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EMC

Plug-in unit

NSG 222

Manual

Interference Simulator

Schaffner Instruments AG
4708 Luterbach
Telefon 065 42 31 31
Telex 34 491-CH

SCHAFFNER

Plug-in unit

NSG 222



1.1 Introduction

Using the NSG 200 series of instruments, different types of mains interference can be simulated. These instruments use plug-in units for different types to interference.

New plug-in units will correspond to different national and international standards and will reflect the latest technology.

The instruments consist of a main frame NSG 200 C or D and different plug-in units.

The following units are available:

MAINFRAME	NSG 200 C or NSG 200 D	contains line switches, line filter, fuses and other elements
PLUG-IN	NSG 203 A	simulates shor variations and interruptions in line voltage
	NSG 204	simulates DC line interruptions
	NSG 222	simulates short pulses with fast rise time
	NSG 223	simulates 50 µsec. interference pulses with high energy
	NSG 224	simulates pulses with medium energy and rise time
	NSG 226	Data line interference simulator

HIGH VOLTAGE TEST SOURCES

INSTRUMENTS	NSG 504	1.2/50 pulse test voltage generator
	NSG 505	Surge transient generator
	NSG 522	Connecting network to superpose NSG 505 pulses on power lines (DC/AC)
	NSG 500 A	Interference simulator for automotive electroni equipments
	NSG 509	High voltage insulation tester 5kV/50 Hz 500 VA

2.1. Introduction

Line interference voltage with a fast rise time (< 5nsec) and low energy content (~2 millijoule) can be simulated with the NSG 222 plug-in unit together with the NSG 200 C main frame. The same unit will generate data line interference and control static discharges.

Using this equipment it is possible to simulate interference due to for example electromechanical switches, interruptors, and circuit breakers. The corresponding frequency spectrum will extend well past 100 Mc.

In electronic circuits this type of interference will cause malfunctioning in some logic circuits (TTl,ECL) but in others (CMOS) they may in addition cause a slow deterioration and eventual distruction.

The interference pulses will be injected between ground and the conductors (common mode) and may be changed in amplitude rise time and phase angle. Three amplitudes corresponding to three levels of interference commonly encountered are:

Low	corresponds to interference occuring continously in a normal electrical mains.
Medium	corresponds to interference encountered in the proximity of interruptors.
High	corresponds to high intensity interference occuring (infrequently) in an industrial electrical mains.

Experience has shown that only equipment with very good power line filters will function properly with pulses on intensity "high" and 5nsec rise time.

Long power line cables will attenuate the amplitude of interference pulses and slow down their rise time. A cable of 20 meters will reduce the amplitude by approximately 25 % and add approximately 10nsec to the rise time. The possibility of changing the rise time in the NSG 222 will help to study the effect of rise time.

If no malfunctioning occurs on interference level "medium" and 5nsec rise time the interference suppression may be considered adequate for normal use. Equipment that will malfunction on amplitude "low" and 20nsec rise time will not perform properly in most application and does need additional filtering.

The susceptibility of digital equipment to interference entering through data lines may be testet by wrapping a wire around the data line (For ex. 10 turns) and connecting it to the terminal marked "line".

Static discharges occuring in dry rooms can be simulated with the NSG 312 probe. A person causing the discharge is simulated with a capacitance of 150 picoforads in series with a 10k Ohm resistance. The discharge voltages depends on the length of the discharge path and has a maximum value of 7 kV, this discharge will occur approximately 20 µsec after the pulse appearing on the "pulse" terminal.

The discharge pulse has an energy content of about three millijouls.

The trigger pulse appearing at the terminal marked "Main" is synchronized to the electrical mains. It occurs at the last zero crossing before the discharge cycle (during which the interference pulse occurs). The pulse appearing at the terminal marked " Pulse " will occur approximal 2o micro-seconds ahead of the interference pulse. It can be used to locate this pulse approximately. For a reproducible observation the oscilloscope should be used with internal synchronisation.

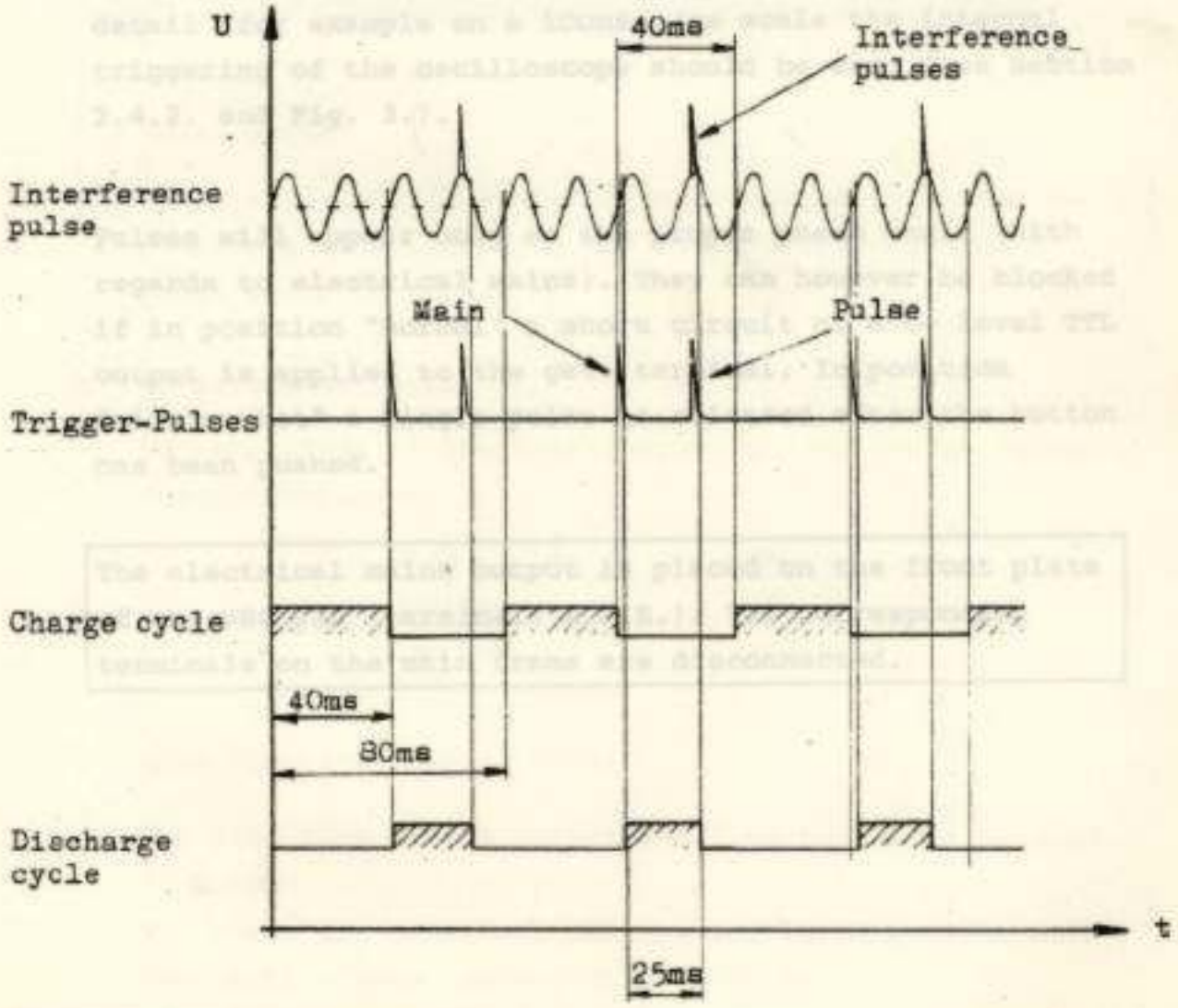


Fig. 1 - Time sequence

Fig. 1 shows the positions of the two sync. pulses in the time sequence of the NSG 222. They occur:

a) "Main" at the start of the discharge cycle.

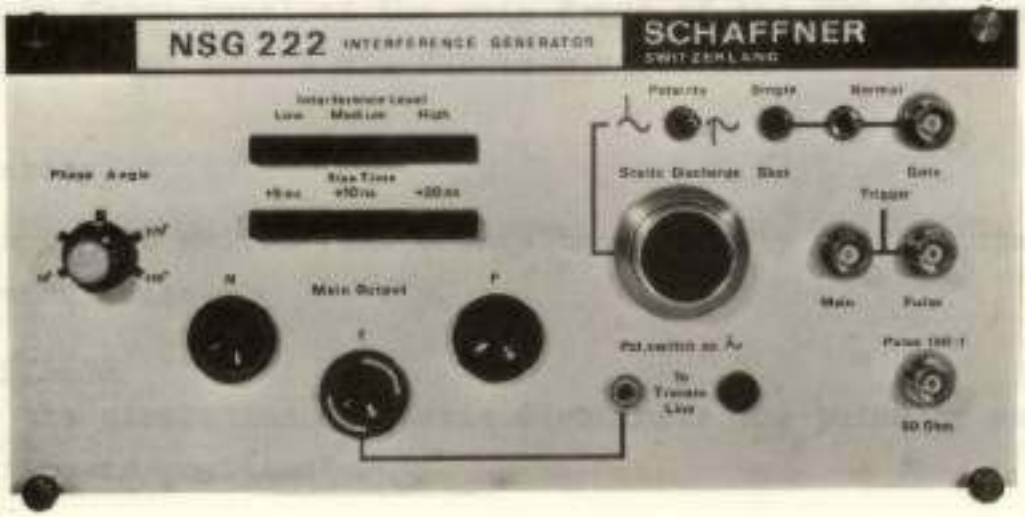
b) "Pulse" 20 µsec ahead of the interference pulse.

The sync. pulse appearing at the "pulse" terminal should be used only for approximately locating the interference pulse since the time lag between the two pulses is approximately 20 µsec. For observing the pulse and its effects in detail (for example on a 100nsec/cm scale the internal triggering of the oscilloscope should be used (see section 2.4.2. and Fig. 3.).

Pulses will appear only at the proper phase angle (with regards to electrical mains). They can however be blocked if in position "normal" a short circuit or a 0- level TTL output is applied to the gate terminal. In position "single shot" a single pulse is released after the button has been pushed.

The electrical mains output is placed on the front plate of the NSG 222 (terminals N.P.E.). The corresponding terminals on the main frame are disconnected.

2.1.1 The front panel



A.) Phase Angle

Using this control knob the interference pulse can be displaced with regard to the mains frequency over a phase angle of 380°.

B.) Interference Level

The amplitude of the interference pulses can be chosen approximately at:

High	1500 V
Medium	1000 V
Low	500 V

C.) Rise Time (normaly 5 nsec)

The rise time of the interference pulse can be changed in steps.
The steps are additive, pushing all three buttons will result in a rise time of 35 nsec.

D.) Main Output

The supply voltage with added interference voltage will appear at terminals N.P. und E. The corresponding terminals on the front panel of the main frame of the NSG 200 C are disconnected if the NSG 222 is plugged in.

E.) Polarity

This toggle switch will change the polarity of the interference pulse.

Important

For the simulation of static discharges the polarity switch must be in position '⌒'

F.) Single Shot-Normal Toggle switch

On position "single shot" a single pulse will be released as the push-button is pressed. On position "normal", pulses will appear periodically - unless a short circuit or a 0- level TTL signal is applied to the BNC "gate" terminal. Such a zero level signal or short circuit will block pulses.

G.) Line socket "To Transm. Line"

By connecting a wire to this terminal interference may be coupled capacitively to other lines or wires (for example to a data line by wrapping a wire around it and connecting it to the "line" terminal).

H.) Pulse 100:1 /into 50 Ohm

BNC output with internal impedance of 50 Ohm for monitoring the interference pulse (attenuated by 100:1). This terminal must be connected either to an oscilloscope with high impedance input though a 50 Ohm adaptor or to an oscilloscope with 50 Ohm input. Since this terminal is coupled to the mains terminals over a small capacitance the line voltage will not appear on it.

2.2. Spezifications

2.2.1. Electrical characteristics

Pulse (conductors to ground)

Width	100 nsec
Rise time	5-35nsec
Amplitude	500/1000/1500 Volt(Rise time 5ns)
Int. Impedance	200 Ohm

Phase angle

The phase angle with regard to the 50 c/s power line can be changed over a range of 80° to 460°. This corresponds to 25 msec.

Polarity	+ or -
Trigger pulses	10 V / 1.5 usec.
Pulse 100:1 (BNC)	Impedance 50 Ohm

Gate

Operated by TTL or by mechanical contact. TTl-0- level or short circuit: no pulses appear.

TTL-1- level or open circuit: pulses appear in regular sequence.

2.2.2. Mechanical data

Weigth	4.900 kg
Dimensions	265 x 130 x 340 mm 10.4 x 5.1 x 13.4 inches

2.3. Application notes

2.3.1. Placing the unit in operation

(Mains born interference or interference over data lines)

A.) The plug in unit should be placed in the main frame only if the power switch of the NSG 200 C main frame is in position "off".

B.) The main frame NSG 200 C must be grounded over the "ground" socket on the back panel. Grounding through the mains cable is not sufficient.

C.) In electrical mains with one conductor (neutral, Marked N) on ground potential, care should be taken that the connection through cord and plug is made properly - that is that the terminal N is really connected to neutral and therefore on ground potential. The green lamp on the main frame will then light up if the power switch on the main frame is in position "on".

D.) For mains born interference the equipment that should be tested is connected to the terminals N.P. and E. on the front panel of the NSG 222 (not to the terminals on the NSG 200 C these are now disconnected). The power can now be turned on by means of the power switch on the NSG 200 C.

Important

The mains current passing through the instrument should be monitored. It should not exceed 16 amps for any length of time.

2.3.2. Operating the NSG 222 (static discharges)

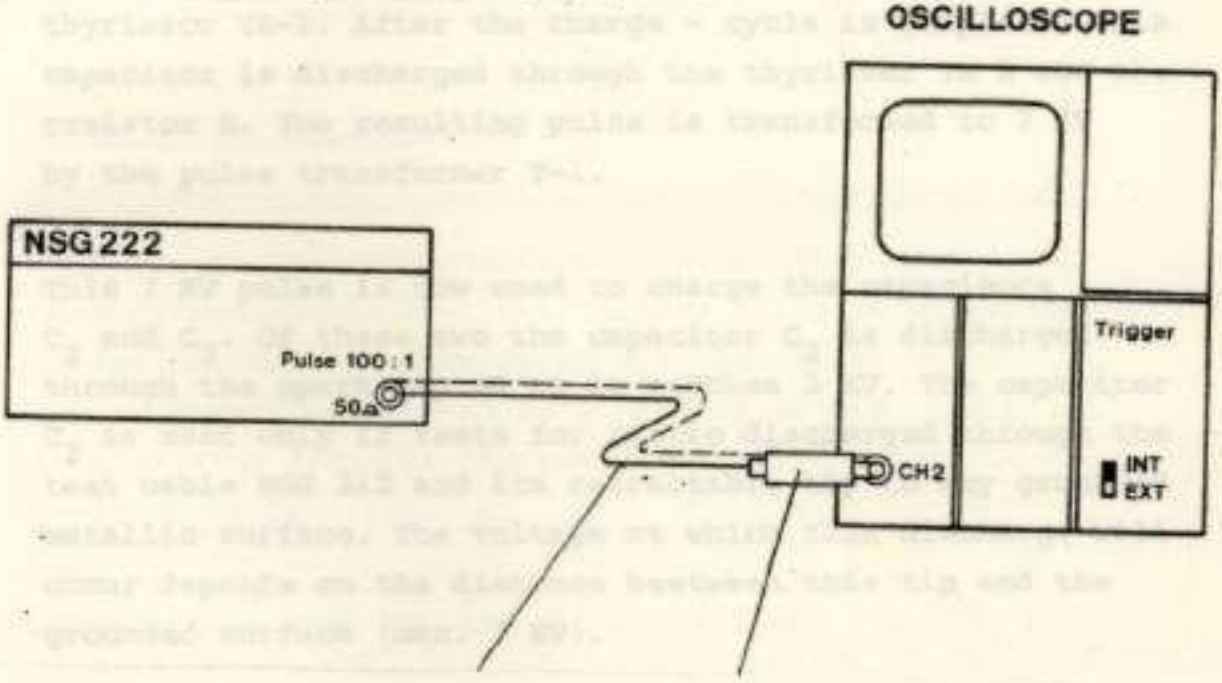
A.) B.) C.) Identical to 2.3.1.
D.) The test point with its cable (NSG 312) must be screwed to the corresponding terminal on the front panel of the NSG 222. The polarity switch must be placed on positive pulses (∿).

As the equipment is turned on sparks may be drawn to any grounded suface. Since the spark gap will operate, the terminals P.N. and "line" should not be used during tests for static discharges.

2.3.3. Monitoring the pulse

In order to measure the pulses generated by the NSG 222 an oscilloscope with a bandwidth of 50 MHz to 100 MHz and high intensity should be used. Best results can be obtained a fast storage oscilloscope. Since with a normal oscilloscope the intensity will be low it migth be necessary to use a dark cloth over the oscilloscope or to darken the room. In our laboratories the Tektronix 7633 with probes has been used but the corresponding HP oscilloscope will do just as well.

For monitoring the interference pulse the "Pulse 100:1" output should be used together with a 50 Ohm coax cable. In order to avoid reflections at the oscilloscope a 50 Ohm adaptor should be used (for example Tektronix 011-0049-01). The connection is shown in Fig. 3



50 Ohm coax cable 50 Ohm adaptor
Tektronix 011 -0049-01

Fig. 3 - Monitoring the interference pulse

2.3.4. Applications

All logic circuits (for example TTL, ECL, CMOS) are susceptible to interference from fast high ampiitude mains pulses.

Experience has shown that equipment with good interference suppression (filters, ground plates, well shielded cabinets, decoupled datalines) cannot be induced to malfunction by the NSG 222. This type of equipment is however rare, the vast majority of electronic equipment will malfunction when connected to the NSG 222.

2.4. Circuit diagrams

2.4.1. Blockdiagram

The time sequence (see page 17) shows that each interference pulse is preceded by a charge - cycle. During this cycle the capacitor C_1 is charged to 800 Volt through the thyristor TR-1. After the charge - cycle is completed this capacitor is discharged through the thyristor TR 2 and the resistor R. The resulting pulse is transformed to 7 KV by the pulse transformer T-1.

This 7 KV pulse is now used to charge the capacitors C_2 and C_3. Of these two the capacitor C_2 is discharged through the spark gap SG as it reaches 3 KV. The capacitor C_3 is used only if tests for static discharged through the test cable NSG 312 and its retractable tip to any grounded metallic surface. The voltage at which this discharge will occur depends on the distance beetween this tip and the grounded surface (max. 7 KV).

The interference pulse generated as the capacitor C_2 is discharged through the spark gap SG is coupled through an RC network to the mains (terminals N and P) and to the terminal marked "line". Through this RC network amplitude and rise time can be changed in discrete steps. The mains terminals on the front panel are connected to electrical mains by means of a power line filter. The interference pulses will be blocked by this filter from entering the electrical mains or any other power supply feeding power to the instrument.

New experimental has shown that some types of logic circuits can be destroyed by repeated applications of low energy (millijoule) pulses.

Malfunctioning and destruction of logic circuits can be simulated with the NSG 222 using pulses superosed on mains and on data line. The susceptibility to static discharges shows if the equipment is well shielded.

Power - line interference

A.) Power applied from electrical mains through power cord

This is the type of interference most often used in testing equipment. The interference pulse is superposed on the 120/220/240 Volt 50/60 c/s electrical mains. The equipment under test is connected to P.N. and E terminals on front of the equipment. Main switch is in position "on".

B.) Power (other than 220/240 V, 50 c/s resp. 120 V 60 Hz is applied to "Ext" terminals on rear panel of main - frame NSG 200

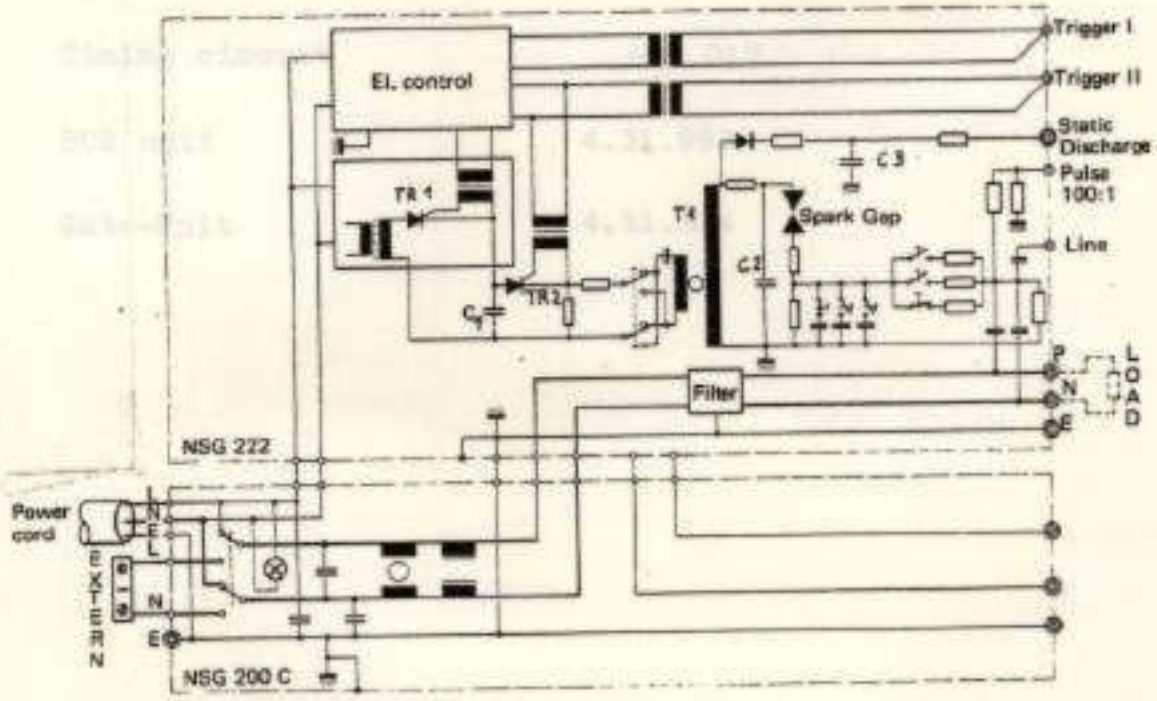
Main switch is in position "Ext"
Maximum limits on current are indicated in section of manual on main frame.

Typical supply voltages may be:

a) 115 V / 50 c/s
b) 115 V / 400 c/s
c) 48 V / d.c.

of course the power cord must still be connected to a 220 V / 240 V 50 c/s resp. 120 V 60 Hz outlet.

For 400 c/s applications the current should be limited to 2,5 Amps and one capacitor in the main frame NSG 200 C must be disconnected (see section on main frame).

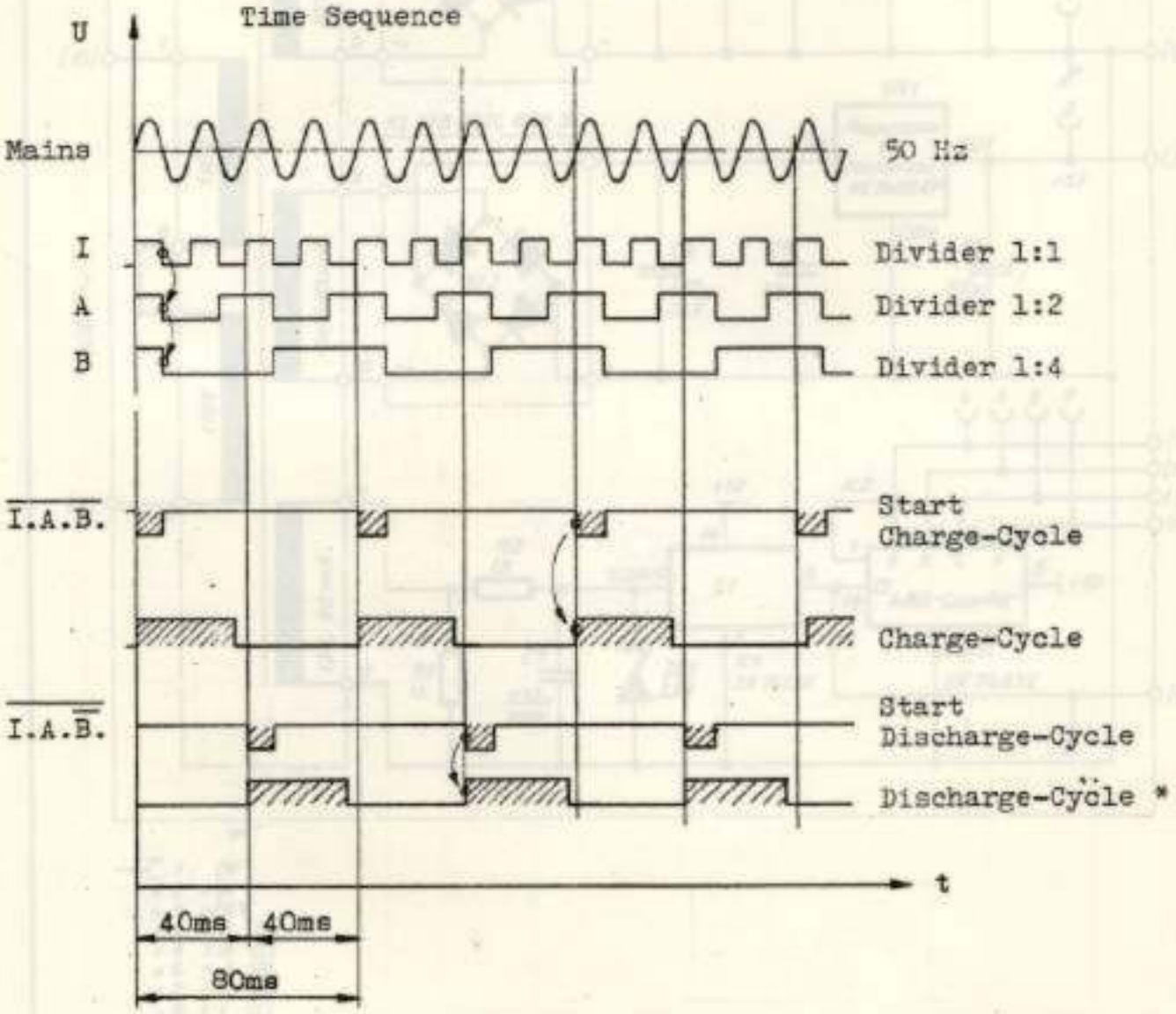


Block diagram NSG 222 Plug-in

2.4.3. Detailed circuit diagrams

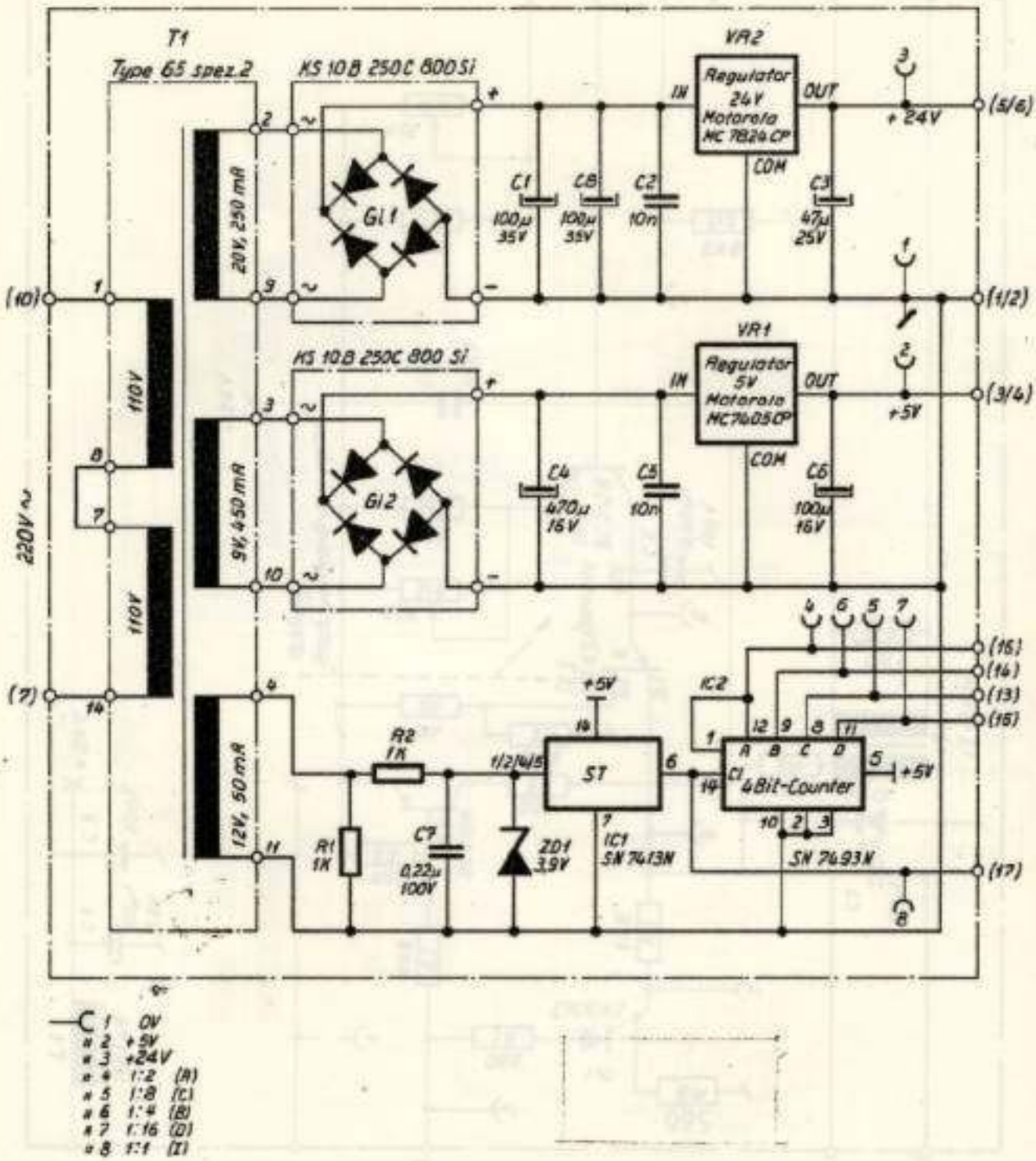
The following circuit diagrams are shown:

Complete unit	3.31.593
Individual prints	
Power supply	4.31.507
Timing circuit	600.017
SCR unit	4.31.993
Gate-Unit	4.31.514



The interference pulse occurs during the discharge cycle.

Fig. 5



1	0V
2	+5V
3	+24V
4	1:2 (A)
5	1:8 (C)
6	1:4 (B)
7	1:16 (D)
8	1:1 (I)

Stück	Gegenstand	Pos.	Werkstoff		Modell	Bemerkung

II | I

Aenderungen:

Ersetzt durch: .....

Ersatz für: .....

Power-Supply-Unit

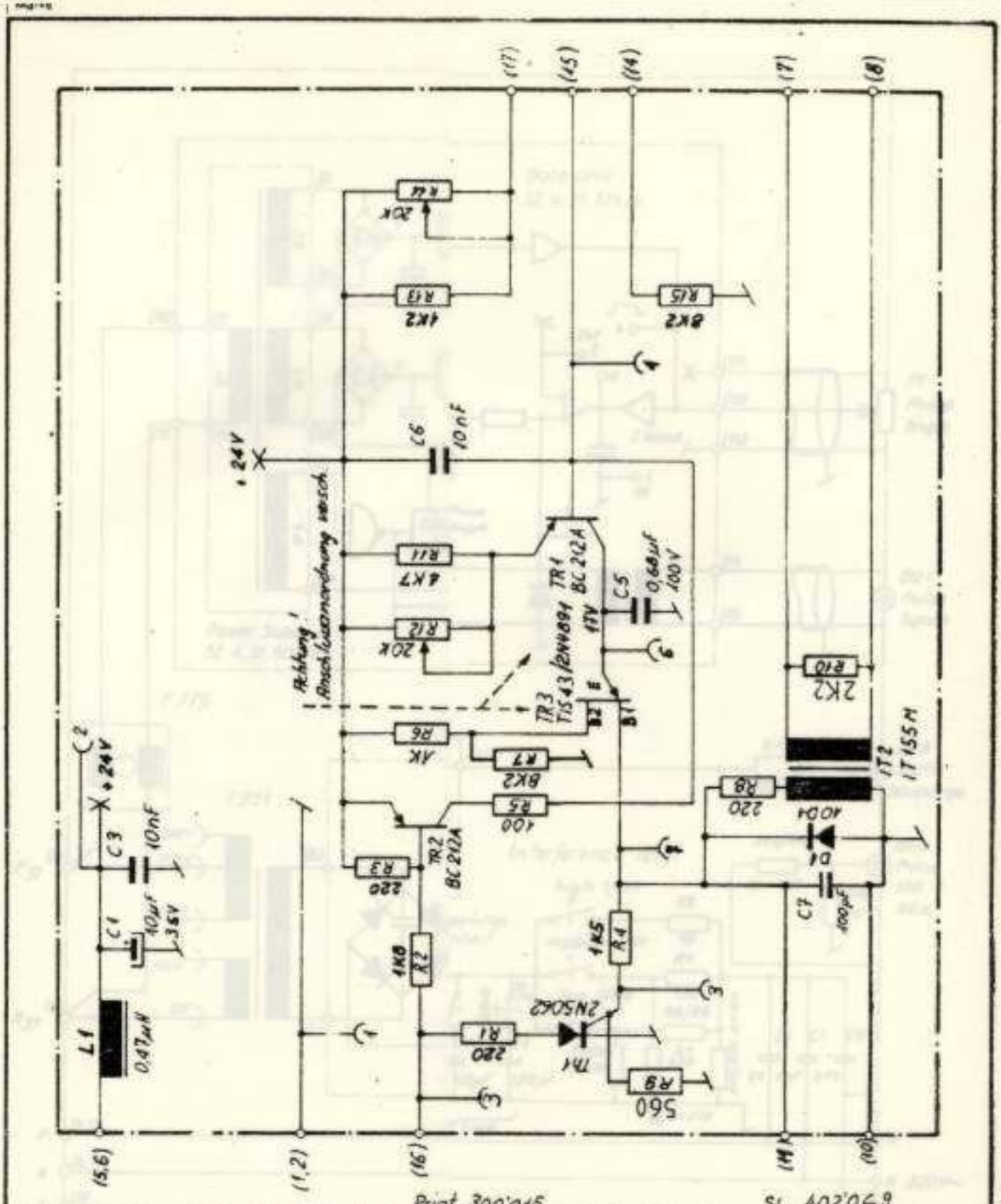
Maßstab			
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	Geprüft	30.4.74	
		27.6.74	
	Gesehen	2.10.74	

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SZ

4.31.507/a



Print 300'015

SL 402'069

Stück	Gegenstand	Pos.	Werkstoff		Modell	Bemerkung
II I	Aenderungen I 134 7.8.79 / I 197 10.6.80					

Ersetzt durch

Ersatz für

Gate-Unit zu NSG 222,223

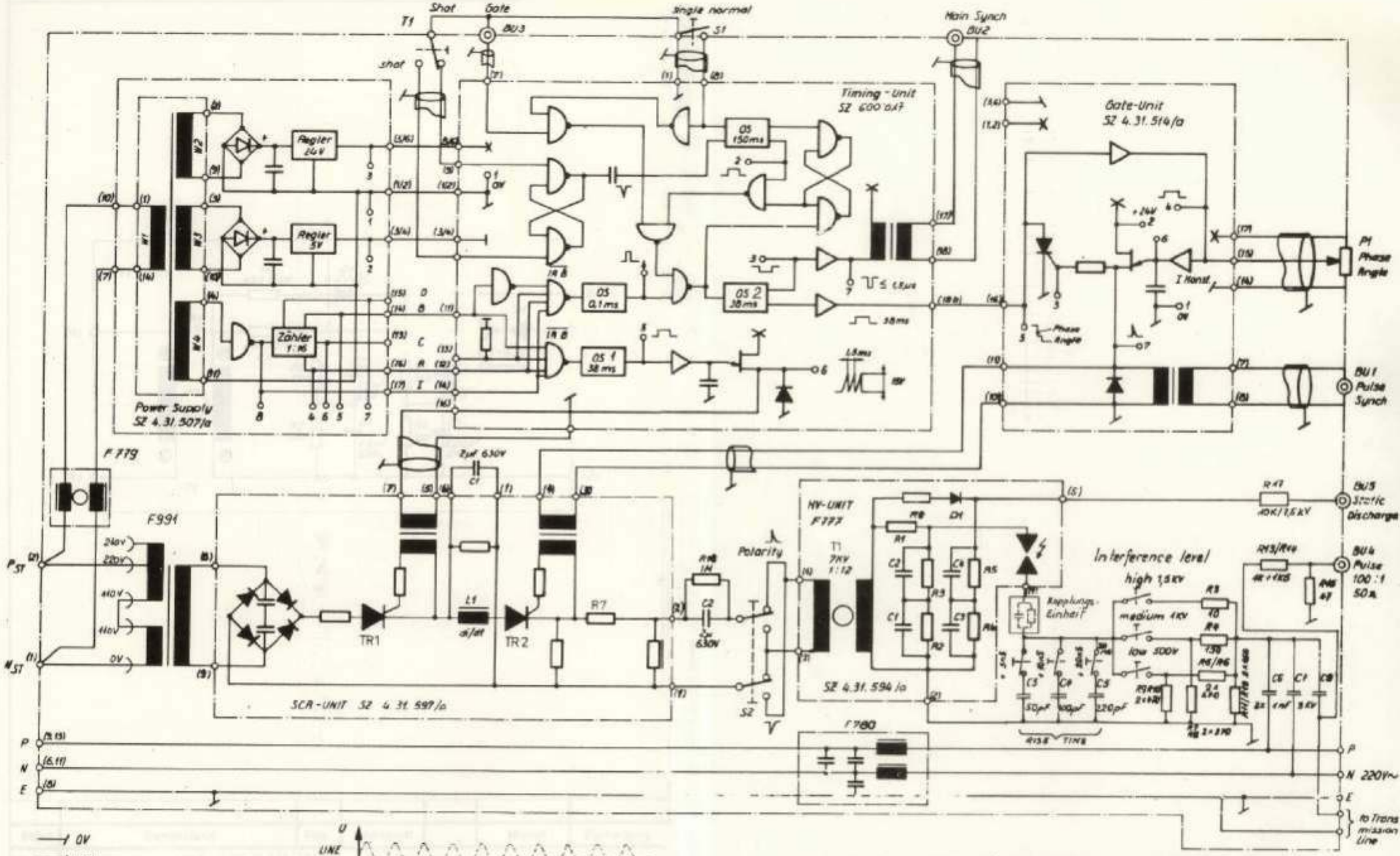
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/	Gezeichnet	6.11.73	
	Geprüft	17.12.73	
		16.7.74	7
	Gesehen	2.10.74	4

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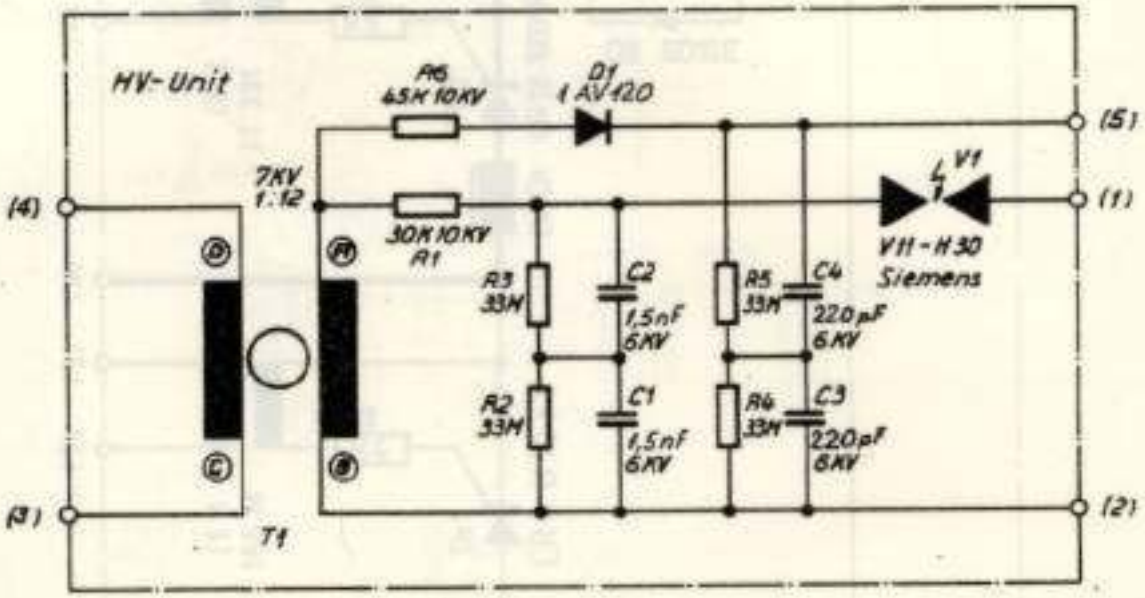
I 54 22.8.78/f I 131 12.7.79/f I 143/a 23.8.79 I 167 18.2.80/20.3.80/f

PRINZIPSCHEMA ZU NSG 222

Maßstab	Gezeichnet	6.2.74	
	Geprüft	22.4.74	
		13.4.76	
	Geschen		

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SZ 3.31.593/f



Stück	Gegenstand	Pos.	Werkstoff		Modell	Bemerkung
II I	Aenderungen: b/7.9.78/p I 431 12.7.79/20.3.81					

Ersetzt durch: .....

Ersatz für: .....

Prinzipschema HV-Unit NSG 222

Maßstab			
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		4.10.76	
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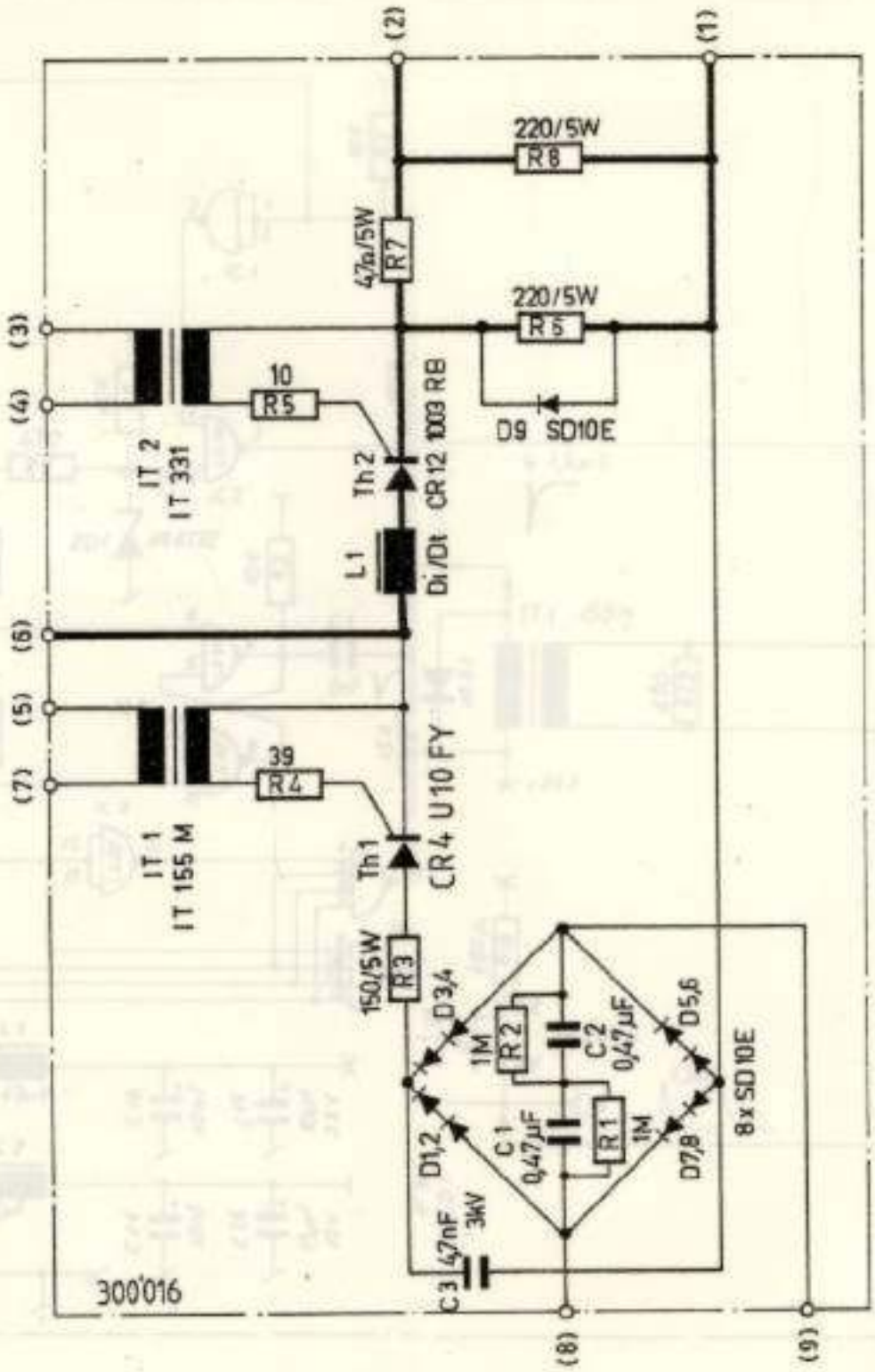
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4. 31. 594/d

Heftrand- | Marke



SL 402'066

Stück		Gegenstand	Pos.	Werkstoff		Modell	Bemerkung
II	I	Aenderungen: 9.1.78 G14 R 7.8.79 I/30 P				Ersetzt durch: ..... Ersatz für:	

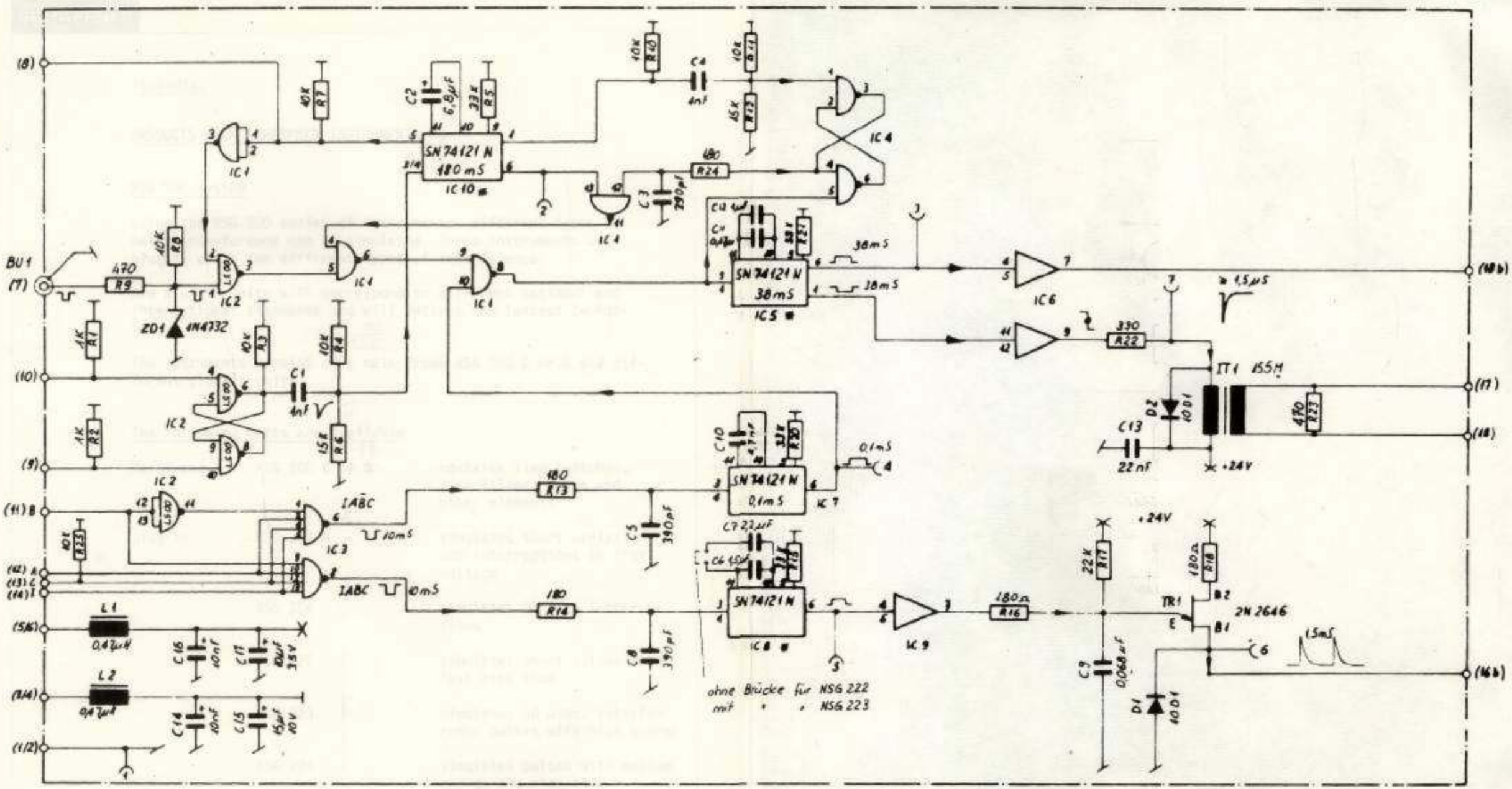
SCR Unit to NSG 226, 222

Maßstab			
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	Geprüft	3.8.77	Fl
	Gesehen		

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IC1, IC4	SN 7400N	Pin 7 — Masse	— Masse
IC2	SN 74LS00N	Pin 14 — + 5V	— + 5V
IC3	SN 7420N		
IC5, IC7, IC8, IC10	SN 74121N	Pin 8 — Masse	X — + 24V
IC6, IC9	SN 7900N	Pin 16 — + 5V	

Stück	Gegenstand	Pos.	Werkstoff		Modell	Bemerkung
11	1	Aenderungen			Ersetzt durch:	
					Ersatz für	

Timing Unit zu NSG 222/223

Maßstab	Gezeichnet	18.2.80	
	Geprüft	18.2.80	PG
	Gepasst		

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600'017

Appendix:

PRODUCTS FROM SCHAFFNER INSTRUMENTS AG

NSG 200-System

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	NSG 204	simulates DC line interruptions
	NSG 222	simulates short pulses with fast rise time
	NSG 223	simulates 50 µsec. interference pulses with high energy
	NSG 224	simulates pulses with medium energy and rise time
	NSG 226	data line interference simulator
Instrument	NSG 523	3-phase coupling network for NSG 222, 223, 224, 505 and CISPR 150Hz - 30MHz

High voltage test sources

Instruments	NSG 504	1.2/50 us pulse test voltage generator
	NSG 505	Surge transient generator (1 MHz, 2,75 kV)
	NSG 522	Connecting network to superpose NSG 505 pulses on power lines (DC/AC)
	NSG 509	High voltage insulation tester 5 kV/50 Hz
	NSG 510	AC/DC high voltage tester

Interference simulators

Instruments	NSG 500 A	Interference simulator for automotive electronic equipments.
	NSG 422	Simulates short pules with fast rise time
	NSG 430	Simulates static discharges 2 ÷ 16 kV

Uninterruptible power supply

Instrument	NPS 300	Uninterruptible EMC power supply 300 VA AC

Vertretungen

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