LES 03 / LES 04
LES 05 / LES 06

Final Power Stage

Operating instructions

4.890-0324
5.800-2317/4

MK43 - Br/bd
Hanau - 03/05/83

Table of Contents

1 Operating instructions

1.1 General description

1.1.1 Functional description

The final power stage LES 03 or LES 04 serves as an universal bipolar current source with a controlled output current of +/- 3 A maximum. The device is useable in the electron-beam technology where it serves as a power supply for the deflection or focussing coils and in the drive technology where it is used as a power supply for speed controlled motors.

The desired current value (setpoint) is introduced either thru the internal setpoint potentiometer (only in case of LES 04) or thru an external voltage signal which is compared with the actual current value, obtained thru the voltage drop on a precision shunt on the current controller. The difference between the desired and the actual value produces the control signal which is amplified and causes a current to flow thru the load which corresponds to the setpoint value. If desired a second controller circuit can be super-imposed. The device is initiated thru an external floating contact. The actual value of current is available as normalized voltage signal (10V).

1.1.2 Mechanical descriptions

The device is designed as a plug in module using the Europe-Card format. The supply voltages as well as the inputs and outputs are connected thru a 15-pole H-connector.

The unit LES 03 is without any adjustment and test elements on the front panel. A lockable 10-turn potentiometr is mounted on the front panel of the LES 04 is mounted to adjust the setpoint in manual mode.

1.2 Technical data

1.2.1 Voltage supply

Supply for the electronic elements:

Voltage	± 15 V ± 2 %
Current	+45 / - 30 mA

Supply for power stage:

Voltage	see table 1
Current	and diagrams 1 to 7 in appendix

1.2.2 Inputs

Analog inputs

Setpoint „We“ (d26, z28)

Voltage	$-10\ V \leq U \leq +10\ V$
Input inpedance	approx. 136 kΩ
For impressed current I_e use	R8 = 10 V / $\lvert I_e \rvert$; $\lvert I_e \rvert \leq 10$ mA

Control input „ON“ (d30, RE)

Command by external floating contact

Voltage	+ 15 V
Current	approx. 1.5 mA

1.2.3 Outputs

Power output (z8, d6)	
Current	$\lvert I_N \rvert \leq 3$ A
TK	$\pm$ 560 ppm / K max.
Load resistance	see diagram 1 + 7
Actual value out put „XI“ (d22, RE)	
Voltage	0 to $\pm$ 10 V
Load resistance	≥ 2 kΩ

1.2.4 Ambient requirements

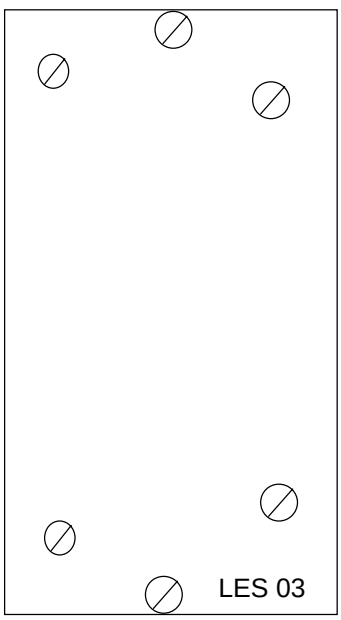
Class of application	KWG according to DIN 40040
	IEC category 0/050/
Ambient temperature	0 °C to 50 °C (32 °F to 120 °F)
Power loss no load	< 2.5 W
Power loss rated load	$\leq$ 37 W
(without additional cooling)	

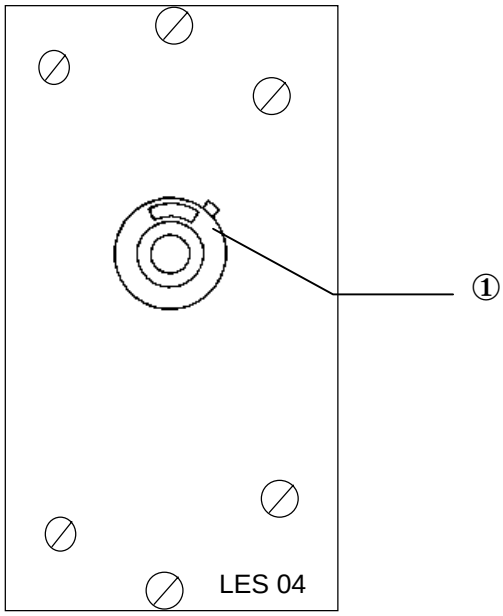
1.2.5 Dimensions

Width	60.6 mm
Height	128.4 mm
Depth without plug connector	175 mm
Depth, overall without plug connector	200 mm

1.3 Adjusting Elements

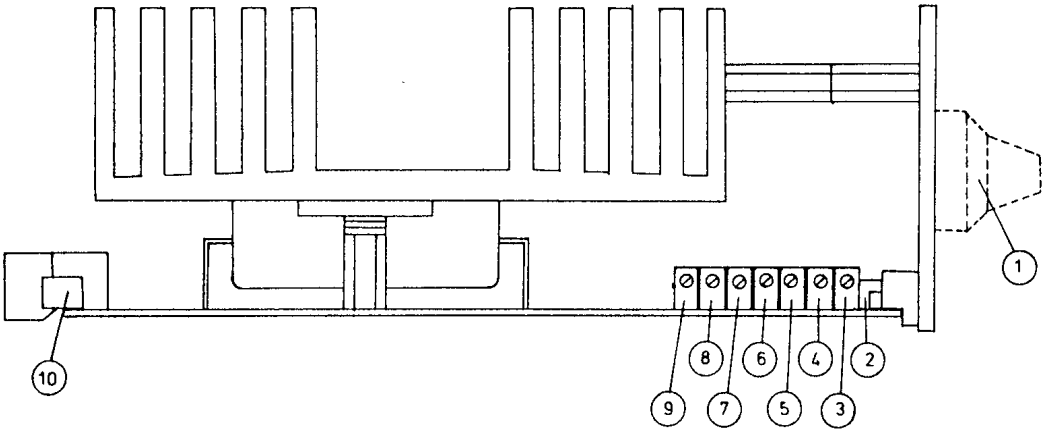
1.3.1 Front view





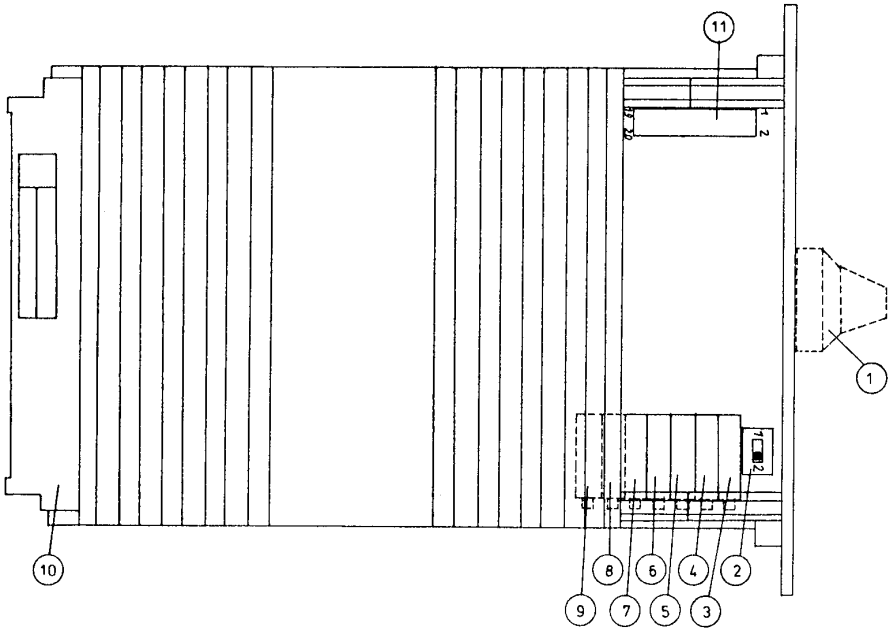
① R1 (102) Setpoint potentiometer

1.3.2 Top view



No.	Symbol	Dwg. Zone		
①	R1	(102)	Setpoint potentiometer	
②	E1/S1	(105)	Switch:	test function
③	E1/R1	(105)	Adjustment Pot.	Integral part of super-imposed controller
④	E1/R2	(107)	Adjustment Pot.	Gain setpoint, resp. Proportional part of super-imposed controller
⑤	E1/R3	(108)	Adjustment Pot.	Offset current controller
⑥	E1/R4	(104)	Adjustment Pot.	Setpoint while in test function
⑦	E1/R5	(110)	Adjustment Pot.	Offset power stage
⑧	E1/R6	(112)	Adjustment Pot.	Gain actual value of current
⑨	E1/R7	(110)	Adjustment Pot.	Offset actual value amplifier
⑩	E1/X1	(101/114)	Connector	15-pole
(11)	E1/X2		Test connector	20-pole

1.3.3 View of component side



1.4 Operating instructions

1.4.1 Connection

Connect the supply voltages, external signals and the load according to LH. Dwg. No. 5.804-2909/3. Command signal „ON“ releases the setpoint interlock.

1.4.2 Normal operation

LES 03

The plug-in device LES 03 has no elements on the front panel for adjusting or controlling. The setpoint is intoduced as a analog signal between 0 and ± 10 V.

LES 04

The 10-turn potentiometer R1 „W“ ① (102) on the front panel allows to set a DC - current between 0 and $+I_N$ (LB 1b closed) resp. Between $-I_N$ and $+I_N$ (LB 1a closed. Additional external setpoint signals at inputs „W_e“ and /or „W_z“ were added to the internal setpoint.

1.4.3 Test operation

With switches S1 „Test“ ② (105) in position „1“ the adjustment potentiometer E1/R4 ⑥ (104) allows to set the output current from 0 to $+I_N$ resp. $-I_N$ to $+I_N$.

1.5 Ordering instructions

Final power stage LES 03: 5.807-2592/3

Final power stage LES 04: 5.807-2611/3

2 Service instructions

2.1 Description of circuit

Numbers in „(( ))“ refer to the block diagram, numbers in „( )“ refer to the drawing zone in the circuit diagram.

2.1.1 Voltage supplies

The +15 V voltage to supply the integrated circuits, relays, transistors etc. is fed from external as well as the $\pm U_S$ - votage to supply the power stage

2.1.2 Setpoints

Normally the setpoint is fed in as a voltage signal between - 10V and + 10V thru the differential amplifier A1/B ((01)), (103). If the setpoint is present as impressed current signal, the resistor E1/R8 (602) must be used (R8 = 10 V / I, I ≤ 20 mA). For test operation the adjustment potentiometer E1/R4 ⑥ ((02)), (104) can be used to produce a setpoint, if the switch E1/S1 „Test“ ② ((03)), (105) is in position „1“. Solder strip E1/LB1 (104) sets the current range to 0 to $+I_N$ resp. $-I_N$ to $+I_N$ .This range is valid too for the 10-turn setpoint potentiometer R1 „W“ ① ((04)), (102) that is present in the version LES 04. Withsuitable selection of the values E1/R19, R23 the input X1/z24 („W_e“ and /or „W_z“)can be used as additional setpoint input. The amplifier A1/A ((05a)), (106) adds all setpoints, limits the sum and sets the maximum output current IN by means of the adjustment potentiometer E1/R2 ④ (107).

2.1.3 Current control circuit

The current controller A1/D ((07)), (108) forms the difference between the setpoint and the actual value. This control signal Y is amplified by the power stage ((09)), (111) and drives a current thru the load. The voltage drop in the shunt E1/R22 ((10)), (112) is fed back to the current controller as actual value signal.

2.1.4 Actual value output

The voltage drop in the shunt E1/R22 ((10)), (112) is amplified by the amplifier A1/C ((114)), (112) to a signal of 10 V at nominal current.

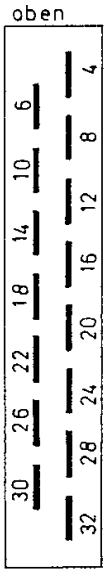
2.1.5 Control input

To release the setpoint interlock d30 is to be connected to elctronic ground (RE) via an external floating contact. The „ON“ command is AND ed with the supply voltage $+U_S$. The relay E1/K1 ((12)), (108) attracts if both the supply voltage $+U_S$ and the „ON“ command are present.

2.2 Connector description

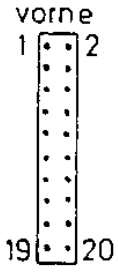
2.2.1 Connector E1/X1 (male, type H, 15-pole)

Pin	dwg. Zone	description	
.z4	(114)	voltage supply	$+U_S$
.d6	(114)	feed back	
.z8	(114)	output	final stage
.d10	(114)	connection for thermal sensor	
.z12	(114)	voltage supply	+15 V
.d14	(114)	electronic ground RE	
.z16	(114)	voltage supply	0
.d18	(114)	voltage supply	- 15 V
.z20	(114)	output	current controller
.d22	(114)	output	actual of current
.z24	(101)	input	„X_e“ or „W_z“
.d26	(101)	input	„W_e“ (+)
.z28	(101)	input	„W_e“ (-)
d30	(101)	input	„ON“
.z32	(114)	voltage supply	$-U_S$



2.2.2 Connector E1/X2 (pin strip, 20-pole)

Pin	dwg. Zone	description	
.1	(103)	input	„X_e“ or „W_z“
.2	(107)	output of amplifier A1/A	
.3	(108)	collector V3	
.4	(104)	slider of setpoint potentiometer (LES 04)	
.5	(105)	collector V6	
.6	(113)	voltage supply	- 15 V
.7	(107)	anode V5, V9 and V10	
.8	(104)	slider of setpoint potentiometer E1/R1	
.9	(106)	collector V8	
.10	(113)	voltage supply	+15 V
.11	(103)	collector V7	
.12	(113)	actual value output	
.13	(114)	voltage supply	$-U_S$
.d14	(104)	output amplifier A1/B	
.d15	(114)	output final stage	
.d16	(109)	output current amplifier („Y“)	
.d17	(113)	electronic ground RE	
.d18	(110)	feed back	
.d19	114)	voltage supply	$+U_S$
.d20	(114)	voltage supply	0



2.3 Test and adjustment instructions

Necessary test and measuring devices:

- digital voltmeter, 3 ½ digits
- amperemeter, DC, 3A
- oscilloscope, if necessary

All voltages are to be measured with respect to electronic ground (RE) on E1/X1.d14 or E1/X2.17 unless another reference point is indicated.

2.3.1 Initial adjustments

Potentiometer	R1 „W“ ①	(LES 04 only)	:	centre position
	E1/R1 ③	(if existing)	:	centre position
	E1/R2 ④		:	fully cw
	E1/R3 ⑤		:	centre position
	E1/R4 ⑥		:	centre position
	E1/R5 ⑦	(if existing)	:	centre position
	E1/R6 ⑧		:	centre position
	E1/R7 ⑨	(if existing)	:	centre position
Switch	E1/S1 ②		:	position „1“
Solder strip	E1/LB1a		:	closed
	E1/LB3b		:	closed
	E1/LB5b		:	closed
	E1/LB2		:	open
	E1/LB4		:	open

2.3.2 External connections

Connect load resistor of 1 / 10 W in series with amperemeter between z8 and d6.

Apply supply voltages $\pm U_S$ ($\pm$ 7 to $\pm$ 14 V $\pm$ 1%) and $\pm$ 15 V.

Both supply voltages are to be turned on simultanously.

2.3.3 Zero adjustment

Test point X2.8: adjust 0 V $\pm$ 10 mV with potentiometer E1/R4

set the current with amperemeter to 0 A $\pm$ 2.5 mA with potentiometer E1/R3 .

2.3.4 Nominal value of current

Turn potentiometer E1/R4 fully clockwise.

Test oint X2.8: read +15 V.

set the current with amperemeter to 2.5 A $\pm$ 25 mA with potentiometer E1/R2 .

2.3.5 Actual value output

Adjust the nominal value as described in 2.3.4.

Test point X2.12: adjust 10 V ± 0.1 V with potentiometer E1/R6 .

If E1/R7 and E1/R18 are added, an additional offset adjustment can be made.

Set output current to 0 A ± 2.5 mA.

Test point X2.12: adjust 10 V ± 10 mV with potentiometer E1/R7.

2.3.6 Release of setpoint interlock

Pin X1.d30 not connected, supply voltage ± US is present.

Test oint X2.3: read approx. +15 V.

Connect pin X1.d30 to electronic ground (RE).

Test point X2.3: read a voltage less than 1 V.

Switch off the US supply

Test oint X2.3: read approx +15 V.

2.4 Instructions for initial start-up

Necessary measuring devices:

- digital voltmeter 3 ½ digits
- amperemeter (3 A DC)

All voltages refere to electronic ground (RE) at E1/X1.d14 or E1/X2.17 unless another reference point is indicated.

- connect amperemeter in series with load
- switch on supply voltages
  - test point X2.10: + 15 V
  - test point X2.6: - 15 V
  - test point X2.19: + US
  - test point X2.13: - US
- switch S1 ② in position „2“
- testing of setpoint interlock release
  - test point X2.3: les than 1 V
- testing nominal value of output current
- turn potentiometer R1 1 (LES 04) resp. The external setpoint potentiometer fully clockwise.
  Adjust the output current to the nominal value using E1/R2 ④.
  test point X2.12: adjust + 10 V ± 100 mV with potentiometer E1/R6 ⑧.
- disconnect the amperemeter and connect the load for normal operation.

3 LES 05 / LES 06

3.1 Description

The final power stages LES 05 / LES 06 are equivalent to the devices LES 03 resp. LES 04 but have an additional LED bar display to show the actual value of the output current. The control for the display is on the pc-board LBA1, behind the front panel. The unit is connected to the test connector X2 on the board LES 3 via a flat ribbon cable.

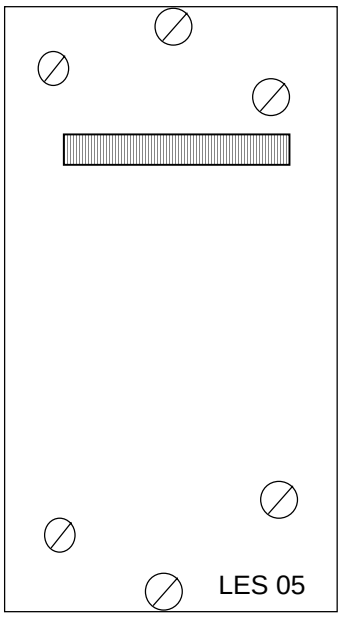
The normalized actual valueof the current (0 V to + 10 V, - 10 V to + 10 V, - 10 V to 0 V) is adapted to the LED display driver. The resistors R10 and R12 select the changeover between the LED ‘s.

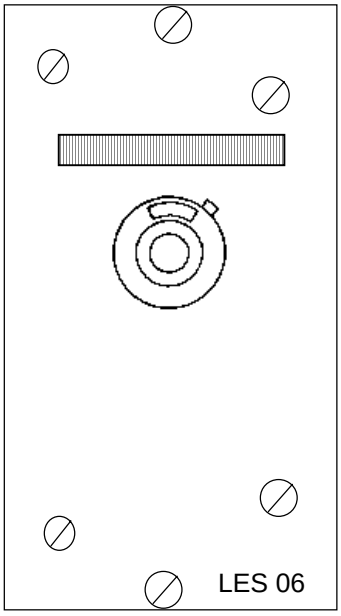
The resistors R1 and R2 determine the brightness of the display.

The two solder links LB1 and LB2 select the range of the displayed current:

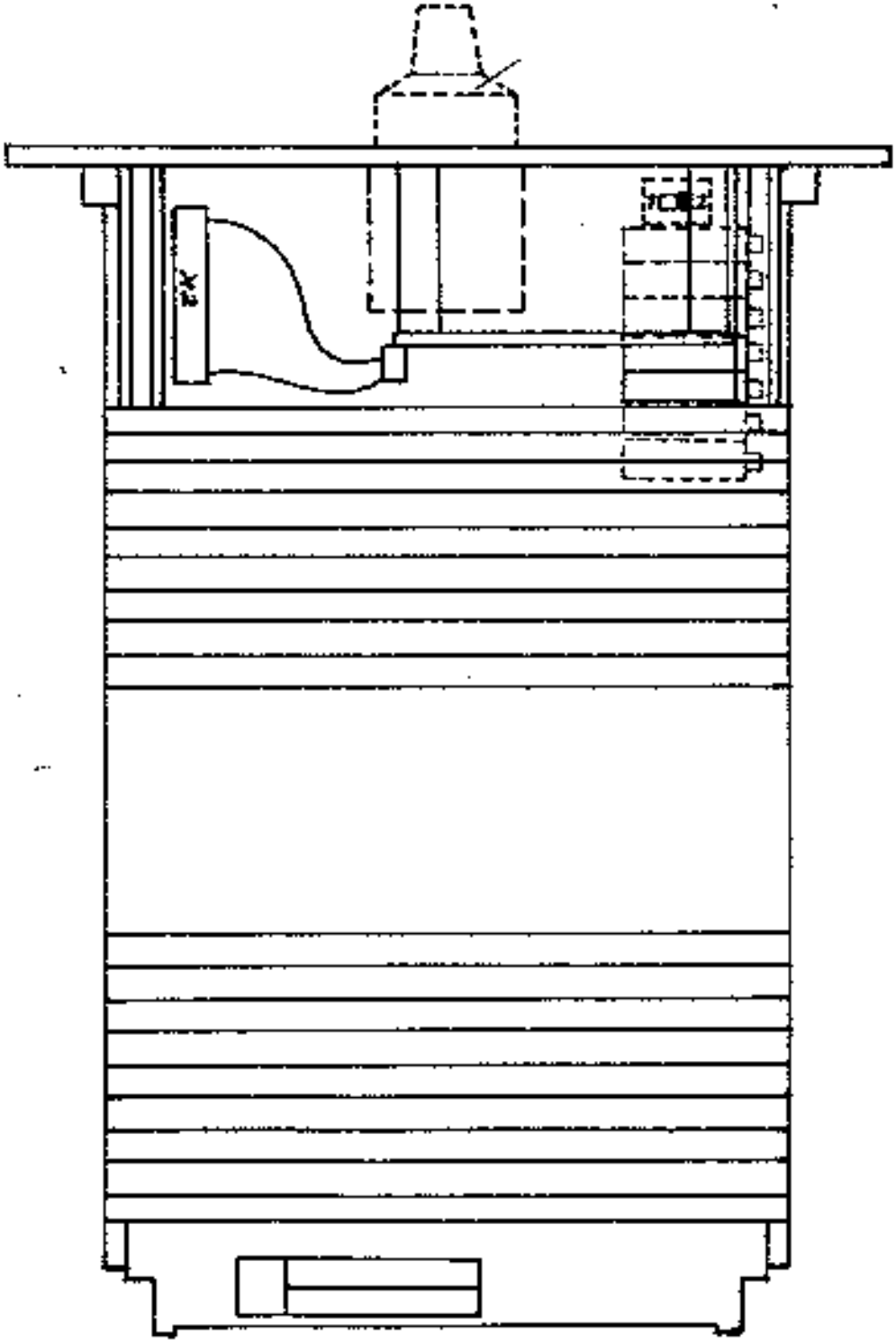
LB1	LB2	range
open	open	0 ...+I_N
closed	open	-I_N ... 0
closed	closed	-I_N ...+I_N

3.2 Front view





3.3 View of component side



3.4 Test and adjustment instructions

First check the pc-board LES 3 is to be tested as described in section 2.3

Close LB1 and LB2 on board LB1.

Adjust output current to 0 A $\pm$ 2.5 mA.

Adjust the ligting dot with potentiometer R9 exactly to the center LED (H8).

3.5 Instructions for initial start-up

First check and adjust the pc-board LES 3 as described in section 2.4

Select range with LB1 and LB2 on board LBA1:

LB1	LB2	range
open	open	0 ...+I_N
closed	open	-I_N ... 0
closed	closed	-I_N ...+I_N

.

Adjust output current to 0 A $\pm$ 2.5 mA.

Adjust the ligting dot with potentiometer R9 exactly to zero position.

4 Appendix

4.1 Technical drawings

Type	Circuit dwg.	Connection dwg.	Parts list
LES 03	5.802-3469/3	5.804-2909/3	5.807-2592/3-2595/3
LES 04	5.802-3469/3	5.804-2909/3	5.807-2610/3-2614/3
LES 05	5.802-3669/3	5.804-2909/3	5.807-2664/3-2666/3
LES 06	5.802-3669/3	5.804-2909/3	5.807-2667/3-2669/3

4.2 Design instructions for power supplies

Use the following diagrams and tables to design the power supply for the final stage.
The diagrams 1 to 5 should be used to design a supply for universal use. The diagrams are calculated for different values of the nominal current. The upper diagram (suffix a) refers to a stabilized supply ($|\Delta U_S / U_{SN}| \leq 1\ \%$) , the lower one (suffix b) is valid than a three-phase current transformer and a three-phase bridge rectifier supplied by a standard power unit (+ 10 %, - 15 %) is used. U_{EFFN} is rated RMS voltage between the output lines of the transformer.
The parameter „k“ of the lower limt line is the ratio of lead-in resistance at 25 °C to the rated resistance of the load (in %).
The from the appropriate curve if the rated current, the rated load resistance and the power supply available or necessary is known.

If a appropriate supply voltage is selected with the rated current and the rated load, so the maximum power loss value (P_V-axis) is determined. With this value Pv diagram 5 delivers a minimal value of cooling air velocity.

Example 1:	$I_N = 2.5$ A	$R_L = 2\ \Omega$
	three phase supply, $k \leq 10\ \%$	
from diagram 2b:	$U_{EFFN} = 12$ V	$P_{VMax} \approx 27$ W
from diagram 5:	no forced cooling necessary	

Example 2:	$I_N = 3$ A	$R_L = 7\ \Omega$
	stabilized supply, $k \leq 10\ \%$	
from diagram 2b:	$U_{EFFN} = 31$ V	$P_{VMax} \approx 36.5$ W
from diagram 5:	$VL \geq 1$ m/s	

When the main power supply is chosen, it must be considered that the values pertain to a pure d.c. output operation. If the lowest possible voltage is used, the coil or solenoid cannot be operated with a superposed alternating current. If high deflection frequencies are necessary, the highest voltage source possible (device can be cooled) must be used.

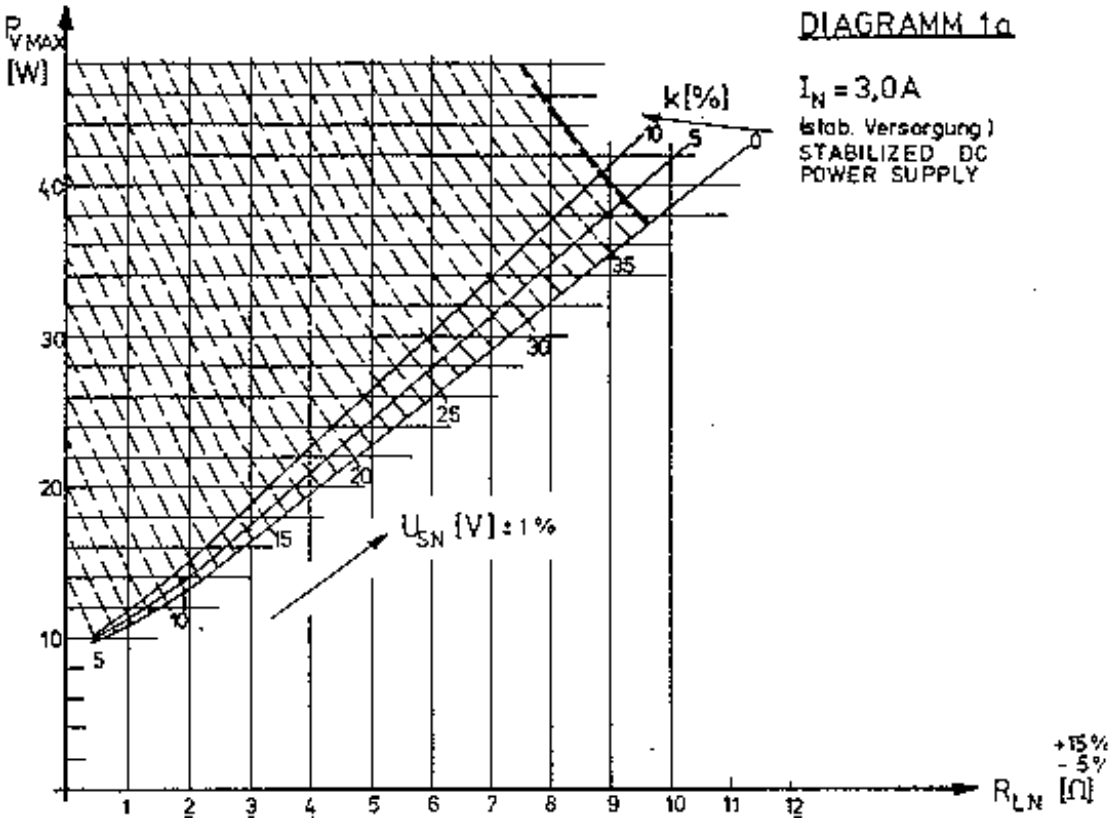


DIAGRAMM 1a
I_N = 3,0A
(stab. Versorgung)
STABILIZED DC
POWER SUPPLY
P_{VMAX} [W]
k [%]
10
5
0
40
30
20
10
35
30
25
20
15
10
5
U_{SN} [V] ± 1%
1
2
3
4
5
6
7
8
9
10
11
12
R_{LN} [Ω]
+15%
-5%

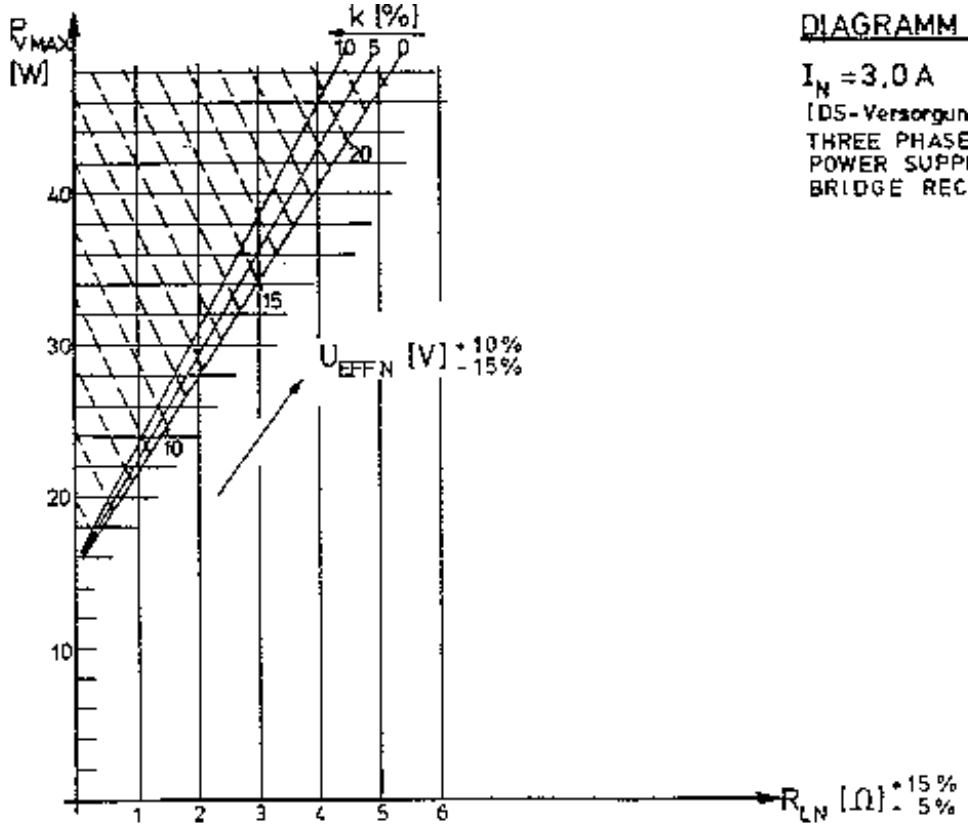


DIAGRAMM 1b
I_N = 3,0A
(DS-Versorgung)
THREE PHASE AC
POWER SUPPLY TO
BRIDGE RECTIFIER
P_{VMAX} [W]
k [%]
10 5 0
40
30
20
10
20
15
10
U_{EFFN} [V] +10%
-15%
1
2
3
4
5
6
R_{LN} [Ω] +15%
-5%

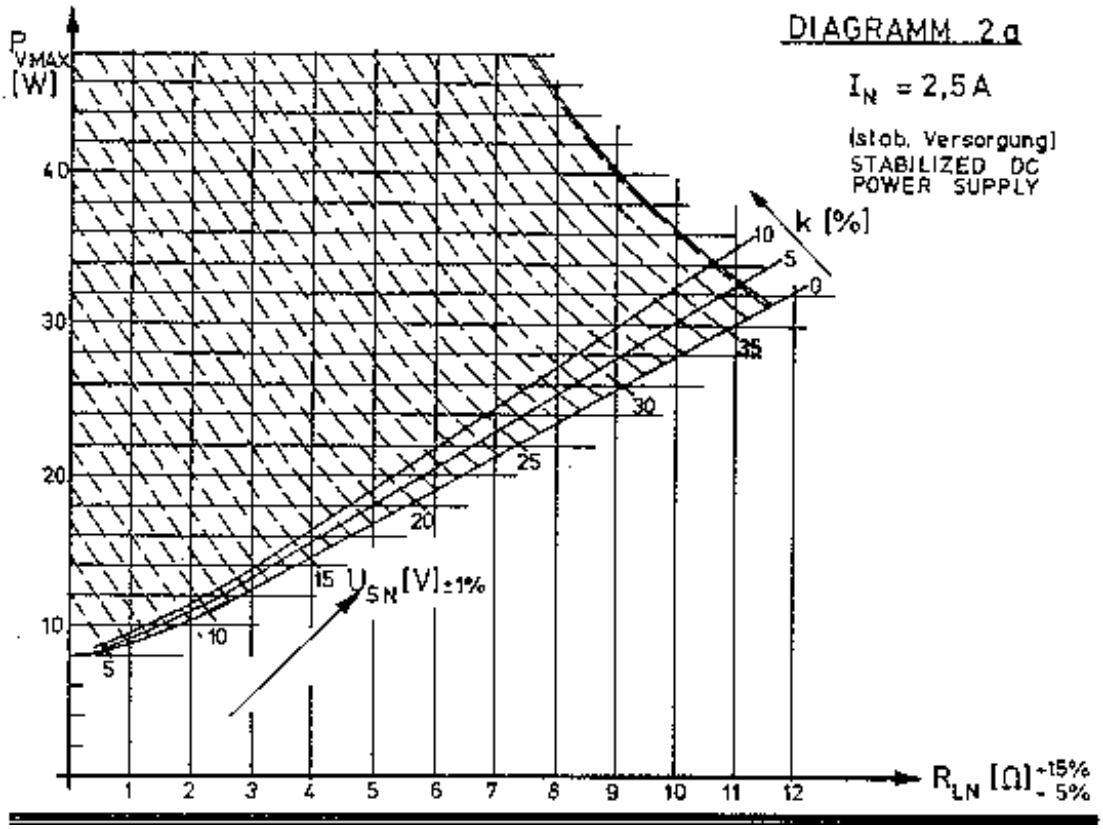


DIAGRAMM 2a
I_N = 2,5 A
(stab. Versorgung]
STABILIZED DC
POWER SUPPLY
P_{VMAX} [W]
k [%]
10
5
0
35
30
25
20
15
10
5
U_{SN} [V] ±1%
R_{LN} [Ω] +15% -5%
1 2 3 4 5 6 7 8 9 10 11 12
40
30
20
10

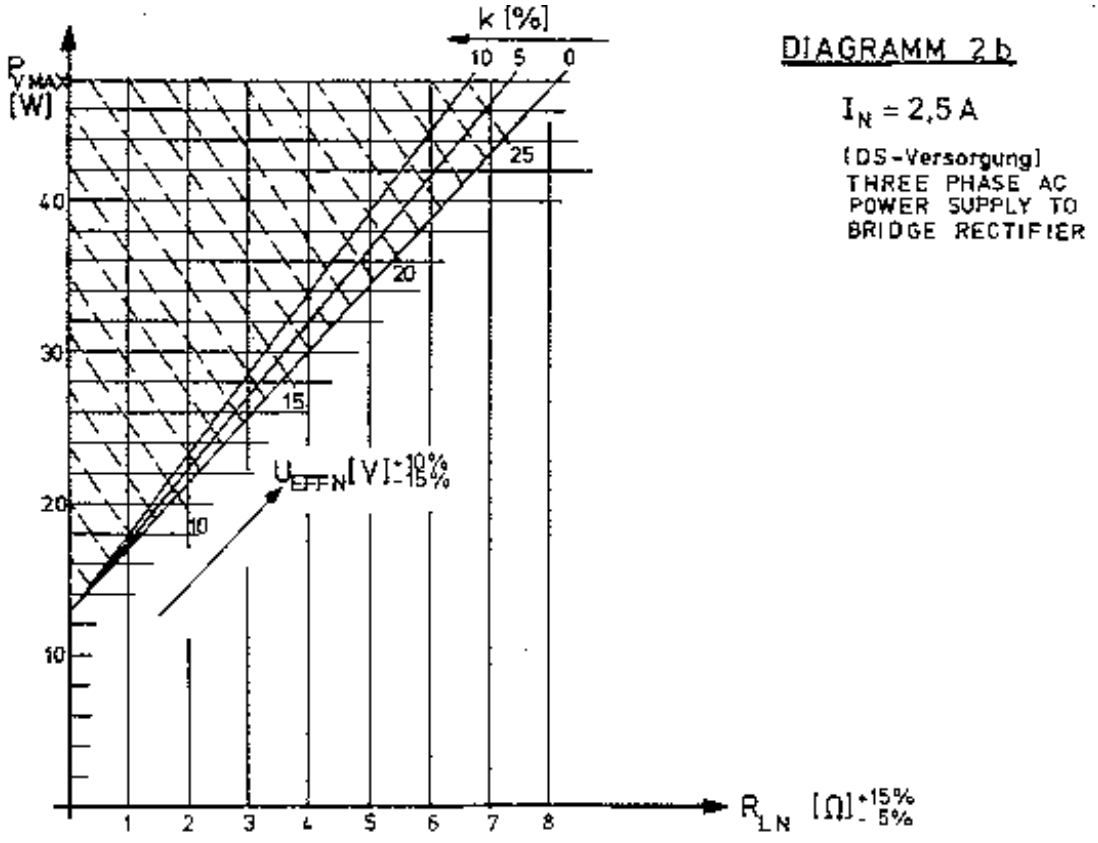


DIAGRAMM 2b
I_N = 2,5 A
(DS-Versorgung]
THREE PHASE AC
POWER SUPPLY TO
BRIDGE RECTIFIER
P_{VMAX} [W]
k [%]
10 5 0
25
20
15
10
U_{EFFN} [V] +10% -15%
R_{LN} [Ω] +15% -5%
1 2 3 4 5 6 7 8
40
30
20
10

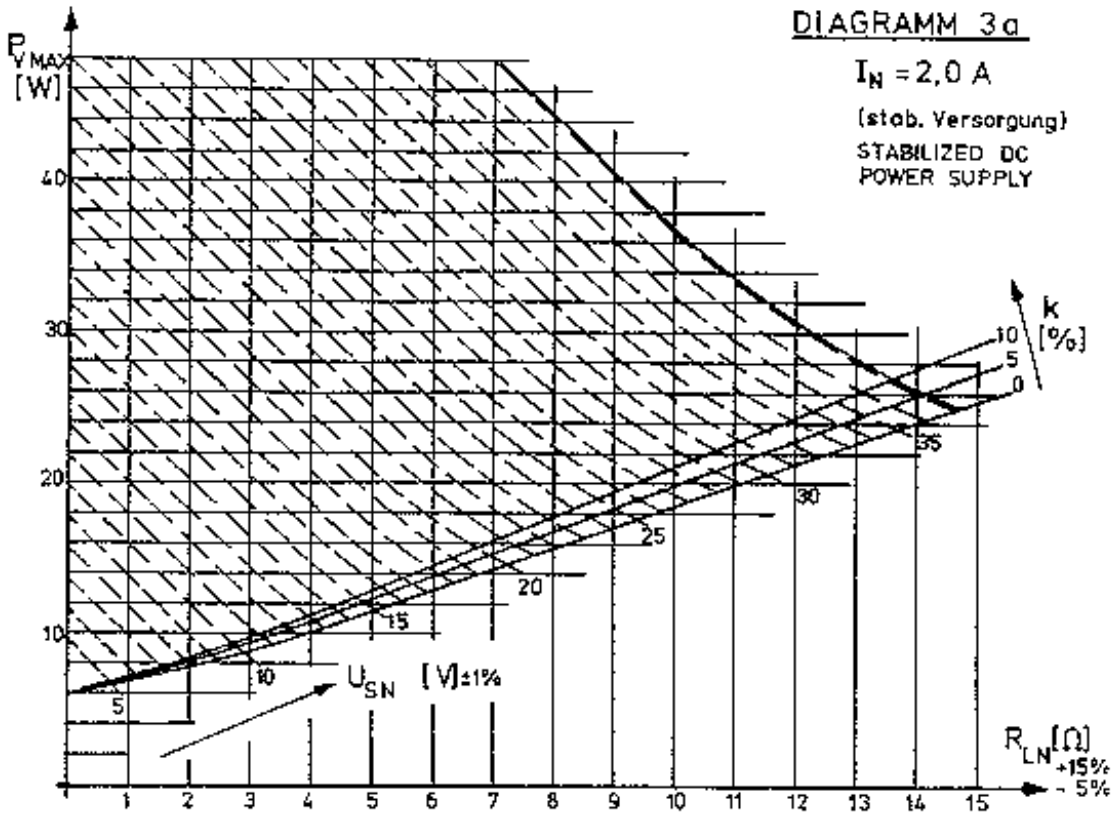


DIAGRAMM 3a
I_N = 2,0 A
(stab. Versorgung)
STABILIZED DC
POWER SUPPLY
$P_{V\,MAX}$ [W]
k [%]
10
5
0
35
30
25
20
15
10
5
U_{SN} [V]±1%
R_{LN} [Ω] +15% - 5%

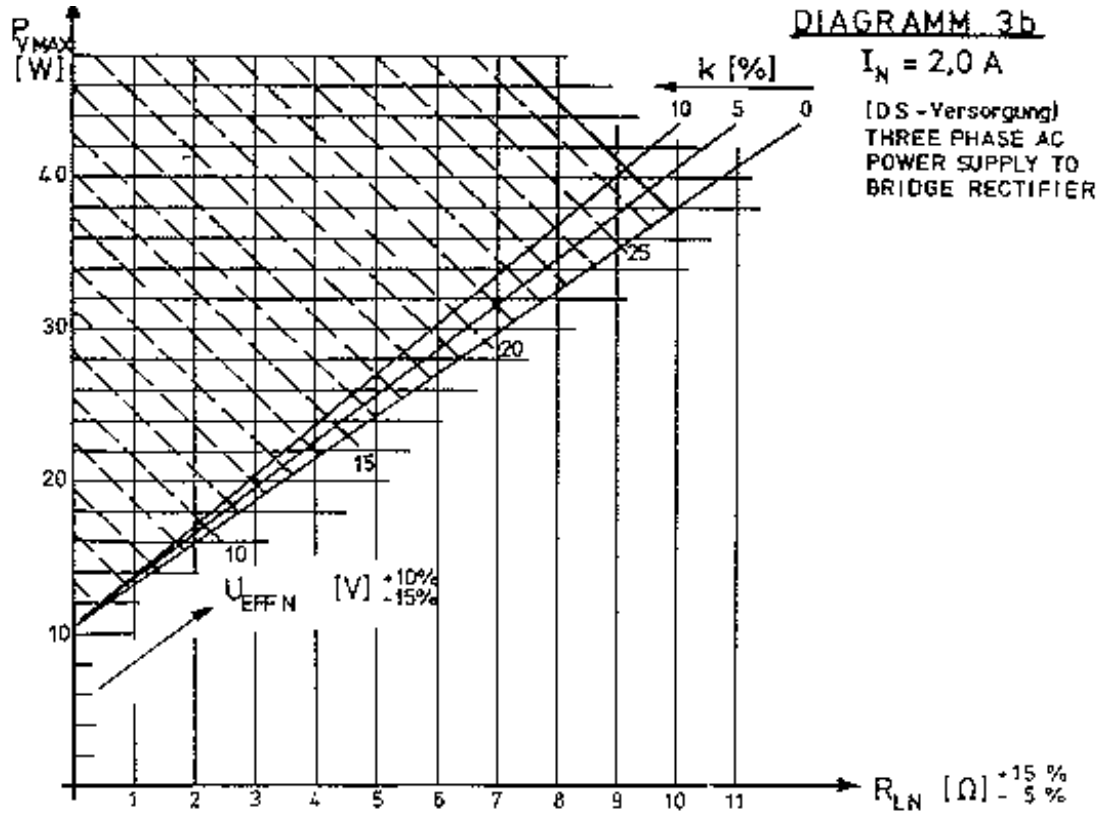


DIAGRAMM 3b
I_N = 2,0 A
(DS-Versorgung)
THREE PHASE AC
POWER SUPPLY TO
BRIDGE RECTIFIER
$P_{V\,MAX}$ [W]
k [%]
10
5
0
25
20
15
10
$U_{EFF\,N}$ [V] +10% -15%
R_{LN} [Ω] +15 % - 5 %

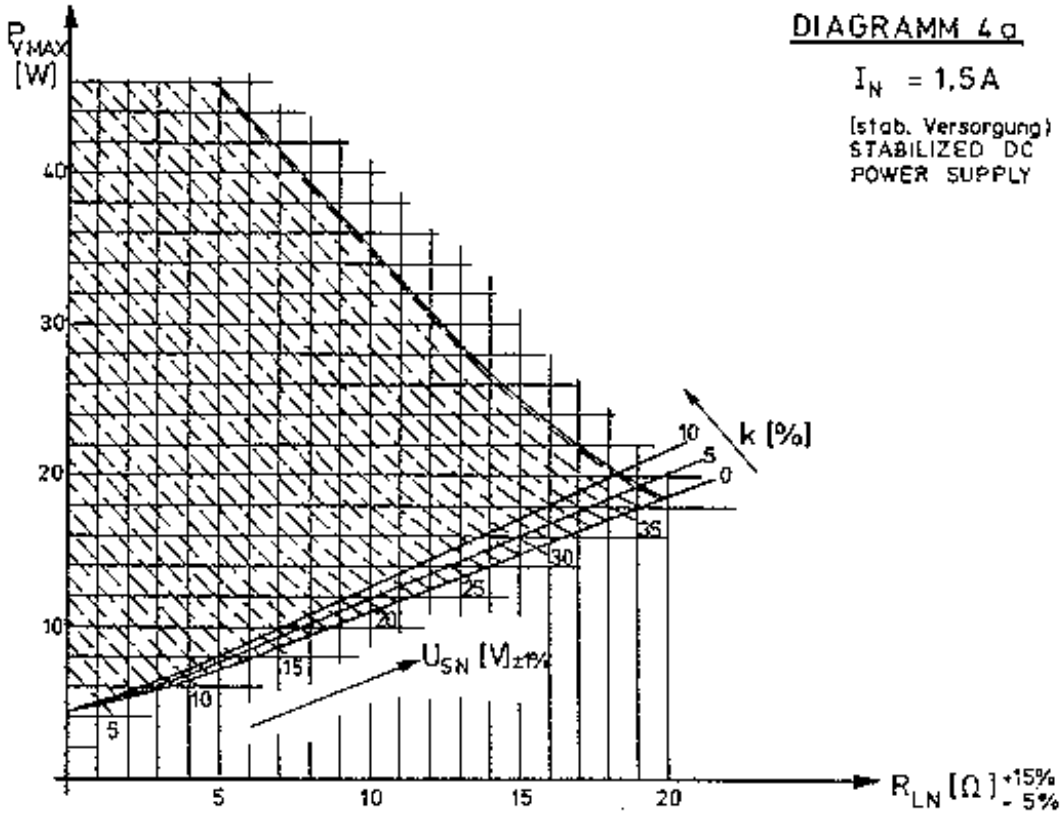


DIAGRAMM 4a
I_N = 1,5A
(stab. Versorgung)
STABILIZED DC
POWER SUPPLY
P_{VMAX} [W]
40
30
20
10
k [%]
10
5
0
35
30
25
20
15
10
5
U_{SN} [V]±1%
5
10
15
20
R_{LN} [Ω] +15% -5%

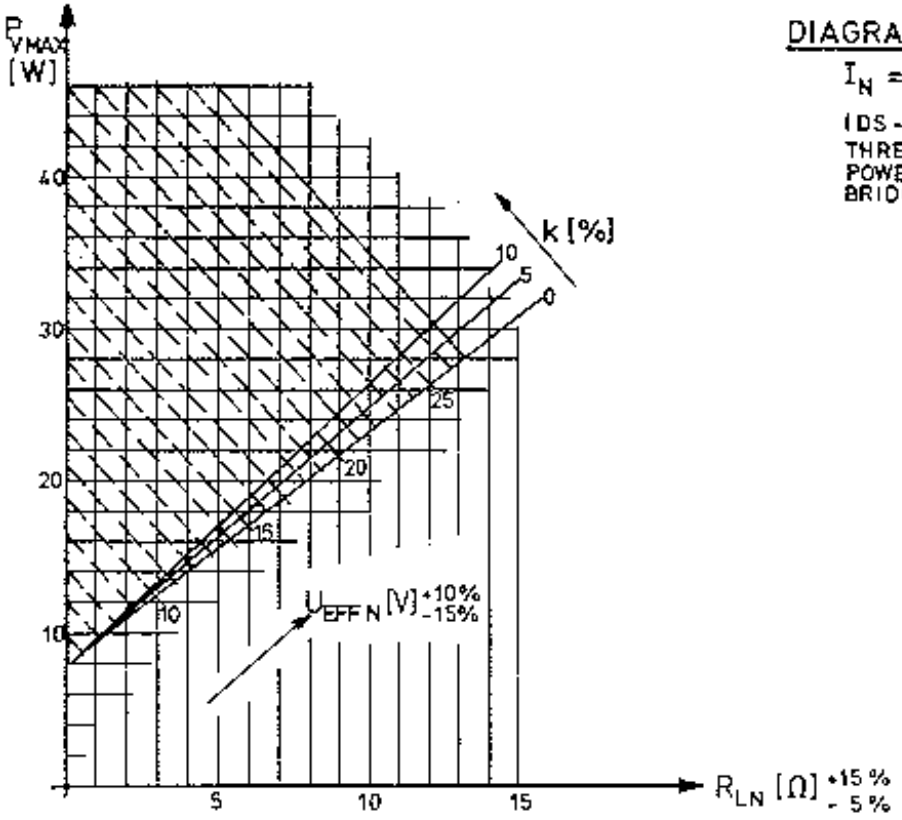


DIAGRAMM 4b
I_N = 1,5A
(DS - Versorgung)
THREE PHASE AC
POWER SUPPLY TO
BRIDGE RECTIFIER
P_{VMAX} [W]
40
30
20
10
k [%]
10
5
0
25
20
15
10
$U_{EFF\,N}$ [V] +10% -15%
5
10
15
R_{LN} [Ω] +15 % -5 %

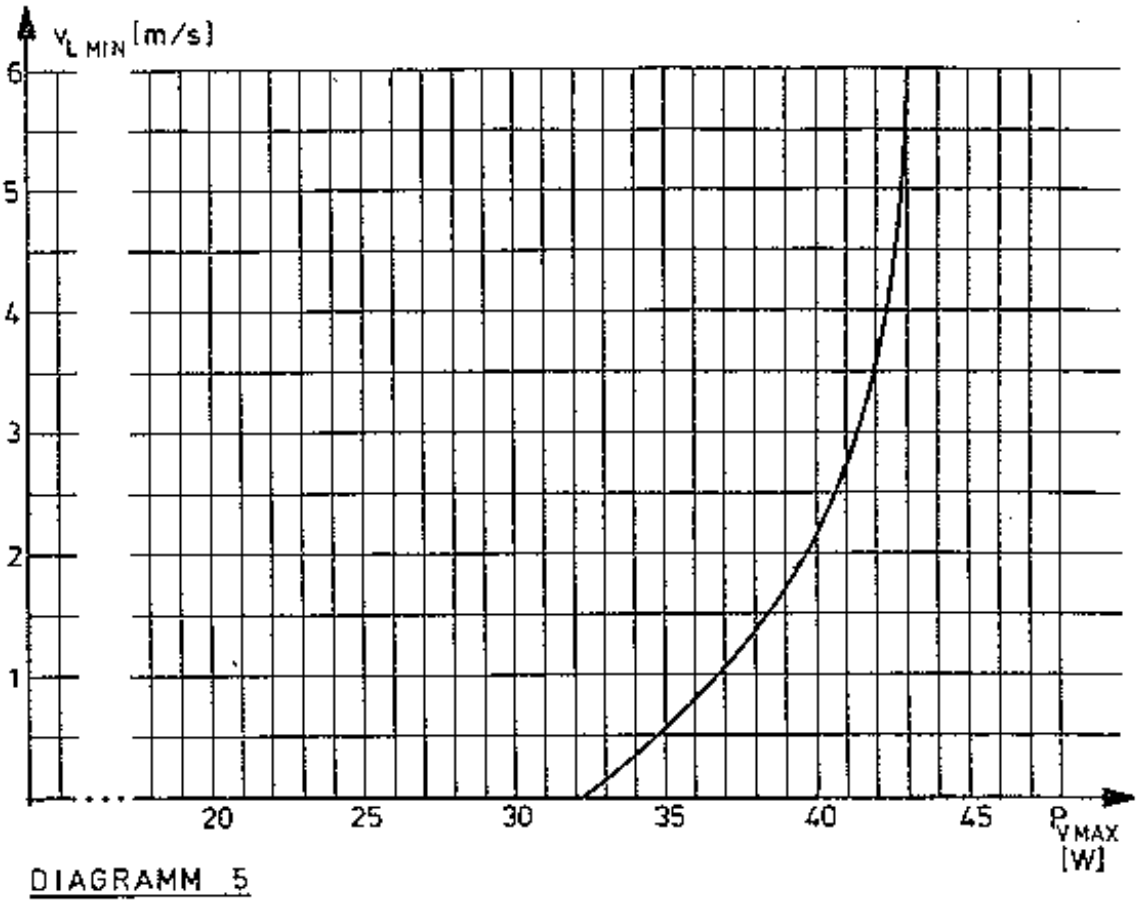
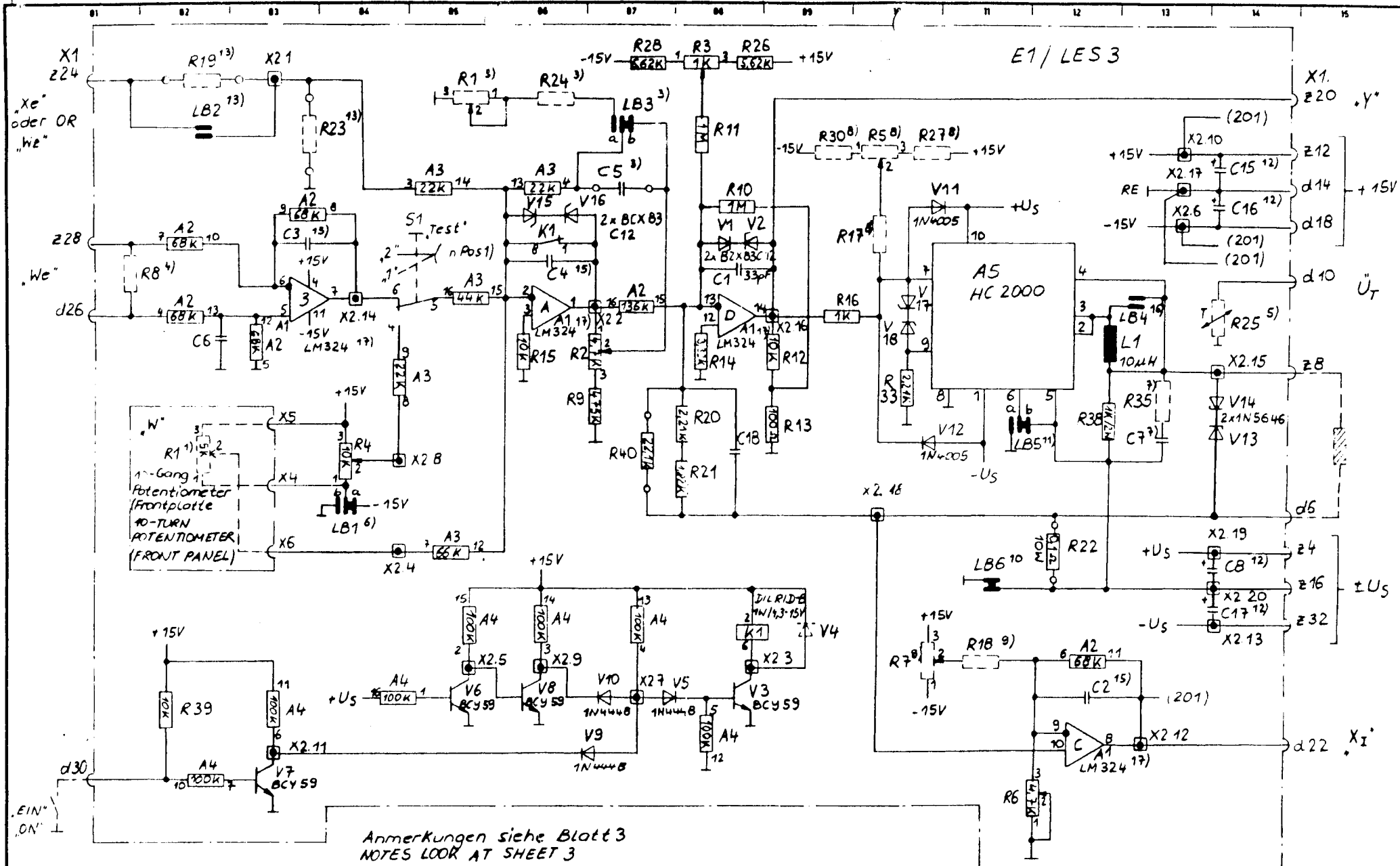


DIAGRAMM 5

APPLICATION		R_{LN} (Ω)	STABILIZED DC POWER SUPPLY ±1% U_{SN}(V)				THREE PHASE AC POWER SUPPLY TO BRIDGE RECTIFIER U_{EFFN} (V) +10 % −15 %			
			I_N=1,5A	I_N=2,0A	I_N=2,5A	I_N=3,0A	I_N=1,5A	I_N=2,0A	I_N=2,5A	I_N=3,0A
ESV6	rad	3	9÷25	11÷21	13÷19	15÷19	11÷18	13÷16	14÷15	–
	tan	1,6	7÷23	8÷19	9÷16	10÷15	8÷17	9÷14	10÷12	11
ESV8/14/18	rad	2,1	7÷24	9÷20	10÷17	12÷16	9÷17	10÷14	12÷13	–
	tan	1,7	7÷23	8÷19	9÷17	10÷15	8÷17	10÷14	11÷12	12
KA 6	rad	3,4	10÷26	12÷22	14÷20	17÷20	11÷19	14÷16	–	–
	tan	0,5	5÷17	5÷17	5÷14	6÷12	6÷16	7÷12	7÷10	7÷9
	fok	3,7	10÷26	13÷22	15÷21	18÷21	12÷19	14÷17	–	–
KA25	rad	2,9	9÷25	11÷21	12÷19	15÷19	11÷18	12÷16	14	–
	tan	1	5÷22	6÷17	7÷15	8÷13	7÷16	8÷13	8÷11	9÷10
	fok	4,5	12÷27	15÷24	18÷23	21÷23	13÷20	16÷18	–	–
KA 150	rad	1,2	6÷22	7÷18	7÷15	8÷14	7÷17	8÷13	9÷12	10÷11
	tan	0,7	5÷22	5÷17	6÷14	6÷12	7÷16	7÷13	7÷11	8÷10
	fok	4,2	11÷27	14÷23	17÷22	20÷22	13÷19	15÷17	–	–
ESV12	rad	2,9	9–25	11–21	13–19	15–19	10–18	11–16	13–14	–
	tan	4,4	12–27	15–24	18–23	21–23	12–20	15–17	17	–

APPLICATION		R_{LN} (Ω)	STABILIZED DC POWER SUPPLY ±1% U_{SN}(V)				THREE PHASE AC POWER SUPPLY TO BRIDGE RECTIFIER U_{EFFN} (V) +10 % -15 %			
			I_N=1,5A	I_N=2,0A	I_N=2,5A	I_N=3,0A	I_N=1,5A	I_N=2,0A	I_N=2,5A	I_N=3,0A
ESV6	rad	3	9÷25	11÷21	13÷19	15÷19	11÷18	13÷16	14÷15	–
	tan	1,6	7÷23	8÷19	9÷16	10÷15	8÷17	9÷14	10÷12	11
ESV8/14/18	rad	2,1	7÷24	9÷20	10÷17	12÷16	9÷17	10÷14	12÷13	–
	tan	1,7	7÷23	8÷19	9÷17	10÷15	8÷17	10÷14	11÷12	12
KA 6	rad	3,4	10÷26	12÷22	14÷20	17÷20	11÷19	14÷16	–	–
	tan	0,5	5÷17	5÷17	5÷14	6÷12	6÷16	7÷12	7÷10	7÷9
	fok	3,7	10÷26	13÷22	15÷21	18÷21	12÷19	14÷17	–	–
KA25	rad	2,9	9÷25	11÷21	12÷19	15÷19	11÷18	12÷16	14	–
	tan	1	5÷22	6÷17	7÷15	8÷13	7÷16	8÷13	8÷11	9÷10
	fok	4,5	12÷27	15÷24	18÷23	21÷23	13÷20	16÷18	–	–
KA 150	rad	1,2	6÷22	7÷18	7÷15	8÷14	7÷17	8÷13	9÷12	10÷11
	tan	0,7	5÷22	5÷17	6÷14	6÷12	7÷16	7÷13	7÷11	8÷10
	fok	4,2	11÷27	14÷23	17÷22	20÷22	13÷19	15÷17	–	–
ESV12	rad	2,9	9–25	11–21	13–19	15–19	10–18	11–16	13–14	–
	tan	4,4	12–27	15–24	18–23	21–23	12–20	15–17	17	–



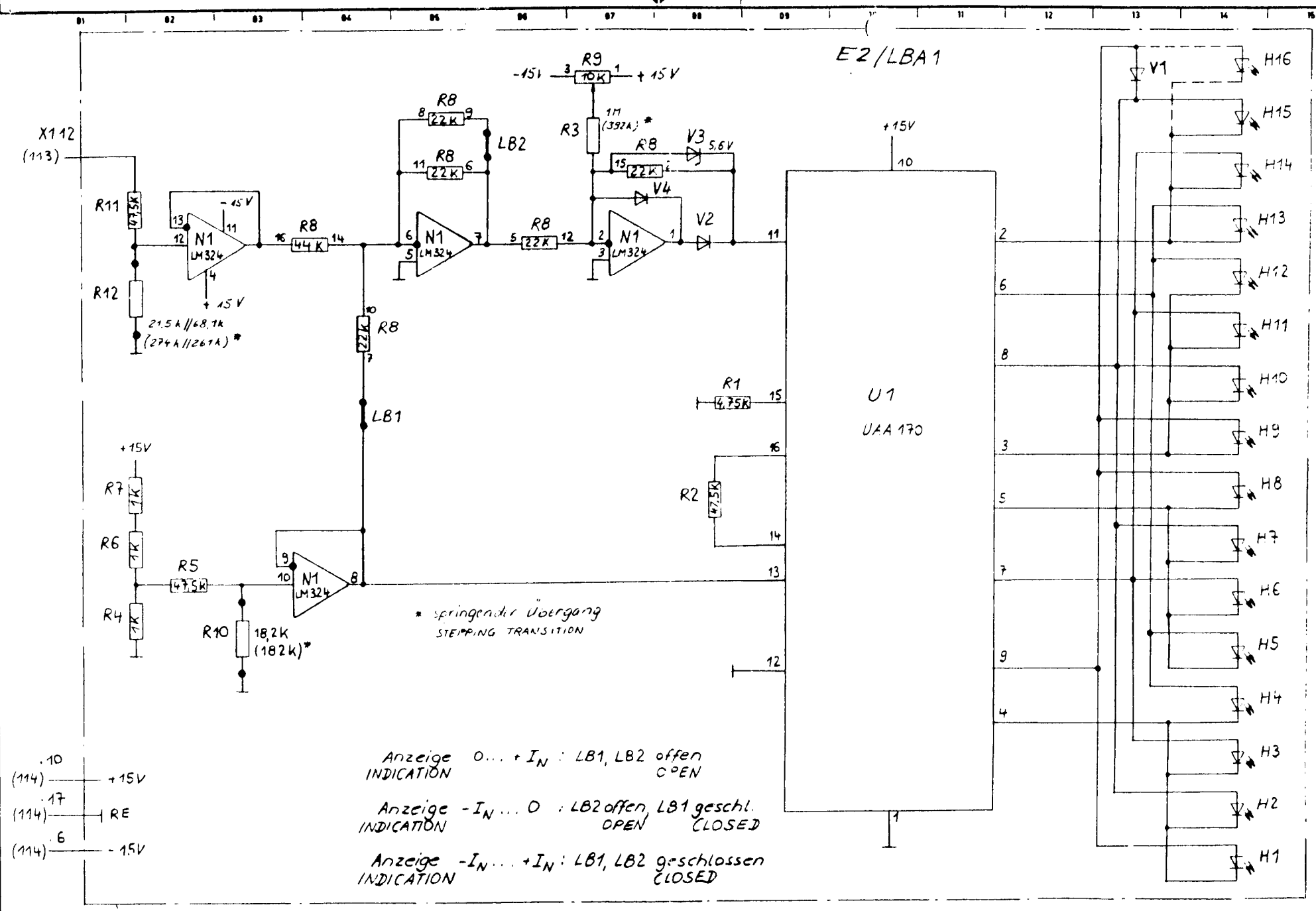
Änderungen a) Bl. 2 geänd. 10.5.83 Br.
b) V13, V14 geändert 20.9.83 Br.

Bearb.	2.2.	Hauck	
Geprüft			
Norm	Datum	Name	

Benennung: LES05/LES06
Leistungsendstufe
POWER STAGE (V/C)

LEYBOLD-HERAEUS HANAU

Blattzahl	Zeichnung-Nr.	Blatt-Nr.
3	5.802 - 3969/3	1



Änderungen a) R3, R12 10.5.83 Dr.

Bearb.		Name	Benennung: LES05/ LES06 Leistungsendstufe Stromlaufplan
Geprüft			
Datum			

LEYBOLD-HERAEUS HANAU

Blattzahl 3 | Zeichnung-Nr. 5.802 - 3969/3 | Blatt-Nr. 2

Anmerkungen:

1. Nur bei LES06 vorhanden
2. Für I_N = 3,0 A nicht bestückt

   Achtung! Für ausreichend Kühlung der Endstufe sorgen.
3. Zusatzregelkreis: LB3a anstelle von LB3b schließen; R1, R24, C3 nach Bedarf.
4. Bei eingeprägtem Strom bestücken R8 = 10V/I
5. Zur ext. Überwachung d. Kühlkörpertemperatur (bei Bedarf).
6. LB1a für bipolaren Ausgang $\pm I_N$
   LB1b für unipolaren Ausgang $+I_N$
7. Dämpfungsglied, bei Bedarf bestücken.
8. Offsetkompensation des Leistungsverstärkers, bei Bedarf bestücken.
9. Offsetkompensation des Istwertverstärkers, bei Bedarf bestücken.
10. Verbindungspunkt zwischen RE und 0V ($\pm U_S$). Bei Bedarf auftrennen und extern verbinden.
11. LB5b legt Substrat d. Leistungsvorverstärkers auf 0V ($\pm U_S$). Bei Bedarf legt LB5a das Substrat auf RE.
12. Stützkondensatoren für die Versorgungsspannungen, bei Bedarf bestücken.
13. Eingang für externen Istwert (Zusatzregelkreis) oder zusätzlichen Sollwert; Nach Bedarf bestücken.
14. Stützkondensatoren für d. Versorgungsspannung d. Leistungsverstärkervorstufe.
15. Bestückungsplätze für Kondensatoren. Nach Bedarf bestücken.
16. LB4 geschlossen bei Variante 2 und 3
17. Für schnelle Stromänderungen durch RC 4157 ersetzen.

Achtung!

Alle Änderungen oder Ergänzungen der Grundbestückung müssen im übergeordneten, anlagenspezifischen Stromlaufplan angegeben werden!

NOTES:

1. EXISTENT ONLY LES 06
2. TO REACH 3,0A REMOVE R40

   ATTENTION: LOOK FOR SUFFICIENT COOLING OF THE POWER STAGE
3. ADDITIONAL CONTROL CIRCUIT: CLOSE LB3b INSTEAD OF LB3a; R1, R24, C3 AS NEEDED.
4. WITH IMPRESSED CURRENT MAKE R8 = 10V/I
5. FOR EXTERNAL SUPERVISION OF HEAT SINK TEMPERATURE (IF NEEDED).
6. CLOSE LB1a FOR BIPOLAR OUTPUT CURRENT $\pm I_N$,
   CLOSE LB1b " UNIPOLAR " " $+I_N$
7. ATTENUATOR, IF NEEDED.
8. OFFSETCOMPENSATION OF POWER AMPLIFIER, IF NEEDED.
9. OFFSETCOMPENSATION OF ACTUAL VALUE AMPLIFIER, IF NEEDED.
10. CONNECTION POINT BETWEEN RE (ELECTRONIC GROUND) AND 0V ($\pm U_S$). OPEN* IF AN EXTERNAL CONNECTION POINT IS NEEDED. *LB 6
11. LB5b CONNECTS SUBSTRATE OF POWER AMPLIFIER TO 0V ($\pm U_S$). LB5a CONNECTS IT TO RE (ELECTRONIC GROUND), IF WANTED.
12. CAPACITORS TO BUFFER THE SUPPLY VOLTAGES, IF NEEDED.
13. INPUT FOR EXTERNAL ACTUAL VALVE (ADDITIONAL CONTROL CIRCUIT) OR ADDITIONAL SET POINT. SELECTSUITABLE VALVES, IF INPUT IS NEEDED.
14. CAPACITORS TO BUFFER THE SUPPLY VOLTAGE OF THE POWER AMPLIFIER PRE-STAGE, IF NEEDED.
15. PLACE FOR CAPACITORS, IF NEEDED.
16. LB4 CLOSED BY VERSION 2 and 3
17. FOR FAST CURRENT CHANGES REPLACE BY RC 4157

ATTENTION !

ALL MODIFICATIONS OF THE BASIC VERSIONS MUST BE SPECIFIED IN THE SUPERIOR CIRCUIT DIAGRAM OF THE PLANT !

Änderungen: a) 10.5.83 Br.	Bearb. z.t. Handl	Benennung: LES05/LES06 Leistungsendstufe POWER STAGE (V/C)	LEYBOLD-HERAEUS Werk Hanau
	Geprüft		Zeichnungs-Nr. 5.802-396913
	1983 Datum Name		Blatt-Nr. 3