



**SWITCHED MODE TRIPLE POWER SUPPLIES ST 60 AND ST 60A**

**Three independend fully regulated outputs**

	ST60	adj.	ST60A	adj.
Output 1 :	5 V 6 A <sup>*</sup> )	4,8- 5,5 V	5 V 6 A <sup>*</sup> )	4,8- 5,5 V
Output 2 :	12 V 1 A	11,8-12,5 V	15 V 1 A	14,0-15,5 V
Output 3 :	12 V 1 A	11,8-12,5 V	15 V 1 A	14,0-15,5 V

<sup>\*</sup>) max. 10 A when only output 1 is loaded.

All outputs are floating, so they can be connected in any desired configuration. The two 12V outputs can be used as 2 isolated sources or as a + and - 12V or as 24V.

V<sub>2</sub> and V<sub>3</sub> have additional linear regulators, which make them independent of V<sub>1</sub>.

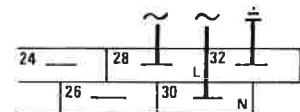
The large input voltage range allows **world wide** use on 110-115-125-220-230-240 V 50-400Hz line voltages and even on 250 to 365 VDC.

**Input voltage**

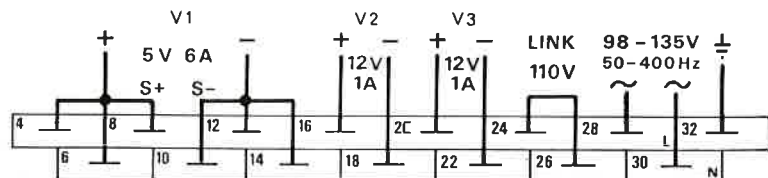
185 - 265 V AC 50-400 Hz  
 or 250 - 365 V DC

or with a link on the connector  
 98 - 135 V AC 50-400 Hz

185 - 265 V 50 - 400 Hz  
 or 250 - 365 V DC



Standardized H 15 connector according to DIN 41612.



## Voltage regulation

At 10-100% load variation:  
 $V_1$  20mV,  $V_2$  and  $V_3$  125 mV

At 185-265 V AC line variation:  
 $V_1$  15 mV,  $V_2$  and  $V_3$  5 mV

## Ripple + noise (incl. spikes)

30 mVp-p on all outputs

## Transient response

At a load change 10 to 100%  
Max. deviation 0.5 V  
Recovery time:  $V_1$  1mS  
 $V_2$  and  $V_3$  less than 0.1mS  
( $V_1$  loaded with minimum 10%).

## Temp. coeff. of output voltages

0.02% per °C (at constant load after 15 min. warm up).

## Efficiency

Typically 70% at full load and 220 V AC input.

## Overvoltage protection

Internal SCR crowbar OVP, set to operate at approximately 7 V on  $V_1$ . This also shuts down  $V_2$  and  $V_3$

## Hold-up time

40 mS at full load and 220 V AC input.

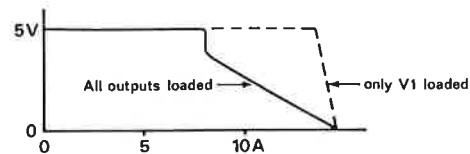
## Temperature range

-10 to +50 °C at 100% output current.  
Derate current linearly to 20% at 75 °C.  
A thermoswitch shuts down the output when the unit gets overheated.

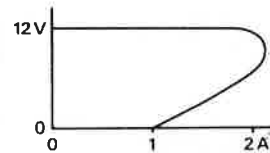
## Led lamp

Led lamp on front end indicates output state of  $V_1$

## Overload protection



## Current limit of $V_1$



## Current limit of $V_2$ and $V_3$

## Series operation

Up to 100 V combined output.

## RFI suppression

Conducted interference complies with VDE 0875 curve N-12db on input and curve N on output.

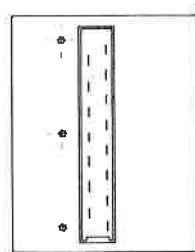
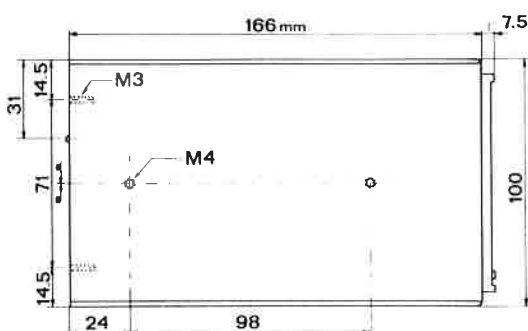
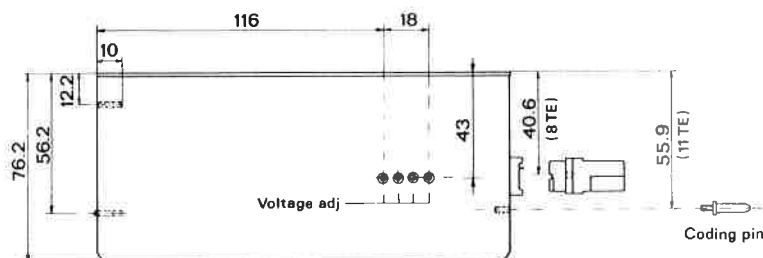
## Insulation

2.5 kV AC RMS (1 min.) input to output and input to case. 500 V DC output to case and between outputs.

Insulation resistance better than 50 MOhm (measured at 500 V DC).

Safety in accordance with IEC 348.

**Weight** 1.4 kgs



Eurocassette according to DIN 41494.

A 16 TE front panel, a coding strip and pin can be ordered separately.

An adapter for panel mounting (model PA1) is also available.

R = Ohm

- 1 = 16 25 °C  
(Keystone RL 450-10-73-S48)
- 2 = 150 k
- 3 = -
- 4 = 150 k
- 5 = -
- 6 = 8,2
- 7 = 10
- 8 = 1 k
- 9 = -
- 10 = 390
- 11 = 10 k
- 12 = 10 k
- 13 = 10 k
- 14 = 10 k
- 15 = 12 k
- 16 = 33 k
- 17 = 15 k
- 18 = 470
- 19 = 4,7 k
- 20 = 470
- 21 = 33 k
- 22 = 1 k
- 23 = 18
- 24 = 18
- 25 = 10
- 26 = 560
- 27 = 100 potm.
- 28 = 220
- 29 = 330 NTC
- 30 = 1,5
- 31 = 1,5
- 32 = 1 k 7W WW
- 33 = 120
- 34 = 100
- 35 = 470
- 36 = 150
- 37 = 1 k potm. 20 trn
- 38 = 1 k
- 39 = 1,5 k
- 40 = -
- 41 = -
- 42 = -
- 43 = 100
- 44 = 4,7 k
- 45 = CR
- 46 = 1 k potm.
- 47 = 100 k
- 48 = 150 k
- 49 = -
- 50 = 68
- 51 = 47
- 52 = 1 k potm. 20 trn
- 53 = 1,8 k
- 54 = 220
- 55 = 1,8 k

- 56 = 1 k potm. 20 trn
- 57 = 220

D

- 1 = VJ 1048 Varo
- 2 = BYV 26D Philips
- 3 = BYV 26D Philips
- 4 = BYV 26D Philips
- 5 = ZPY 6,2 ITT
- 6 = VSK 3030S Varo
- 7 = VSK 3030S Varo
- 8 = ZPY 6,2 ITT
- 9 = BTY 79-200R Philips
- 10 = G 314 N4 Philips
- 11 = ZPD 5,6 ITT
- 12 = ZPD 6,8 ITT
- 13 = 1 N 4148 TI
- 14 = 1 N 4148 TI
- 15 = 1 N 4148 TI
- 16 = ZPD 6,2 ITT
- 17 = BYV 26D Philips
- 18 = BYV 26D Philips
- 19 = BYV 26D Philips
- 20 = -
- 21 = -
- 22 = TL 431 ILP TI
- 23 = TL 431 ILP TI
- 24 = BYV 32/150 Philips
- 25 = BYV 32/150 Philips
- 26 = BYV 26D Philips
- 27 = ZPU 150 ITT
- 28 = 1 N 4148 TI
- 29 = 1 N 4004 Philips
- 30 = 1 N 4004 Philips

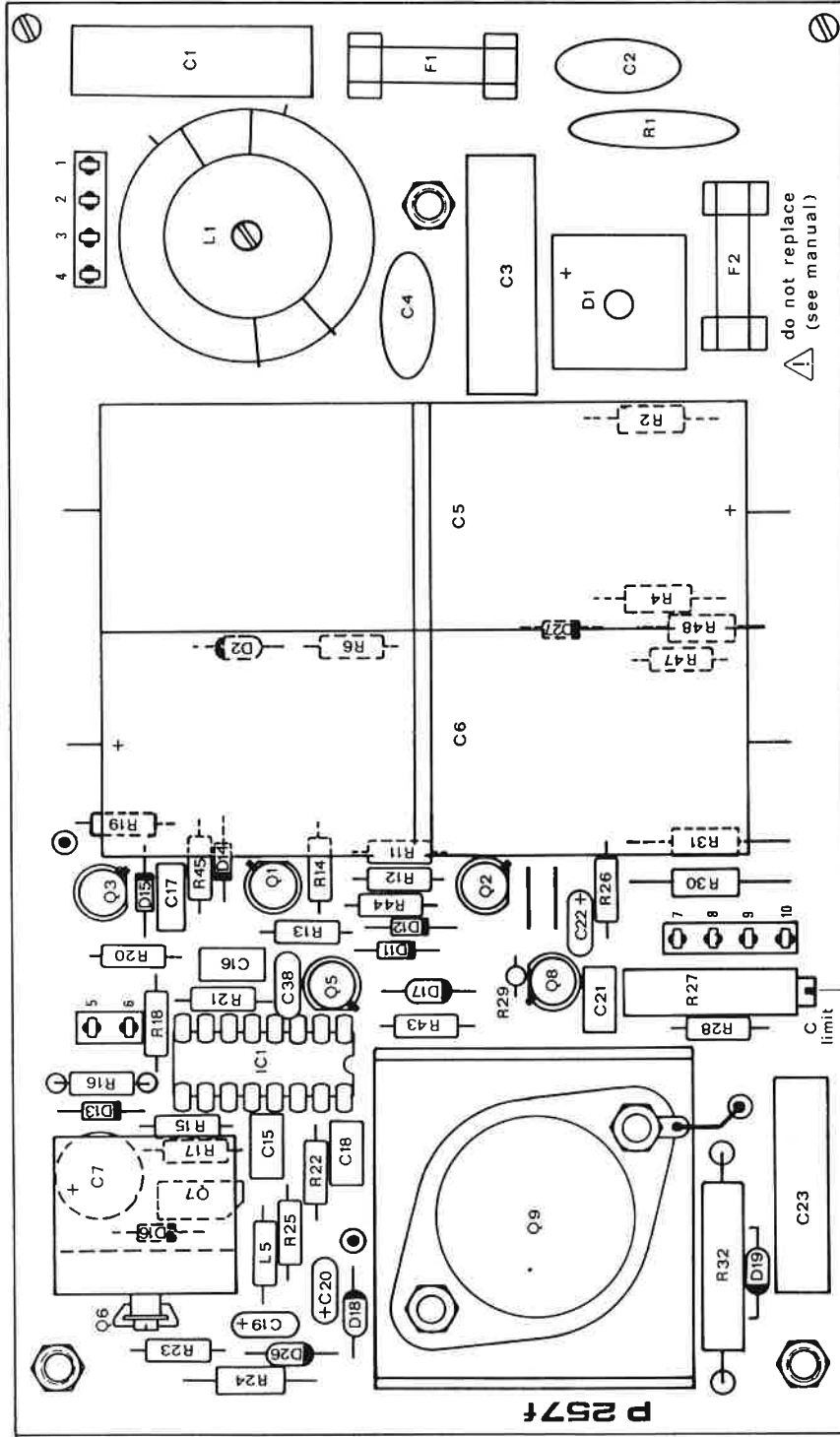
D10 rd = grn	10-89	Ur.	Title: Part list
R40,46,52,56 (12V/15V)	3-87	Ur.	ST60 / ST60A
D2,3,4,17,18,19,26	7-86	Ur.	Date: 12-'84
Modifications	Date	App.	delta elektronika bv



<b>C</b>				<b>Q</b>			
1 =	0,22	μF	X 250V	1 =	2 N 2222		Sescosem
2 =	2200	pF	Y 400V	2 =	2 N 2907		Sescosem
3 =	0,15	μF	X 250V	3 =	2 N 2907		Sescosem
4 =	2200	pF	Y 400V	4 =	-		
5 =	330	μF	200V	5 =	2 N 2907		Sescosem
6 =	330	μF	200V	6 =	MPSU 05		Motorola
7 =	100	μF	25V	7 =	VN 66 AF		Siliconix
8 =	10	nF	500V	8 =	2 N 2222		Sescosem
9 =	10	nF	500V	9 =	BUX 48		Sescosem
10 =	1000	μF	16V	10 =	2 N 2907		Sescosem
11 =	0,15	μF	X 250V				
12 =	0,15	μF	X 250V				
13 =	1000	μF	16V	<b>IC</b>			
14 =	0,22	μF	100V	1 =	HEF 4049		Philips
15 =	1000	pF	100V	2 =	TLP 580		ITT
16 =	2200	pF	100V	3 =	LM 317		
17 =	0,047	μF	250V	4 =	LM 317		
18 =	2200	pF	100V				
19 =	2,2	μF	16V	<b>L</b>			
20 =	1	μF	40V	1 =	L 165		Delta
21 =	1000	pF	100V	2 =	L 166		Delta
22 =	1	μF	40V	3 =	L 220 A		Delta
23 =	680	pF	1600V	4 =	L 221		Delta
24 =	0,22	μF	100V	5 =	2,2 μH		Secre
25 =	2,2	μF	25V				
26 =	2200	pF	160V	T1 =	T 222 A		Delta
27 =	1	μF	40V				
28 =	0,22	μF	100V	F1 =	2A slow		
29 =	0,22	μF	100V	2 =	800 mA quick		
30 =	0,22	μF	100V				
31 =	2500	pF	250V	Ts =	Thermo switch.		Uchiya
32 =	0,22	μF	100V		UP 62	80 °C 5%	
33 =	220	μF	25V				
34 =	220	μF	25V				
35 =	0,22	μF	100V				
36 =	0,22	μF	100V				
37 =	0,22	μF	100V				
38 =	15	pF	500V				
39 =	0,22	μF	100V				
40 =	1	μF	40V				
41 =	0,22	μF	100V				
42 =	0,22	μF	100V				
43 =	0,22	μF	100V				
44 =	220	μF	25V				
45 =	15	μF	16V				
46 =	0,22	μF	100V				
47 =	0,22	μF	100V				
48 =	15	μF	16V				
49 =	220	μF	25V				
50 =	15	μF	16V				

			Title: Part list
C 2,4,15,16,18,21,26	4-'87	Vr.	ST60 / ST60A
L 220A, T 222A (12V/15V)	3-'87	Vr.	Date: 12-'84
Modifications	Date	App.	delta elektronika bv





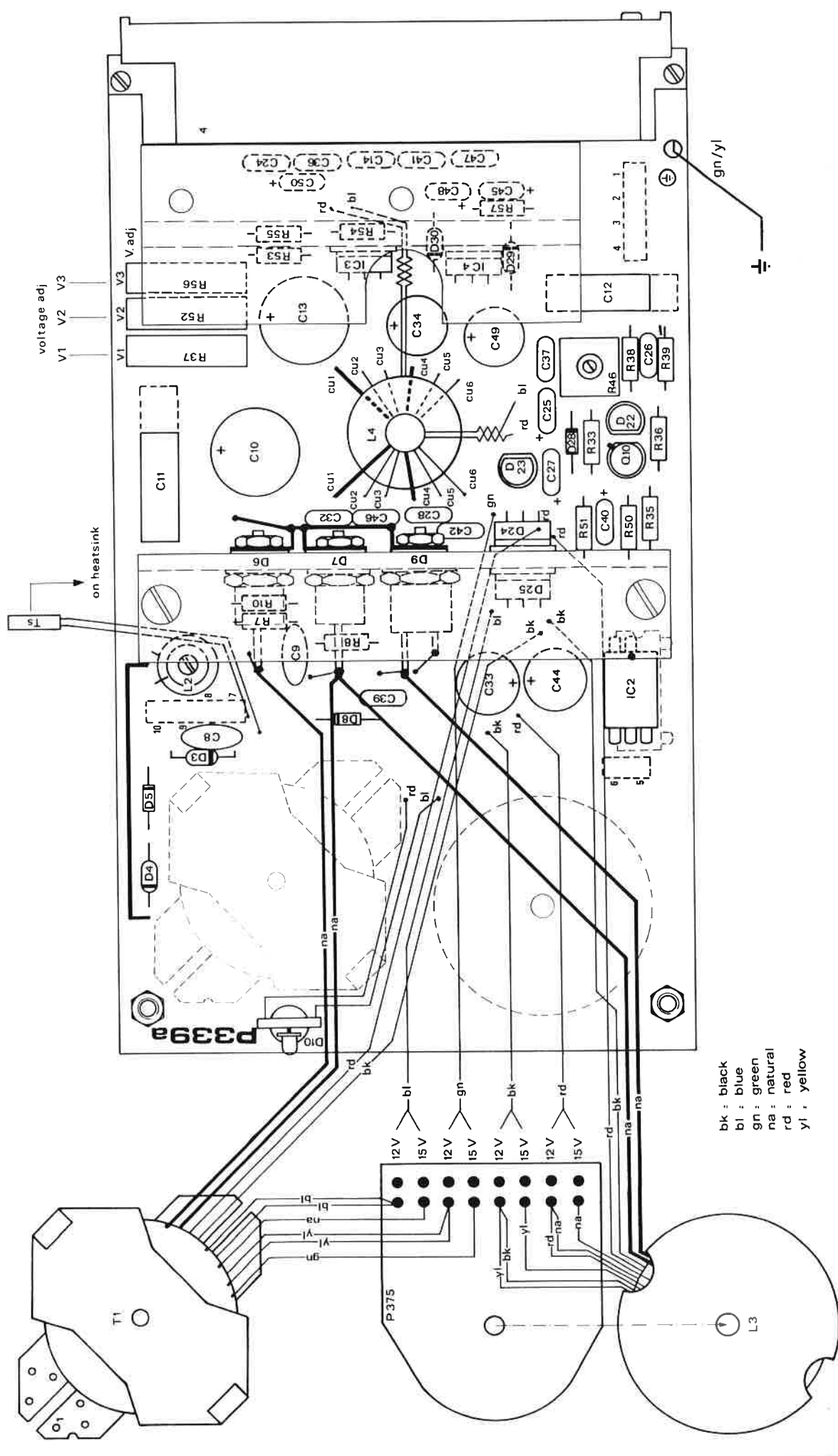
Current limit adj.  
factory adjusted  
and sealed  
Warranty lapses  
if seal is broken

Do not replace F2  
F2 blows when Q9 gets defective  
In that case replacement of F2 can  
also damage other components

**⚠** do not replace  
(see manual)

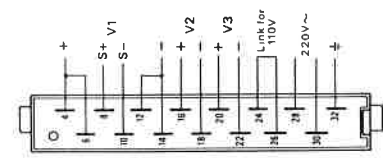
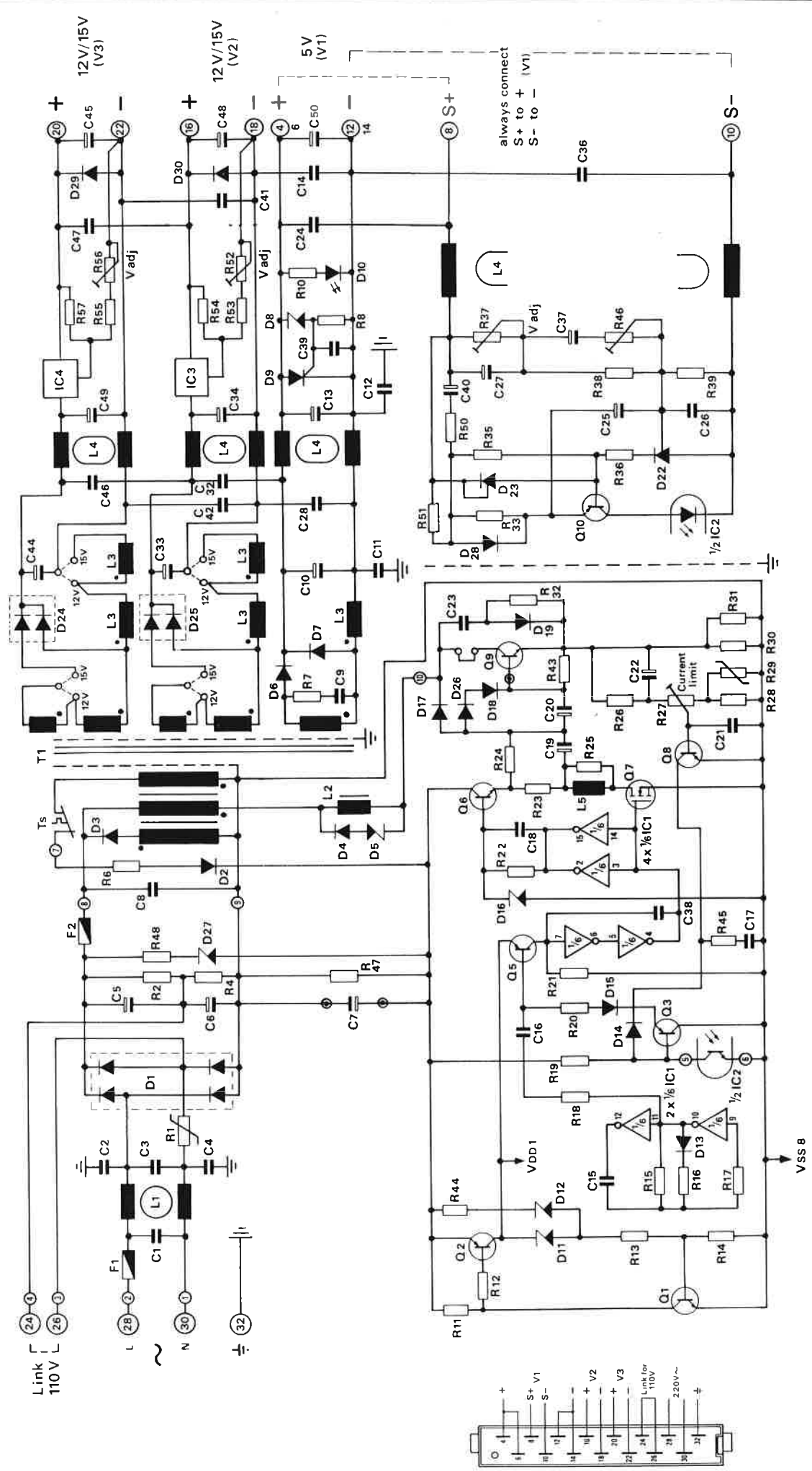
P 257f	U. G.	U. r.	Title: PC board
P 257e	4.87	U. r.	ST 60 / ST 60A
(C 2, 4, 15, 16, 18, 21)			Date: 12 -84
Modifications	Date	App	delta elektronika by





Title: PC board	
ST 60 / ST 60A	
12 V / 15V	Date: 12 - '84
3-87	Uhr.
Modifications	Date App
delta elektronika bv	

- bk : black
- bl : blue
- gn : green
- na : natural
- rd : red
- yl : yellow

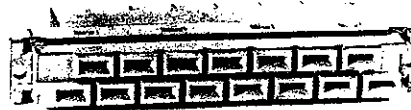
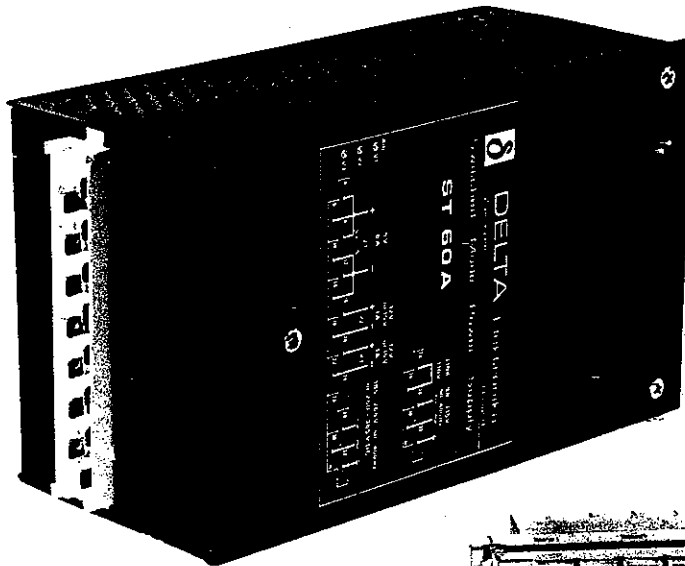


Title: Circuit diagram	
ST 60 / ST 60A	
12 V / 15 V	3.87 V.
Modifications	Date App
	12 - '84
	delta elektronika bv





**ST 60 A**



## TRIPLE OUTPUT POWER SUPPLY ST 60 A

**Three isolated outputs, each individually regulated**

After Serial No 9286 ST 60 A is changed for use at 12V as well as at 15V

	Voltage	Current	Adj.range	Remarks
Output 1:	<b>5V</b>	<b>6A</b>	4.8 - 5.5 V	Max. 10A when outputs 2 and 3 are not loaded
Output 2:	<b>12 or 15V</b>	<b>1A</b>	11.8 - 15.5 V	Put range switch at 12V or 15V
Output 3:	<b>12 or 15V</b>	<b>1A</b>	11.8 - 15.5 V	Put range switch at 12V or 15V

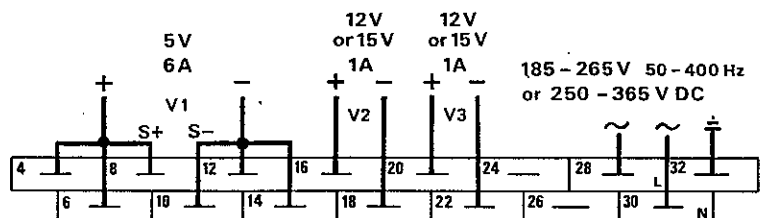
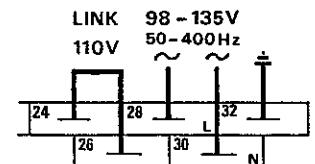
Output 1 is switched mode regulated. Outputs 2 and 3 are slave outputs with extra linear regulators. This makes their regulation independent from output 1.

All-outputs are floating and can be connected in any desired configuration, in series, parallel or floating. The outputs 2 and 3 can also be used unequal like +15V and -12V.

To keep the dissipation in the linear regulators low the transformer has taps for 12 and 15 V which can be chosen with small switches. The voltage adjustment is with trim pots. If the outputs 2 and 3 are used on 12 V with the switches still in the 15 V position the unit gets hot and might be switched off by the thermal protection.

### Input Voltage

AC: 185 - 265 V 50 - 400 Hz  
98 - 135 V 50 - 400 Hz (With 110 V link at connector)  
DC: 250 - 365 V



*H15 connector according to DIN 41612*

### Voltage regulation

At 10-100% load variation:  
V1 20 mV, V2 and V3 125 mV

At 185 - 265 V AC line variation:  
V1 15 mV, V2 and V3 5 mV

### Ripple + noise (incl. spikes)

30 mV p-p on all outputs

### Transient response

At a load change 10 to 100%

Max. deviation 0.5V

Recovery time: V1 1 mS

V2 and V3 less than 0.1 mS

(V1 loaded with minimum 10%)

### Temp. coeff. of output voltages

0.02% per °C (at constant load after 15 min. warm up)

### Efficiency

72% at full load and 220V AC input.

### Overvoltage protection

Internal SCR crowbar OVP, set to operate at approximately 7 V on V1.

This also shuts down V2 and V3.

### Hold-up time

40 mS at full load and 220V AC input.

### Temperature range

-10 to +50 °C at 100% output current.

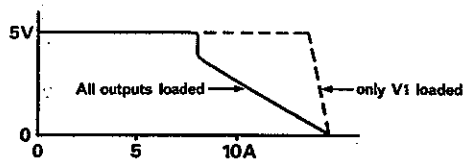
Derate current linearly to 20% at 75 °C.

A thermoswitch shuts down the output when the unit gets overheated.

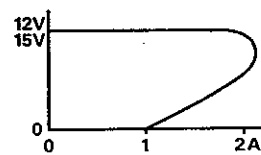
### Led lamp

Led lamp on front end indicates output state of V1

### Overload protection



### Current limit of V1



### Current limit of V2 and V3

### Series operation

Up to 100 V combined output.

### RFI suppression

Conducted interference complies with VDE0875 curve N-12 db on input and curve N on output.

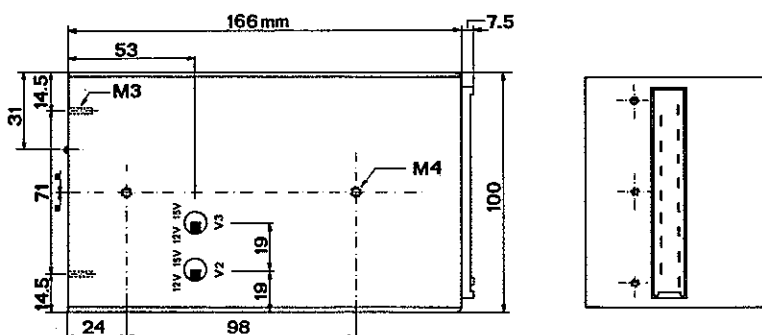
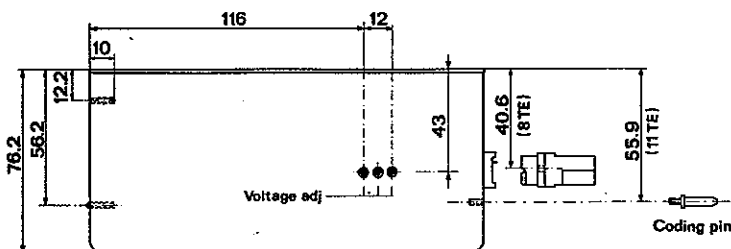
### Insulation

2.5 kV AC RMS (1 min.) input to output and input to case. 500V DC output to case and between outputs.

Insulation resistance better than 50 MOhm (measured at 500V DC).

Safety in accordance with IEC 348.

Weight 1.4 kgs



*Eurocassette according to DIN 41494.*

*A 16 TE front panel, a coding strip and pin can be ordered separately.*

*An adapter for panel mounting (model PA1) is also available.*

R = Ohm

- 1 = 16 25 °C  
(Keystone RL 450-10-73-S48)
- 2 = 150 k
- 3 = -
- 4 = 150 k
- 5 = -
- 6 = 8,2
- 7 = 10
- 8 = 1 k
- 9 = -
- 10 = 390
- 11 = 10 k
- 12 = 10 k
- 13 = 10 k
- 14 = 10 k
- 15 = 12 k
- 16 = 33 k
- 17 = 15 k
- 18 = 470
- 19 = 4,7 k
- 20 = 470
- 21 = 33 k
- 22 = 1 k
- 23 = 18
- 24 = 18
- 25 = 10
- 26 = 560
- 27 = 100 potm.
- 28 = 220
- 29 = 330 NTC
- 30 = 1,5
- 31 = 1,5
- 32 = 1 k 7W WW
- 33 = -
- 34 = 100
- 35 = 470
- 36 = 150
- 37 = 1 k potm. 20 trn
- 38 = 1 k
- 39 = 1,5 k
- 40 = -
- 41 = -
- 42 = -
- 43 = 100
- 44 = 4,7 k
- 45 = CR
- 46 = 1 k potm.
- 47 = 100 k
- 48 = 150 k
- 49 = -
- 50 = -
- 51 = 270
- 52 = 1 k potm. 20 trn
- 53 = 1,8 k
- 54 = 220
- 55 = 1,8 k

- 56 = 1 k potm. 20 trn
- 57 = 220

- D
- 1 = VJ 1048 Varo
  - 2 = BYV 26D Philips
  - 3 = BYV 26D Philips
  - 4 = BYV 26D Philips
  - 5 = ZPY 6,2 ITT
  - 6 = VSK 3030S Varo
  - 7 = VSK 3030S Varo
  - 8 = ZPY 6,2 ITT
  - 9 = BTY 79-200R Philips
  - 10 = G 314 N4 Philips
  - 11 = ZPD 5,6 ITT
  - 12 = ZPD 6,8 ITT
  - 13 = 1 N 4148 TI
  - 14 = 1 N 4148 TI
  - 15 = 1 N 4148 TI
  - 16 = ZPD 6,2 ITT
  - 17 = BYV 26D Philips
  - 18 = BYV 26D Philips
  - 19 = BYV 26D Philips
  - 20 = -
  - 21 = -
  - 22 = TL 431 ILP TI
  - 23 = TL 431 ILP TI
  - 24 = BYV 32/150 Philips
  - 25 = BYV 32/150 Philips
  - 26 = BYV 26D Philips
  - 27 = ZPU 150 ITT
  - 28 = link
  - 29 = 1 N 4004 Philips
  - 30 = 1 N 4004 Philips

SW1 = switch DPDT 6A SLD C en K  
 SW2 = switch DPDT 6A SLD C en K

R33,50,51 / D28	7-92	Ur	
SW1 + SW2	2-90	Ur	
D10 rd = grn	10-89	Ur	Title: ST60A
R40,46,52,56 (12V/15V)	3-87	Ur	Date: 12-84
D2,3,4,17,18,19,26	7-86	Ur	
Modifications	Date	App.	delta elektronika bv



C			
1 =	0,22	μF	X 250V
2 =	2200	pF	Y 400V
3 =	0,15	μF	X 250V
4 =	2200	pF	Y 400V
5 =	330	μF	200V
6 =	330	μF	200V
7 =	100	μF	25V
8 =	10	nF	500V
9 =	10	nF	500V
10 =	1000	μF	16V
11 =	0,15	μF	X 250V
12 =	0,15 <sup>t</sup>	μF	X 250V
13 =	1000	μF	16V
14 =	0,22	μF	100V
15 =	1000	pF	100V
16 =	2200	pF	100V
17 =	0,047	μF	250V
18 =	2200	pF	100V
19 =	2,2	μF	16V
20 =	1	μF	40V
21 =	1000	pF	100V
22 =	1	μF	40V
23 =	680	pF	1600V
24 =	0,22	μF	100V
25 =	1	μF	40V
26 =	2200	pF	160V
27 =	15	μF	16V
28 =	0,22	μF	100V
29 =	0,22	μF	100V
30 =	0,22	μF	100V
31 =	2500	pF	250V
32 =	0,22	μF	100V
33 =	220	μF	25V
34 =	220	μF	25V
35 =	0,22	μF	100V
36 =	0,22	μF	100V
37 =	0,47	μF	40V
38 =	15	pF	500V
39 =	0,22	μF	100V
40 =	—		
41 =	0,22	μF	100V
42 =	0,22	μF	100V
43 =	0,22	μF	100V
44 =	220	μF	25V
45 =	15	μF	16V
46 =	0,22	μF	100V
47 =	0,22	μF	100V
48 =	15	μF	16V
49 =	220	μF	25V
50 =	15	μF	16V

Q		
1 =	2 N 2222	Sescosem
2 =	2 N 2907	Sescosem
3 =	2 N 2907	Sescosem
4 =	-	
5 =	2 N 2907	Sescosem
6 =	MPSU 05	Motorola
7 =	VN 66 AF	Siliconix
8 =	2 N 2222	Sescosem
9 =	BUX 48	Sescosem
10 =	2 N 2907	Sescosem


IC		
1 =	HEF 4049	Philips
2 =	TLP 580	ITT
3 =	LM 317	
4 =	LM 317	

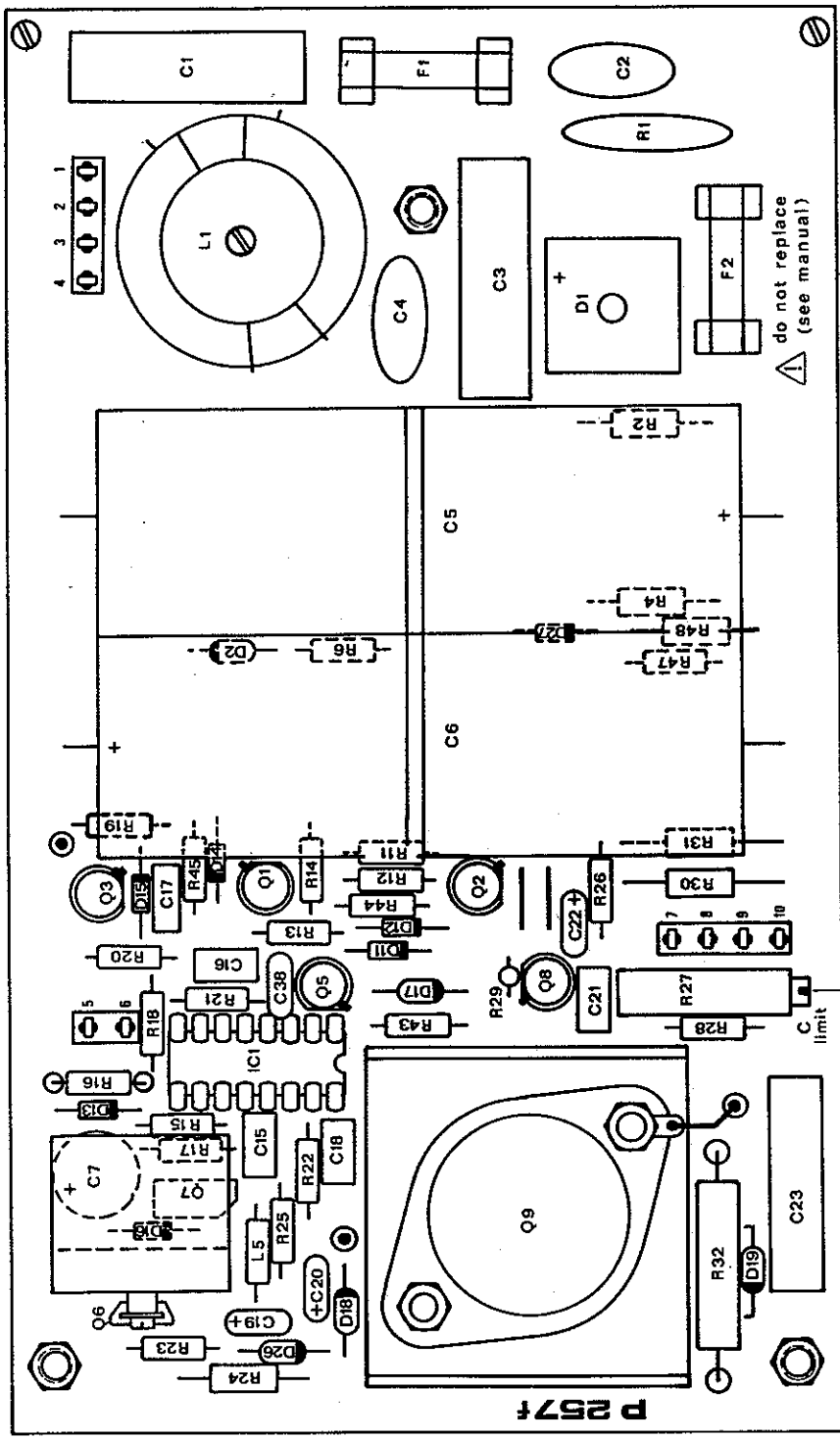
L		
1 =	L 165	Delta
2 =	L 166	Delta
3 =	XL 350	Delta
4 =	L 221	Delta
5 =	2,2 μH	Secre

T1 =	T 222 A	Delta
------	---------	-------

F1 =	2A slow
2 =	800 mA quick

Ts =	Thermo switch.	Uchiya
	UP 62	80 °C 5%

C 25, 27, 37, 40	7-91	Vr	Title: <b>ST60 A</b>	
L3 = XL350	4-91	Vr		
C 2, 4, 15, 16, 18, 21, 26	4-87	Vr	Date: 12-84	
L 220A, T 222A (12V/15V)	3-87	Vr		
Modifications	Date	App.	delta elektronika bv	

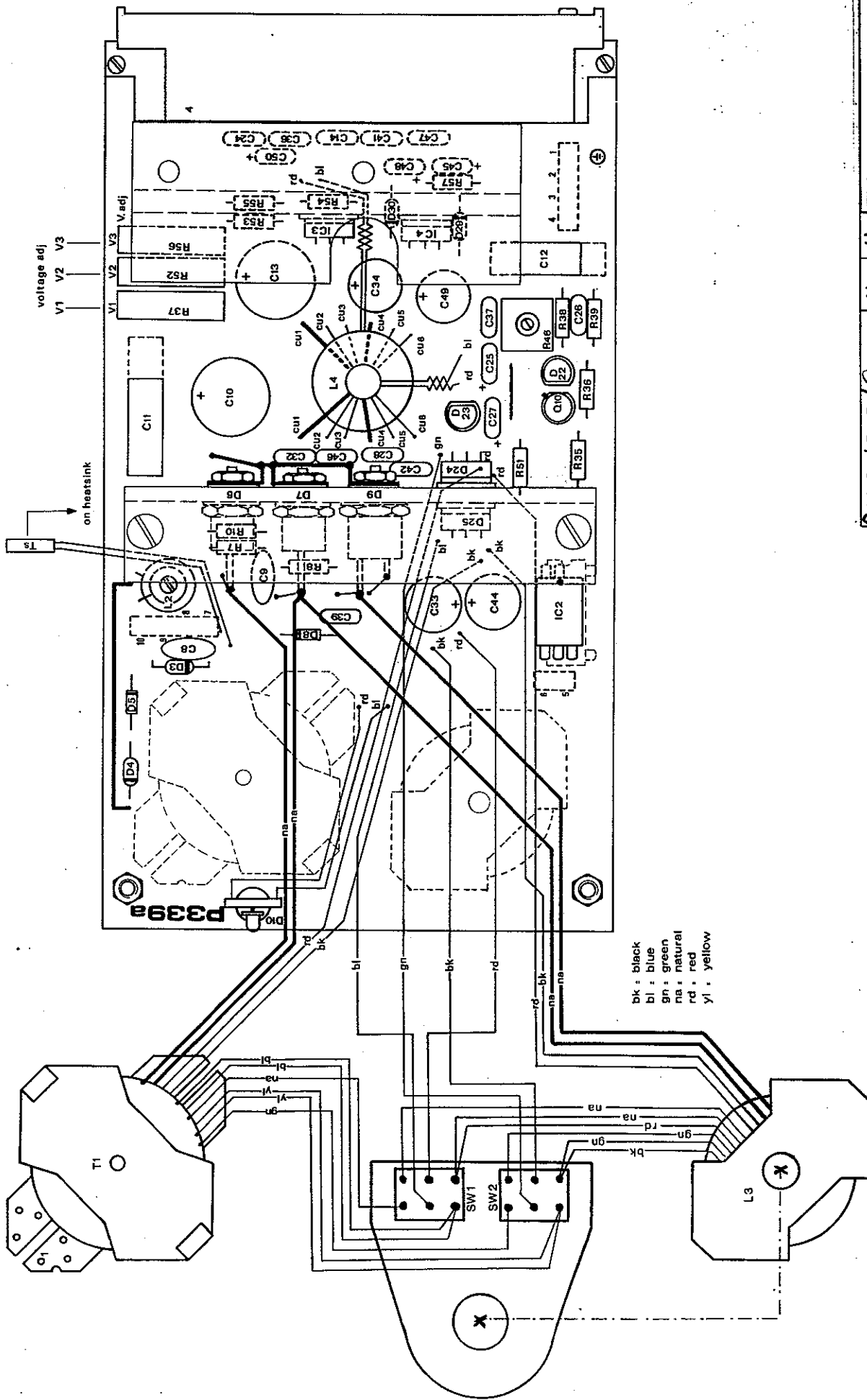


Do not replace F2  
 F2 blows when Q9 gets defective  
 In that case replacement of F2 can  
 also damage other components

Current limit adj.  
 factory adjusted  
 and sealed  
 Warranty lapses  
 if seal is broken

P 257f		Title: ST 60A	
P 257 e		Dr. 11-89	Dr. 4-87
(C2,4,15,16,18,21)		Date: 12-84	
Modifications		Date App	delta elektronika bv

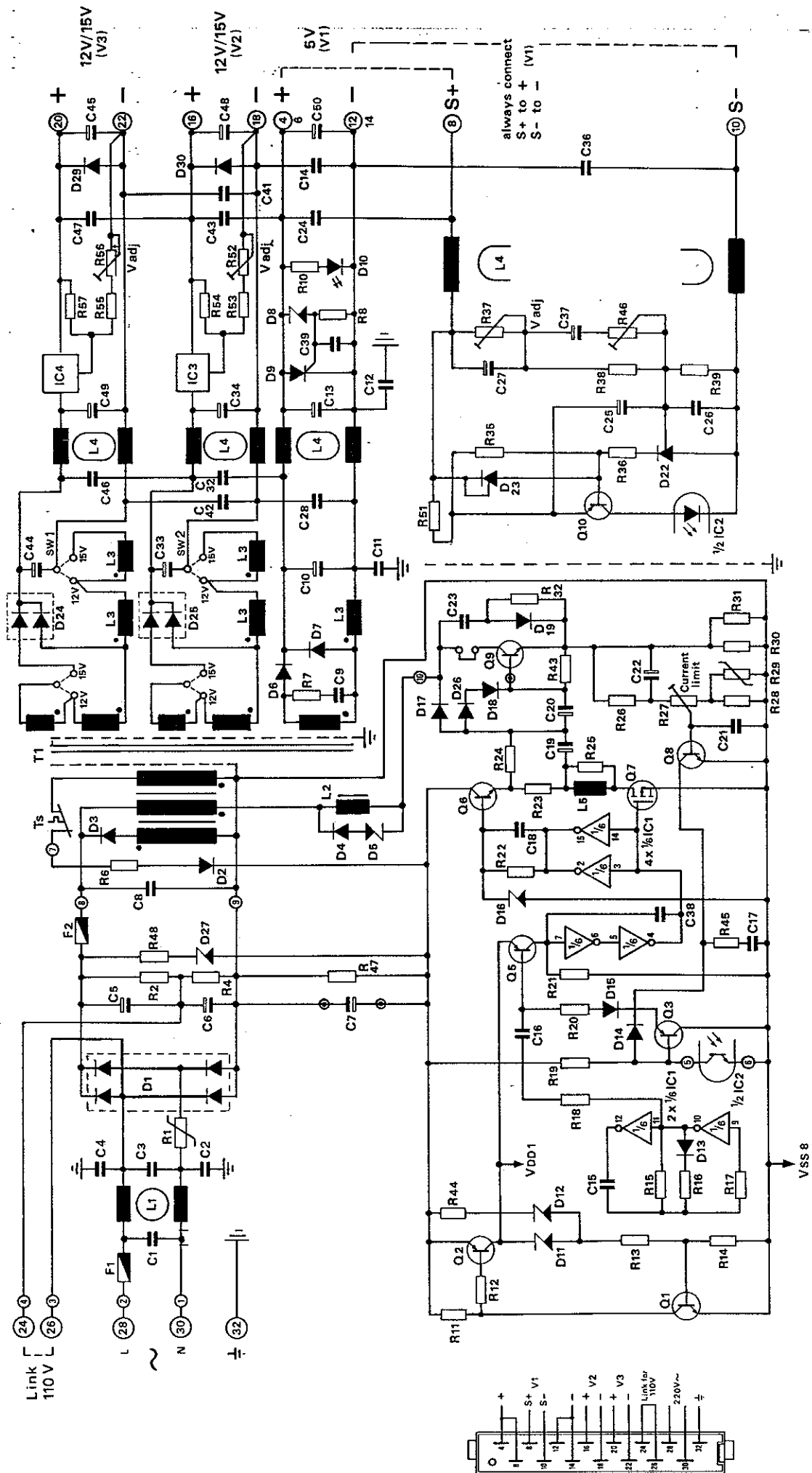




bk : black  
 bl : blue  
 gn : green  
 na : natural  
 rd : red  
 yl : yellow

R33.50/D28/C40		Title: <b>ST60A</b>	
Sw1 + Sw2	7-92 Ur	Ur	Date: 12-84
12V/15V	2-80 Ur	Ur	
Modifications	3-87 Ur	App	delta elektronika bv
		Date	





R33,50/D28/C40		Title: <b>ST60A</b>	
Sw1 + Sw2	7.92 Ur	Ur	Date: 12-84
12V/15V	2.90 Ur	Ur	Date App
Modifications	3.87 Ur	Ur	



delta elektronika by



After serial No. 9286 in the ST60A two switches are added to make it possible to use the outputs V2 and V3 at 12V as well as at 15V. These switches are accessible through holes in the bottom plate. It is also possible to use one output at 12V and the other at 15V.

The output voltages can be changed from 12 to 15V by adjusting potmeters with a screw driver and putting the switches of the transformer taps in the corresponding position.

**Warning:** If the output is at 12V and the tap at 15V the linear regulator will dissipate 3 Watts extra which might activate the thermal protection.

