DANBRIDGE
DENMARK

INSTRUCTION MANUAL

REGULATED POWER SUPPLY

TYPE SF51B

A/S DANBRIDGE
47 Brigadevej . Copenhagen S . Denmark

SF51B - October 1967.

C O N T E N T S

SECTION 2.

OPERATING INSTRUCTIONS

2.1 INSTALLATION

Set mains voltage selector switch to the required range (pull the switch knob, turn and push back). The 115 volt setting covers the range 100 to 130 volts and the 230 volt setting the range 200 to 260 volts. Check that the correct fuse is fitted on 115 volts 1.5A slow and on 230 volts 0.7A slow.

2.2 OPERATION

Turn both voltage controls fully counter clockwise and set meter switch to the required range. Switch on (power switch down) and adjust voltage by coarse and fine controls. Set the required current limit on the current limit control. This control gives approximate indication (within about ± 20%) of the current limit. If more accurate settings are required, short circuit the output and adjust the limit control to the required reading on the meter set to an appropriate current range.

Current limiting is indicated by the overload lamp lighting up. The instrument may be used in this mode as a stabilised current generator with an output resistance of about 10 kΩ. Note however that the a-c impedance in this mode will be determined by the output capacitance of 130 µF.

Note. Under certain conditions the internal protective circuits will operate and overload will be indicated. At the same time the output will fall to zero. The output after a delay of up to a couple of seconds stabilises at the set value. This will occur in the following cases:

a) if the voltage output control is turned quickly down from a high setting with small external loading.

b) after a short-circuit or heavy overload of the output.

c) if a load causing current-limiting operation is applied at a high voltage setting. In this case overload will be indicated as long as the load is connected, but the output will fall to zero when the load is connected and will stabilise after a delay of up to max. 5 seconds.

The output may be operated floating or earthed with no significant difference in noise or hum. The output may be floated at up to 500 volts potential from chassis.

Note. On current measurement on the meter current ranges the meter reading includes a fixed current of 5mA drawn by the output control voltage divider. Thus for accurate output current measurements, especially on the 0,1A range, the meter reading must be reduced by 5mA to obtain the actual output current.

SECTION 3.

CIRCUIT DESCRIPTION.

3.1 BRIEF FUNCTIONAL DESCRIPTION.

In order to reduce transistor dissipation, the instrument employs two stabiliser circuits connected in series. The first circuit functions as a pre-regulator controlling the voltage drop across the series transistor of the main stabiliser and thus limiting the dissipation in this element to a safe value. A silicon controlled rectifier (scr) is employed in the pre-regulator. A full-wave rectified voltage is applied to the scr, and the conducting time of the scr in each period is regulated by a control circuit, so that about 6 volts voltage drop is maintained across the main series control transistor.

The main stabiliser employs a high-gain amplifier feeding a series control transistor. This amplifier senses the voltage difference between the output and a highly stabilised negative reference voltage and applies this amplified to the series control transistor.

A separate amplifier senses the voltage drop across a resistor in series with the output. This amplifier takes over control of the series control transistor when the output current increases to a pre-set limit and thus limits the output current to this value.

3.2 DETAILED CIRCUIT DESCRIPTION

(Refer to circuit diagram).

3.2.1 PRE-REGULATOR

A full-wave rectified a-c supply from the bridge rectifier D1-D4 is applied to the scr (116 BT 300R). The scr is triggered via pulse transformer TF2 from unijunction transistor TR20. Rectified half sine waves are applied to one base of TR20, and the firing point in each period is determined by the voltage on TR20 emitter. This voltage drops to zero at the start of each period and then rises linearly, C20 being charged through TR19. The charging current is determined by the voltage drop across TR1 fed through R49. This adjusts the firing point of TR20 and the scr so that at all loads the scr delivers the required charging current to C6 with between 6 and 7 volts drop across TR1. Thus the dissipation of TR1 is limited to a safe value. R50 supplies an additional charging current depending on the output voltage, so that the firing of the scr occurs earlier at higher output voltages as required.

3.2.2 MAIN STABILISER

The output voltage is compared to the highly stabilised -18V reference supply in voltage divider P1, P2, R32, R33. The error voltage at the junction of R32, R33 is fed to the input of a high-gain d-c amplifier.

The first stage employs a dual transistor TR10-11 as a differential amplifier to minimise drift. The pre-set potentiometer TP3 is used to balance this stage. The second stage is also arranged as a differential amplifier (TR8, TR9). Output from TR8 collector is taken to TR3, which drives emitter follower TR2. This in turn drives the series transistor TR1, which regulates the output current to compensate any error in output voltage.

3.2.3. CURRENT LIMITING CIRCUIT

Current limiting is obtained by sensing the voltage drop across R9, which is proportional to the output current. P3 sets the current limit. An opposing voltage is fed to one terminal of P3 from the positive 7:5 volt line through TP2-TP1. By choosing suitable ratios between P3, TP1 and TP2 it is possible to to obtain approximately logarithmic variation of P3 for linear output current limit variations over a wide range, so that low current limits may be set with better accuracy and resolution. From P3 the signal is taken to differential amplifier TR4-TR5. TR5 collector drives TR7 via TR6. TR4 and TR7 are normally cut off. When the voltage at TR4 base goes sufficiently negative, due to current in R9, TR4 conducts. In turn, TR7 conducts and takes over control of series transistor TR1 via TR3, TR2. Thus instead of the output voltage being controlled, the output current is controlled at the value set by P3. The pre-set potentiometer TP3 sets the threshold voltage for TR4.

From TR7 collector, drive is taken through TR13, TR14 to indicator lamp I2, which indicates current limited operation.

3.2.4. OVERVOLTAGE PROTECTIVE CIRCUIT

If the output is short-circuited or a high overload current is drawn at a high voltage setting, the safe operating rating of TR1 may be exceeded momentarily due to discharge of C6 through TR1. To avoid this, a protective circuit comprising TR12 limits the voltage across TR1. TR1 is normally cut off, but goes into conduction at about 10V across TR1 and cuts off TR1 through TR7, TR3 and TR2. In this case also indicator lamp I2 lights up until C6 is discharged sufficiently to reset the voltage overload circuit.

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3.2.5. NEGATIVE REFERENCE STABILISER

This stabiliser supplies a -18 volt reference used as a reference for the output voltage, and accordingly a good stability is essential.

The output voltage is taken through the divider network TP5, R46, D19, R45, R47, to TR17 base and compared to the voltage across zener diode D18. The error signal is amplified in TR17, TR16 and taken to the series regulator TR15. R4o, R42 provide compensation for supply voltage variations.

3.2.6. POSITIVE STABILISER 7.5 VOLT

The positive supply is stabilised by zener diode D16 in series with D15. A constant current of about 3omA is provided by TR18.

3.2.7. METER AND OUTPUT CIRCUIT

For voltage measurements the meter (1mA) is connected across the output terminals in series with R55, R58. For current measurements R34 is employed. TP7 and TP8 calibrate the meter.

In order to minimise the output impedance at high frequencies C12, C13 and C14 are mounted directly at the output terminals. D14 protects the circuit against externally applied voltages of reversed polarity.

3.2.8. POWER SUPPLY

The supply transformer has 2 primary windings which are connected either in series or in parallel for 23o or 115 volt operation.

A 66V secondary winding supplies the scr circuit via bridge rectifier D1-4. Filter circuits R4, C3 - L2, C2, R3 and L1, C1 attenuate the high frequency spikes generated by the scr. L1 also limits the peak current in the scr to a safe value at small firing angles.

A 2 x 4oV secondary centre-tapped winding feeds the bridge rectifier D5-D8. One half-section of the rectifier supplies the negative stabiliser. The other half-section provides unsmoothed positive half waves for the scr trigger circuit. These are peak-rectified by D2o and used for supplying the positive stabiliser.

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SECTION 4.

SERVICING INFORMATION

4.1. DISMANTLING AND REASSEMBLY

To dismantle instrument, loosen the 4 screws holding the front panel. Turn instrument upside down, remove the 4 screws holding the bottom cover and remove this.

Remove the top cover by pulling the lower part of the side panels outwards until the cover front-edge is clear of the front-panel upper screws. Then lift cover away.

Fasten front panel screws lightly to ensure that the control knobs are free of the front panel.

To gain access to the components on the main circuit board, remove the upper fastening straps. The board may then be swung outwards.

To reassemble the instrument, put on the top and bottom covers and fasten the bottom cover screws lightly. Then adjust the front panel frame so that it is flush with the top cover on all sides and tighten the top screws in the front panel. With the instrument upside down, center the bottom cover and tighten the bottom front panel screws while pressing the front edge of the bottom cover down. Finally tighten the bottom cover screws.

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SECTION 5.

LIST OF COMPONENTS

5.1. MAIN PRINTED CIRCUIT BOARD

Complete Assembly Part No. 89027.

Capacitors.

Circuit Ref.	Value	Rating V	Tol. %	Manufacturer	Type	Part No.
C1	0.1µF	400	20	Philips	Polyester	40730
C2	0.15µF	160	10	Philips	Polyester	40734
C3	0.01µF	500	20	Ferroperm,Philips	Ceramic	40160
C4	32µF	64	-10 +50	Philips	Electrolyt	40851
C5	100µF	64	-10 +50	Philips	Electrolyt	40876
C7	270pF	500	5	Philips	Ceramic	40110
C8	0.047µF	160	10	Philips	Polyester	40375
C9	1000pF	500	20	Ferroperm,Philips	Ceramic	40140
C10	180pF	500	5	Philips	Ceramic	40075
C11	270pF	500	5	Philips	Ceramic	40110
C12	100µF	64	-10 +50	Philips	Electrolyt	40876
C16	640µF	25	-10 +50	Philips	Electrolyt	40890
C17	0.15µF	160	10	Philips	Polyester	40734
C18	500µF	40	-10 +50	Philips	Electrolyt	40893
C19	32µF	64	-10 +50	Philips	Electrolyt	40851
C20	0.1µF	400	20	Philips	Polyester	40730
C21	40µF	16	-10 +50	Philips	Electrolyt	40852
C22	125µF	16	-10 +50	Philips	Electrolyt	40861

MAIN PRINTED CIRCUIT BOARD (continued)

Resistors

Circuit Ref.	Value Ω	Rating W	Tol. %	Manufacturer	Type	Part No.
R2	1K	9	5	Vitrohm	Wirewound	46276
R3	43	1/3	5	Bayschlag	Dep.Carbon	43o43
R4	1o	1/3	5	Bayschlag	Dep.Carbon	43o1o
R5	56o	9	5	Vitrohm	Wirewound	46275
R6	33o	1/3	5	Bayschlag	Dep.Carbon	43133
R7	56o	1/3	5	Bayschlag	Dep.Carbon	43156
R8	4.7K	1/3	5	Bayschlag	Dep.Carbon	43247
R9	2.2	9	5	Modulohm	Wirewound	46271
R1o	1.8K	1/3	5	Bayschlag	Dep.Carbon	43218
R11	33	1/3	5	Bayschlag	Dep.Carbon	43o33
R12	1.8K	1/3	5	Bayschlag	Dep.Carbon	43218
R13	1.8K	1/3	5	Bayschlag	Dep.Carbon	43218
R14	1oo	1/3	5	Bayschlag	Dep.Carbon	4311o
R15	1K	1/3	5	Bayschlag	Dep.Carbon	4321o
R16	3K	1/3	5	Bayschlag	Dep.Carbon	4323o
R17	3.3K	1/3	5	Bayschlag	Dep.Carbon	43233
R18	2.2K	1/3	5	Bayschlag	Dep.Carbon	43222
R19	56o	1/3	5	Bayschlag	Dep.Carbon	43156
R2o	68o	1	5	Bayschlag	Dep.Carbon	45168
R21	18	1/3	5	Bayschlag	Dep.Carbon	43318
R22	56o	1/3	5	Bayschlag	Dep.Carbon	43156

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MAIN PRINTED CIRCUIT BOARD (continued)

Resistors

Circuit Ref.	Value Ω	Rating W	Tol. %	Manufacturer	Type	Part No.
R23	1K	1/3	5	Bayschlag	Dep.Carbon	4321o
R24	1.5K	1/3	5	Bayschlag	Dep.Carbon	43215
R25	8.2K	1/3	5	Bayschlag	Dep.Carbon	43282
R26	3.3K	1/3	5	Bayschlag	Dep.Carbon	43233
R27	1K	1/3	5	Bayschlag	Dep.Carbon	4321o
R28	8.2K	1/3	5	Bayschlag	Dep.Carbon	43282
R29	2.2K	1/3	5	Bayschlag	Dep.Carbon	43222
R3o	1.8K	1/3	5	Bayschlag	Dep.Carbon	43218
R31	1.8K	1/3	5	Bayschlag	Dep.Carbon	43218
R32	3oo	1/3	5	Bayschlag	Dep.Carbon	4313o
R33	3.3K	1	1o	Diplohmatic	Wirewound	46281
R34	1	3	5	Modulohm	Wirewound	4627o
R35	56o	9	5	Vitrohm	Wirewound	46275
R36	22o	1/3	5	Bayschlag	Dep.Carbon	43122
R37	7.5K	1/3	5	Bayschlag	Dep.Carbon	43275
R38	27o	9	5	Vitrohm	Wirewound	46273
R39	3oo	1/3	5	Bayschlag	Dep.Carbon	4313o
R4o	51o	1/3	5	Bayschlag	Dep.Carbon	43151
R41	56	1/3	5	Bayschlag	Dep.Carbon	43o56
R42	18K	1/3	5	Bayschlag	Dep.Carbon	43318
R43	1.2K	1/3	5	Bayschlag	Dep.Carbon	43212

MAIN PRINTED CIRCUIT BOARD (continued)

Resistors

Circuit Ref.	Value Ω	Rating W	Tol. %	Manufacturer	Type	Part No.
R44	1oK	1/3	5	Bayschlag	Dep.Carbon	4331o
R45	27K	1/3	5	Bayschlag	Dep.Carbon	43327
R46	8.2K	1/3	5	Bayschlag	Dep.Carbon	43282
R47	4.7K	1/3	5	Bayschlag	Dep.Carbon	43247
R48	2.2K	1/3	5	Bayschlag	Dep.Carbon	43222
R49	2oK	1/3	5	Bayschlag	Dep.Carbon	4332o
R5o	27oK	1/3	5	Bayschlag	Dep.Carbon	43427
R51	5.6K	1/3	5	Bayschlag	Dep.Carbon	43256
R52	43K	1/3	5	Bayschlag	Dep.Carbon	43343
R53	3oK	1/3	5	Bayschlag	Dep.Carbon	4333o
R54	22	1/3	5	Bayschlag	Dep.Carbon	43o22

Pre-set Potentiometers

Circuit Ref.	Value Ω	Rating W	Tol. %	Manufacturer	Type	Part No.
TP1	1K	o.2		Vitrohm	Carbon	518o9
TP2	1oK	o.2		Vitrohm	Carbon	51817
TP3	4.7K	o.2		Vitrohm	Carbon	51813
TP4	1oK	o.2		Vitrohm	Carbon	51817
TP5	1K	o.5		Diplohmatic	Wirewound	518o9

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MAIN PRINTED CIRCUIT BOARD (continued)

Diodes

Circuit REF.	Type No.	Rating	Manufacturer	Type	Part No.
D1-4	B80C5000-3000	80V,3A	ITT	Bridge Rectifier	26252
D5-8	BY 122	40V,0.5A	Philips	Bridge Rectifier	26253
D9	116BT300R	200V,2A	Philips	SCR	26300
D10	1N4148	75V,75mA	ITT	Silicon	26151
D11	1N4148	75V,75mA	ITT	Silicon	26151
D12	1N4003	100V,1A	ITT	Silicon	26153
D13	1N4003	100V,1A	ITT	Silicon	26153
D15	1N4148	75V,75mA	ITT	Silicon	26151
D16	1N710A	6.8V 1/4W $\pm$5%	Silec	Zener	26200
D17	1N710A	6.8V 1/4W $\pm$5%	Silec	Zener	26200
D18	1N710A	6.8V 1/4W+5%	Silec	Zener	26200A
D19	1N4148	75V,75mA	ITT	Silicon	26151
D20	1N4148	75V,75mA	ITT	Silicon	26151

Transistors

Circuit Ref.	Type No.	Rating	Manufacturer	Type	Part No.
TR1	TIP14	60V,2A,10W	Texas Instr.	NPN Silicon Power	60600
TR2-TR15	BSY51 (2N697)		ITT	NPN Medium Silicon Power	60200
TR3 - 4 - 5 - 8 - 9 - 12 - 13 - 17 - 19	2N3705 or equivalent	PNP	Texas Instr.	Silicon Plastic	60500
TR6 - 14 - 16	2N3705 or -	NPN	Texas Instr.	Silicon Plastic	60301

PRINTED CIRCUIT BOARD (continued)

Circuit Ref.	Type No.	Manufacturer	Type	Part No.
TR1o-11	MD7ooo	Motorola	Double NPN Silicon	6o39o
TR18	BSX4o (2N2904)	ITT	PNP Medium Power Silicon	6o4ol
TR2o	TIS43	Texas Instr.	Unijunction	6o9o2
Pulse Transformer				
TF2	11 Z 14	Sprague	Ratio 1:2	61oo5
Filter Coil				
L2	15oμH	Danbridge		9254o

5.2. METER PRINTED CIRCUIT BOARD

Complete Assembly — Part No. 89o28

Resistors

Circuit Ref.	Value	Rating W	Tol. %	Manufacturer	Type	Part No.
R55	1oKΩ	1/4	1	Vitrohm	Metal Film	46278
R56	33Ω	1/3	5	Bayschlag	Dep.Carbon	43o33
R57	1.2KΩ	1/3	5	Bayschlag	Dep.Carbon	43212
R58	4oKΩ	1/4	1	Vitrohm	Metal Film	46279

Pre-set Potentiometers

Circuit Ref.	Value	Rating W	Tol. %	Manufacturer	Type	Part No.
TP6	1K	o,2		Vitrohm	Dep.Carbon	51811
TP7	1oK	o,2		Vitrohm	Dep.Carbon	51817

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5.3. TERMINAL PRINTED CIRCUIT BOARD

Complete Assembly — Part No. 89029.

Capacitors

	Value	Rating		Manufacturer	Type	Part No.
C13	100µF	64V	-10% +50%	Philips	Electrolyt	40876
C14	1µF	160V	10%	Philips	Polyester	40740

Diode

	Type No.	Rating	Manufacturer	Type	Part No.
D14	1N4003	100V,1A	ITT	Silicon	26153

5.4. REAR PANEL COMPONENTS

Circuit Ref.	Value	Rating	Tol. %	Manufacturer	Type	Part No.
TF1	Mains Transformer			Schou.J.		61006
Fuse,Mains	5x20mm	115V/1.5A 220V/0.7A				55915 55913

Capacitor

C6	5000 µF	70V	-20% +50%	Hunt	Electrolyt	40905

Resistor

R1	100KΩ	1/3W	5	Bayschlag	Dep.Carbon	43410

Mains voltage switch	Schurter A.G.	57800
Fuse Holder		55900
Mains input socket (panel mounted)		25000
Mains input plug (free cable plug)		25001

5.5. FRONT PANEL COMPONENTS

Capacitor

C15	32µF	64V	-10% +50%	Philips	Electrolyt	40851

Rotating switch 1 section, 2 poles, 4 position manuf. MEC		49017

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FRONT PANEL COMPONENTS (continued)

Potentiometers

Circuit Ref.	Value	Rating	Tol. %	Manufacturer	Type	Part No.
P1	10KΩ	2W		Colvern	Wirewound	51530
P2	500Ω	2W		Colvern	Wirewound	51512
P3	1KΩ	0.2W		Vitrohm	Carbon	51521

Indicator Lamps

I1	Neon	110V	Schurter AG	33580
I2	Filament	16V/40mA	Schurter AG	33599
Lamp holder for I2			Schurter AG	41204
Main switch		DPST	Torotex	20080
Meter Moving coil		1mA FSD	Sifam	42658

Front plate components

Terminals			37700
Control Knob	Pointer	Philips	38101
Control Knob	Round	Philips	38104
Front Plate			29021

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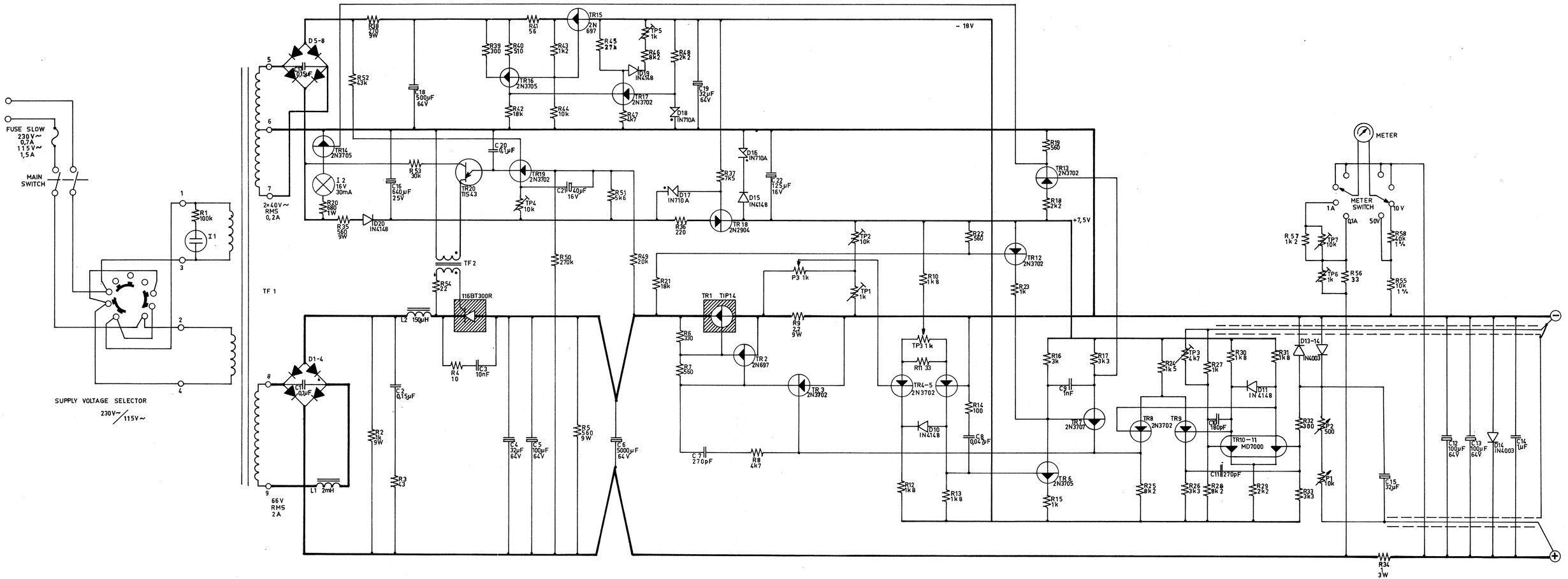

	92160 REGULATED POWER SUPPLY TYPE SF 51-B Circuit Diagram.	Konstr: Jens W. Hansen Tegnet: B.Lehnē 22-9-67 A/S DANBRIDGE