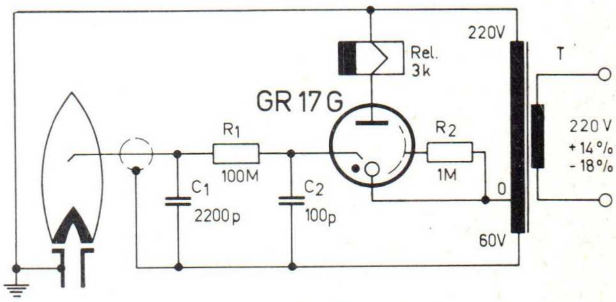


Fig. 2

Stehen hingegen nur kleine Steuerströme zur Verfügung (0,5µA und mehr), ist das Schaltbild Fig. 2 zu verwenden.

Le circuit selon fig. 2 doit par contre être choisi en présence de faibles courants de commande (0,5µA et davantage).

However, if relatively small control currents (0,5µA and higher) are available, the circuit given in Fig. 2 should be used.

Der Kondensator C_1 wird durch den Sondenstrom aufgeladen und die in ihm gespeicherte Energie der Steuerstrecke der Röhre zugeführt. (Die Hilfsspannung von 60V in Fig. 2 bewirkt eine Steigerung der Ansprechempfindlichkeit gegenüber Fig. 1.) Sobald die Spannung an C_1 150V und mehr beträgt, kann die Röhre GR 17 G zünden und das Relais zieht an.

Le condensateur C_1 est chargé par le courant de sondage; l'énergie qui s'y accumule arrive au starter du tube. (La tension auxiliaire de 60V selon fig. 2 augmente la sensibilité de réponse par rapport à la fig. 1.) Dès que la tension auprès de C_1 est égale ou supérieure à 150 V, le tube GR 17 G est en mesure d'amorcer et le relais attire son armature.

The capacitor C_1 is charged by the probe-current, the energy stored being applied to the control electrode of the tube. (The auxiliary voltage of 60 V in Fig. 2 increases the sensitivity compared to Fig. 1.) As soon as the voltage across C_1 reaches 150 V and more, the GR 17 G tube can fire and the relay can then operate.

Bleibt die Flamme aus, entlädt die gezündete Kaltkathodenröhre den Kondensator C_1 innerhalb von ca. 0,3 sec, worauf das Relais abfällt.

Beide Schaltungen sind so aufgebaut, dass bei irgend einer Störung - Kurzschluss oder Unterbruch eines Bauelementes (ausgenommen Röhre und Relais) - stets ein Fehlen der Gasflamme vorgetäuscht wird.

Lorsque la flamme fait défaut, le tube à cathode froide amorcé décharge le condensateur C_1 en l'espace d'env. 0,3 sec., de sorte que le relais retombe.

Les deux circuits sont conçus de manière à ce qu'ils signalent "absence de flamme" lors d'un dérangement quelconque (court-circuit ou rupture d'un élément, tube et relais exceptés).

If there is no flame, the fired cold-cathode tube discharges the capacitor C_1 within about 0,3 sec., thus causing the relay to drop out.

Both circuits are designed in such a manner that any disturbance - short-circuit or open-circuit of a component, with the exception of the tube and relay - always results in a signal corresponding to disappearance of the gas flame.

3. FUNKTIONSBESCHREIBUNG SCHALTUNG 3

Die Schaltung nach Fig. 3 ist für den intermittierenden Betrieb selbstüberwachend, d.h. nach einem beliebigen Defekt (Kurzschluss oder Unterbruch eines Bauelementes, Freilauf der Röhre, Nichtabfallen eines Relais) wird stets ein Nichtvorhandensein der Flamme angezeigt.

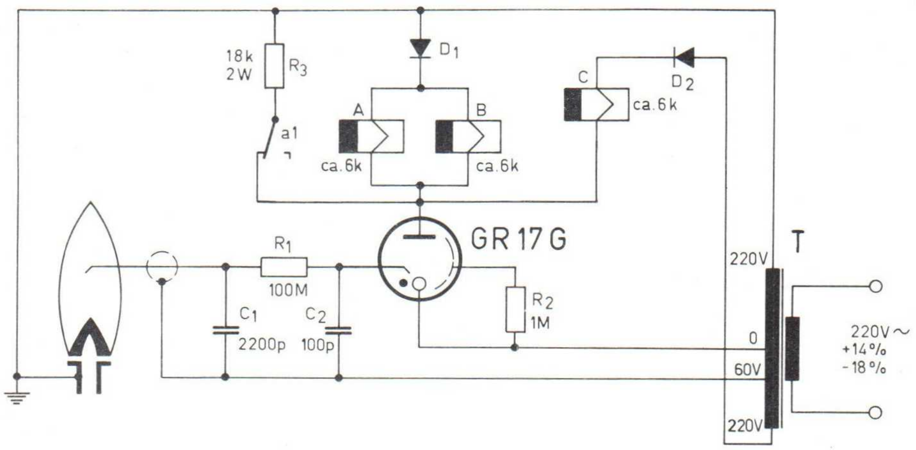
3. DESCRIPTIF DU FONCTIONNEMENT SELON CIRCUIT 3

Ce circuit est autocontrôlé pour le service intermittent. Cela veut dire qu'il signale "absence de flamme" lors d'une défection quelconque (court-circuit ou rupture d'un élément, amorçage spontané du tube, relais dont l'armature ne retombe pas).

3. MODE OF OPERATING OF CIRCUIT 3

The circuit given in Fig. 3 is self-inspected for intermittent operation, that is to say, any kind of defect (short-circuit or open-circuit of a component, free-running of the tube, non-operation of the relay) always signals the disappearance of the gas flame.

Fig. 3



Die Steuerempfindlichkeit und Funktionsweise entspricht Fig. 2; für die Relaisstellungen gilt:

Korrekte Dunkelüberwachung
Relais A-, B-, C+

Korrekter Betriebszustand
Relais A+, B+, C-

La sensibilité de commande et le mode de fonctionnement correspondent à ce qui a été dit en rapport avec la fig. 2. Les relais opèrent comme suit:

Surveillance obscurité, relais A-, B-, C+
Etat de service normal, relais A+, B+, C-

The control sensitivity and the mode of operation correspond to those of Fig. 2. The relay positions are as follows:

Correct dark monitoring:
relay A-, B-, C+

Correct operation conditions:
relay A+, B+, C-

4. BAUTEILE / LES DIVERS ELEMENTS / COMPONENTS

D_1, D_2:
- Dioden, 400 V Spitzensperrspannung, 50 mA, z.B. Philips BYX 10, International Rectifiers SD 94
- Diodes, tension inverse de crête 400 V, 50 mA, p.ex. Philips BYX 10 ou International Rect. SD 94
- Diodes, 400 V peak voltage, 50 mA, e.g. Philips BYX 10, International Rectifiers SD 94

Rel 3 kΩ:
- Relais 3 kΩ, Kurzschlusswicklung 1/4 des Wickelraumes ausfüllend, Ansprechleistung 0,5 W Dauerleistung 4 W
- Relais 3 kΩ, enroulement en court-circuit remplissant env. 1/4 du volume de bobinage, puissance de réponse 0,5 W, puissance permanente 4 W
- Relay 3 kΩ, short-circuit winding filling 1/4 of the winding space, operating power 0,5 W continuous power 4 W

Rel 6 kΩ:
- Relais 6 kΩ, Kurzschlusswicklung ca. 1/4 des Wickelraumes ausfüllend, Ansprechleistung 0,25 W Dauerleistung 2 W
- Relais 6 kΩ, enroulement en court-circuit remplissant env. 1/4 du volume de bobinage, puissance de réponse 0,25 W, puissance permanente 2 W
- Relay 6 kΩ, short-circuit winding filling about 1/4 of the winding space, operating power 0,25W continuous power 2 W

C_1, C_2: min. 1 GΩ
- Kondensatoren 400 V, mit hohem Isolationswiderstand
- Condensateurs 400 V, avec résistance d'isolement élevée
- Capacitors 400 V, with high insulation resistance

R: ± 10 %, 1/2 W
- Widerstände (wo nichts anderes vermerkt)
- Résistances (à défaut d'indications contraires)
- Resistors (when not otherwise indicated)

T:
- Transformator; Kern M 55, ca. 9 VA / Transformateur; noyau M 55, env. 9 VA
Transformer; M 55 core, approx. 9 VA

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5

1. INTRODUCTION

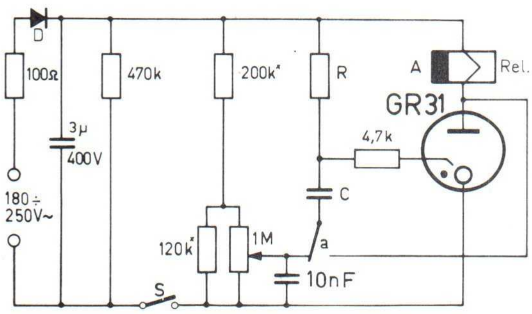
The circuits given here are particularly suitable for timing relays having time delays between 10 seconds and 1 hour. The charging resistor R together with the capacitor C serves as a delay circuit, the charging time being adjustable by the 1 MΩ potentiometer. - By employing two subminiature stabilizing tubes type SR 44 for stabilizing the charging voltage, the effect of mains voltage variations on the delay time can be practically eliminated (stabilizing factor approx. 50). Care should be taken to utilize suitable insulation for the starter line (including the 4.7 kΩ resistor and the tube socket) and to ensure a high insulation resistance R_{is} for the capacitor C ($R_{is} = 10 \cdot R$).

The delay capacitor C is discharged by a relay contact, there being no special requirements on its insulation resistance. Discharging is effected by applying an auxiliary voltage over the relay contact on the capacitor, after the tube has ignited and the relay energized. The value of this voltage in the examples given below corresponds roughly to the starter probe voltage, thus bringing both terminals of C to the same potential and hence effecting the discharge (patent pending).

This arrangement of the relay contact enables the user to protect all parts of the timing circuit with high insulation requirements from moisture by casting in a resin.

2. CIRCUIT EXAMPLES, DESCRIPTION OF OPERATION

2.1 Timer - relay provides delay

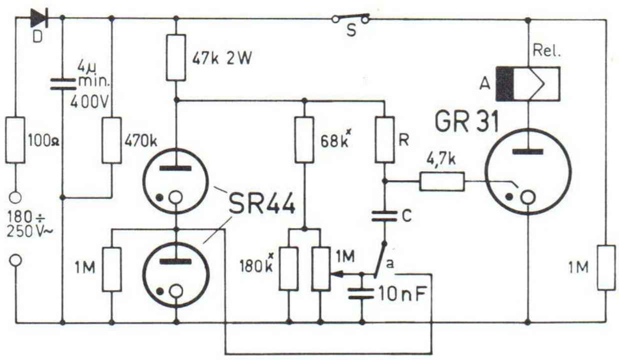


After the switch S is closed, the delay time t_v starts to expire until the tube is ignited over the RC delay circuit. After this the relay is energized. The opening of switch S causes the relay to be de-energized, and renewed closure of S causes the delay time t_v to be run through again.

$t_{v\ max}$ (sec) : approx. $0.5 \cdot R_{(M\Omega)} \cdot C_{(\mu F)}$

Adjustment range: approx. 5 : 1

2.2 Timer - relay provides delay, charging voltage stabilized

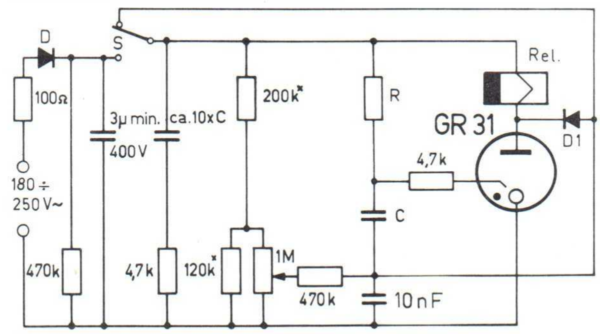


Description of mode of operation same as in example 2.1

$t_{v\ max}$ (sec) : approx. $1.4 \cdot R_{(M\Omega)} \cdot C_{(\mu F)}$

Adjustment range: approx. 4 : 1

2.3 Timer - relay provides delay, resetting facility during the timing operation

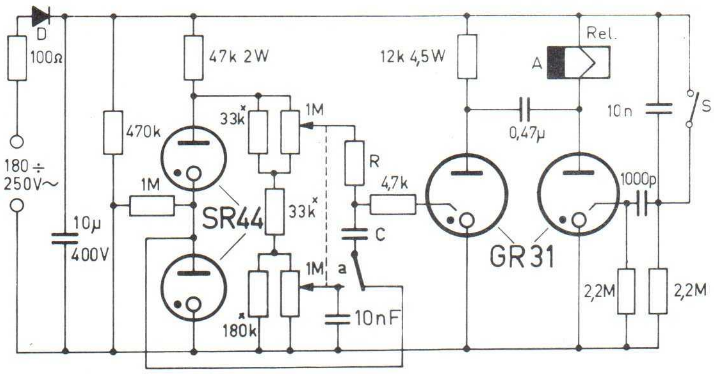


After the switch S is closed, the delay time starts to expire until the tube is ignited over the RC delay circuit. - Opening of switch S during the delay time t_v causes the timing circuit to be reset; as soon as S is closed again, the delay time t_v starts again. - After ignition, the relay operates again and is de-energized when the switch S is opened.

$t_{v\ max}$ (sec) : approx. $0.5 \cdot R_{(M\Omega)} \cdot C_{(\mu F)}$

Adjustment range: approx. 5: 1

2.4 Timer - relay provides release, charging voltage stabilized

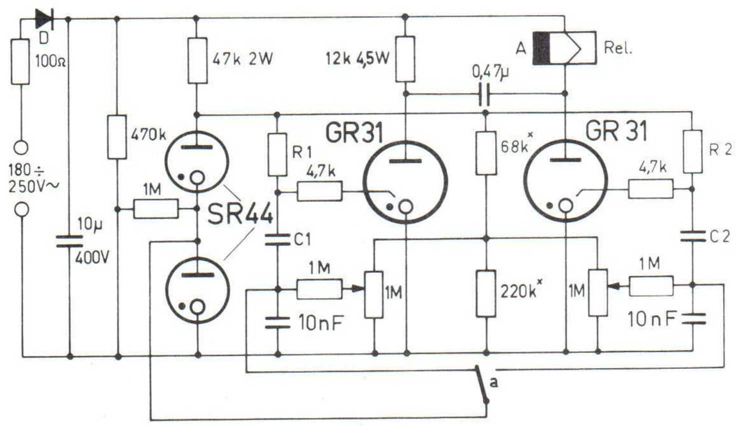


Initially, the left-hand tube is ignited. When the switch S is closed, the delay time starts to expire, e.e. the right-hand tube is ignited thus causing the relay to be energized and the left-hand tube to be extinguished. At the end of the delay time t_v, the left-hand tube is ignited, thus causing the opposing tube to be extinguished and the relay to be de-energized. The switch S can be opened during the delay time t_v or after expiration of this time (Pulse control).

$t_{v\ max\ (sec)}$: approx. $3.5 \cdot R_{(M\Omega)} \cdot C_{(\mu F)}$

Adjustment range : approx. 10 : 1

2.5 Pulse generator, pulse duration and pulse interval adjustable, charging voltage stabilized



At a given instant, the left-hand tube is ignited and the opposing tube is extinguished. After this the pulse pause network (R_2, C_2) is charged until the right-hand tube is ignited. This causes the relay to operate and the left-hand tube to be extinguished. After this the pulse duration network (R_1, C_1) is charged until the left-hand tube ignites, this causing the relay to be again de-energized and the right-hand tube to be extinguished, and so on.

$t_{v\ max\ (sec)}$: approx. $1.4 \cdot R_{(M\Omega)} \cdot C_{(\mu F)}$

Adjustment range: approx. 1 : 4

3. NOTES ON COMPONENTS

D:	Diode, 700 V peak inverse voltage, 50 mA, - e.g. International Rectifiers SD 98, Philips BY 100
D_1:	Diode, 400 V peak inverse voltage, 10 mA, - e.g. International Rectifiers SD 94, Philips BY 100
Rel:	Relay 12 kΩ, short-circuit winding approx. 1/4 of winding space, power required for operating 1.4 W min., continuously rated power 4.5 W
C:	Delay time capacitor with high insulation resistance, 150 V, e.g. polystyrol, e.g. Siemens, Fribourg. A metallized-paper capacitor having two layers can be used (but no electrolytic capacitors)
R:	Charging resistor: high-ohmic composition resistor, e.g. Rosenthal, Victoreen, Dralowid (R_{max} approx. 10'000 MΩ)
Resistors:	± 10%, 1/2 W (unless otherwise specified)
*Resistors:	± 1 %, 1/2 W

1. INTRODUCTION

The circuit arrangements shown below are the most commonly used for periods from milliseconds to minutes. As timing elements, an adjustable resistor R (generally 10 MΩ) and a fixed capacitor C are used. The timing range in this configuration is approx. 10 : 1.

For accurate timers 3 main points have to be observed:

1. Stabilisation of the RC-network charging voltage by means of 2 voltage reference tubes, type SR 44 (stabilizing coefficient approx. 50).
2. Good quality components must be used for the adjustable resistor R and the fixed capacitor C (low temperature coefficient and good long-term stability).
3. The insulation resistances of the starter connections parallel to the insulation resistances of the relay-contacts a and b have to exceed 100 MΩ.

2. CALCULATING THE DELAY-TIME t_v

Circuits with voltage reference tubes

t_v (sec) : approx. $1.4 \cdot (0.47 + R)_{(M\Omega)} \cdot C_{(\mu F)}$

(valid for circuits 4.2, 4.3 and 4.5)

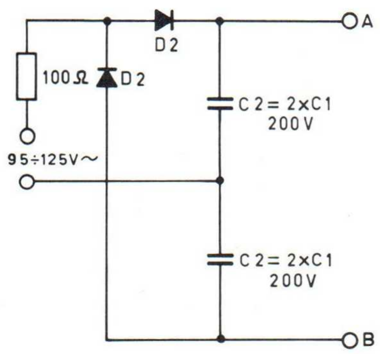
Circuits without voltage reference tubes

t_v (sec) : approx. $0.6 \cdot (0.47 + R)_{(M\Omega)} \cdot C_{(\mu F)}$

(connect the points E and F in circuits 4.2, 4.3 and 4.5)

3. 115 VOLTS AC MAINS SUPPLY

The circuits shown below can be supplied from the 115 Volts AC mains without using a transformer.

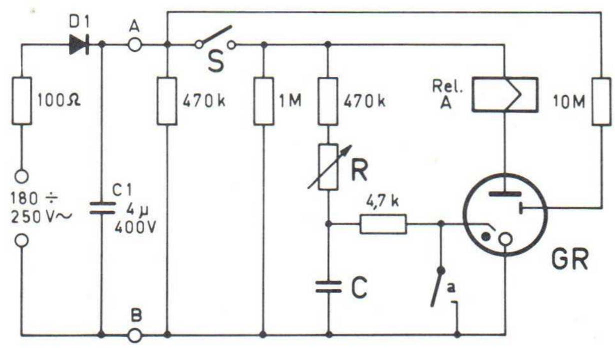


The points A and B are connected to the corresponding points in the circuits 4.1 to 4.5. Components C_1, D_1 and the 100 Ω resistor would not be needed. C_2 should be approx. $2 \cdot C_1$; except in circuit 4.4 where C_1 is used and $C_2 = C_1$.

4. CIRCUITS; MODE OF OPERATION

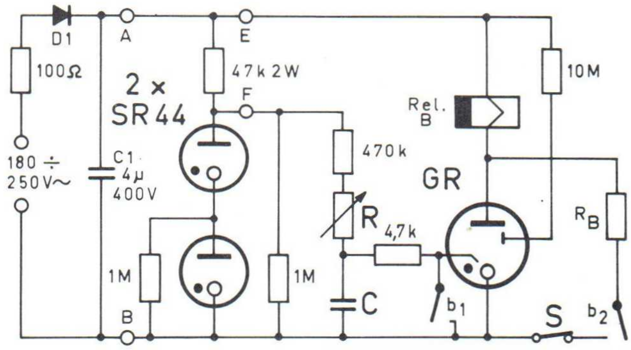
When using the subminiature tube GR 44, the two starters must be connected in parallel in the following circuits 4.1 – 4.5.

4.1 Timer – relay provides delay



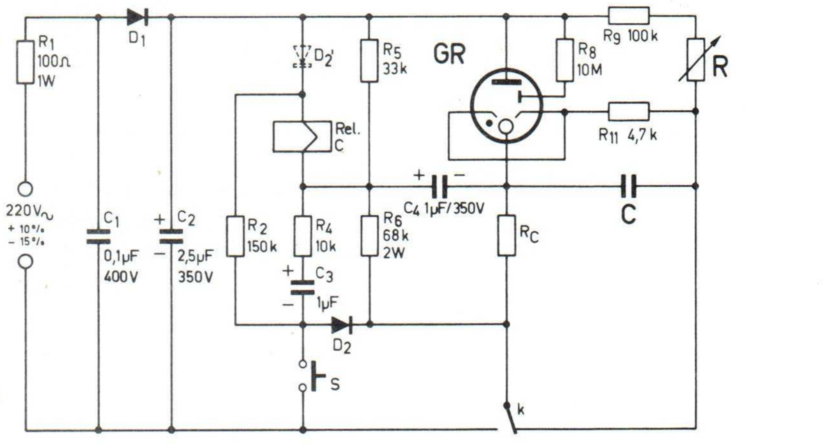
After the closure of S, the delay time t_v elapses until the tube is ignited via the RC delay-network. This energizes the relay. When S is opened the relay drops out.

4.2 Timer with stabilisation – relay provides delay



During the normal state the tube GR is extinguished and the relay energized. After opening S the relay is deenergized and the delay time t_v elapses until the tube is fired. Then the relay pulls in again and the tube is extinguished as soon as S is closed (S can be closed during or after the elapse of t_v – control by impulse).

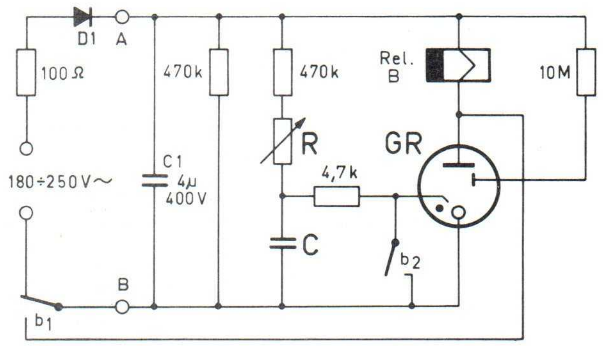
4.3 Single Pulse Generator



When S is pressed, relay K energizes via R_4 and C_3 and k effects self-holding. D_2 is now conductive and by-passes S with k. Re-actuation of S is unnecessary; that is S can be opened before and after the t_V has elapsed.

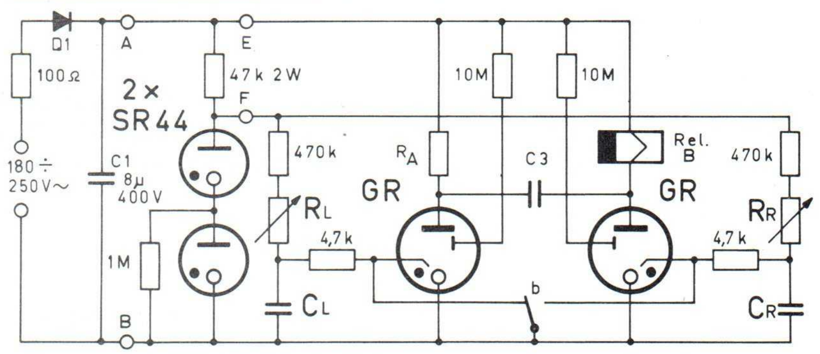
C_5 is energized via R_9 and R_{10} whereby the tube is ignited at the end of the t_V. K thus receives a pulse in the direction opposite to the holding current and therefore de-energizes. The circuit can only be re-actuated if S has been opened before. At the end of the switching cycle C_3 discharges via R_2, K, R_4. D_2 prevents a sensitive relay being re-energized after correct de-energizing.

4.4 Pulse Generator – Pulse duration fixed, pulse interval adjustable



After switching on the supply voltage, the delay time t_V begins to elapse (pulse interval). Then the tube is fired and the relay pulls in, changing its contacts b. This extinguishes the tube and the capacitor C_1 becomes discharged across the relay till it drops out (pulse duration approx. 200 ms, depending on supply voltage, C_1 and relay). Then the next elapse of t_V begins, etc.

4.5 Pulse Generator – Pulse duration and pulse interval adjustable



Assume that the tube GR "left" is fired and its partner is extinguished. Then the pulse interval network (R_R, C_R) is charged until the tube "right" is fired. This energizes the relay and the tube "left" becomes extinguished. This allows the pulse duration network (R_L, C_L) to become charged until the tube "left" fires thus extinguishing its partner and deenergizing the relay, etc.

5. NOTES ON COMPONENTS

			GR 31 (Noval)	GR 44 (Subminiature)
GR	CERBERUS relay tube		GR 31 (Noval)	GR 44 (Subminiature)
R_A	Resistor		12 kΩ / 4.5 W	18 kΩ / 3 W
R_B	Resistor		3.9 kΩ / 3 W	5.6 kΩ / 2 W
R_C	Resistor		10 kΩ / 1 W	15 kΩ / 1/2 W
Rel A	(without retarding winding)	Coil resistance	12 kΩ	18 kΩ
Rel B	(retarding winding in approx. 1/4 of the window area)	Sensitivity	1.4 W	0.8 W
		Dissipation	4.5 W	3 W
Rel C	Coil resistance 5 kΩ, Sensitivity 0.8 W, Dissipation 3 W			

D_1 Diode, 700 V peak inverse voltage, 50 mA, – e.g. International Rectifiers SD 98, Philips BY 100

D_2 Diode, 400 V peak inverse voltage, 100 mA, – e.g. International Rectifiers SD 94, Philips BY 100

D_3 Diode, 400 V peak inverse voltage, leakage current < 1 μA, e.g. Philips BYX 10

C Timing capacitor with high insulation resistance, 150 V =, e.g. metal-paper capacitor, 2 layers (no Electrolytic-Capacitors)

R Composition Potentiometer, max. 10 MΩ

Resistors: ± 10 %, 1/2 W (if not otherwise specified)

1. INTRODUCTION

Simple, reliable and inexpensive timing circuits can be designed using the G 42 switching diode. Distinction is made between delay relays, which delay the switching-on of a load, and timing relays, which allow a load resistor to be in circuit during a definite time interval. The time periods associated with these circuits range from several seconds to around 30 minutes. A standard 24 V relay serves as the electro-magnetic switch. In the following examples, the lifetime of the G 42 diode covers about $50 \cdot 10^6$ operations.

2. PARTITION OF TIMING CIRCUITS

The following timers are divided into the supply section (para. 3) and timer section (para.4). The two parts are connected by joining the correspondingly numbered terminals.

3. SUPPLY SECTION, CALCULATION OF TIME DELAY t_v

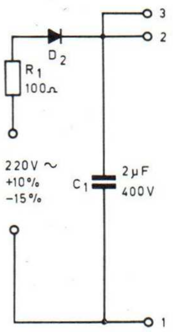
Choice of optimum power supply depends on the required range of time delay and the necessary switching accuracy for varying supply voltage. The power supplies differ in their charging voltage which is fed to the timing element via terminals 3 and 4.

Range 1 - 100 secs.

unstabilised, charging voltage 300 V DC

(Fig. 1)

$t_{v(s)} \approx 0{,}6 \cdot (R_3+R_4)_{(M\Omega)} \cdot C_{2\,(\mu F)}$

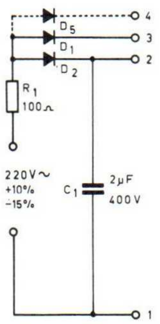


Range 20 secs. to 30 mins.

unstabilised, charging voltage 300 V half-wave

(Fig. 2)

$t_{v(s)} \approx 3 \cdot (R_3+R_4)_{(M\Omega)} \cdot C_{2\,(\mu F)}$

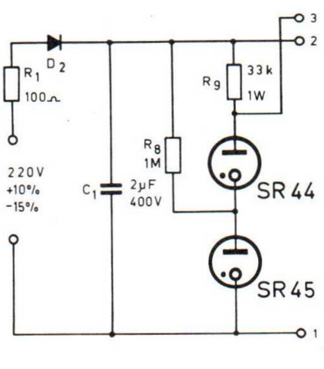


Range 10 secs. to 15 mins.

stabilised, charging voltage 190 V DC

(Fig. 3)

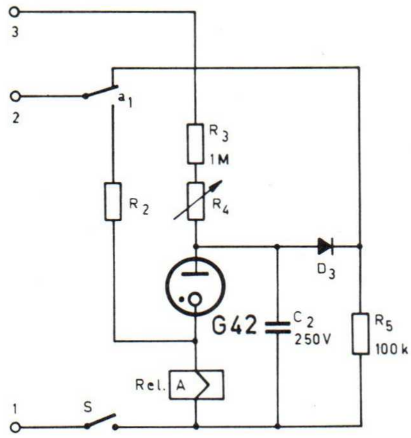
$t_{v(s)} \approx 1{,}6 \cdot (R_3+R_4)_{(M\Omega)} \cdot C_{2\,(\mu F)}$



As can be seen from the expressions in Figs. 1 - 3, the time delay can be varied by the charging resistor R_4 and, to a limited extent, by capacitor C_2. However, it must be noted that the minimum charging resistance is 1 MΩ (R_3) in all circuits. Similarly, the lower limit for the capacitor C_2, at about 1-2 µF, is determined by the pull-in and drop-out characteristics of the relay.

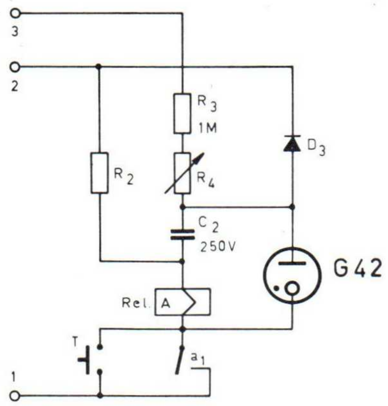
4. TIMER SECTION, CIRCUIT DESCRIPTIONS

4.1 Delay relay (Fig. 4)



During off-time the relay is de-energised. When S closes, the delay begins. C_2 charges via $R_3 + R_4$ until G 42 breaks down. The relay then energises and is held via a_1 and R_2. The residual charge from C_2 is removed via D_3 and R_5. When S is opened, the relay holding circuit is broken and the relay drops out. The circuit is again in the off-condition. If S is opened briefly during the timing cycle, C_2 discharges via D_3 and R_5, whereupon t_v starts again.

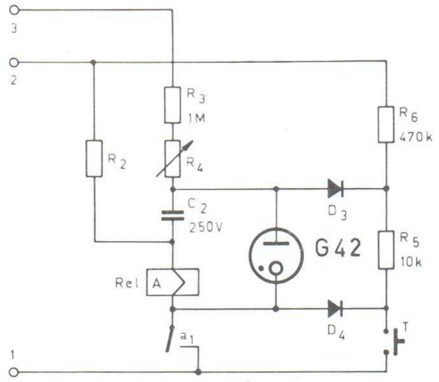
4.2 Timing relay, non-reset type (patent pending), (Fig. 5)



After pressing T a short while, relay A is energised and is held via R_2 and a_1. C_2 starts to charge at the same time via $R_3 + R_4$ until the diode G 42 breaks down.

As a consequence the voltage across C_2 collapses and the relay drops out because of the resultant reverse current. C_2 then loses its residual charge via D_3 and R_2. The circuit returns to the off-condition.

4.3 Timing relay, reset type (patent pending), (Fig. 6)

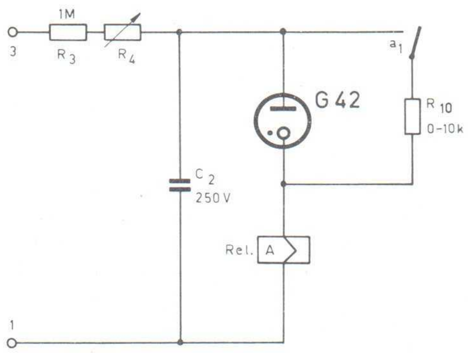


When T is closed, relay A puls in via R_2 and D_4 and holds via a_1. As soon as T is released, the switching time begins to elapse due to C_2 charging via $R_3 + R_4$. When the voltage across C_2 is high enough, G 42 breaks down and the relay de-energises as described in paragraph 4.2. The circuit is again in the off-condition.

By repeated operation of T during the charging time, C_2 discharges via D_3, R_5 and Rel. A, by which the original condition is again produced (resetting).

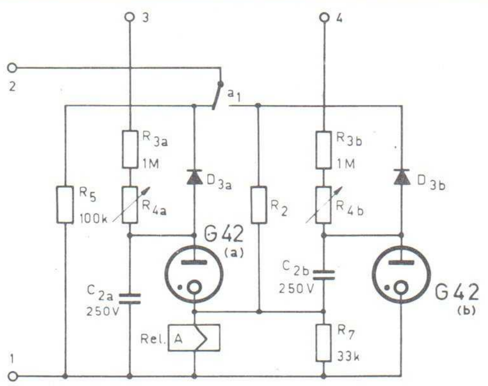
Resistor R_5 limits the discharge current. It should be of such a value that the relay does not drop out when resetting is profounded at minimum supply voltage.

4.4 Pulse generator, pulse repetition frequency adjustable (Fig. 7)



When the supply voltage is switched-on, capacitor C_2 charges, during the intervals between pulses, via R_3 and R_4 until G 42 breaks down. The relay closes via circuit C_2 - G 42, and then it short circuits the diode via a_1 and R_{10}. The values of C_2 and R_{10} affect the relay holding time to a certain extent, and thus the pulse length as well. When C_2 can no longer supply the relay holding current, the latter de-energises and the above process is repeated.

4.5 Flip-flop, pulse duration and pulse interval adjustable (Fig. 8)



A flip-flop circuit is produced from a combination of the delay relay (Fig. 4) and timing relay (Fig. 5).

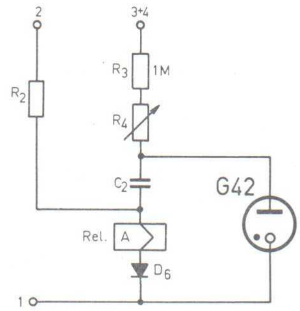
When the supply voltage is connected, C_{2a} charges via R_{3a} and R_{4a} until G 42 (a) breaks down and the relay is energised. This is held via a_1 and R_2 until it is de-energised when G 42 (b) breaks down. The pulse duration is determined by the product $(R_{3b} + R_{4b}) \cdot C_{2b}$, and the interval by $(R_{3a} + R_{4a}) \cdot C_{2a}$. Complete discharge of C_{2a} and C_{2b} takes place during breaks in operation.

5. RATING OF COMPONENTS

C_1: Smoothing capacitor 400 V $\pm$ 20%, e.g. electrolytic

C_2: Charging capacitor 250 V with low leakage current, e.g. 2-layer metal paper or polyester foil capacitor (not electrolytic).
C_2 min. has to correspond with the pull-in and drop-out characteristics of the relay (approx. 1 to 2 µF depending on relay type).
When using larger values of C_2, the diode D_6 (Fig. 9) should be connected in series with the relay.

Fig. 9



D_1-D_6: Diodes, e.g. BYX 10 (Philips) or S1A 150 (Shindengen)

D_1, D_5: Diodes, 800 V peak reverse voltage
leakage current less than 1 µA

D_2: Diode, 800 V peak reverse voltage
current approx. 25 mA

D_3: Diode, 400 V peak reverse voltage
leakage current less than 1 µA

D_4, D_6: Diodes, 400 V peak reverse voltage
current approx. 25 mA

D_6: See Fig. 9 - The diode prevents relay from bouncing due to a large value of C_2 (min. 3-6µF). (Valid for circuits Figs. 5, 6 and 8).

G 42: Subminiature switching diode with flying leads (Cerberus), breakdown voltage approx. 155 V
maintaining voltage approx. 60 V

R_2: Series resistor for 300 V relay supply:

$$R_2 = R_{Rel} \left(\frac{300\ V - U_{Rel}}{U_{Rel}} \right)$$

power rating of R_2: $P_{R2} = (300\,V - U_{Rel}) \cdot \frac{U_{Rel}}{R_{Rel}}$

R_{Rel} = resistance of relay coil
U_{Rel} = relay working voltage

R_4: Charging resistor max. 100 MΩ, high ohmic carbon resistor or potentiometer, e.g. Dralowid 20 MΩ

Rel A: DC relay, working voltage approx. 24 - 36 V, coil resistance approx. 3 kΩ

SR 44: Subminiature stabiliser tube with flying leads, maintaining voltage approx. 85 V (Cerberus)

SR 45: Subminiature stabiliser tube with flying leads, maintaining voltage approx. 105 V (Cerberus)

Resistors: $\pm$ 10% 1/2W, unless otherwise stated

CERBERUS	STAIRCASE TIMER WITH SWITCHING DIODE G 42	Type	
		Nr. **53.18 e**	
		Ed. 9.66	Fol. 1

1. INTRODUCTION

Reliable and inexpensive automatic staircase lighting can be obtained in a simple manner using the Cerberus G 42 switching diode. The staircase timer works from a control circuit in which the pilot lights are fed in parallel with the push buttons (Pat. pending). A timing relay is descript, keeping a load (staircase illumination) switched-on during a definite time interval. The circuits can be reset during the entire time interval. They are practically silent in operation and independent of mounting position. A standard 24 V relay serves as the electro-magnetic switch. The life of the switching diode is about $50 \cdot 10^6$ operations.

Matching capacitor 250 V AC at least 0,1 μF per push button with 10 mm diameter pilot light

2. GENERAL REMARKS

The following circuits differ only in the waveshape of charging voltage for the RC-circuit, which determines the switch-on period. If the RC-circuit is fed with a smoothed DC voltage (Fig. 1), the delay time is calculated as follows:

$$t_v\,(s) = 0{,}7 \cdot (R_3 + R_4)\,(M\Omega) \cdot C_2\,(\mu F) \qquad (1)$$

If the supply is pulsating DC (Fig. 2):

$$t_v\,(s) = 3 \cdot (R_3 + R_4)\,(M\Omega) \cdot C_2\,(\mu F) \qquad (2)$$

The circuit shown in Fig. 1 is suitable for delays up to a minute if a 20 MΩ potentiometer (R_4) and a 5 μF charging capacitor (C_2) are used.

With the same components, the modified circuit arrangement in Fig. 2 gives a switch-on time of about 5 minutes. In both circuits the use of a fixed 100 MΩ resistor in place of R_3 and R_4 multiplies the time interval five times. All components requiring a high insulation resistance (C_2, D_1, G 42 and the fixed resistor in place of R_3 and R_4) are best cast in resin. This protects the installation from damage due to humidity and dirt. Both versions are designed for push buttons with pilot lights. The value of capacitor C_3 is dependent on the consumption of the pilot lamps and consequently on the number of buttons connected. At least 0,1 μF should be allowed for each 10 mm diameter pilot lamp.

3. FUNCTIONING

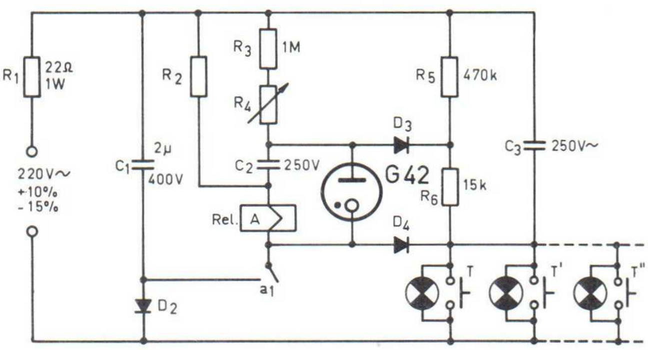
In the off-condition the relay Rel is de-energised and the staircase lighting switched off. The button pilot lights are on (for location in the dark). All the pilot lights go out when a button T is operated and a current flows through R_1, R_2, Rel A and D_4. The relay energises and is held via the working contact a_1. When the button T is released, the pilot lights come on again, and C_2 charges via R_3 and R_4. The pre-set time period during which the staircase is illuminated starts to elapse. If a button is pressed during this period, C_2 discharges to cathode potential via R_1, R_2, D_3 and R_6 (resetting). Charging recommences when the button is released and continues until C_2 has attained the breakdown voltage of the G 42. The latter conducts and C_2 discharges through the relay. The negative discharge causes the relay to drop out. Contact a_1 opens, and any residual voltage on C_2 is discharged via D_3, R_5 and R_2. The circuit is then again in its initial off-condition.

4. CIRCUITS

4.1 Staircase timer with smoothed charging voltage

(delay time t_v calculated according to formula 1)

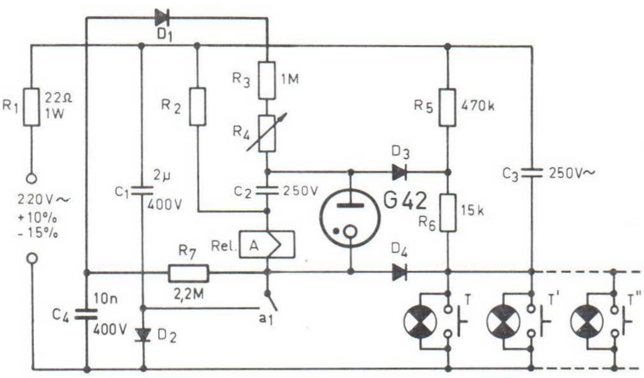
Fig. 1



4.2 Staircase timer with pulsating charging voltage

(delay time t_v calculated according to formula 2)

Fig. 2

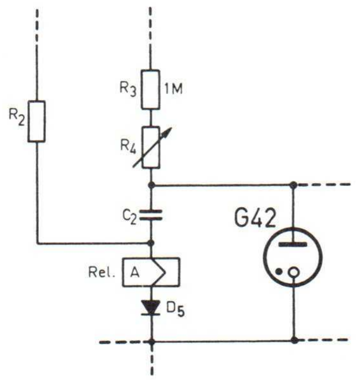


5. RATING OF COMPONENTS

C_1: Smoothing capacitor 400 V ± 20%, e.g. electrolytic capacitor

C_2: Charging capacitor 250 V DC with low leakage current, e.g. 2 layer metal paper or polyester foil capacitor (not electrolytic). C_2 min. has to correspond with the drop-out characteristics for the relay (approx. 1 to 2 µF depending on relay type).
If a larger value of C_2 is used, the diode D_5 must be connected in series with the relay (see Fig. 3 and description of D_5).

Fig. 3



C_3: Matching capacitor 250 V AC at least 0,1 µF per push button with 10 mm diameter pilot light

D_1-D_5: Diodes, e.g. BYX 10 (Philips) or S1A 150 (Shindengen)

D_1: Diode, 800 V peak reverse voltage, leakage current less than 1 µA

D_2: Diode, 800 V peak reverse voltage, current approx. 25 mA

D_3: Diode, 400 V peak reverse voltage, leakage current less than 1 µA

D_4, D_5: Diodes, 400 V peak reverse voltage, current approx. 25 mA

D_5: See Fig. 3 - The diode prevents the relay from bouncing due to a large value of C_2 (min. 3-6 µF).

G 42: Subminiature switching diode with flying leads (Cerberus),
breakdown voltage approx. 155 V
maintaining voltage approx. 60 V

R_2: Series resistor for 300 V relay supply:

$$R_2 = R_{Rel} \left(\frac{300\,V - U_{Rel}}{U_{Rel}} \right)$$

power rating of R_2: $P_{R2} = (300\,V - U_{Rel}) \frac{U_{Rel}}{R_{Rel}}$

R_{Rel} = resistance of relay coil
U_{Rel} = relay working voltage

R_4: Charging resistor max. 100 MΩ, high ohmic carbon resistor or potentiometer, e.g. Dralowid 20 MΩ

Rel A: DC relay, working voltage approx. 24 - 36 V, coil resistance approx. 3 kΩ

CERBERUS

RELAY TIMING CIRCUITS FOR 115 V A.C. UTILIZING THE G42 DIODE

Type	
Nr.	53.19 e
Ed. 6.69	Fol. 1-2

1. INTRODUCTION

The Cerberus G42 Switching Diode in conjunction with a 115V a.c. supply enables reliable and economic commercial relay timing circuits to be constructed. Certain circuits require a "time lag" before the relay becomes energized; other circuits require the relay to be energized for a pre-set time. Both of these circuits can easily be constructed and are described below.

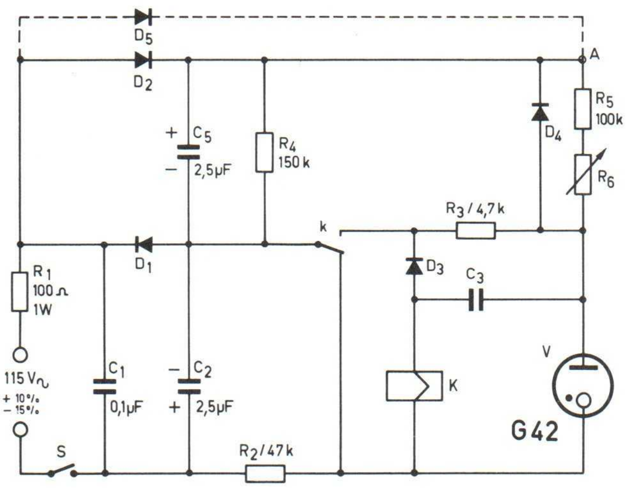
A "time lag" circuit requires an adjustable resistor and a complementary capacitor. A time lag can then be selected ranging from 100 milliseconds to a few minutes. A commercial type 24 V relay and its contacts are arranged to form the output circuit. In the following examples these relays are assumed to have about $50 \cdot 10^6$ operations.

A low-pass filter (R_1, C_1) comprises the input circuit, this acts as a protection against dangerous transient peaks from the mains. Transients are thus reduced to a harmless level, which helps to ensure a high degree of operating reliability.

The time lag can be shown to be inversely proportional to the mains voltage fluctuations, i.e. an increase in the mains of 1% reduces the switching time by 1,4%. This inverse feature can be utilized to advantage e.g. in photographic equipment, where the exposure time could be automatically compensated for.

2. OPERATIONAL DESCRIPTIONS OF TIMER CIRCUITS

2.1 Delayed energization (Fig. 1)



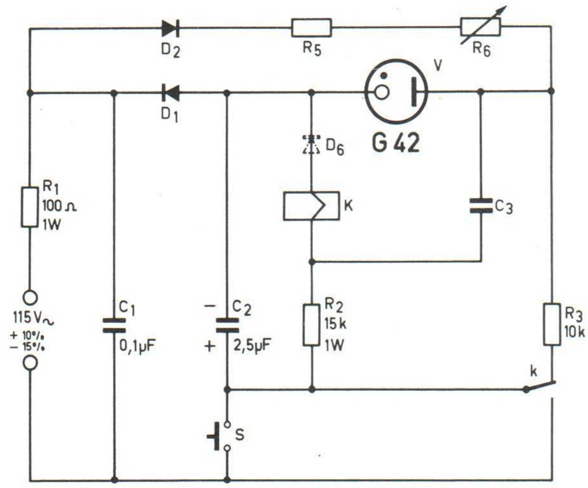
When switch S is closed a time delay commences. C_3 receives a charging voltage from the voltage doubling circuit (D_1, C_2 and D_2, C_5) via R_5 and R_6. If the firing voltage of the G42 switching diode (V) is reached, the diode will fire and discharge C_3. Relay K will become energized and will be held on by contact k, D_3 and R_2. R_3 prevents C_3 from being recharged. By opening switch S the initial conditions are restored and relay K is de-energized. If switch S is opened whilst the time delay is in operation, the charge is removed from C_3 via D_4, R_4 and contact k. The circuit is thus restored to its initial state, i.e. reset.

For short time delays a smoothed d.c. charging voltage is preferable, i.e. with point A disconnected (diode D_5 removed). The alternative circuit indicated by the dotted line connection gives an unsmoothed charging voltage (D_5 connected to R_5). This alternative circuit is best suited to longer time delays.

Smoothed charging voltage: $t = 0.7 \cdot (R_5+R_6) \cdot C_3$
Unsmoothed charging voltage: $t = 2 \cdot (R_5+R_6) \cdot C_3$

(If R is in M ohms, C is in µF, then t is in secs).

2.2 Time-lag before de-energization, non-reset (Fig. 2)

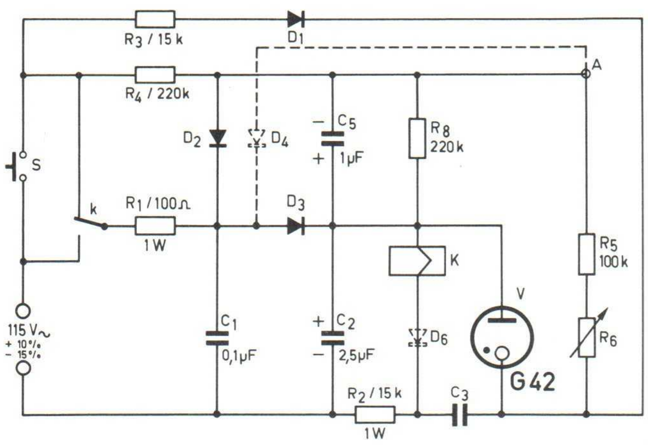


Time-lag: $t = 2 \cdot (R_5 + R_6) \cdot C_3$

(If R is in M ohms, C is in µF, then t is in secs).

By holding key S depressed for a short period, relay K becomes energized and is held on via R_2 and contact k. C_3 becomes charged by an unsmoothed d.c. voltage (equal to double the peak value of the mains voltage) via D_2, R_5 and R_6. Thus firing the switching diode (V), whereupon relay K receives a current pulse from V and C_3. This current is in opposition to the hold on current. Relay K therefore de-energizes, and C_3 discharges via R_2, contact k and R_3.

2.3 Time-lag before de-energization, reset (Fig. 3)



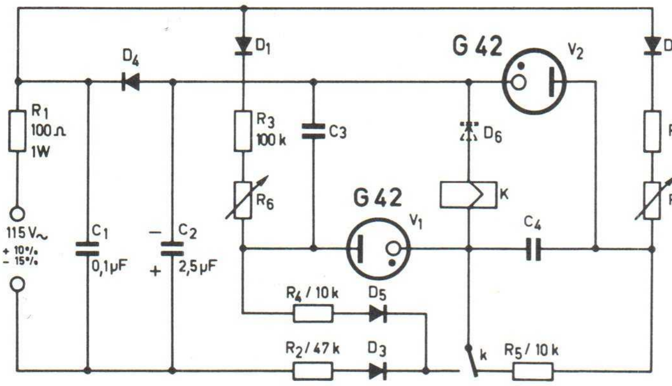
Smoothed charging voltage: $t = 0.7 \cdot (R_5 + R_6) \cdot C_3$
Unsmoothed charging voltage: $t = 2 \cdot (R_5 + R_6) \cdot C_3$

(If R is in M ohms, C is in µF, then t is in secs).

By holding key S depressed for a short period filter capacitor C_2 becomes charged via contact k, R_1 and D_3. Relay K energizes via R_2 and is held on by contact k. The timing circuit (R_5, R_6, C_3) has a voltage corresponding to the difference between double the peak value of the supply voltage and the relay operating voltage. C_3 is charged until the switching diode fires, whereupon relay K receives a pulse of current in opposition to the retaining current and relay K de-energizes.

By depressing switch S during the time-lag, C_3 is discharged via R_3 and D_1, i.e. the initial conditions are restored. The circuit connection shown by the dotted line (D_4 connected to R_5) indicates an unsmoothed d.c. voltage connection. This is the best configuration for time-lags of more than 30 seconds.

2.4 Separately adjustable timing for continuous relay energization and de-energization (Fig. 4)



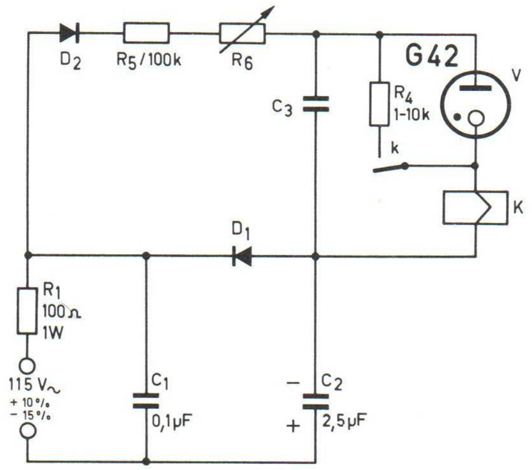
De-energization time: $t = 2 \cdot (R_3 + R_6) \cdot C_3$
Energization time: $t = 2 \cdot (R_7 + R_8) \cdot C_3$

(If R is in M ohms, C is in µF, then t is in secs).

Energization time: When the supply voltage is applied to the Pulse Generator circuit shown, C_3 is charged via R_3 and R_6 until the switching diode (V_1) fires. Relay K thus becomes energized due to a voltage pulse. R_2, D_3 and contact k ensure that relay K remains energized. C_3 begins to discharge via R_4, D_5, contact k and relay K. Simultaneously, C_4 charges via D_2, R_8 and R_7 until V_2 fires. Firing of V_2 produces a pulse at relay K in opposition to the retaining current; relay K therefore de-energizes.

De-energization time: C_4 discharges via R_5 and contact k and C_3 once again becomes charged. Relay K thus energizes and the switching cycle is repeated. The present design of the voltage doubler (D_4, C_2, D_1 and D_2) enables both timing capacitors (C_3 and C_4) to be charged with an unsmoothed d.c. voltage.

2.5 Adjustable timing for continuous pulsed relay energization (Fig. 5)



Pulse sequence: $t = 2 \cdot (R_5 + R_6) \cdot C_3$

(If R is in M ohms, and C is in µF, the t is in secs).

Pulse duration: Several hundred milliseconds, depending on the values of relay K, C_3 and R_4.

When the supply voltage is connected to the Pulse Generator shown, an unsmoothed d.c. voltage is applied to the timing circuit (R_5, R_6 and C_3) corresponding to double the peak value of the supply. C_3 becomes charged and the switching diode (V) fires, relay K then becomes energized for a pre-set period. Since the switching diode is in parallel with R_4 and contact k, the retaining interval may be pre-set by suitable choice of C_3 and R_4. If C_3 is discharged to such an extent that it can no longer supply the necessary retaining current for the relay, then relay K de-energizes and the process just described recommences.

3. DIMENSIONING OF THE ELEMENTS

V, V_1, V_2 : Cerberus G42 switching diodes.

K : D.C. - Relay 24 ... 36 V. Coil resistance 3 kΩ, approx. e.g. Type GA-11-D, 2500 Ω (Potter and Brumfield).

D_1 ... D_5 : Diodes, peak inverse voltage 400 V, forward current 25 mA approx., leak current < 1 µA, e.g. BA 133 (Siemens).

D_6 : Diode, peak inverse voltage 400 V, forward current 25 mA approx., e.g. BA 133 (Siemens). The diode is required if C_3 and C_4 resp. are in excess of 4 µF, to prevent the relay from bouncing.

C_1 : Protective capacitor, of low inductance 0.1 µF/ 250 V.

C_2 : Electrolytic capacitor, resistant to switching transients, 200 V.

C_3, C_4 : Metallized plastic capacitors, 250 V (see hints for choosing values).

C_5 : Electrolytic capacitor, resistant to switching transients, 350 V.

R_2 : Series resistance (see hints for choosing values).

R_6 : Linear potentiometer, e.g. 10 M ohms.

Hints for choosing values:

Time-delay relay: Choose a value for C_3 so that the relay energizes firmly. For the lowest supply voltage select R_2 so that the minimum retaining current is ensured.

Time-lag relay: At a maximum supply voltage select C_3 and C_4 so that the relay can de-energize. C_{min} according to relay type 1...2 µF/250 V. For the lowest supply voltage select R_2 so that the minimum energizing current is safely exceeded.

1. INTRODUCTION

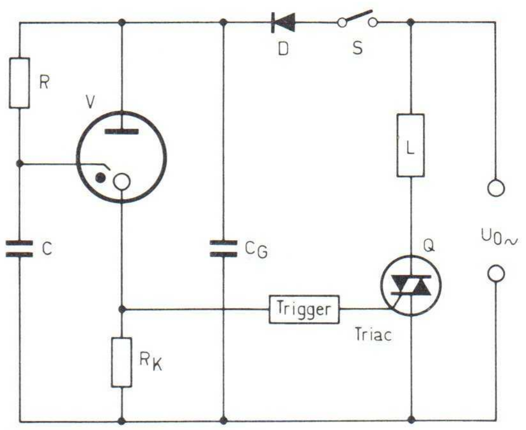
Heavy duty timers with a.c. thyristors permit contactless switching of load currents of a few amperes. An attractive control element for triacs is the GR 44 which is sturdy and insensitive to temperature. Timer circuits with this solderable subminiature trigger tube are easily arranged and require few components. Delay time varies between some hundreds of milliseconds to some tens of minutes.

The reliability of these recommended circuits is high. All semi-conductors are protected by RC-filters from electrical interference, (overvoltage peaks and surge currents). Therefore, timers with the GR 44 are reliable, sturdy, economical and space-saving.

2. GENERAL FUNCTIONAL DESCRIPTION

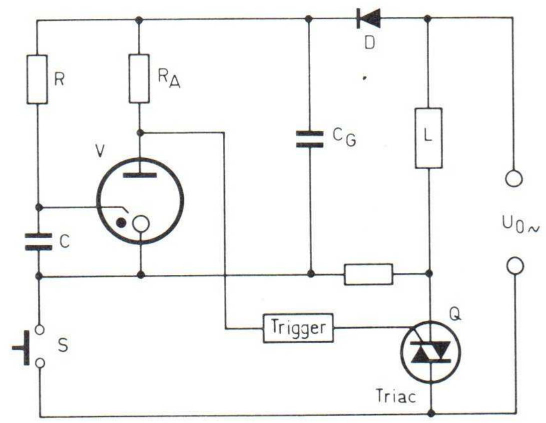
2.1 Delay on-make (Fig. 1)

In the normal position, switch S is open, the triac Q is blocked and the load L open circuited. After S is closed, the delay time t_v begins. The smoothing capacitor C_G immediately reaches the peak value of the supply voltage U_0~ through the rectifier diode D. The time based capacitor C is charged simultaneously through the charging resistor R until the tube V fires. A gate voltage $U_{CG} - U_B$ (U_{CG} = peak value of supply voltage, U_B = tube sustaining voltage) appears at the cathode resistor R_K, turning on the triac through the trigger. The load circuit is then closed and the delay time begins. When S opens, the tube V is extinguished, supply to the trigger stops and the triac blocks after the next supply voltage zero, thus opening the load circuit and re-establishing the normal position.



2.2 Delay on-break (Fig. 2)

The triac Q is blocked in the normal position and the load L disconnected. Pressing the key S has the effect that the smoothing capacitor C_G is charged to the peak value of the supply voltage U_0~ through the rectifier diode D. The triac is then fired by this control voltage through the anode resistor R_A and the trigger. The load is then switched on and S may be released. Switching time t_v, determined by the charging resistor R and the delay capacitor C, then elapses until the tube V fires. As a result, the supply voltage of the trigger collapses, the control signal disappears and the triac blocks after the next supply voltage zero. The load is then disconnected and the circuit is in the normal position again. With this kind of connection the trigger tube V operates in the pulsed mode.



3. CALCULATING THE SWITCHING TIME t_v

Switching time t_v depends on the dimensioning of the timing element and the value of charging voltage. The latter is selected with reference to the desired switching time and accuracy. The timing element is fed by a smoothed recitified voltage for switching times up to 5 minutes. Operation with a half-wave rectified voltage has been proved efficient for longer time delays (up to some tens of minutes).

An increase in the supply voltage of 1 % in unstabilised circuits causes a reduction in switching time of about 1,3 %, whereas a decrease in the supply voltage results in a corresponding lengthening of the switching time. Owing to stabilisation of the charging voltage (2 x SR 44) the effect on delay time with a varying supply voltage, will be reduced by about 15 times.

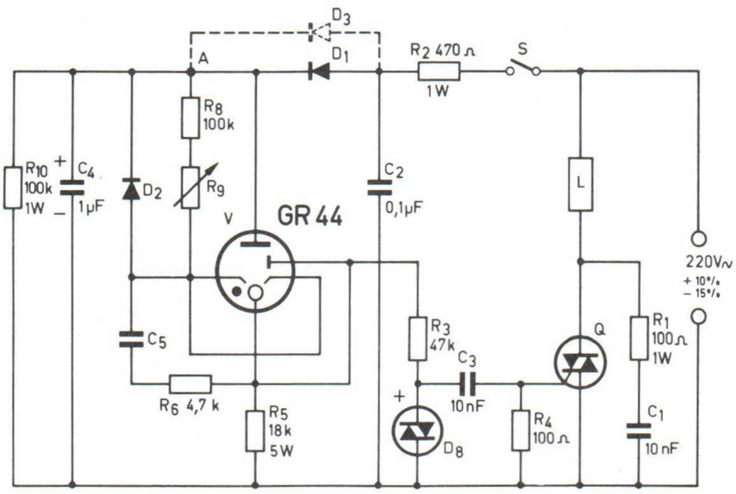
Calculation and layout of the different circuits are in accordance with the following table.

Recommended Switching time t_v up to:	Type of charging Voltage for Timing Element	Calculation of Switching time t_v (t_v in s; R in MΩ; C in µF)	Valid for Fig.	Variants: Connect. point A yes	Connect. point A no	Mount. D3 yes	Mount. D3 no	Mount. R10 yes	Mount. R10 no
5 minutes	smoothed 300 V d.c.	$t_v = 0{,}6 \cdot (R_8 + R_9) \cdot C_5$ [1]	3, 4, 5, 6, 8	x			x		x
		$t_v = 0{,}6 \cdot (R_{12} + R_{13}) \cdot C_8$ [2]	8						
30 minutes	pulsating 300 V ⎍⎍	$t_v = 2{,}5 \cdot (R_8 + R_9) \cdot C_5$ [3]	3		x	x		-	-
		$t_v = 2{,}5 \cdot (R_7 + R_9) \cdot C_5$ [4]	4, 5, 6		x	x		x	
15 minutes	stabilised 170 V d.c.	$t_v = 1{,}4 \cdot (R_8 + R_9) \cdot C_5$ [5]	7	-	-	-	-	-	-

4. CIRCUITS, FUNCTIONAL DESCRIPTIONS

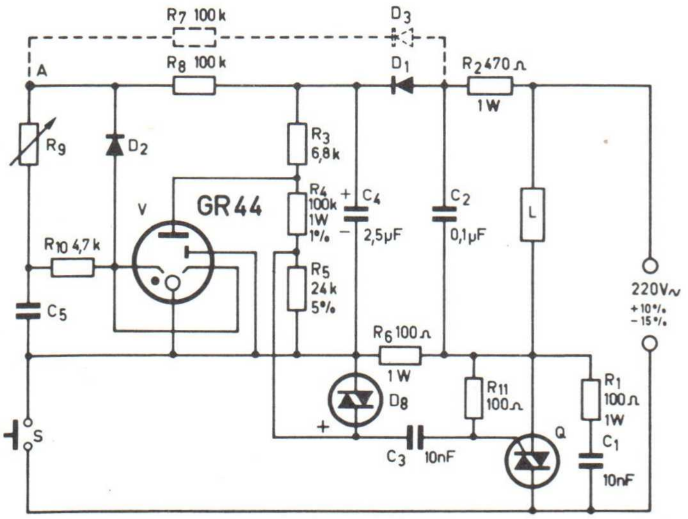
The circuits shown in fig. 3 to fig. 7 carry no current in the quiescent state, i.e. both the triac Q and the load L are switched off. The triac and the rectifier diodes are protected from dangerous overvoltages by components $R_1 - C_1$ or $R_2 - C_2$ and $R_3 - C_7$ shown in fig. 8. Moreover, the resistors R_2 and R_3 shown in fig. 8, limit the surge current when the filter capacitor is being charged (electrolytic capacitor).

4.1 Delay on-make (Fig. 3)



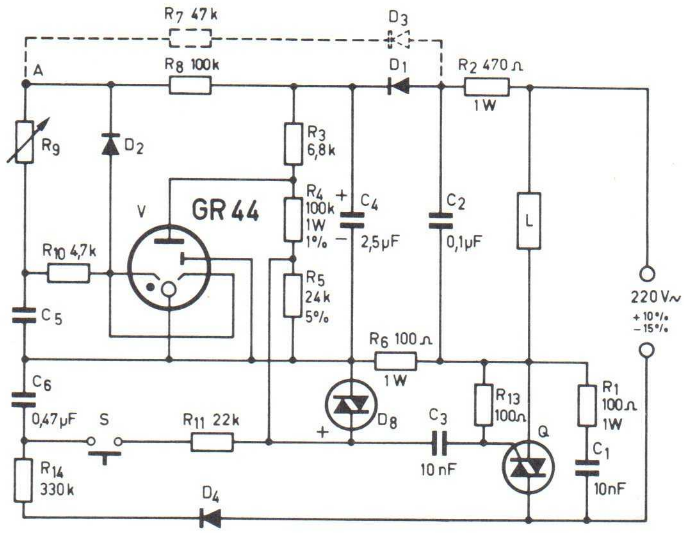
When S closes, the delay time begins to elapse until the trigger tube fires and closes the load circuit. The switching time t_v elapses each time switch S operates, regardless of whether the triac is fired or not. (A, D_3 see table)

4.2 Delay on-break without reset (Fig. 4)



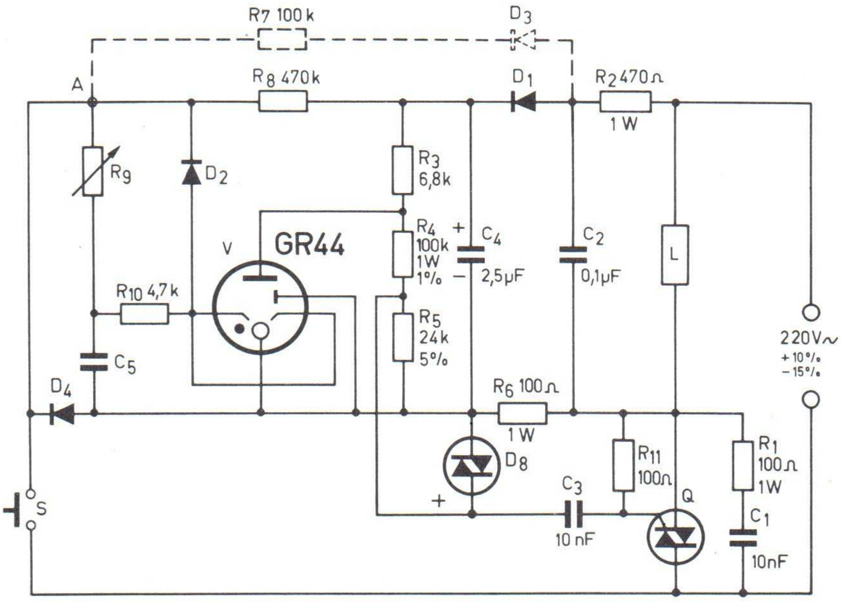
The load is connected by a momentary actuation (less than t_v) of S, and t_v begins to elapse. The switching time cannot then be further affected by S. When t_v has elapsed, the load will be disconnected by a firing pulse of the GR 44. (A, D_3, R_7 see table.)

4.3 Delay on-break triggered by firing contact (Fig. 5)



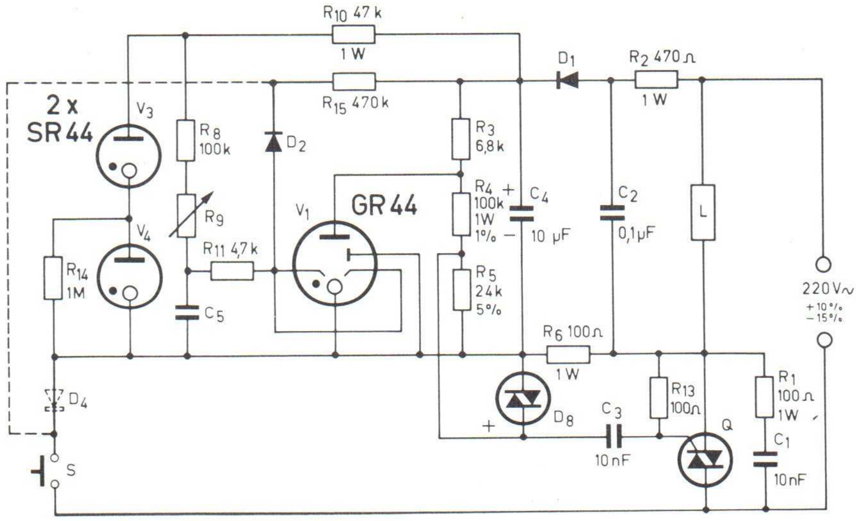
Operation of this circuit is analogous to 4.2, yet without any prescribed time for actuating key S. The latter may be released both before and after t_v has elapsed. (A, D_3, R_7 see table.)

4.4 Delay on-break with reset (Fig. 6)



The load is connected by pressing key S; t_v however, does not start until S is released. Any actuation of S during the delay time resets t_v. The switching cycle is ended by a firing pulse of the GR 44. (A, D_3, R_7 see table.)

4.5 Delay on-break charging voltage stabilised (Fig. 7)

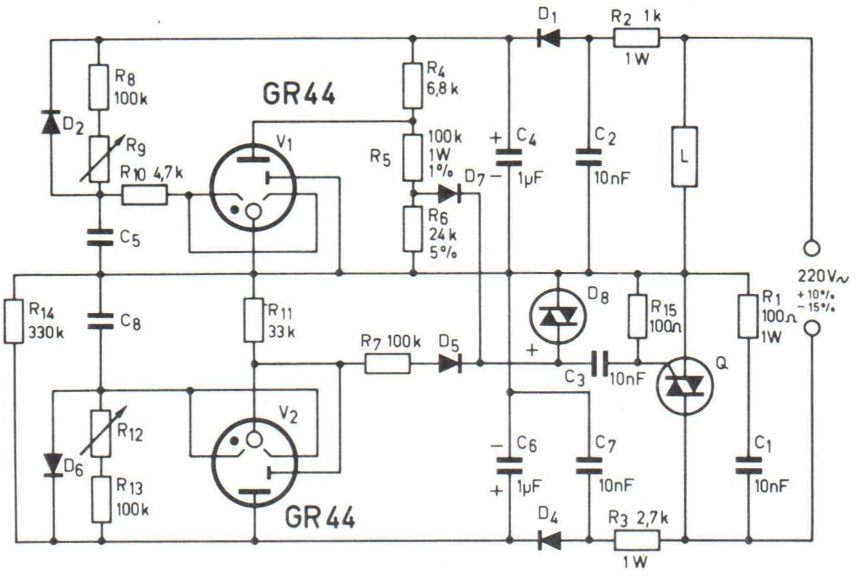


The circuit can be designed with or without reset. For the corresponding functional description see 4.4 or 4.2

Variant with reset:
Mount dashed connection and D_4

Variant without reset:
Omit dashed connection and D_4

4.6 Pulse generator with adjustable pulse duration and pulse interval (Fig. 8)



The pulse generator combines the circuits of delay on-make and delay on-break. The load does not carry current during the pulse interval. The duration of the latter is fixed by timing element of the GR 44 (V_2). The pulse duration during which the load circuit is closed is limited by the timing element of the GR 44 (V_1).

Calculation of pulse duration:
According to formula [1]

Calculation of pulse interval:
According to formula [2]

5. DIMENSIONING THE COMPONENTS

V, V_1, V_2: Subminiature type trigger tube GR 44 (Cerberus)

V_3, V_4: Subminiature type voltage stabilizer SR 44 (Cerberus)

Q: Triac, 250 V~ (a.c.thyristor) 40430, 40486 (RCA); SC 40 D, SC 45 D, SC 50 D (General Electric); TAC 6-400, TAC 16-400 (Transistor AG)

C_4, C_6: Smoothing capacitor, 400 V d.c. ± 20 % (plastic foil or electrolytic capacitor)

C_5, C_8: Delay capacitors with small leakage current, 250 V d.c. (unless indicated otherwise) e.g. capacitor with two layers of metallised paper or polyester foil (no electrolyte!)

C_3: Trigger condenser, 160 V d.c.

C_1, C_2, C_7: Protective capacitors, low inductance, 250 V a.c.

$D_1 \dots D_7$: Diodes, e.g. BYX 10 (Philips), BA 133 (Siemens) or S 1A 150 (Shindengen)

D_1, D_4, D_5, D_7: Diodes, 800 V peak inverse voltage, forward current about 25 mA

D_2, D_6: Diodes, 400 V peak inverse voltage, leakage current < 1 µA

D_3: Diode, 800 V peak inverse voltage, leakage current < 1 µA

D_8: Trigger diode, breakdown voltage 32 V, e.g. TI 42, TI 43 (Texas Instruments), ST-2 (General Electric), STD-33 (Mallory)

$R_1 \dots R_{15}$: Resistors ± 10 % 1/2 W (unless indicated otherwise)

R_9: Charging resistor, 100 MΩ max., fixed or potentiometer, e.g. potentiometer 20 MΩ (Dralowid)

L: Load, ohmic or inductive, maximum load current 6...15 A (according to triac-type)

Important: Correct operation of the circuit cannot be guaranteed if the minimum load current falls below the current according to manufacturer's documentations.

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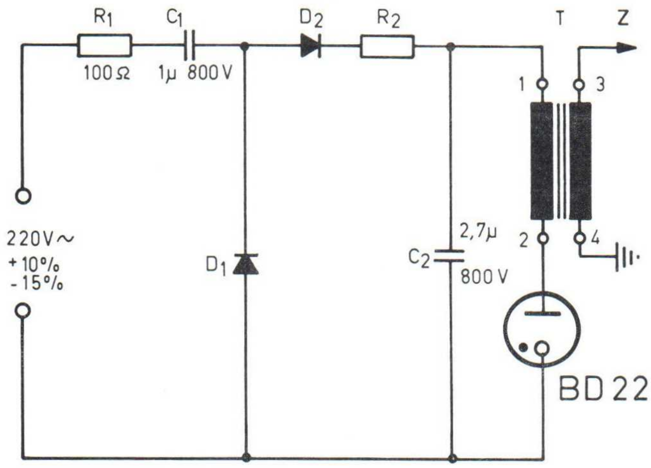
5

WEIDEZAUNGERAET MIT DER HOCHSTROM-SCHALTDIODE BD 22 APPAREIL POUR CLOTURES ELECTRIQUES AVEC LA DIODE DE COMMUTATION A IMPULSIONS DE FORTE INTENSITE BD 22 FENCE EQUIPMENT WITH THE HIGH CURRENT SWITCHING DIODE BD 22	Type	
	Nr. 54.12	
	Ed. 10.66	Fol. 1

Die Schaltung eignet sich zur elektronischen Erzeugung von Impulsen zum Schutze von Elektrozäunen. Die Speisung des Gerätes erfolgt aus dem 220 V~ Netz.

Connecté au secteur alternatif de 220V, le circuit produit par voie électronique les impulsions alimentant des clôtures électriques.

The circuit arrangement is suitable for the electronic generation of impulses for the protection of electric fences. The supply voltage to the equipment is 220 V AC.



FUNKTION

Die über dem Spannungsverdoppler nach der Diode D_2 anliegende Spannung lädt über den Widerstand R_2 den Kondensator C_2 soweit auf, bis die Röhre BD 22 zündet. C_2 entlädt sich durch die BD 22 und die Primärwicklung des Hochspannungs-Transformators T. Dies induziert einen Impuls hoher Spannung auf der Sekundärseite. Die Röhre löscht und der Zyklus beginnt von neuem. Die Zündfolge kann durch Vergrösserung des Widerstandes R_2 verlangsamt werden.

MODE DE FONCTIONNEMENT

La tension produite par le doubleur et une fois passée par la diode D_2 charge le condensateur C_2 à travers la résistance R_2 jusqu'à ce que le tube BD 22 amorce. Le condensateur C_2 se décharge alors à travers le tube BD 22 et l'enroulement primaire du transformateur haute tension T. Le courant primaire qui en résulte induit dans l'enroulement secondaire une impulsion de voltage élevé. La diode BD 22 s'éteint ensuite et le prochain cycle commence. La suite des amorçages peut être ralentie par une résistance R_2 de valeur plus élevée.

FUNCTION

The line voltage is fed via the voltage doubler C_1, D_1 and the coppling diode D_2. It charges the condensor C_2 via the resistance R_2 to the point where the BD22 ignites. Thereby C_2 discharges through the BD 22 and the primary winding of the high voltage transformer T. The primary current then flowing induces a high voltage impulse on the secondary side. Thereupon the BD 22 is extinguished and the cycle recommences. The ignition rate can be slowed down by increasing the resistance R_2.

ANGABEN UEBER DIE BAUTEILE / LES ELEMENTS / NOTES ON COMPONENTS

C_1, C_2: Metallpapier-Kondensatoren 800 V / Condensateurs PM 800 V / Metalized paper condensors 800 V

D_1, D_2: Dioden, 800 V Spitzensperrspannung, z.B. BYX 10 (Philips)
Diodes, tension inverse de crête 800 V, p.ex. BYX 10 (Philips)
Diodes, 800 V peak inverse voltage, e.g. BYX 10 (Philips)

R_2: Ladewiderstand, für 1 Entladung/s = ca. 39 kΩ, 5 W (R min. 18 kΩ, 10 W)
Résistance de charge, pour 1 décharge par seconde = env. 39 kΩ, 5 W (R min. 18 kΩ, 10 W)
Charge resistor, for 1 discharge/sec approx. 39 kΩ, 5 W (R min. 18 kΩ, 10 W)

T:

Transformer M55A (mit Luftspalt ca. 1 mm),	1 - 2 = 350 Wdg., 0,08 CuL,	3 - 4 = 2700 Wdg., 0,08 CuL
Transformateur M55A (entrefer env. 1 mm),	1 - 2 = 350 sp., 0,08 CuL,	3 - 4 = 2700 sp., 0,08 CuL
Transformer M55A (with an air gap approx. 1 mm),	1 - 2 = 350 wdg., 0,08 CuL,	3 - 4 = 2700 wdg., 0,08 CuL

Die Auslegung des Impulstransformers T entspricht den zur Zeit gültigen Vorschriften für Weidezaungeräte (VDE 0667 - 0668 und SEV-Entwurf 214 (FK) 64/3)
Les données pour le transformateur d'impulsions T sont conformes aux prescriptions actuellement en vigueur pour les appareils de clôtures électriques (VDE 0667 - 0668 et projet ASE 214 (FK) 64/3)
The layout of the impulse transformer T conforms to the present instructions for fence equipment (VDE 0667 - 0668 and SEV-plan 214 (FK) 64/3)

Scheitelwert der Impulsspannung / Valeur de crête de la tension des impulsions / Peak value of impulse voltage	ca. 4 kV
Max. Ladung je Impuls / Charge max. par impulsion / Maximum charge per impulse	ca. 0,13 mAs
Max. Energie je Impuls / Energie max. par impulsion / Maximum energy per impulse	ca. 28 mWs
Impulsdauer / Durée des impulsions / Impulse duration	ca. 4 ms

Z: Zaun / Clôture / Fence

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5

RING COUNTER FOR ADDITION AND SUBSTRACTION WITH GR 44

Type	
Nr.	55.20 e
Ed. 1.65	Fol. 1-2

1. INTRODUCTION

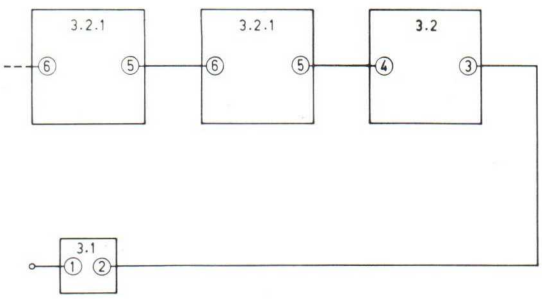
This application sheet gives data and circuits for a ring counting system with cold-cathode tubes of Type GR 44. The maximum counting frequency is 1000 c/s with input voltages greater than 1 V and of random waveform. For smaller counting frequencies the input decade for 150 c/s should be used. All follower decades are designed for 150 c/s. The circuits are suitable for forward counting as well as for forward and backward counting. If required, the switching condition can be indicated either by neon tubes or by digital indicating tubes. The supply voltage for the counting circuits is 450 V. In contrast to the supply voltage of 108 V for the transistor circuits, the voltage of 450 V does not have to be stabilized.

The pre-selection circuit serves to trigger further control pulses when a pre-selected number of pulses is reached.

The reset button enables the circuit to be brought to its initial position at any time.

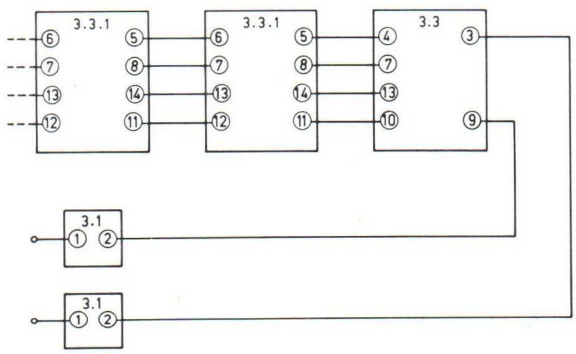
2. BLOCK CIRCUIT DIAGRAMS

2.1 Forward Counter (Adding)



In principle a counter consists of a pulse shaper 3.1, an input decade 3.2 and any number of follower decades 3.2.1. The input decade can be designed for 1000 or 150 c/s, as required.

2.2 Forward and Backward Counter (Adding and Substracting)

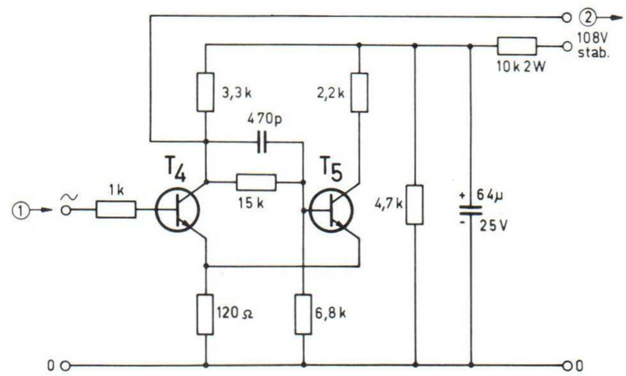


For counters which operate in both directions, i.e. count forwards and backwards, two identical pulse shaping stages 3.1 are required at the input. These are followed by the input decades 3.3 and any required number of follower decades 3.3.1, all of which can count in both directions. The maximum operating frequency is 1000 or 150 c/s.

3. COUNTER UNITS

3.1 Pulse Shaper

The pulse shaper serves to generate pulses of defined amplitude and rate of rise, both independent of the form and amplitude of the input voltage.



Technical Data:

Supply:	108 V stabilized, 20 mA
Input voltage:	(peak value) >1 V <20 V
Output voltage:	>10 V
Transistors T_4, T_5:	NPN type, e.g. 2 N1304
Resistors:	± 10%, 1/2 W, if not otherwise specified

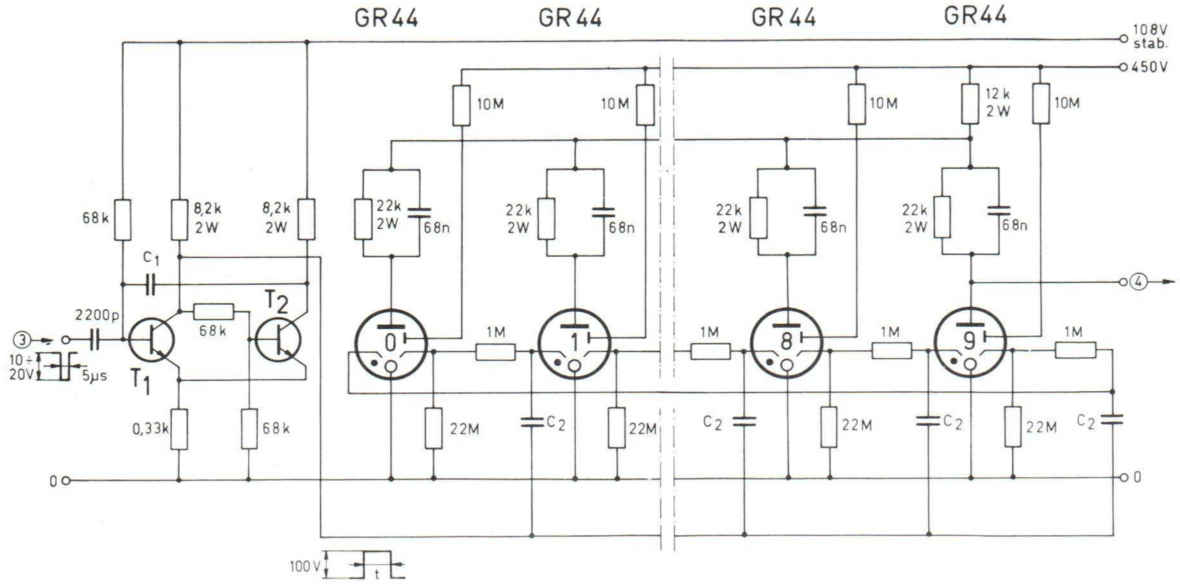
Terminals:

①	Input
②	Output
0	Ground
108 V stab.:	stabilized voltage (e.g. SR 3B)

3.2 Input Decade "Forwards"

The pulses generated by the preceding pulse shaper (3.1) are used for triggering a monostable multivibrator formed by transistors T_1 and T_2 (one-shot multivibrator). This multivibrator generates the pulses of defined height and width required for driving the following decades (formed by GR 44 0 to 9).

There are two different types of input decades, one for counting frequencies of up to 1000 c/s, and one for maximum 150 c/s. the slower decade is definitely recommended for counting frequencies less than 150 c/s.



Technical Data:

Supply:	108 V stabilized, 10 mA 450 V ± 10%, 10 mA
Transistors T_1, T_2:	Collector to base breakdown-voltage > 120 V, e.g. BF 109
Resistors:	± 10%, 1/2 W, if not otherwise specified

Terminals:

③ Input
④ Output
0 Ground

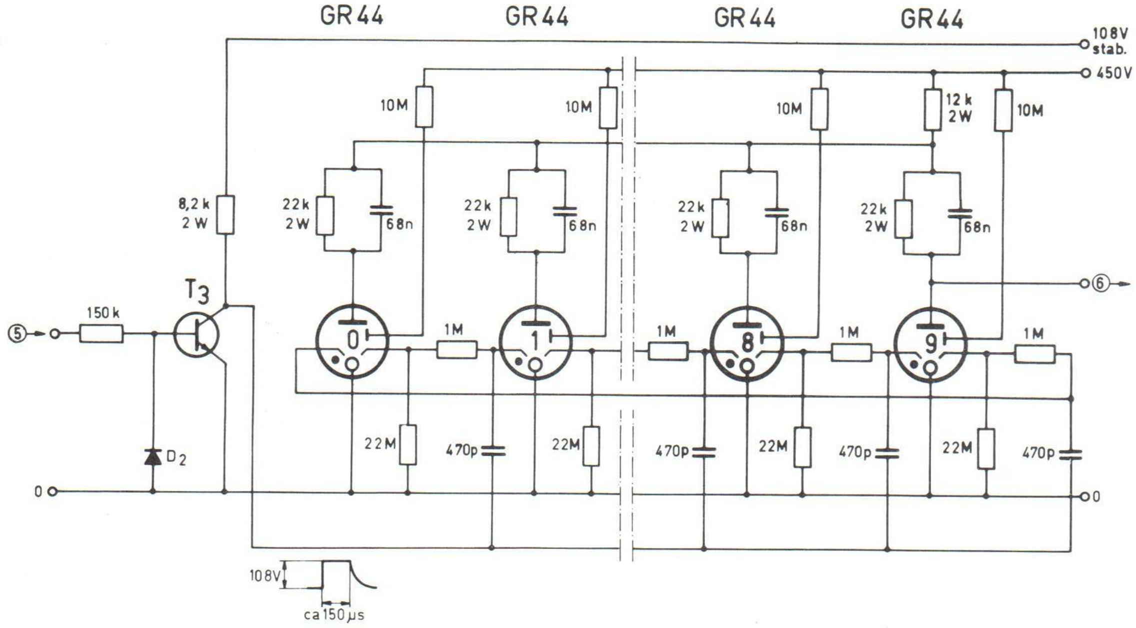
Variants for different counting frequencies:

Pulse frequency:

1000 c/s	C_1 = 1000 pF,	C_2 = 100 pF,	t = 15 μs
150 c/s	C_1 = 6800 pF,	C_2 = 470 pF,	t = 100 μs

3.2.1 Follower Decades "Forwards"

The buffer stage (T_3) at the input of the follower decade changes the pulses fed by the preceding decade in such a way that the following decade (formed by GR 44 0 to 9) can be driven. Any number of follower decades can be connected in series.



Technical Data:

Supply:	108 V stabilized, 13 mA 450 V ± 10%, 10 mA
Transistor T_3:	Collector to base breakdown voltage >120 V, e.g. BF 109
Diode D_2:	e.g. OA 200
Resistors:	± 10%, 1/2 W, if not otherwise specified

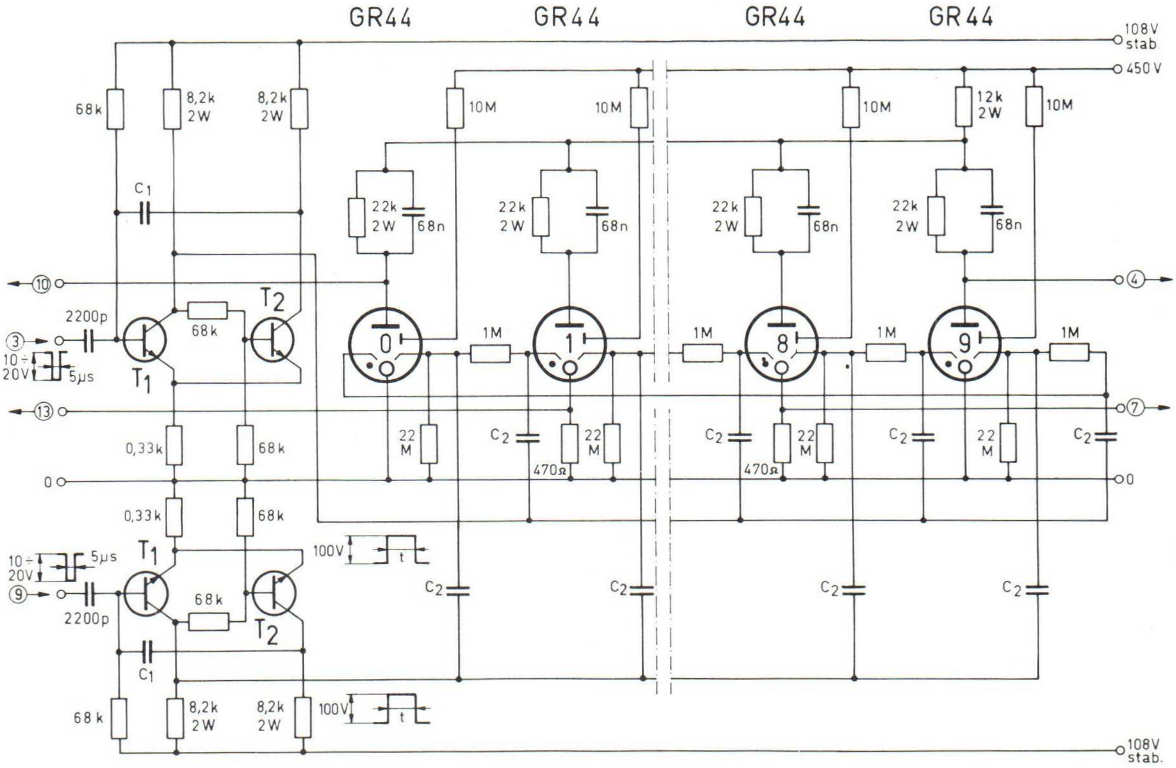
Terminals:

⑤ Input
⑥ Output
0 Ground

3.3 Input Decade "Forwards and Backwards"

The pulses generated by the preceding pulse shaping units (3.1) are employed for triggering two monostable (one-shot) multivibrators formed by transistors T_1 and T_2. These multivibrators generate the pulses of defined height and width for driving the following decade (formed by GR 44 0 to 9).

There are two different types of input decades, one for counting frequencies of up to 1000 c/s, and the other for maximum 150 c/s. The slower decade is definitely recommended for counting frequencies less than 150 c/s.



Technical Data:

Supply:	108 V stabilized, 26 mA 450 V ± 10%, 10 mA
Transistors T_1, T_2:	Collector to base breakdown voltage > 120 V, e.g. BF 109
Resistors:	± 10%, 1/2 W, if not otherwise specified

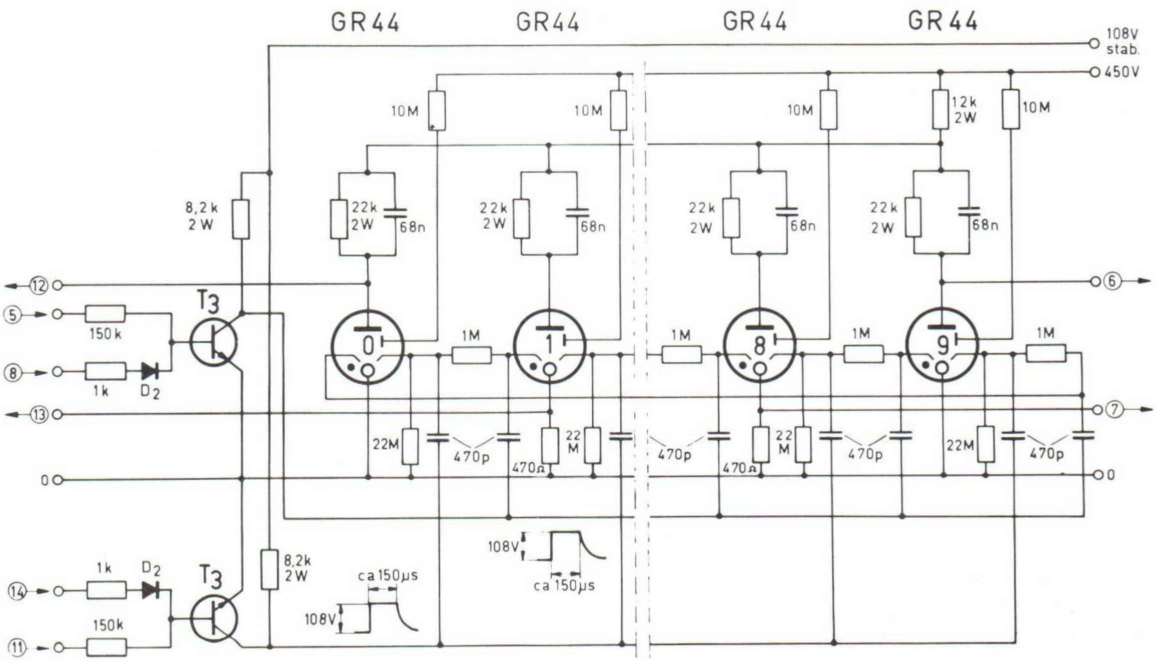
Terminals:

③	Input, forwards
⑨	Input, backwards
④ , ⑦	Outputs, forwards
⑩ , ⑬	Outputs, backwards

Values of C_1 and C_2 see 3.2

3.3.1 Follower Decades "Forwards and Backwards"

The buffer stages (T_3) at the input of the follower decade changes the pulses fed by the preceding decade in such a way that the following decade (formed by GR 44 0 to 9) can be driven. Any number of follower decades can be connected in series.



Technical Data:

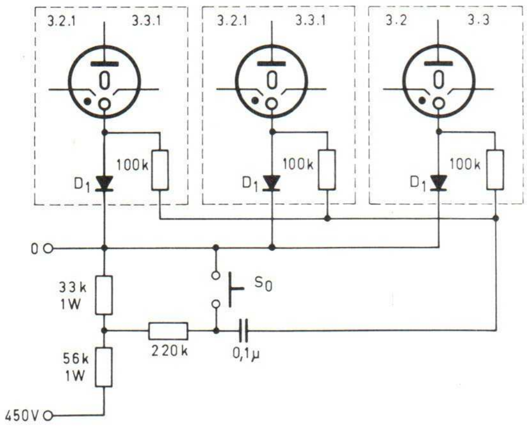
Supply:	108 V stabilized, 26 mA 450 V ± 10%, 10 mA
Transistor T_3:	Collector to base breakdown voltage > 120 V, e.g. BF 109
Diode D_2:	e.g. OA 200
Resistors:	± 10%, 1/2 W, if not otherwise specified

Terminals:

(5) , (8)	Inputs, forwards
(11) , (14)	Inputs, backwards
(6) , (7)	Outputs, forwards
(12) , (13)	Outputs, backwards

4. EXTENSION POSSIBILITIES

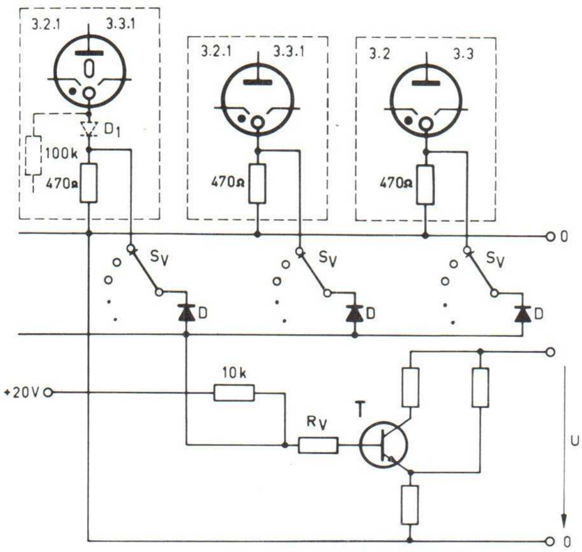
4.1 Resetting



By operating the pushbutton S_0 the "0" tubes of all the decades are fired by momentarily applying a negative pulse between cathode and ground.

(The diodes D_1 should be placed in the cathode leads of the GR 44 "0" tubes of all the decades). D_1 can, for example, be a 2E4 diode of International Rectifiers.

4.2 Preselection

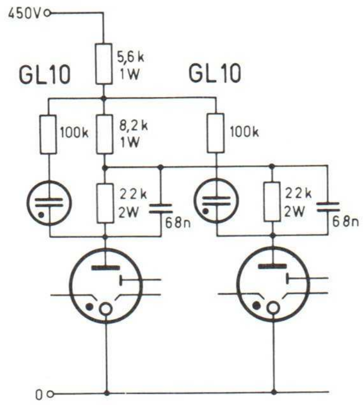


As soon as the digits preselected by the switch S_V are reached by the individual decades, the transistor T becomes conducting and supplies a signal which can be employed for several purposes. (If resetting and preselection are to be carried out on the same tube, the diodes D_1 (see circuit 4.1) should be inserted as indicated in dotted lines in fig. 4.2).

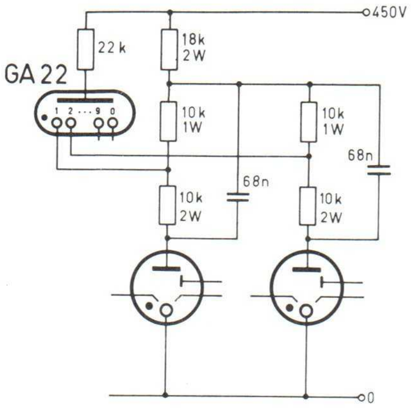
4.3 Indication Possibilities

For visual indication of the switching condition of the anode circuit, the counter units should be modified as shown in the following circuits.

4.3.1 Indication with glow lamps (GL 10)



4.3.2 Indication with numerical indicating tubes (GA 22)



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CERBERUS

TEMPERATURGESTEUERTES RELAIS MIT NTC-WIDERSTAND UND GT 21
RELAIS COMMANDE PAR TEMPERATURE AVEC THERMISTANCE ET GT 21
TEMPERATURE CONTROLLED RELAY WITH THERMISTOR AND GT 21

Type	
Nr.	58.11
Ed. 6.64	Fol. 1

Die Schaltungen eignen sich zur Zweipunkttemperaturregulierung und zur Temperaturüberwachung im Bereiche von -25° C bis +125° C.

Als Temperaturfühler wird ein NTC-Widerstand verwendet.

FUNKTIONSBESCHREIBUNG

Das Relais Rel zieht bei einem bestimmten, durch das Potentiometer P einstellbaren Wert des NTC-Widerstandes R (und damit der Temperatur) an und fällt bei einem kleineren Wert wieder ab. Die Umkehrung dieser Schaltfunktion entsteht durch das Vertauschen der Komponenten R und P.

Die Schaltgenauigkeit ist vom Temperaturkoeffizienten des NTC, der Spannung über dem NTC, der Konstanz der Netzspannung, der Schalttemperatur und dem Schaltintervall abhängig.

Les circuits se prêtent au réglage de température par système "tout-ou-rien" et à la surveillance de températures dans la gamme de -25°C jusqu'à +125°C.

Une thermistance est utilisée à titre de sonde sensible à la température.

DESCRIPTION DU FONCTIONNEMENT

Le relais Rel attire à une certaine valeur de la thermistance R, réglable par le potentiomètre P déterminant la température de commutation; il retombe lorsque la valeur devient inférieure. On inverse le procédé de commutation en interchangeant les éléments R et P.

La précision de la commutation dépend du coefficient de température de la thermistance, de la constance du secteur, de la température de commutation et de l'intervalle.

The circuits are especially suitable for ON - OFF temperature regulators and temperature supervision in the range from -25°C to +125°C.

A thermistor is used as temperature-sensor.

CIRCUIT DESCRIPTION

When the thermistor R reaches the value determined by the temperature setting potentiometer P, the relay Rel will be energized. It will be deenergized at a lower level. If the components R and P are interchanged this operation is reversed.

The switching accuracy depends on the temperature coefficient of the thermistor, the voltage across the thermistor, the stability of the line voltage, the switching temperature and the switching interval.

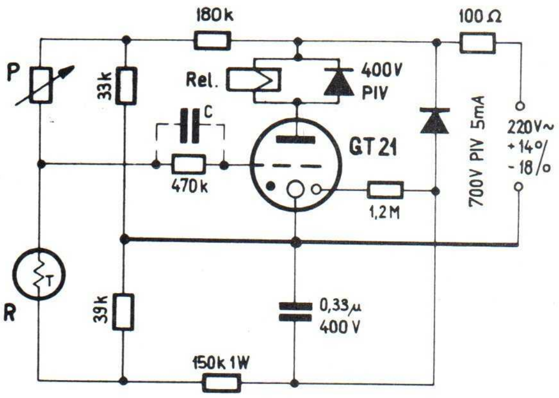

Fig. 1
Schaltung für kleine Schaltgenauigkeit
Circuit à large tolérance d'enclenchement
Circuit for large switching tolerance

	NTC ca. 500 kΩ, K ≥ 4%/°C, L ≤ 0,12°C/mW
R	Thermistance env. 500 kΩ, K ≥ 4%/°C, L ≤ 0,12°C/mW
	Thermistor approx. 500 kΩ, K ≥ 4%/°C, L ≤ 0,12°C/mW

Siemens K II 500 / 3 x Philips B 8.320.07P/150 k / Compagnie Industrielle des Céramiques Electroniques 1 MΩ, type B, 5%/°C

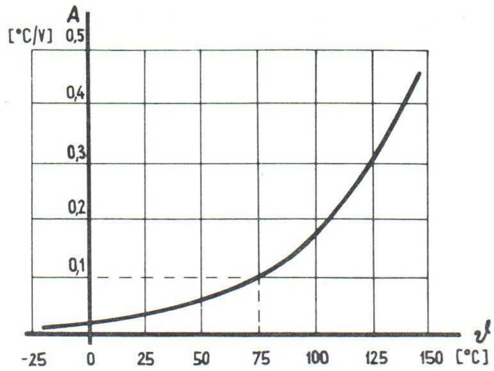

Fig. 2
Typischer Netzspannungskoeffizient der Schaltung 1 (A= Schaltfehler in °C pro Volt Netzspannungsänderung als Funktion der Schalttemperatur)

Influence de la tension du réseau dans circuit 1 (A=erreur de commutation en °C par volt de variation de la tension du réseau en fonction de la température de commutation)

Typical line voltage coefficient of circuit 1 (A= switching error in °C per volt change of line voltage as a function of the switching temperature)

ANWENDUNGSBEISPIEL FUER FIG. 2

Gegeben ist die Schalttemperatur von 75° C und die Netzspannung von 220 V ± 20 V ; es wird nach der Schaltgenauigkeit B in °C gefragt.

Die Kurve zeigt, dass zur Schalttemperatur von 75°C ein Schaltfehler (A) von 0,1°C/V gehört. Daraus folgt:
B = ± 20 V · 0,1° C/V = ± 2° C.

EXEMPLE D'APPLICATION POUR FIG.2

Connaissant la température de commutation (75° C) et la tension du secteur de 220 V ± 20 V, on désire connaître la précision de commutation B en °C.

La courbe indique pour la température de commutation une erreur (A) de 0,1°C/V.
Il en suit: B = ±20 V · 0,1° C/V = ± 2°C.

APPLICATION EXAMPLE FOR FIG. 2

Given a switching temperature of 75°C and a line voltage of 220 V ± 20 V; it is desired to find the switching tolerance B in ° C. The curve shows for 75° C a switching error (A) of 0,1°C/V.
Therefore:
B = ± 20 V · 0,1°C/V = ± 2° C.

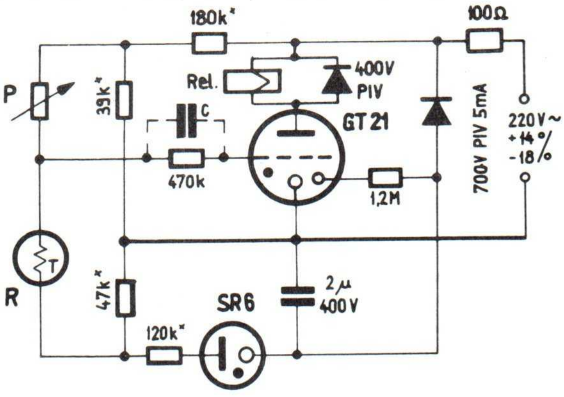

Fig. 3
Schaltung für grosse Schaltgenauigkeit
Circuit à tolérance étroite d'enclenchement
Circuit for close tolerance switching

R wie Schaltung 1 / comme circuit 1 / as circuit 1

x Widerstände / résistances / resistors / ± 5%, 1/2 W

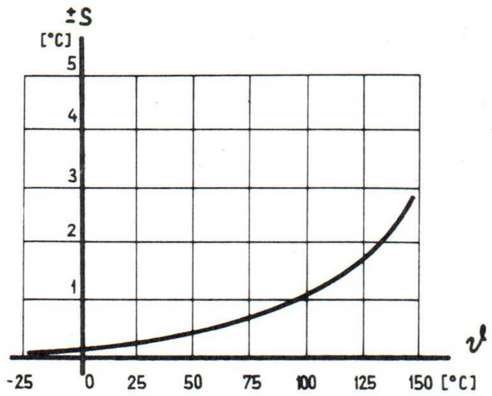

Fig. 4
Typischer Schaltfehler in °C für Schaltung 3 bei Netzspannungsvariationen von -18% bis +14%

Erreur de commutation typique en °C pour le circuit 3 due à une variation de la tension réseau de -18% à +14%

Typical switching error in °C for circuit 3 with line voltage variations of -18% to +14%

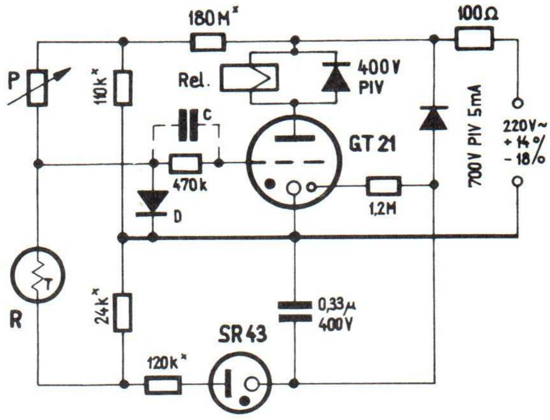

Fig. 5
Schaltung für schwach belastbare NTC
Circuit pour thermistances à faible puissance
Circuit for low dissipation thermistor

NTC ca. 500 kΩ, K ≥ 4%/°C, L ≤ 3°C/mW
R Thermistance env. 500 kΩ, K ≥ 4%/°C, L ≤ 3°C/mW
Thermistor approx. 500 kΩ, K ≥ 4%/°C, L ≤ 3°C/mW

Standard Telephones and Cables Ltd. G 55, GT 55 / Philips B 8.320.03P/680 k.

D Diode, Texas Instruments 1 S 130, Philips OA 200

x Widerstände / résistances / resistors / ± 5%, 1/2 W

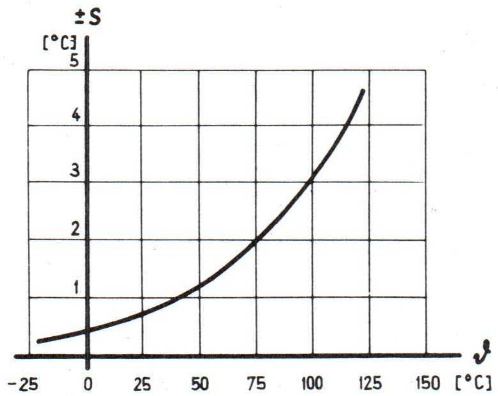

Fig. 6
Typischer Schaltfehler in °C für Schaltung 5 bei Netzspannungsvariation von -18% bis +14%

Erreur de commutation typique en °C pour le circuit 5 due à une variation de la tension du réseau de -18% à +14%

Typical switching error in °C for circuit 5 with line voltage variations of -18% to +14%

Potentiometer, log. 1/4 W, ca. 2 x Widerstandswert von NTC bei tiefster Schalttemperatur
P Potentiomètre, log. 1/4 W, env. le double de la résistance de la thermistance à la plus basse température de commutation
Potentiometer, log. 1/4 W, approx. 2 x resistance of thermistor at lowest switching temperature

K Temperaturkoeffizient / coefficient de température / temperature coefficient / %/°C

Wärmewiderstand (NTC gegen Umgebung) °C / mW
L Résistance thermique (entre thermistance et entourage) °C / mW
Thermal resistance (thermistor to ambient) °C / mW

C ~6800 pF, 150 V / (nur für Schaltintervall) / (pour intervalle de commutation seulement) / (for switching interval only)

Relais, siehe Blatt "Relais zu Kaltkathoden-Relaisröhren"
Rel Relais, voir feuille "Relais pour tubes à cathode froide"
Relay, see sheet "Relays for cold cathode tubes"

Widerstände ± 10 %, 1/2 W (wo nicht anders vermerkt)
Résistances ± 10 %, 1/2 W (à défaut d'indications contraires)
Resistors ± 10 %, 1/2 W (if not otherwise specified)

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CERBERUS	INDUKTIVER GRENZWERTSCHALTER MIT TRANSISTOR-OSZILLATOR UND GT 21 PALPEUR FIN DE COURSE INDUCTIF A OSCILLATEUR TRANSISTORISE ET GT 21 INDUCTIVE LIMIT SENSER WITH TRANSISTOR OSCILLATOR AND GT 21	Type Nr. 63.11 Ed. 8.63 — Fol. 1

Die unten angegebenen Schaltungen können z.B. zur induktiven Ueberwachung der Zeigerstellung von Messinstrumenten oder als induktiv betätigte Endschalter verwendet werden. Die Schaltgenauigkeit hängt unter anderem von der Durchbildung des Abtastkopfes ab. Ohne darauf besonderes Gewicht zu legen, wurden in der praktischen Erprobung Schaltgenauigkeiten von einigen Zehntelsmillimetern erreicht (Netzspannung 180 V - 250 V, Umgebungstemperatur 0°C - 55°C).

Les circuits indiqués sont utilisés pour surveiller la position de l'aiguille d'un instrument de mesure par capteur inductif ou comme interrupteur fin de course inductif. La précision de commutation dépend entre autre de la construction de la tête de mesure. Sans la soigner, des exactitudes de quelques dixièmes d'un millimètre ont été réalisés. (Tension d'alimentation variant entre 180 et 250 volts CA, température ambiante variant entre 0°C et 55°C).

The circuits given below can be used for inductive sensing of the pointer position on instruments or as inductively activated limit switch. Precision of switching depends, amongst other factors, on the construction of the senser. Without pushing this construction, switching accuracies of a few tenths of a millimeter have been obtained (line voltage 180 V to 250 V AC, Ambient temperature 0°C to 55°C).

FUNKTIONSWEISE

Beim eingestellten Schaltpunkt dämpft die Metall-Abstimmfahne (A) den Oszillator so stark, dass die gleichgerichtete Schwingungsamplitude die Röhre GT 21 nicht mehr zündet. Das Relais (Rel) fällt ab und zieht erst wieder an, nachdem die Stellung der Abstimmfahne genügend verändert ist. (Wählbares Schaltintervall)

FONCTIONNEMENT

Au point de commutation ajusté la plaquette métallique (A) amortit l'oscillateur à mesure que l'amplitude de l'oscillation redressée ne suffit plus à amorcer le tube GT 21. Le relais (Rel) relâche et attire seulement après un déplacement suffisant de la plaquette A. (L'intervalle de commutation peut être choisi).

PRINCIPLE OF OPERATION

At a set switching point the metal flag (A) damps the oscillator so much that its rectified output voltage does not fire the tube GT 21 anymore. The relay (Rel) falls off and is operated again after a sufficient displacement of the flag. (Switching interval can be selected).

Schaltung A

(Oszillatorschaltung gemäss Camille Bauer, Capa-Regler, Oszillatorfrequenz ca. 5 MHz).

Das Schaltintervall ist durch das Produkt $R_I \cdot C_I$ bestimmt. Für kleines Schaltintervall: R_I = 470 kΩ, C_I = 15 nF.

Schaltung B

(Oszillatorschaltung gemäss Withof Getrosist-Regler, Oszillatorfrequenz ca. 200 kHz).

Das Schaltintervall ist durch das Produkt $R_I \cdot C_I$ bestimmt. Für kleineres Schaltintervall: R_I = 470 kΩ, C_I = 10 nF.

Circuit A

(Circuit de l'oscillateur: Camille Bauer, Capa-Regler, frequence env. 5 Mc).

L'intervalle de commutation est déterminé par le produit $R_I \cdot C_I$. Faible intervalle avec: R_I = 470 kΩ, C_I = 15 nF.

Circuit B

(Circuit de l'oscillateur: Withof Getrosist-Regler, frequence env. 200 kc).

L'intervalle de commutation est déterminé par le produit $R_I \cdot C_I$. Faible intervalle avec R_I = 470 kΩ, C_I = 10 nF.

Circuit A

(Oscillator circuit according to Camille Bauer, Capa-Regler, Oscillator frequency approx. 5 Mc).

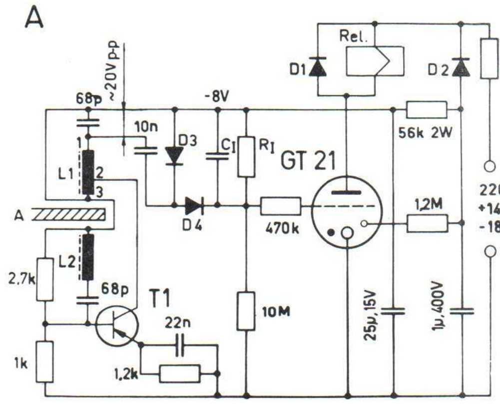
The product $R_I \cdot C_I$ determines the switching interval. Small switching interval when: R_I = 470 kΩ, C_I = 15 nF.

Circuit B

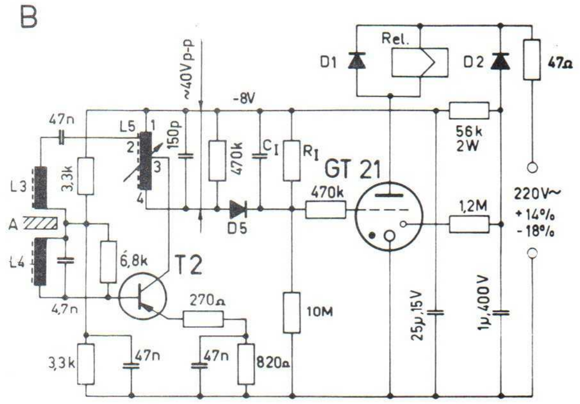
(Oscillator circuit according to Withof Getrosist-Regler, Oscillator frequency approx. 200 kc).

The product $R_I \cdot C_I$ determines the switching interval. Small switching interval when: R_I = 470 kΩ, C_I = 10 nF.

A



B



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Rel	Relais, siehe Blatt 20.01 "Relais zu Kaltkathodenröhren" Relais, voir feuille 20.01 "Relais pour tubes à cathode froide" Relay, see sheet 20.01 "Relays for cold cathode tubes"
T1	Transistor / transistor / transistor OC 615 (Telefunken)
T2	Transistor / transistor / transistor 2N1305 (Texas Instruments)
D1	Diode, 300 V PIV*, 25 mA (2E4: Internat. Rectifiers)
D2	Diode, 700 V PIV*, 5 mA (SD98: Internat. Rectifiers - OA211: Philips)
D3, D4	Diode, 40 V PIV*, (TI - 2: Texas Instruments)
D5	Diode, 150 V PIV*, (OA202: Philips)
	* PIV : Spitzensperrspannung / Tension inverse de pointe / Peak inverse voltage
L1	Kernmaterial / Matériau de noyeau / Core material : 300 M II, Siemens 1-2: Windungen / tours / turns : 30 - 0,20 CuL 2-3: Windungen / tours / turns : 20 - 0,20 CuL
L2	Kernmaterial / Matériau de noyeau / Core material : 300 M II, Siemens Windungen / tours / turns : 25 - 0,20 CuL
L3, L4	ca. / environ / approx. 125 µH
L5	Kern / noyeau / core : K.3.002.22, Philips 1-2: Windungen / tours / turns: 5 - 0,15 CuL 2-3: Windungen / tours / turns: 18 - 0,15 CuL 3-4: Windungen / tours / turns: 180 - 0,15 CuL
Widerstände	± 10%, 1/2 Watt
Résistances	± 10%, 1/2 Watt
Resistors	± 10%, 1/2 Watt

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