

NSG 431



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ATTENTION:

THIS EQUIPMENT AND ALL THE ACCESSORIES DESCRIBED THEREIN OPERATE AT HIGH VOLTAGE. IMPROPER HANDLING AND IGNORING INSTRUCTIONS IS DANGEROUS. ONLY TRAINED PERSONNEL SHOULD WORK WITH THE UNITS, EQUIPMENT COVER MUST NOT BE REMOVED. COMPONENT REPLACEMENT AND ALL INTERNAL ADJUSTMENTS MUST BE CARRIED OUT BY QUALIFIED PERSONNEL.

1) INTRODUCTION

In certain environmental conditions, objects - as well as human beings - can charge themselves with electrical energy.

This can be explained as follows:

When two insulating materials with different dielectric constants are rubbed against each other one material transfers electrons to the other. The resulting potential difference is discharged in a short compensating action when another metal object is approached, whereby an arc occurs and strong magnetic fields are built up.

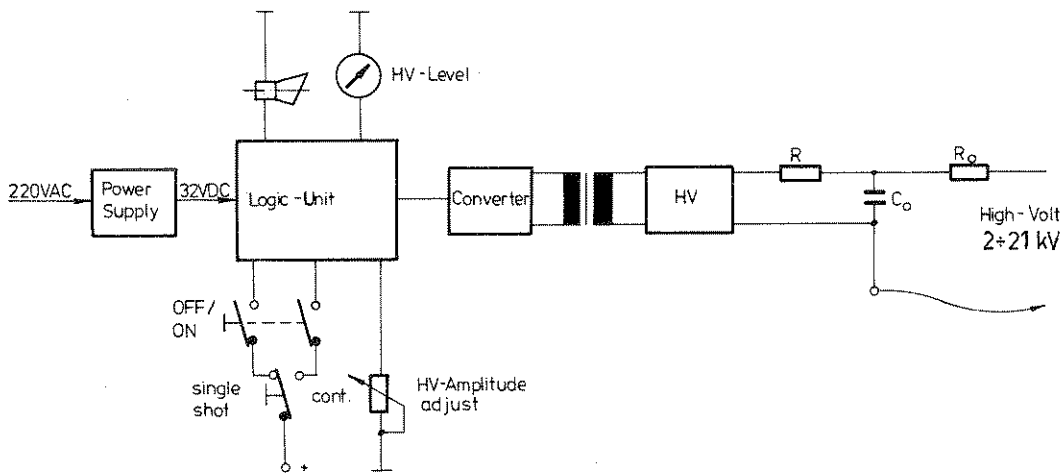
In areas where data processing equipments are installed the relative humidity can drop below 50 % due to the dissipation from the equipment which is given up to the surroundings. Since the danger exists that electrostatic charging takes place with decreasing humidity, it is possible that people also charge themselves up in such surroundings. This can take place through friction on a synthetic carpet or between two vestments. The resulting potential can reach several kV. When a conducting object is approached a compensating action occurs, which is felt as a slight shock. The compensating current which flows and the accompanying electromagnetic field leads to malfunctioning or destruction of components in installations which are not sufficiently protected. It is necessary to systematically test such systems which are subject to interference if the economic disadvantages cannot be accepted.

2) APPLICATION

The effect of electrostatics on the operation of components in data processing systems, control and regulating equipments, automobile electronics as well as measuring and weighing systems

must not be left to chance. For this reason a continuous control is necessary during development and in production. The NSG 431 was developed according to various provisional standards like EWG C.42, CIGRE, VG, VDE, PTT and IEC, TC 65/WG4 Working paper.

3. MODE OF OPERATION



A power supply, which can be operated from 100, 120, 220, and 240 V, supplies a DC voltage ($32 \div 36$ VDC) to the generator. The output voltage can be continuously adjusted by means of the knob "HV-Level" in the range 2 KV to 21 KV and is indicated on a built-in voltmeter. With the change-over switch "Cont/Single" two modes of operation can be selected, these are:

"Cont" for repetitive discharges (approx 10 Hz)

"Single" for single discharges

The distance between test object and test probe, depending on the test voltage, can be set with the distance ring. High voltage is produced when the press switch located in the handle of the generator, is depressed.

4. Operating controls

① Indicator instrument

② Ground connection

③ Ground cable

④ Ground connection for laboratory cable

⑤ Change-over switch "cont./single"

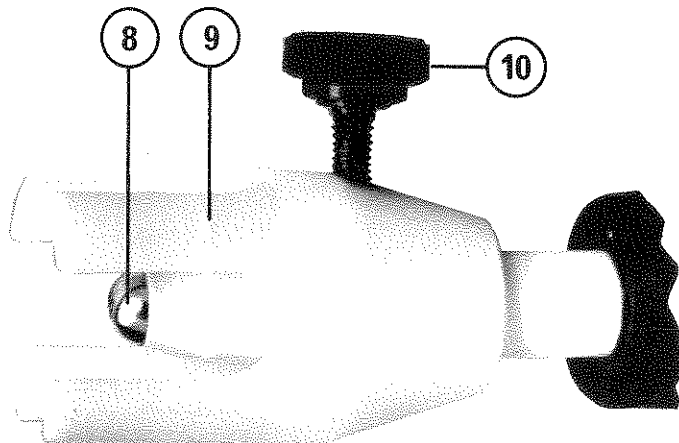
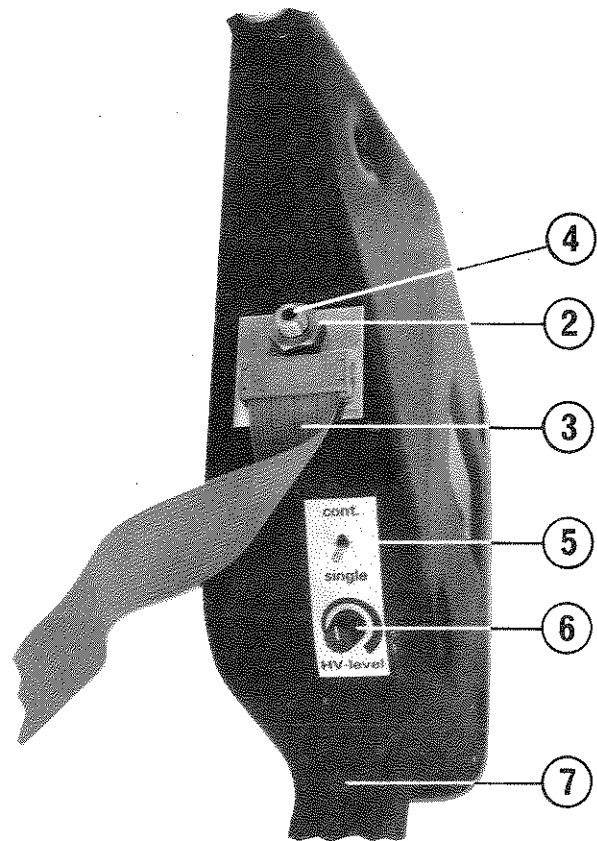
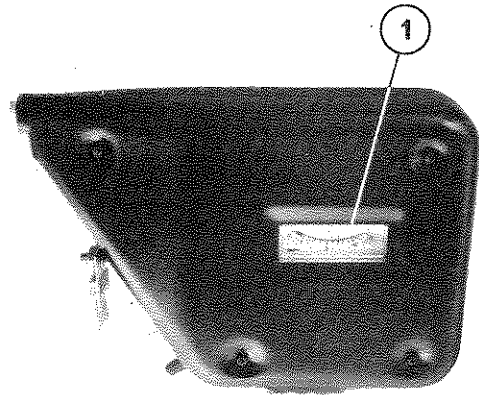
⑥ HV-Level adjustment

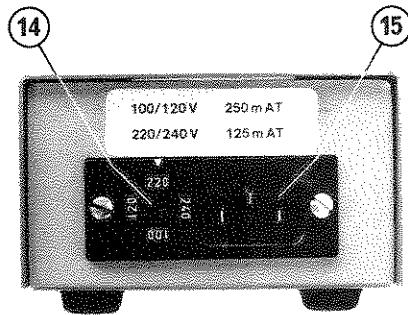
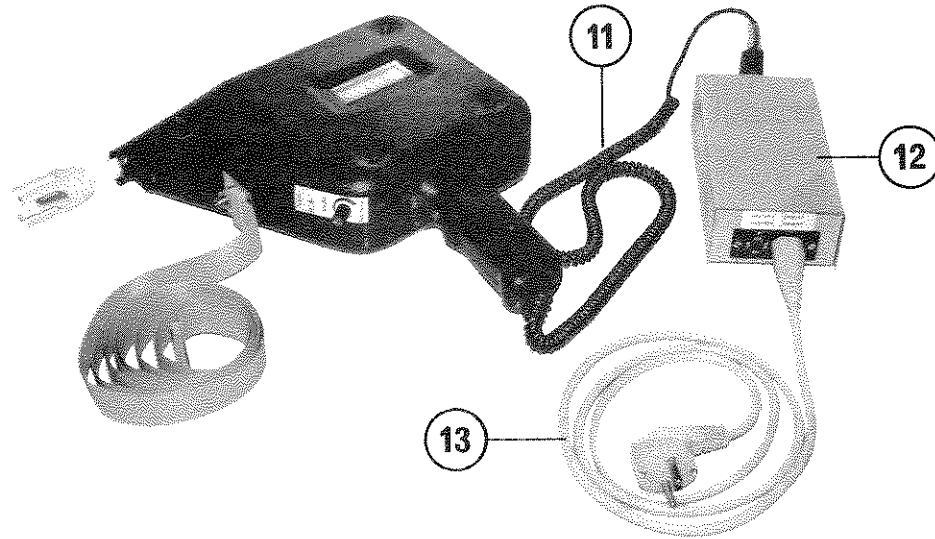
⑦ Switch "ON/OFF"

⑧ Test finger (IEC-Standard)

⑨ Distance ring

⑩ Test adjustment screw





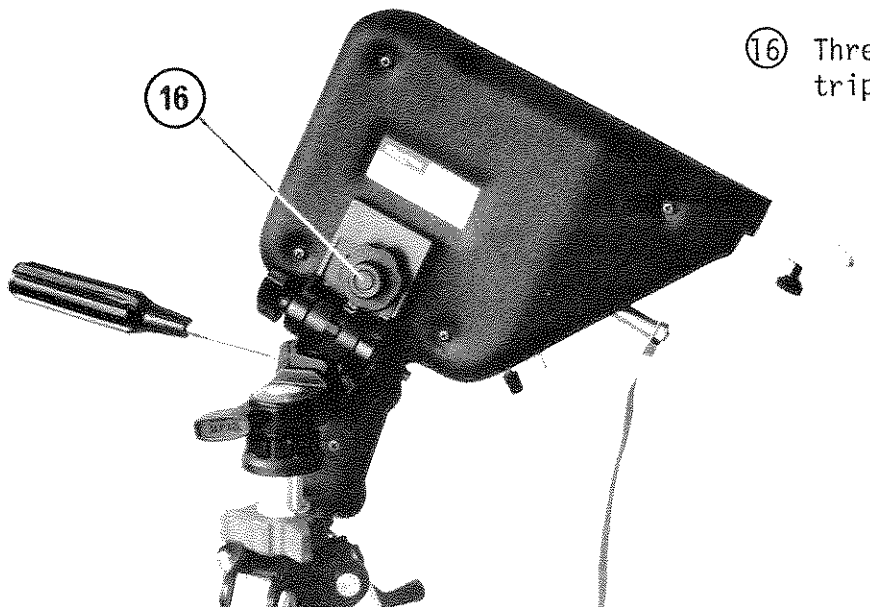
① Connection cable 32VDC

② Power supply

③ Mains cable

④ Voltage selector whit fuse

⑤ Mains connection



⑥ Thread for fixation of tripod

5. OPERATION


5.1 Preparation

Before putting the generator into operation, the following points should be checked:

- a) Set voltage selector (14) on power supply (12) to the correct value and put in the appropriate fuse.
- b) Only connect power supply to a mains socket where a protecting earth line is available.
- c) Connect ground cable (3) to ground connection (2) and to test object or ground.
- d) Set HV Level to the minimum position.
- e) Connect test pistol with cable (11) to power supply (12).
- f) As a safety measure the test finger (8) should be discharged by grounding it.

5.2 Adjustments

5.2.1 Repetitive discharges

- a) Set switch (5) to position "cont". The repetition frequency is approx 10 Hz, depending on voltage setting and amplitude.
- b) Select the desired discharge voltage with knob (6). The value selected ($2\div 21\text{ kV} \pm 10\%$) can be read on the built-in voltmeter (1).
-  c) After every reduction of the setting on (6) the test finger must be discharged to ground. (the condenser could still be charged to a higher voltage)
- d) To ensure repetitive discharges a minimum distance (gen. $0.3\div 1.5\text{ kV/mm}$) must be maintained, so that the discharge condenser can recharge itself. The required distance can be set with the distance ring (9) and a depth gauge.
- e) To switch on the high voltage, press switch (7) must be depressed continuously.

5.2.2 Single discharges

- a) Set switch (5) to position "single".
- b) Select the desired voltage with knob (6). The value selected ($2 \div 21 \text{ kV} \pm 10\%$) can be read on the built-in voltmeter (1).
- c) After every reduction of the setting (6) the test finger must be discharged to ground.
- d) With switch (7) the discharge condenser C_0 will be charged once only.
- e) Slowly approach test object with the test finger (0.1 m/s) until contact is made, in order that a guaranteed discharge takes place at low voltages.



5.2.3 Continuous operation

The test generator was not developed for continuous operation or long term investigations. Operating times in excess of 1Hr. should be avoided.

- a) Set switch (5) to position "cont".
- b) Select desired discharge voltage with knob (6).
- c) Press switch (7) and in this position set switch (5) to position "single". Continuous operation is switched on.
- d) Release switch (7). The unit remains in operation.
- e) The test finger must be discharged to ground after every reduction of the discharge voltage.
- f) Continuous operation can be switched off by switching over switch (5) to position "cont". The press switch (7) should not be depressed.

5.2.4 Tripod mounting

The generator can be mounted onto a tripod by means of thread (16). When testing, the required distance is set with the distance ring and the tripod adjusted so that a slight pressure is obtained between the distance ring and the test object. Thread type: UNC 1/4"

5.3 Breakdown recognition

Above approx. 2000V discharge voltage, discharges to HV ground ④ are indicated by an acoustic signal when switch ⑥ is in position "single". (when several discharges occur consecutively however, each discharge cannot be indicated)

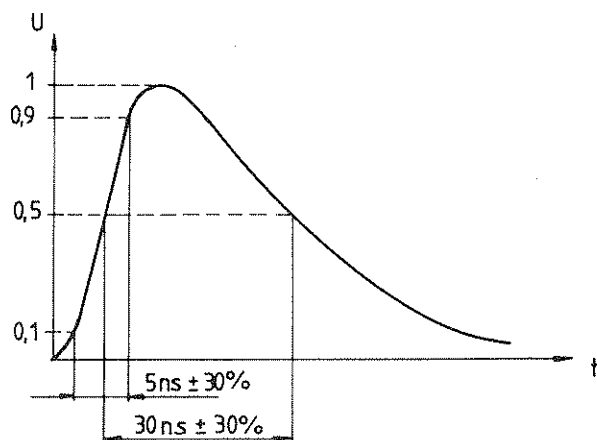
5.4 Safety

- The maximum discharge parameters are defined by IEC regulation 348.
- Discharge before use, HV condensers have no discharge resistances!
- Discharge after use (single discharges would otherwise not be possible)
- Grounding compulsory (Protection class I)
- Only use the unit in dry rooms.
- Units with faulty covers may not be put into operation. Emergency repairs do not fulfil the safety regulations.
- There is a high frequency current of approx 6 mA AC (measured between HV-ground ④ and distribution system ground)

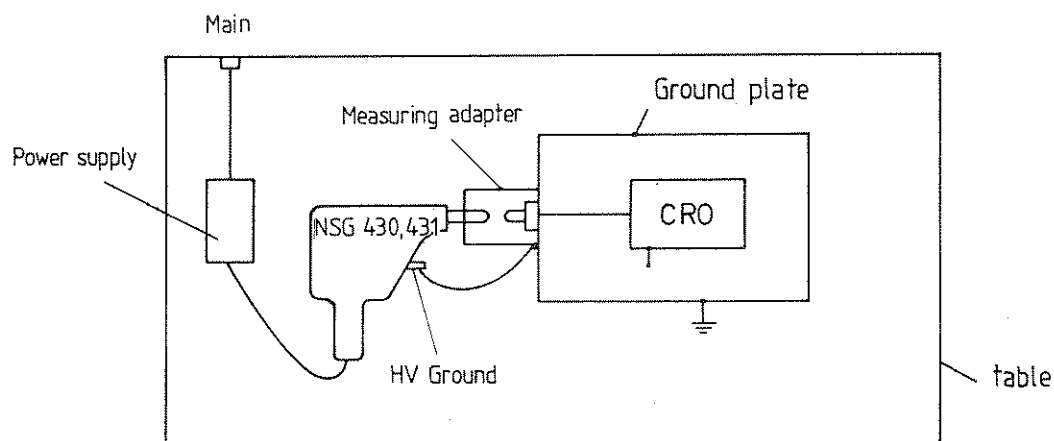
Attention

The return line of the HV discharge should be always setted to the ground connection ② / ④ . If there is a discharge directly to earth and the connection ② / ④ is not connected to the same earth, electronic devices being close by may be disturbed or even destroyed. Also NSG 430 or 431 may be damaged.

d) Discharge pulse definition



e) Complete measuring set-up



The oscilloscope required for the measurements must meet the following specifications:

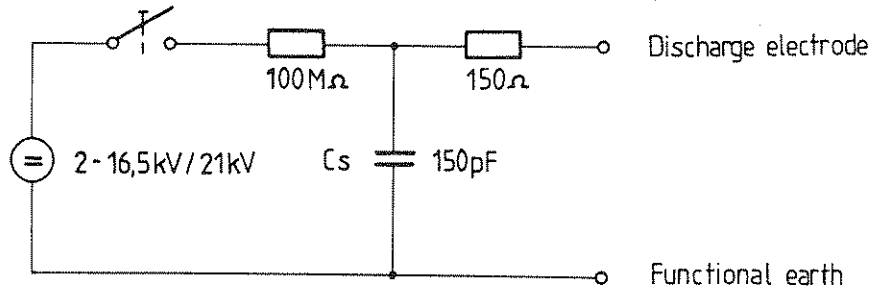
- Storage capability
- Rise time $< 4.5 \text{ ns}$
- Good EMC screening (ie not portable model)
- Input impedance 50Ω or $1 \text{ M}\Omega$ with 50Ω terminal at the oscilloscope input

9. OPTIONS

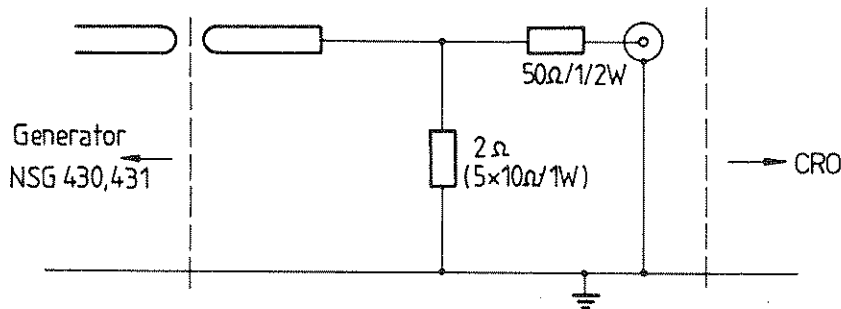
9.1 Measuring adapter

The measuring adapter SL 402-283 is intended (in the first instance) for use in measuring the discharge pulses of the NSG 430 and NSG 431 equipments. The development of the measuring is based on an IEC standards draft 65 (sec) 80. The following diagrams have been taken from this draft.

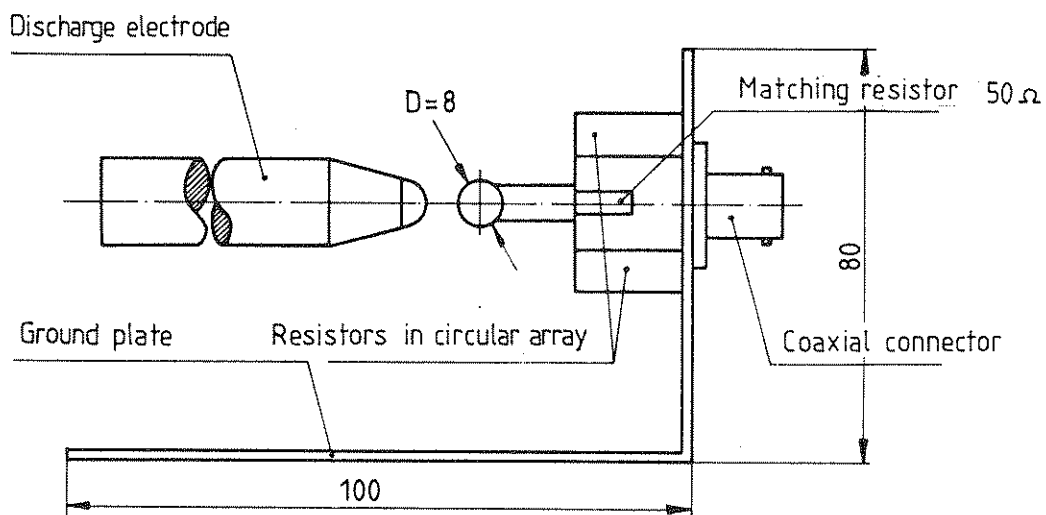
a) Equivalent electrical circuit of the generator



b) Equivalent electrical circuit of the measuring adapter



c) Mechanical construction of the measuring adapter (see mech. drg. 500 312)



- To calibrate the indicator instruments the right-hand cover case has also to be removed. Then the output voltage must be measured with a high resistance external meter (R_i 20G) at the test finger with the unit in operation "cont" and "on". This measurement is then valid for the calibration with P_3 (see Schematic and layout) of the internal instrument. The calibration current-which controls the 1 kV indication-can be adjusted additionally by P_4 . The tolerance between the indication value of the instrument in NSG 430/431 and the real output voltage is as follows.

for $< 5 \text{ kV} \pm 500 \text{ V}$

for $> 5 \text{ kV} \pm 10 \%$

- Fuse set after removing the right-hand cover case (400mAF/5 x 20mm according to IEC 127/II (DIN 41661))
- When the cover case is damaged it must be replaced. It is not permitted to make a temporary repair, since the insulation can no longer be guaranteed.

8.3 Parts list and layout

8.4 Schematics

8. MAINTENANCE

Attention:

- Maintenance work may only be carried out by qualified personnel.
- Before opening unit pull out mains plug.
- Consider the high voltage condensers as charged until you have assured yourself otherwise.
- The unit may only be transported in the original packing.

8.1 Power supply

The power supply is maintenance free.

The fuse is in the voltage selector (15) , it can be removed with a screw driver from the plug side after removing the mains cable. Fuse type 5x20 mm according to IEC 127/III (DIN 41662)

220/240 V	125mA slow blow
100/120 V	250mA slow blow

8.2 Simulator

- Clean cover case only with soapy water cloth
- After removing the righthand cover casing the output voltage calibration is done with the trimmer P_2 (see Schematic and layout). The HV - Level is set to maximum and the voltage is measured with a suitable instrument ($R_i \geq 20G\Omega$)* in the operational mode "cont" and "on". If the voltage does not agree with the 21 kVDC setting readjust with P_2 . It must, however, be noted that the cascade input AC voltage may not exceed 6kVpp. When necessary the AC voltage can also be measured with an high impedance probe ($R_i \geq 100M\Omega$).

Reasons for the fault could be the cascade, series resistances or the charging condenser when the voltage ist too low.

(Class of the external calibration device better than $\geq 2\%$).

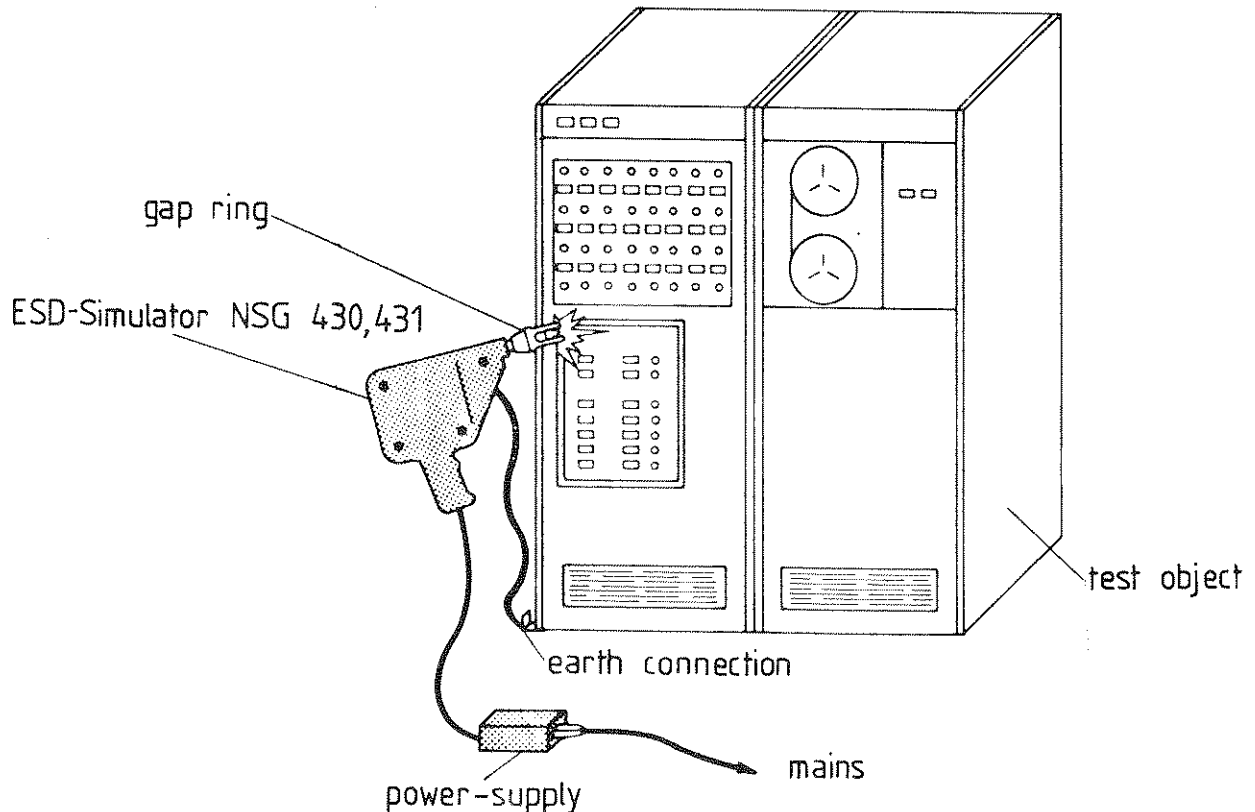
7) EXAMPLES OF USAGE

In general measurements are made with single discharges. For search and calibration a repetitive discharge is more useful.

The following examples are gathered together from recommendations and guide lines.

- 1) Setting of the desired voltage and slowly approaching the test object (approx. 0,1 m/s) until a discharge occurs.
- 2) Setting of the required distance (approx. $0,3 \div 1,5$ kV/mm) with the distance ring adjustment between the test finger and the test object and then raising the voltage until a discharge occurs.

Typical test set-up



6) TECHNICAL DATA

Discharge voltage U_0	:	2kV to 21 kV $\pm 10\%$
Rise Time	:	5 ns $\pm 30\%$ at 2kV
Half amplitude width	:	30 ns $\pm 30\%$ at 2kV
Polarity	:	positive *
Discharge condenser C_0	:	150 pF * $\pm 10\%$
Discharge resistance R_0	:	150 ohm * $\pm 5\%$
Repetition frequency	:	approx. 10Hz $U_c \cong 99\%$
Source resistance HV generator R_1	:	150 M Ω $\pm 10\%$
Hold time single	:	5s ($U_0 - 10\%$)
Supply voltages	:	100/120/220/240 VAC $\pm 10\%$ 50/60Hz
Power consumption	:	approx. 25 VA
Temperature range	:	5 - 40 $^{\circ}$ C
Humidity	:	20% - 80% (not condensing)
Suppression level	:	N (according to VDE 0875)

* Other values on request

Dimensions:

Test finger	:	\emptyset 12x80 mm \emptyset 0.47x3.15"
Generator	:	260x300x56 mm 10.23"x11.81"x2.20"
Power supply	:	160x91x56 mm 6.3"x3.58"x2.20"
Ground cable	:	approx. 2m 78.75"
Carrying case	:	520x375x125 mm 20.47"x14.76"x4.92"

Weight:

Generator	:	approx. 1.2kg 2.65 lb
Power supply	:	approx. 1.1kg 2.43 lb

Accessories (included):

SL 402 194	Carrying case	Mains cable with plug according to order number:
SL 402 193	Fuse set	SL 402 187 for D/F/NL/I/E/B/N/SF
SL 402 170	Power supply	SL 402 188 for Switzerland
SL 402 233	Test finger	SL 402 189 for USA and Canada
SL 402 229	Distance set for test finger	SL 402 033 without plug
SL 402 173	Ground connecting cable (2m)	

Options

SL 402 283	Measuring adapter
SL 402 349	Adjustable Spark gap

In order to obtain the specified data, proceed with the measurements as follows:

1. Switch (5) to "cont" position
2. Set discharge voltage to 2kV with knob (6)
3. Depress button (7) and hold, then switch (5) to "single" position
4. Release button (7) (=>operational mode: operation over a long period)
5. Place NSG 430/431 in line with measuring adapter
6. Rapidly approach the measuring adapter sphere with the test finger of the NSG 430/431 until they fully contact each other
7. Move test finter away from measuring adapter sphere
8. Read resulting measurement on CRO

Note

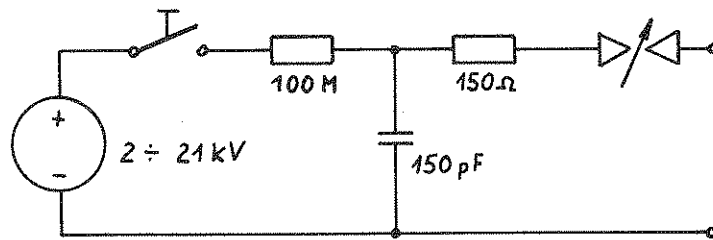
To avoid partial glow discharges and pre-ionisation, the test voltage should be low and the approach speed high.

Measurements which are made according to this procedure ("measuring adapter") and with necessary test set-up enable reproducable results to be obtained as laid down in the IEC draft.

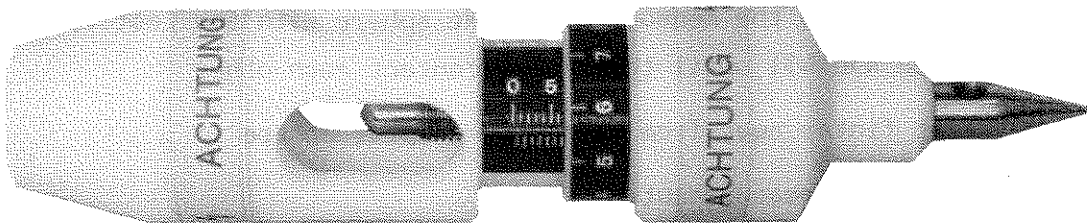
9.2 Adjustable Spark gap

For tests which are not conducted directly on the test object the adjustable spark gap SL 402 349 can be used for the static discharge. The test object is in this case connected directly to the pulse source, the discharge taking place in the additional spark gap.

Principle diagram:



9.2.1 Assembly and operation of the Spark gap



- Set the NSG 430/431 to zero volts and discharge it.
- Set Spark gap to zero mm.
- Push the Spark gap onto the test finger until the discharge point makes contact with the opposite point of the Spark gap. The Spark gap can be locked in this position by using the plastic screw.
- The distance of the Spark gap can now be set according to the test requirements (depending on the environmental conditions 0,3 to 1,5 kV/mm).
- Make contact to the test object (Do not forget the earth connection).
- Switch on the generator and increase the voltage. (If the voltage is set higher than necessary for the Spark gap distance, then the repetition frequency of the discharge will increase. The discharge voltage is in any case dependent on the distance.

1	1	300'031		Leiterplatte			
2	1	125-565		Elektrolytkond. 10µF/40V 20637			ITT
3	1	125-633		" 470µF/100V 20735			"
4	1	120-426		MP-Kond. 150nF/250V~ PM 271 M615			212-007
5	1	114-704		PTC-Wid. 3,5kΩ/6mA/±16% Q63 100-			Siemens
6					p5330 - B 405		
7	1	110'126		Kohleschichtwid.	2,7kΩ/O, 5W/5%		
8	1	130-755		Zenerdiode 36V/1,3W/±5% ZPY36 06341			ITT
9	1	132-205		Transistor Darlington 100V/8A BDW 73C			Fabr.
10	1	131-501		Si-Gleichrichter W 04M B 250 C 800 S			Primotec
11							
12	1	158-203		Lötpilz einfach			
13	2	200'063		Lötpilz doppelt			
14	1	200'321		Winkel			
15	1	159-503		Kabelbinder	SST 1M-M		Summerer
16	1	106'082		Pan-Head-Schraube	M3x10 DIN 85A		CBZ
17	1	109'004		6kt-Mutter	M3 DIN 934		"
18	1	109'628		Schnorr-Si-Scheibe	zu M3		"
19	1	133-502		Glimmerscheibe (12x18)	GS 220P		Summerer
20	1	133-503		Isolierbüchse	ø5xø3x1,9		Fabrimex
21				10-31-483-076 Item 29	Washer		
22							
23							
24							
25							
26							
27							
28							
29				Stromversorgung	600-033		
30							
31							
32							
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34							
35							
36							
37							
38							
39							
40							
41							

Pos.	Stck.	Art. Nr./Lager Nr.	Auftr.	Bezeichnung	Bestell-Nr.	Schema Pos.	Lieferant
Gez	4.2.81/ig						
Änderungen				Leiterplatte kompl. zu Stromversorgung NSG 430/431			
SCHAFFNER		Schaffner Instruments AG CH-4708 Luterbach (Schweiz)		I 264 14.4.81 I 346 24.2.82	Blatt 1	402'190/6	

SCHAFFNER

1	1	402-177		Drossel			ab Lager
2	1	402-237		Spiralschnur			Ab SL
3	1	402-235		Trafo			ab Lager
4	1	300-037		Print			
5	1	118-073		Trimmer 100Ω/lin	70 WTD-K-C	P2	
6	1	118-082		Trimmer 100kΩ/lin	"	P3	
7	1	121-035		Polykarbonatkond. 68nF/400V	222234451683/C7		Philips
8	3	120-555		MKT-Kond.	0,1μF/63V	C2, 3, 4	
9	1	120-560		"	0,68μF/63V	C5	
10	2	125-569		Elektrolytkond. 100μF/40V	20486	C1, 8	
11	1	125-608		"	47μF/63V 20491	C6	
12	1	130-001		Diode 400V/1A	1N 4005	D1	Fabr.
13	11	131-201		" 60V/0,2A	1N 4448	D2-D12	
14	2	132-001		Transistoren	BC 182A	TR1, 2 "	
15	1	132-205		"	BDW 73C	TR3 "	
16	2	132-012		"	TIP 50	TR4, 5 "	
17	1	138-210		IC-Spg. regler	TDB 0117T	IC1	Siemens
18	1	138-215		" + 15V	μA 7815	IC2	
19	2	135-502		Funktions-IC	SAA 1029	IC3, 5	
20	1	200-369		Kühlkörper			
21	2	143-101		Sicherungshalter	1053		Vogt
22	1	144-036		Sicherungseinsatz 400mA	FSF 034,1512		Schurter
23	1	111-426		Metallfilmwid.	180Ω/0,25W/5%	R2	
24	1	111-701		"	100kΩ/ "	R4	
25	1	111-543		"	2,7kΩ/ "	R3	
26	4	111-501		Metallfilmwid.	1kΩ/ "	R7, 8, 9, 11	
27	3	111-601		"	10kΩ/ "	R10, 12, 13	
28	1	111-811		"	220Ω/0,5W/5%	R1	
29							
30	1	112-049		Drahtwiderstand	1kΩ/4W/5%	R5	
31	19	158-203		Lötpilz			
32							
33	1	200-367		Zellkautschukplatte	50x20x15		
34				beidseitig klebend			
35	1	163-505		Messinstrument 200μA+-5%	Nr. 369-E		Wisar
36				inkl. Skala (bis max. 21kV)			
37	1	116-604		Pot. meter 4,7kΩ/0,75W	70 H-C	P1	MOOR
38	1	140-811		Kippschalter 2-pol.	M-2022		Invertag
39	1	140-431		Taster 2-pol.	EB-2061		"
40	1	142-101		Knopf rot Ø8	AT-443		"
41	1	142-103		Plastik-Griffkappe w	AT-415		"

Pos.	Stück	Art. Nr./Lager Nr.	Auflr.	Bezeichnung	Bestell-Nr.	Schema Pos.	Lieferant
Gez	12.8.81	ss	I 485	31.3.83 KP.			
Anderungen	I 340	18.1.82	I 574	29.2.84 WQ.	Elektronik-Print zu NSG 431 komplett		
I 975	30.11.82		I 625	8.8.84			
I 459	3.2.82						

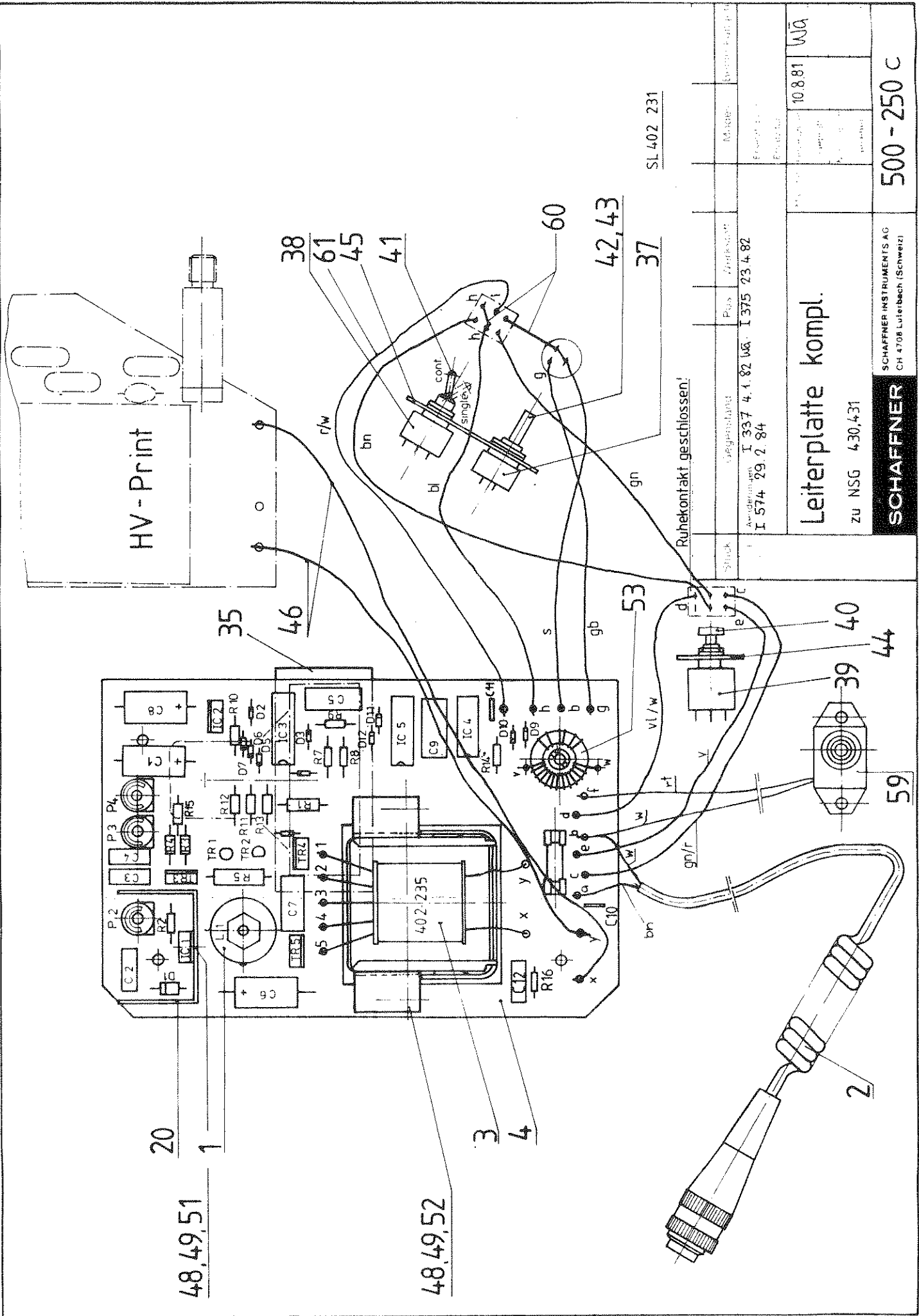
42	1	142-002		Drehknopf	021-2325		Elma
43	1	142-303		Deckel	040-1635		"
44	1	200-357		Halteblech I			
45	1	200-358		" II			
46	460mm	104-006		HV-Kabel	F25 HV 2219		Pfenning
47	2	124-053		Keramikkondensator	22nF / 63V	C10	11
48	3	109-628		Schnorr-Sicherungsscheibe	M3		
49	3	109-004		6-kt-Mutter	M3		
50	1	120-408		Störschutzkondesator	4,7nF/250V	C12	212-002
51	3	106-081		Pan-Head-Schraube	M 3x8		
52	1	112-763		Hochspannungswiderst.	1M Ω /VR 37	R16	211-001
53	1	402-234		Uebertrager			bb Lager
54	1	111-401		Metallfilmwid.	100 Ω /O,25W/5%	R14	
55	1	120-561		Kondensator 1 μ F/63V		C9	
56							
57	1	136-013		IC D-Flip-Flops	IC 4013	IC4	Philips
58							
59	1	147-901		Warntongeber F/SMB 12			Baerl.
60	8cm	103-000		Cu-Draht verzinkt	\emptyset 0,8		019-016
61	10cm	103-613		TQ-Litze 0,22mm ²	\emptyset 1,45		
62	1	133-502		Glimmerscheibe	12x18 GS 220P		
63	3	133-503		Isolierbüchse	\emptyset 5x3x1,9		
64	1	118-086		Trimmer 4,7M Ω	IEC 68	P4	Philips
65	1	110-075		Kohleschichtwid.	1,5M Ω /O,25W/5%	R15	
66	2	109-553		U-Scheibe	M3		
67	1	138-705		IC-Sockel 14 Pin			
68	2	138-706		IC-Sockel 16 Pin			
				Zusammenstellung	500-250		
				Prüfvorschrift	500-285		

Pos.	Stck.	Art. Nr./Lager Nr.	Aufr.	Bezeichnung	Bestell-Nr.	Schema Pos.	Lieferant
Gez. 29.9.81/ig		I 485 31.3.83 R9					
Änderungen I 340 18.1.82		I 574 29.2.84 WD		Elektronik-Print zu NSG 431 komplett			
I 375 30.11.82		I 625 8.8.84					
I 459 3.2.82							

SCHAFFNER	Schaffner Instruments AG CH-4708 Luterbach (Schweiz)	Blatt 2 Anz. Bl. 2	402-260 A
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1	1	402-262		HV-Kaskade kompl.			ab Lager
2	1	300-044		HV-Print			
3	3	112-819		Widerstände VR 68	47M Ω /1W/5%	R1-R3	Philips
4	2	124-827		Keramikkond.	1000 pF/6kV	C4	2
5	3	124-825		"	680pF/6kV	C1,3,6	
6	1	109-112		Kalei-Setzmutter M4x1	(Messing)BN523		BZ
7	1	200-360		Erdungsbolzen			
8	1	106-135		Pan-Head-Schraube	M4x16		BZ
9	1	109-630		Schnorr-Si-Scheibe	M4		
10	4	158-203		Lötspitz			
11	2	107-764		Kerbschraube	ϕ 2,2x6,5 DIN 7971		
12	1	124-803		Keramikkondensator	10pF/6kV	C5	
13	1	111-434		Metallfilmwiderstand	221 Ohm/1/4W/1%	R5	
14	2	112-787		Widerstand VR 68	100k Ω /1W/5%	R6	
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26				Zusammenstellung	500-277		
27							
28							
29							
30							
31							
32							
33				* Achtung:			
34							
35				Für "negative" Ausführung			
36				ist die HV-Kaskade 402-263			
37				zu verwenden			
38							
39							
40							
41							

Pos.	Stck.	Art. Nr./Lager Nr.	Auftr.	Bezeichnung	Bestell-Nr.	Schema Pos.	Lieferant
Gez 11.8.81		SS					
Änderungen I 435 2.12.81				HV-Print NSG 431			



SL 402 231

Ruhekontakt geschlossen!

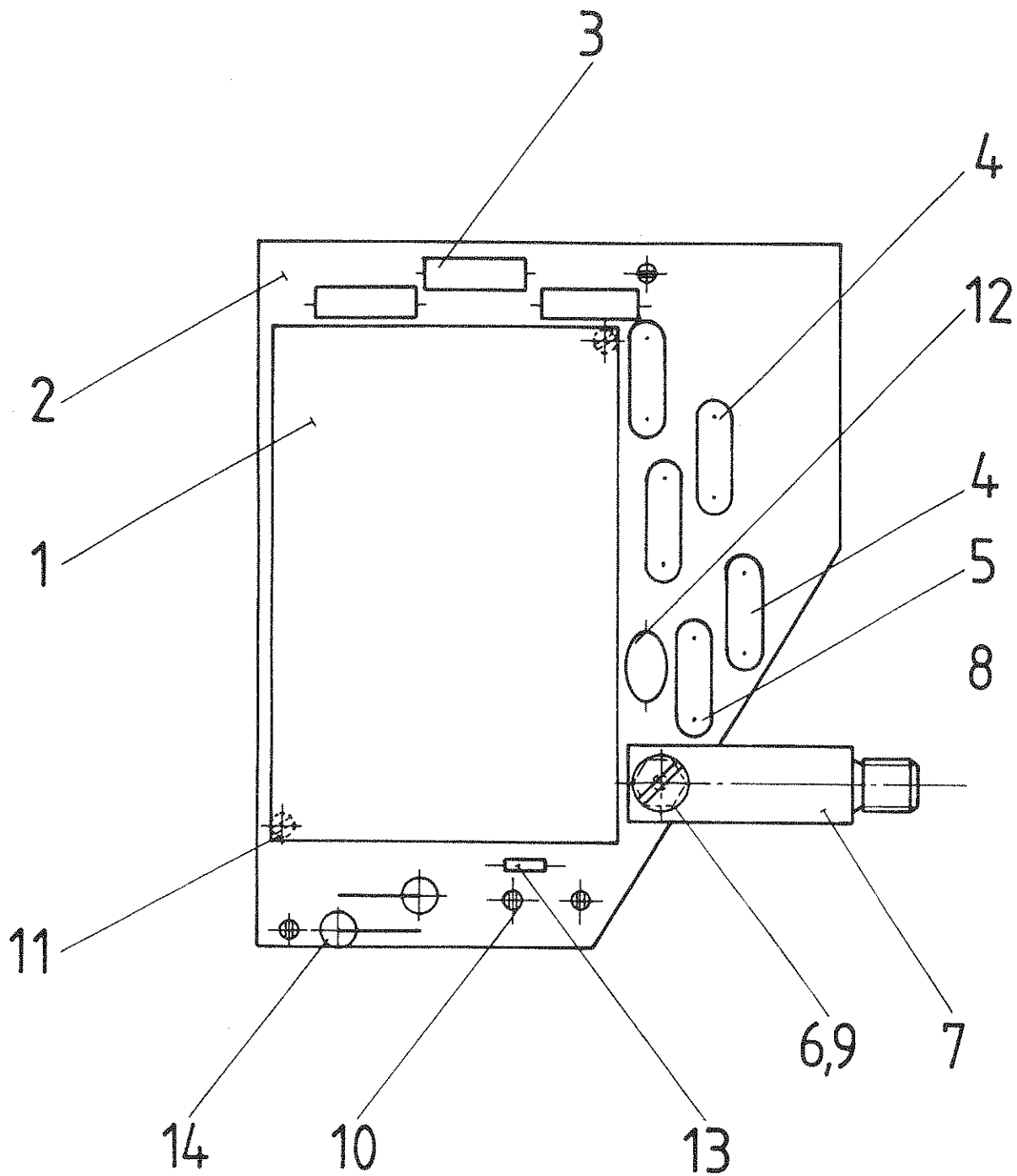
Stück	Gezeichnet	Pos.	Änderung	Material	Bestellungsnummer
1	I 337 4.1.82 WÄ	I 375 23.4.82			
	I 574 29.2.84				
Leiterplatte kompl.					10.8.81 WÄ
ZU NSG 430.431					

SCHAFFNER
SCHAFFNER INSTRUMENTS AG
CH 4708 Lutribach (Schweiz)

500-250 C

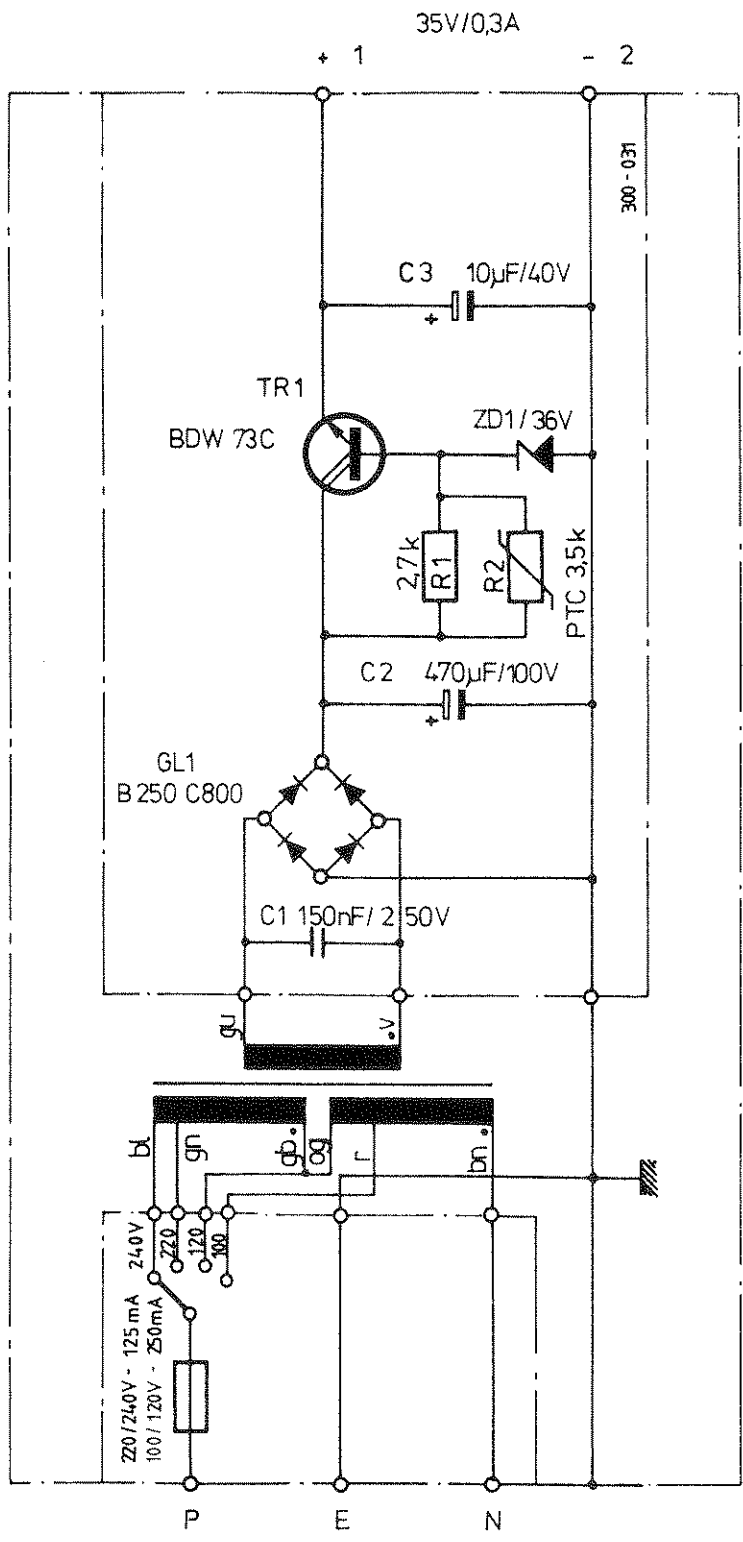
48,49,51

48,49,52



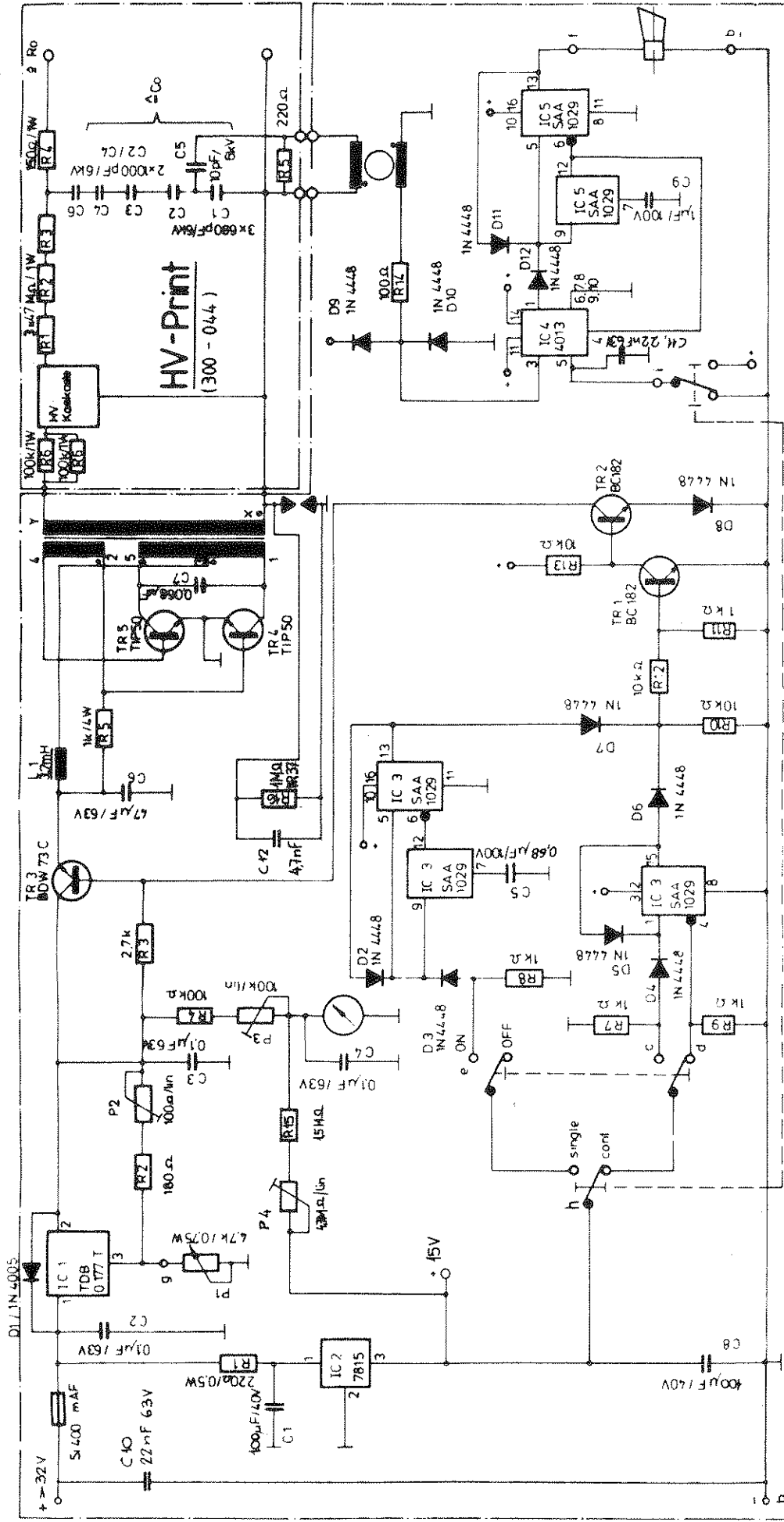
SL 402-261

Stück	Gegenstand	Pos.	Werkstoff	Modell	Bemerkung
II	I	Aenderungen:			Ersetzt durch:
				Ersetzt für:	
				Maßstab	Gezeichnet 12.1.82
				1:1	Geprüft
					Gesehen
HV - Print (zu NSG 431)					ig



SL 402-190

Stück	Gegenstand	Pos.	Werkstoff	Modell	Bemerkung	
II	I	Aenderungen: I 346 22.2.82			Ersetzt durch:	
					Ersetz für:	
Stromversorgung zu NSG 430,431				Maßstab		
				Gezeichnet	22.4.81	<i>[Signature]</i>
				Geprüft		
				Gesehen	22.4.81	



Elektronik - Print

(300 - 037)

Stück	Gegenstand	Pos	Werkstoff	Modell	Bausatz
1	Druckkopf				
Anschlüsse: I 375 15.4.82 WÖ. I 485 5.4.83 Z.					
Gesamtschema zu NSG 431 (mit Durchschlagserkennung)			Multicode	Urspr. Modell	10.8.81 WÖ
SCHAFFNER			SCHAFFNER INSTRUMENTS AG CH 4708 Luterbach (Schweiz)		600 - 044 / C

Widerstände 1/4 W wenn
nichts anderes angegeben!