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half rack full rack

M - SERIES

LINEAR POWER SUPPLIES WITH HIGH EFFICIENCY AND HIGH RELIABILITY

Model	V_{out}	I_{out}	Efficiency	Size
M 15 - 16 HE	**12 V / 15 V**	**16 A**	70 %	half rack
M 24 - 12 HE	**24 V**	**12 A**	74 %	half rack
M 60 - 5 HE	**48 V / 60 V**	**5 A**	75 %	half rack
M 24 - 20 HE	**24 V**	**20 A**	74 %	full rack
M 48 - 10 HE	**48 V**	**10 A**	75 %	full rack

The M-series has proved to be one of the most reliable series of modular power supplies. Many thousands are being used without any problems for more than 25 years. According to our statistics over many years the average number of repairs is less than one per thousand per year, including faults caused by wrong use. The circuits of these linears are very simple compared with the complexity of switchers. The number of components is only a fraction of that of a switcher. Moreover the components are very reliable.
The disadvantages compared with switchers are the relatively larger weight and dimensions and a lower efficiency.

The M-series modular power supplies are designed for use at a fixed output voltage. The M 15-16 HE for 15 V 16 A has a tap point on the transformer secondary so that it can also be used at 12 V 16 A. In the same way the M 60-5 HE can also be used at 48 V 5 A.

Some features are:

* Extra output terminal via a built-in diode for use in redundant operation
* Built-in adjustable overvoltage protection (crowbar type)
* Very low output ripple
* Fast response to load transients
* No generation of RFI
* It withstands the high energy impulse test 2.3 $\hat{U}_N$ 1.3 ms of VDE 0160
* Split bobbin transformer

SPECIFICATIONS

Input voltage
110 - 120 - 230 - 240 V 48/62 Hz
(by changing transformer taps).

Input current (230 V)
Half rack model 2.2 A, full rack 3.5 A

Fuses, 5 x 20 mm, slow blow
Half rack: 4 A T at 230 V, 6.3 A at 110 V
Full rack: 6.3 A T at 230 V, 10 A at 110 V

Power factor 0.8

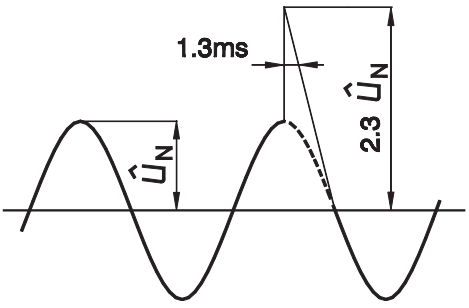
Insulation
Input to output: 4 kV RMS
Input to case: 2500 V RMS
Output to case: 500 V DC

The transformer has a split bobbin according to VDE 0551, CEE 15 which makes the unit very safe.

Safety EN 60950, EN 61010
SELV/PELV (for M15-16HE, M24-12HE, M24-20HE)

EMC
EN 61204-3
EN 61000-6-3 (EN55022B)
EN 61000-6-2

VDE 0160 impulse test
The M-units withstand the high energy impulse test 2.3 $\hat{U}_N$ 1.3 ms of VDE 0160 class 2



Hold-up time (230 V input)
24 V units 20 ms at full and 50 ms at half load. Other models 15 ms at full and 30 ms at half load.

Voltage regulation
0.02% for a +10% to –10% line variation.
0.02% for a 0-100% load change.

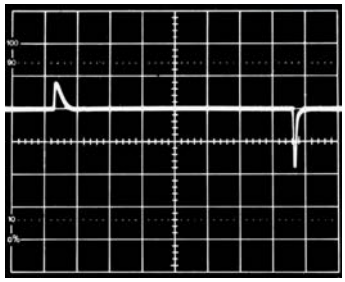
Ripple + noise
0.2 mVrms (BW = 300 kHz)
5 mVp-p (BW = 50 MHz)

Temperature coeff.
0.01% per °C

Drift
Less than 0.1% per 8 hours under constant ambient and load conditions after 1 hour warm-up.

Output impedance
Less than 0.1 Ohm at 0 to 100 kHz load frequency.

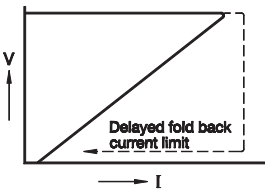
Recovery time
25 us for recovery to within 30 mV of steady state voltage after a step load change from 10% to 100%. Max. deviation: Less than 0.25 V



Recovery time:
M 24-12 HE

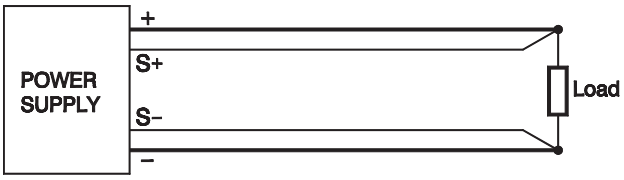
Hor.: 100 us/div.
Vert.: 0.1 V/div.

Current limit
The linear M-models have a fold back overload characteristics (a constant current characteristic would overheat the series pass transistors when the output is short circuited).



A 'delayed fold back' is used to avoid problems during switching-on of series connected power supplies or non linear loads. The current limit is adjustable from about 40 to 100% of the rated current.

Remote sensing
Remote sensing at the load point can be used to compensate for the voltage drop across the load leads.



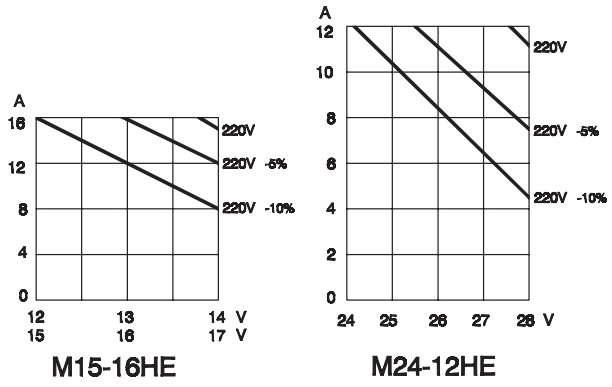
Max. 2 V per load lead can be compensated. The voltage across the output will rise accordingly, which will limit the max. AC input voltage swing (check graphs on next page). Also the OVP has to be set higher. The output is protected against accidental interruption or reversing of the sense leads.
A capacitor of 1000 uF across the load can be usefull to lower the impedance caused by long load leads.

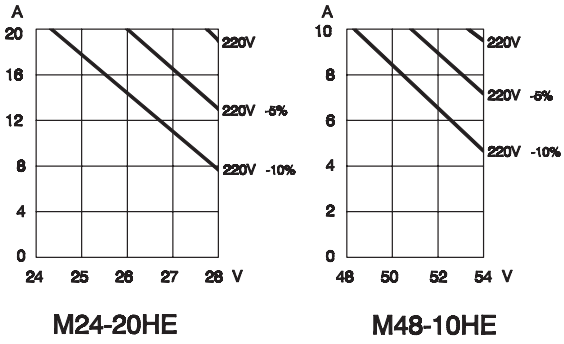
Output voltage adjustment range

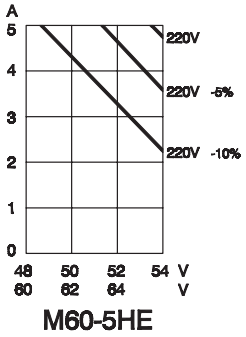
The M-series is meant for use at a fixed output voltage. However it can be used over a larger range at a lower output current or with a smaller AC input variation (see graphs). The adjustment ranges are given below.

M 24-12 HE	24 - 28 V
M 24-20 HE	24 - 28 V
M 48-10 HE	48 - 54 V
M 15-16 HE	
if connected for 12 V:	12 - 14 V
if connected for 15 V:	15 - 17 V
M 60-5HE	
if connected for 48 V:	48 - 54 V
if connected for 60 V:	60 - 64 V

The M 15-16 HE has a tap on the transformer secondary for use at 12 V instead of 15 V. To avoid overheating of the series pass transistors it is very important not to forget to connect it to the lower tap when turning down the output to 12 V. The same applies for the M 60-5 HE for 60 and 48 V.







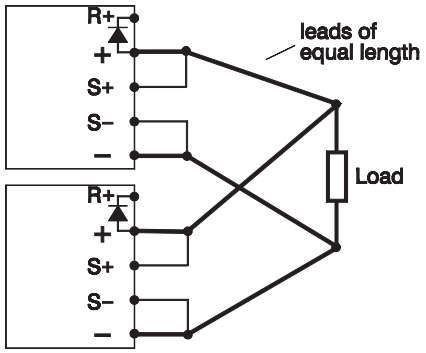
Maximum output at reduced
AC input voltage

Efficiency

The 70 to 75% efficiency of the M series is high for linear power supplies. The power supplies are dimensioned to stay within regulation down to 198 V AC input. However if the line voltage is already stabilized and never drops below 215 V, the input can be connected to the 240 V tap of the transformer. This will still increase the efficiency of the M 24-20 HE from 74 to 79%, saving considerable heat.

Parallel operation

With parallel operation the current will not be shared equally but the current limit of each unit will avoid overloading. The current sharing is better if the load wires are of equal length and the outputs adjusted at equal voltages. To do this a multimeter can be used to measure the difference of the output voltages. Remote sensing is not recommended with parallel operation.

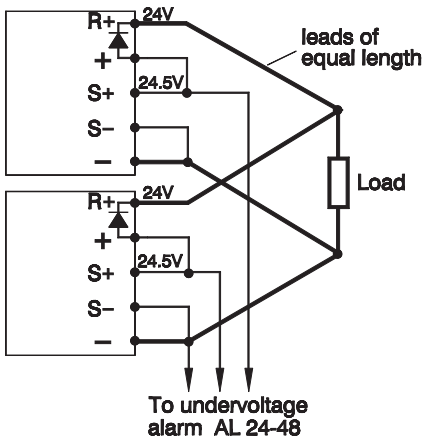


Parallel operation

To enable parallel operation at higher ambient temperatures the current limit of all units can be set lower. At parallel operation without separation diodes, the OVP has to be turned out of range (high) because it is only rated for one power supply.

Parallel operation for redundancy

For redundant parallel operation an extra positive output terminal via a built-in diode is available.
Remote sensing cannot be used.



Redundant parallel operation

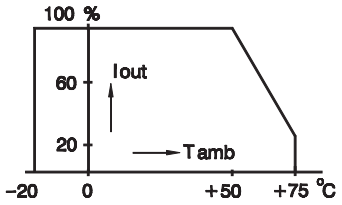
Series operation
Series operation is allowed up to 500 V total voltage.

Overvoltage protector
Built-in OVP shorting the output in case of overvoltage. Adjustable up to 8 V above the output voltage range.

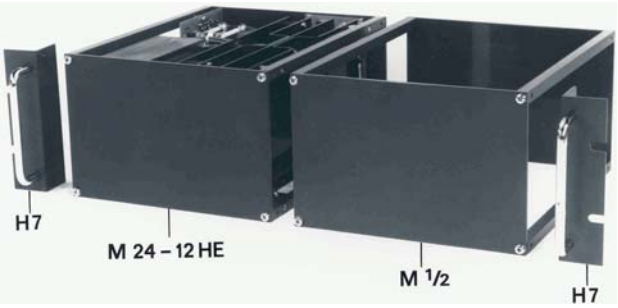
Undervoltage alarm
Built-in P366 is optional.

Cooling
Natural convection cooling. Sufficient space has to be kept above and below the unit to permit a vertical airflow.

Ambient temperature
– 20 to + 50 °C at full output. From + 50 to + 75 °C the output current has to be derated linearly to 20% at 75 °C.



Rack mounting
Two half-rack units can be rack mounted with the help of 2 brackets H7. Empty half rack modules are available, ordering code M 1/2.



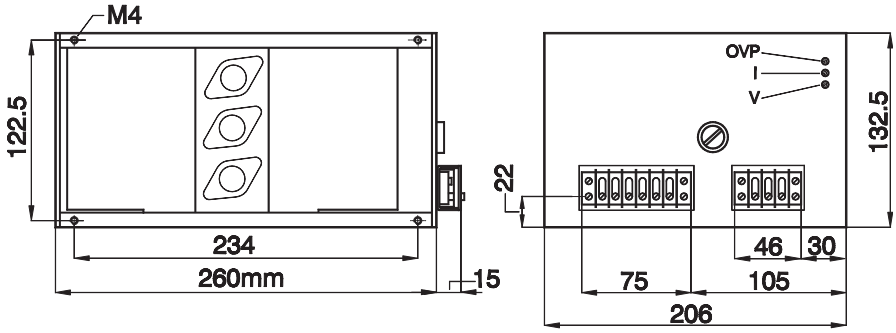
MTBF
1 000 000 hrs

Optional
Built-in undervoltage alarm P366.

Wall mounting of half rack units

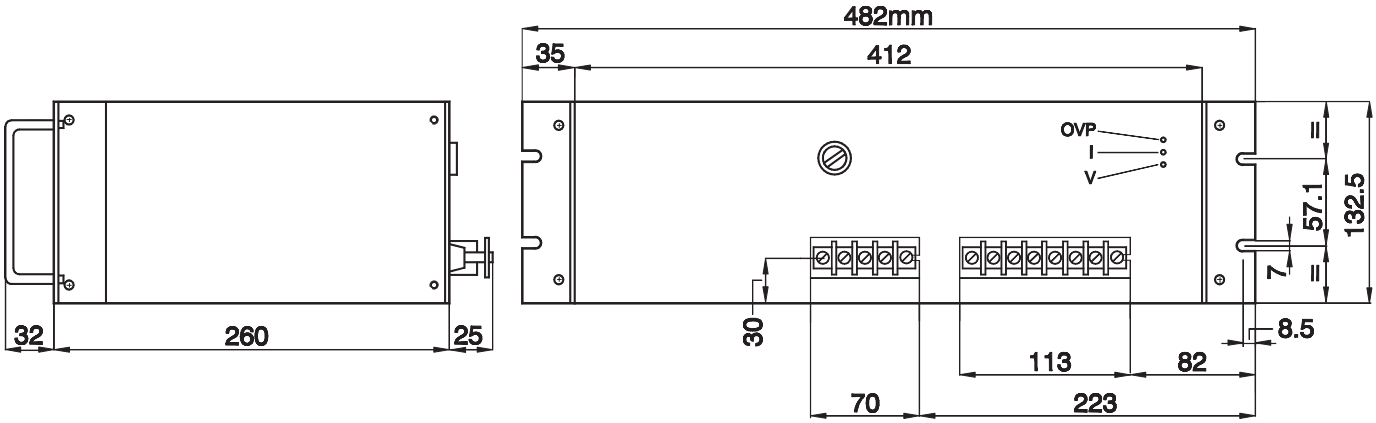
A half rack unit can be wall mounted with two brackets H7 (without grip).

Perforated covers
CM1, set of 2 for M 24-12 HE
CM2, set of 2 for 2 pcs M 24-12 HE



Dimensions and weight
Half rack (h x w x d):
132.5 x 206 x 260 mm 8.8 kg

Full rack (h x w x d):
132.5 x 412 x 260 mm 16.0 kg



Safety Instructions

Caution.

The following safety precaution must be observed during all phases of operation, service and repair of this equipment. Failure to comply with the safety precautions or warnings in this document violates safety standards of design, manufacture and intended use of this equipment and may impair the built-in protections within.
Delta Elektronika shall not be liable for user's failure to comply with these requirements.

Installation category.

The Delta Elektronika power supplies have been evaluated to installation category II.(Over voltage category II)

Grounding

This product is a safety Class 1 instrument. To minimize shock hazard, the instrument chassis must be connected to the AC Power Supply mains through a tree or four conductor power cable for resp. a single or three phase unit, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet.
For instruments designed to be hard-wired to supply mains, the protective earth terminal must be connected to the safety electrical ground before another connection is made. Any interruption of the protective ground conductor, or disconnection of the protective earth terminal will cause a potential shock hazard that might cause personal injury.

Fuses

Fuses must be changed by authorized Delta Elektronika service personnel only, for continued protection against risk of fire.

Input Ratings

Do not use an AC Supply which exceeds the input voltage and frequency rating of this instrument. The input voltage and frequency rating of the Delta Elektronika power supply series are stated in de accompanying datasheet.

Live circuits

Operating personnel must not remove the instrument cover. No internal adjustment or component replacement is allowed by non Delta Elektronika qualified personnel. Never replace components with the power cable connected. To avoid injuries, always disconnect power, discharge circuits and remove external voltage sources before touching components.

Parts Substitutions & modifications

Parts substitutions and modifications are allowed by authorized Delta Elektronika service personnel only. For repairs or modifications the unit must be returned to a Delta Elektronika service facility.

Environmental Conditions

The Delta Elektronika power supplies safety approval applies to the following operating conditions:

Indoor use
Ambient temperature : -20 to 50 °C
Maximum relative humidity : 95%, non condensing, up to 40 °C
: 75%, non condensing, up to 50 °C
Altitude: up to 2000m
Pollution degree 2

Caution risk of electrical Shock

Instruction manual symbol. The instrument will be marked with this symbol when it is necessary for the user to refer to the instruction manual

Protective ground conductor terminal

O *Off (supply)*

I *On (Supply)*

WEEE

(Waste Electrical & Electronic Equipment)

Correct Disposal of this Product

Applicable in the European union.

This marking shown on the product, its packing or its literature indicates that it should not be disposed with other wastes at the end of its working life, but should be collected separately to recycle it responsibly to promote the sustainable reuse of material resources.

DIVIDING THE LOAD IN SECTIONS, EACH WITH ITS OWN FUSE

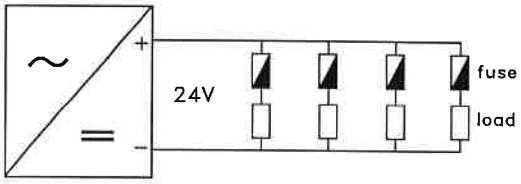
In general it is not recommended to use a fuse in the DC output of an electronic regulated power supply.

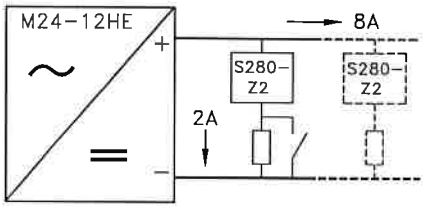
The electronic current limit is very fast compared to fuses and it is sharply defined so there is not enough time and not enough overcurrent to blow a fuse.

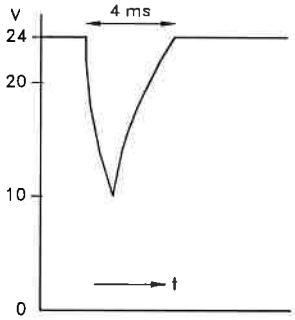
This makes it difficult to divide the load in sections each with its own fuse.

Even for very fast fuses the time to blow is still in the order of 50 seconds at twice the nominal current (2 I_N). At 4 I_N this is already much better and can be in the order of 20 milliseconds.

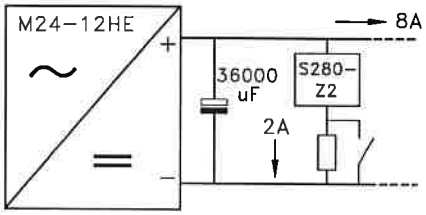
However compared with the electronic current limit this is still too long and all sections will see a dip in the 24V. The best results we found with the circuit breakers S280Z of ABB. They are the fastest.

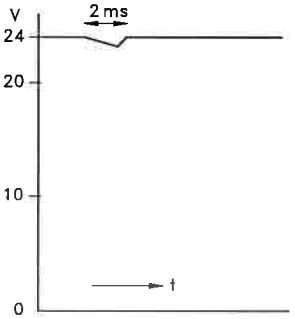




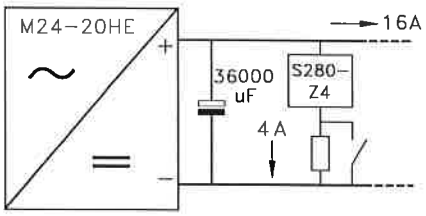


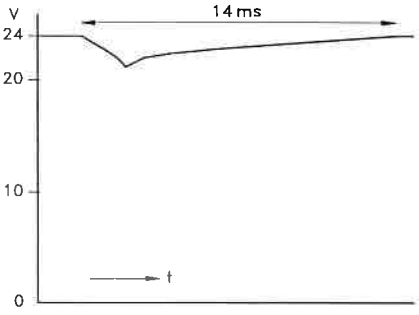
In the above situation there is still a deep voltage dip during 4 ms. This can be very much improved by a large electrolytic capacitor which can supply a high current peak for a fast action of a fuse or a circuit breaker.





M 24-12HE with 36*000* µ*F parallel*



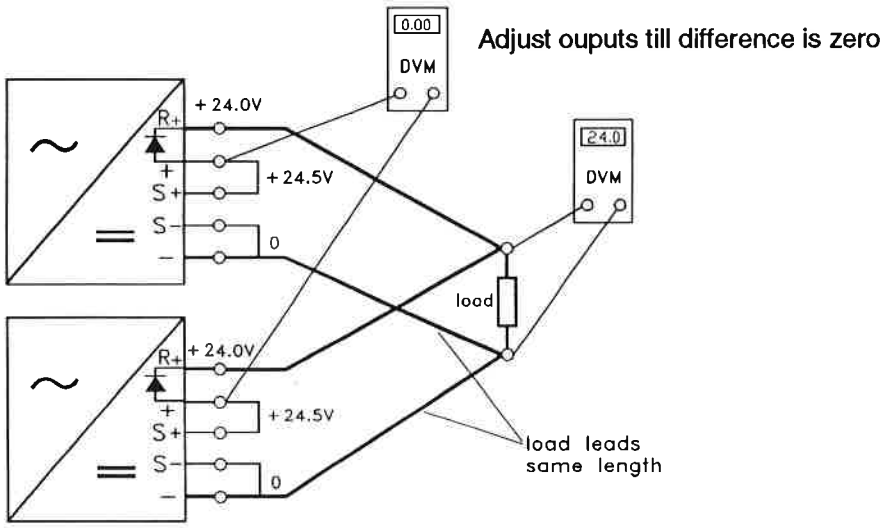


M 24-20HE with 36*000* µ*F parallel*

A disadvantage of the large electrolytic capacitor can be that the current limit is no longer fast.

The inductance of long leads (several meters) between the power supply and the load can cause very large voltage dips when a fuse is blown. This can be avoided by connecting the electrolytic capacitor close to the load.

REDUNDANT PARALLEL OPERATION



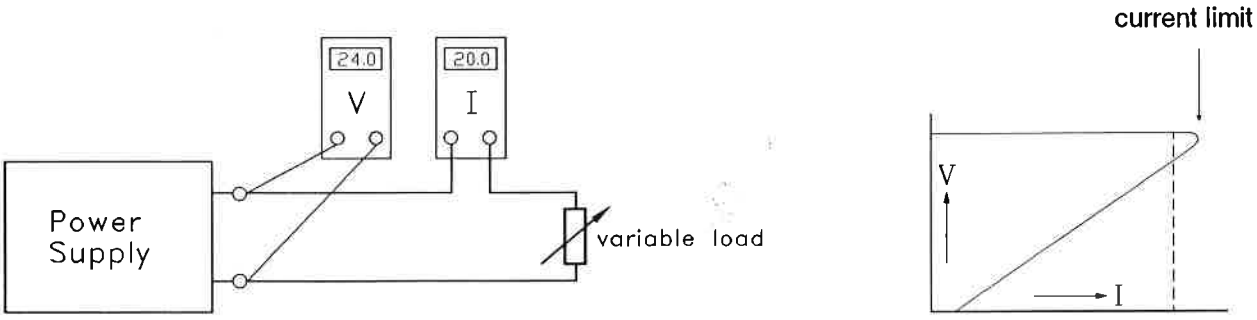
In redundant parallel operation the outputs of the power supplies have to be separated by diodes. For this purpose a Schottky Barrier diode is already built in.
The voltage drop across this diode is 0.5V. So the outputs have to be turned up to 24.5V to get 24.0V at the load.

To get a reasonable current sharing the voltage of the two power supplies have to be equal. This can easily be adjusted when measuring the difference with a multimeter at a low voltage range.

Also the leads to the summing point have to be of equal length for good current sharing.

If it is required that one unit supplies all the current it can be put about 100 mV higher than the other one.

Current limit
The current limit is factory set at about 105%.
For parallel operation it has to be set at 100% or lower. If the 20 turn screw driver adjustment (I) is turned anticlockwise 1 x 360° the current limit will be about 5% lower.
To measure the current limit setting a variable load is required.



Measuring the current limitting.

Alarm circuits
Alarm circuits like P366 can be connected between S+ and S– of each power supply.
The M-series can also be ordered with P366 built in as an option.

SETTING OF THE OVER VOLTAGE PROTECTION (OVP)

The built-in OVP is of the crowbar type, it short circuits the output in case of overvoltage .
This protects the load in case of a defect power supply.

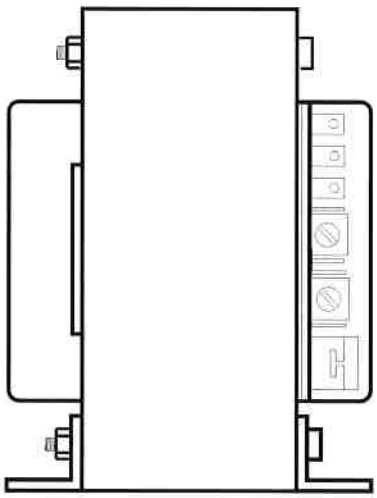
It is recommended to put the OVP tripping point at least 2V higher than the output to avoid accidental tripping.

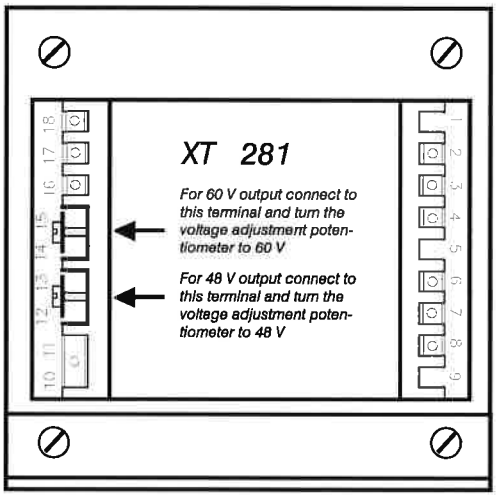
Setting of the OVP (screw driver adjustment at front panel)

1) Put on power supply, without load.
2) Put a voltmeter at the output.
3) Turn OVP adjustment at maximum (clockwise)
4) Turn output voltage (V) about 2V higher than the required output voltage.
5) Turn down the OVP till it shorts the output.
6) Remove the AC input voltage.
7) Turn down the output voltage setting (V) a few turns.
8) Put on the power supply again and adjust the output to the required voltage.

SETTING OF THE OVP WHEN USING A DIFFERENT TRANSFORMER TAP

The M60-5HE has a secondary tap point on the transformer so it can be used at 60V or at 48V.
When selecting a different tap point, make sure not only to adjust the output voltage but also the OVP as described above.





INRUSH CURRENT

In M 24-12HE after serial nr 8900 an inrush current limiter has been installed.
The peak inrush current during one cycle is now limited to 10A at 230V 50 Hz and 20A at 110V 50 Hz.

WIRING

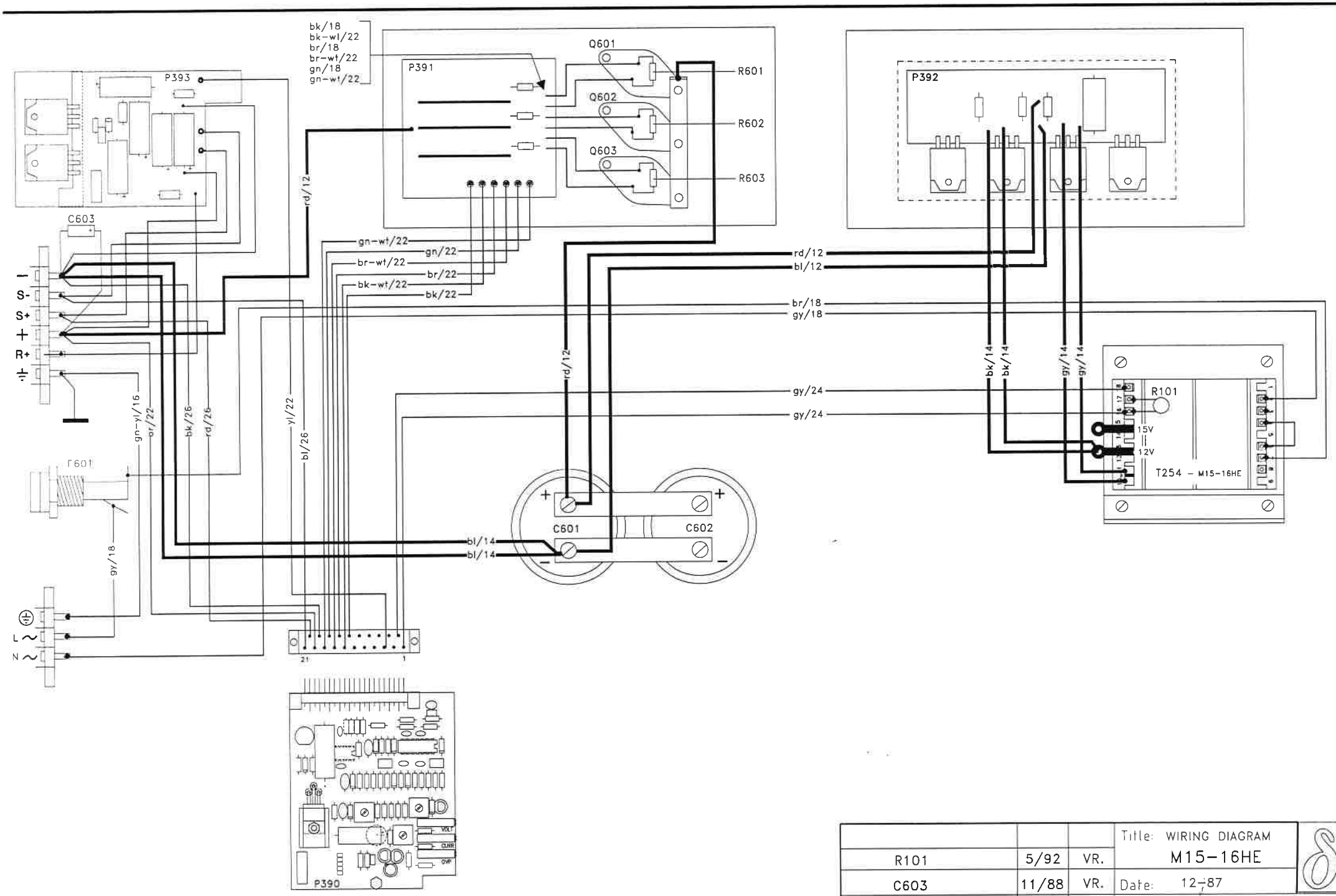
Field wiring: use copper conductors only
Use temperature class 75 °C only

Tightening torque for the field wiring terminals: 0.6 – 0.8 Nm

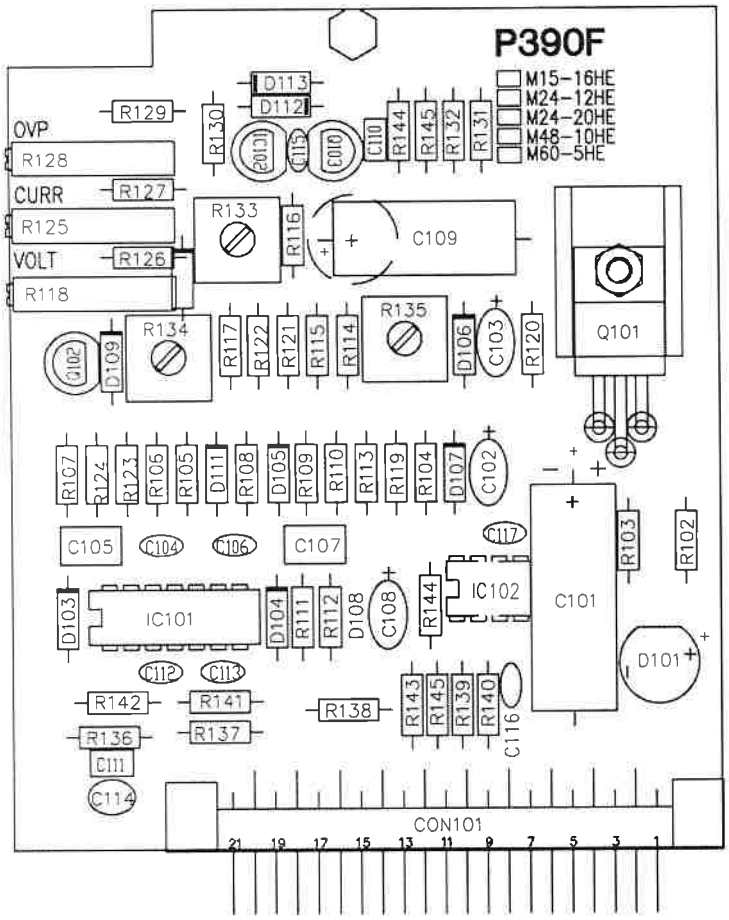
M15-16HE

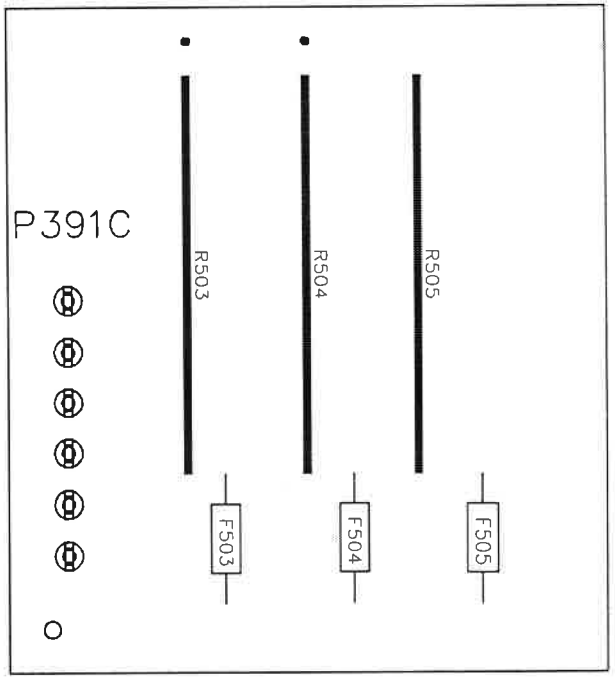
JULY 2002

C101	=	100UF 63V	ROE
C102	=	2.2UF 25V	SOLID ALU
C103	=	2.2UF 25V	SOLID ALU
C104	=	100PF 1000V	CERAMIC
C105	=	1500PF 100V	POLYPROP
C106	=	100PF 1000V	CERAMIC
C107	=	4700PF 63V	POLYPROP
C108	=	2.2UF 25V	SOLID ALU
C109	=	220UF 16V	ROE
C110	=	0.01UF 100V	MULT LAYER
C110	=	0.01UF 100V	MULT LAYER
C111	=	47NF 100V	MULT LAYER
C112	=	100PF 1000V	CERAMIC
C113	=	100PF 1000V	CERAMIC
C114	=	1000PF 100V	POLYPROP
C201	=	4.7UF 63V	MET POLYES
C301	=	1000UF 10V	ROE
C302	=	220UF 40V	ROE
C303	=	220UF 40V	ROE
C304	=	220UF 40V	ROE
C305	=	220UF 40V	ROE
C306	=	220NF 100V	MULT LAYER
C601	=	36000UF 40V	CHEMI-CON
C602	=	36000UF 40V	CHEMI-CON
C603	=	220UF 40V	ROE
D101	=	B250C1500R	GEN.INSTR.
D102	=	ZPD 6.2V	ITT
D103	=	1N4148	PHILIPS
D104	=	1N4148	PHILIPS
D105	=	ZPD 6.2V	ITT
D106	=	1N825	MICROSEMI
D107	=	BZX85-C12	ITT
D108	=	BZX85-C6V2	ITT
D109	=	1N4148	PHILIPS
D111	=	1N4148	PHILIPS
D112	=	BZX55-C30V	GSI
D201	=	BYS28-45	SIEMENS
D202	=	BYS28-45	SIEMENS
D203	=	BYS28-45	SIEMENS
D204	=	BYS28-45	SIEMENS
D301	=	1N4004GP	PHILIPS
D302	=	BYS28-45	SIEMENS
D303	=	BTA41	ST
F501	=	FUSE PICO 20F	
F502	=	FUSE PICO 20F	
F503	=	FUSE PICO 20F	
F601A	=	FUSE 5X20 4T	220V
F601B	=	FUSE 5X20 6.3T	110V
IC101	=	TLO84BCN	TI
IC102	=	TL431	TEXAS
Q101	=	BD242B	POW
Q102	=	BFP22	SIEMENS
Q103	=	PH2907A	PHILIPS
Q601	=	IRF150	HARRIS
Q602	=	IRF150	HARRIS
Q603	=	IRF150	HARRIS
R101	=	PTC 25	A70 SIEMENS
R102	=	182	MF/0.6W/350V
R103	=	15K	MF/0.6W/350V
R104	=	3.92K	MF/0.6W/350V
R105	=	475	MF/0.6W/350V
R106	=	475	MF/0.6W/350V
R107	=	825	MF/0.6W/350V
R108	=	475	MF/0.6W/350V
R109	=	475	MF/0.6W/350V
R110	=	1.5K	MF/0.6W/350V
R111	=	100	MF/0.6W/350V
R112	=	100K	MF/0.6W/350V
R113	=	47.5	MF/0.6W/350V
R114	=	2.21K	MF/0.6W/350V
R115	=	1K	MF/0.6W/350V
R116	=	4.75K	MF/0.6W/350V
R117	=	2.74K	MF/0.6W/350V
R118	=	2K TRIMPOTM 20 TURNS	
R119	=	10K	MF/0.6W/350V
R120	=	562	MF/0.6W/350V
R121	=	10K	MF/0.6W/350V
R122	=	2.21K	MF/0.6W/350V
R123	=	2.21K	MF/0.6W/350V
R124	=	10	MF/0.6W/350V
R125	=	5K TRIMPOTM 20 TURNS	
R126	=	1.5K	MF/0.6W/350V
R127	=	1.5K	MF/0.6W/350V
R128	=	5K TRIMPOTM 15 TURNS	
R129	=	681	MF/0.6W/350V
R130	=	2.21K	MF/0.6W/350V
R131	=	1K	MF/0.6W/350V
R132	=	82.5	MF/0.6W/350V
R133	=	20K TRIMPOTM 1 TURN	
R134	=	20K TRIMPOTM 1 TURN	
R135	=	20K TRIMPOTM 1 TURN	
R136	=	475	MF/0.6W/350V
R137	=	475	MF/0.6W/350V
R138	=	475	MF/0.6W/350V
R141	=	4.75K	MF/0.6W/350V
R142	=	4.75K	MF/0.6W/350V
R143	=	4.75K	MF/0.6W/350V
R201	=	5.62	MF/0.6W/350V
R202	=	2.2K	MF/2.0W/500V
R203	=	2.2K	MF/2.0W/500V
R301	=	560	MF/2.0W/500V
R302	=	560	MF/2.0W/500V
R303	=	5.6K	MF/2.0W/500V
R304	=	2.21	MF/0.6W/350V
R501	=	0.380 R/M	
R502	=	0.380 R/M	
R503	=	0.380 R/M	
R601	=	22.1K	MF/0.6W/350V
R602	=	22.1K	MF/0.6W/350V
R603	=	22.1K	MF/0.6W/350V
R700	=	VARISTOR 510V 190J	
T601	=	XT254	DELTA



			Title: WIRING DIAGRAM M15-16HE
R101	5/92	VR.	
C603	11/88	VR.	Date: 12-87
Modifications	Date	App.	DELTA ELEKTRONIKA BV





Title:	M15–16HE
Date:	1 DEC 87
	DELTA ELEKTRONIKA BV

M24-12HE JULY 2002

C101 = 100UF 63V ROE
C102 = 2.2UF 25V SOLID ALU
C103 = 2.2UF 25V SOLID ALU
C104 = 100PF 1000V CERAMIC
C105 = 1000PF 100V POLYPROP
C106 = 100PF 1000V CERAMIC
C107 = 2200PF 100V POLYPROP
C108 = 2.2UF 25V SOLID ALU
C109 = 220UF 16V ROE
C110 = 0.01UF 100V MULT LAYER
C110 = 0.01UF 100V MULT LAYER
C111 = 47NF 100V MULT LAYER
C112 = 100PF 1000V CERAMIC
C113 = 100PF 1000V CERAMIC
C114 = 1000PF 100V POLYPROP
C201 = 4.7UF 63V MET POLYES
C301 = 1000UF 10V ROE
C302 = 220UF 40V ROE
C303 = 220UF 40V ROE
C304 = 220UF 40V ROE
C305 = 220UF 40V ROE
C306 = 220NF 100V MULT LAYER
C601 = 36000UF 40V CHEMI-CON
C603 = 220UF 40V ROE

D101 = B250C1500R GEN.INSTR.
D102 = ZPD 6.2V ITT
D103 = 1N4148 PHILIPS
D104 = 1N4148 PHILIPS
D105 = ZPD 6.2V ITT
D106 = 1N825 MICROSEMI
D107 = BZX85-C12 ITT
D108 = BZX85-C6V2 ITT
D109 = 1N4148 PHILIPS
D111 = 1N4148 PHILIPS
D112 = BZX55-C30V GSI
D201 = BYS28-45 SIEMENS
D202 = BYS28-45 SIEMENS
D203 = BYS28-45 SIEMENS
D204 = BYS28-45 SIEMENS
D301 = 1N4004GP PHILIPS
D302 = BYS28-45 SIEMENS
D303 = BTA41 ST
D600 = B250C1500R GEN.INSTR.

F501 = FUSE PICO 20F
F502 = FUSE PICO 20F
F503 = FUSE PICO 20F
F601A = FUSE 5X20 4T 220V
F601B = FUSE 5X20 6.3T 110V

IC101 = TLO84BCN TI
IC102 = TL431 TEXAS

Q101 = BD242B POW
Q102 = BFP22 SIEMENS
Q103 = PH2907A PHILIPS
Q601 = IRF150 HARRIS
Q602 = IRF150 HARRIS
Q603 = IRF150 HARRIS

R101 = PTC 25 A70 SIEMENS
R102 = 182 MF/0.6W/350V
R103 = 15K MF/0.6W/350V
R104 = 3.92K MF/0.6W/350V
R105 = 475 MF/0.6W/350V
R106 = 475 MF/0.6W/350V
R107 = 1.5K MF/0.6W/350V
R108 = 475 MF/0.6W/350V
R109 = 475 MF/0.6W/350V
R110 = 2.74K MF/0.6W/350V
R111 = 100 MF/0.6W/350V
R112 = 100K MF/0.6W/350V
R113 = 47.5 MF/0.6W/350V
R114 = 2.21K MF/0.6W/350V
R115 = 1K MF/0.6W/350V
R116 = 4.75K MF/0.6W/350V
R117 = 2.74K MF/0.6W/350V
R118 = 2K TRIMPOTM 15 TURNS
R119 = 10K MF/0.6W/350V
R120 = 681 MF/0.6W/350V
R121 = 4.75K MF/0.6W/350V
R122 = 2.74K MF/0.6W/350V
R123 = 5.62K MF/0.6W/350V
R124 = 681 MF/0.6W/350V
R125 = 5K TRIMPOTM 20 TURNS
R126 = 1.82K MF/0.6W/350V
R127 = 4.75K MF/0.6W/350V
R128 = 5K TRIMPOTM 15 TURNS
R129 = 681 MF/0.6W/350V
R130 = 2.21K MF/0.6W/350V
R131 = 1K MF/0.6W/350V
R132 = 82.5 MF/0.6W/350V
R133 = 20K TRIMPOTM 1 TURN
R134 = 20K TRIMPOTM 1 TURN
R135 = 20K TRIMPOTM 1 TURN
R136 = 475 MF/0.6W/350V
R137 = 475 MF/0.6W/350V
R138 = 475 MF/0.6W/350V
R141 = 4.75K MF/0.6W/350V
R142 = 4.75K MF/0.6W/350V
R143 = 4.75K MF/0.6W/350V
R201 = 27 MF/2.0W/500V
R202 = 2.2K MF/2.0W/500V
R203 = 2.2K MF/2.0W/500V
R301 = 560 MF/2.0W/500V
R302 = 560 MF/2.0W/500V
R303 = 5.6K MF/2.0W/500V
R304 = 2.21 MF/0.6W/350V
R501 = 0.380 R/M
R502 = 0.380 R/M
R503 = 0.380 R/M
R600 = 6R8/5%/0.25W PHILIPS
R601 = 22.1K MF/0.6W/350V
R601 = 22.1K MF/0.6W/350V
R602 = 22.1K MF/0.6W/350V
R603 = 22.1K MF/0.6W/350V
R700 = VARISTOR 510V 190J
RY600 = RELAIS 5VDC 16A

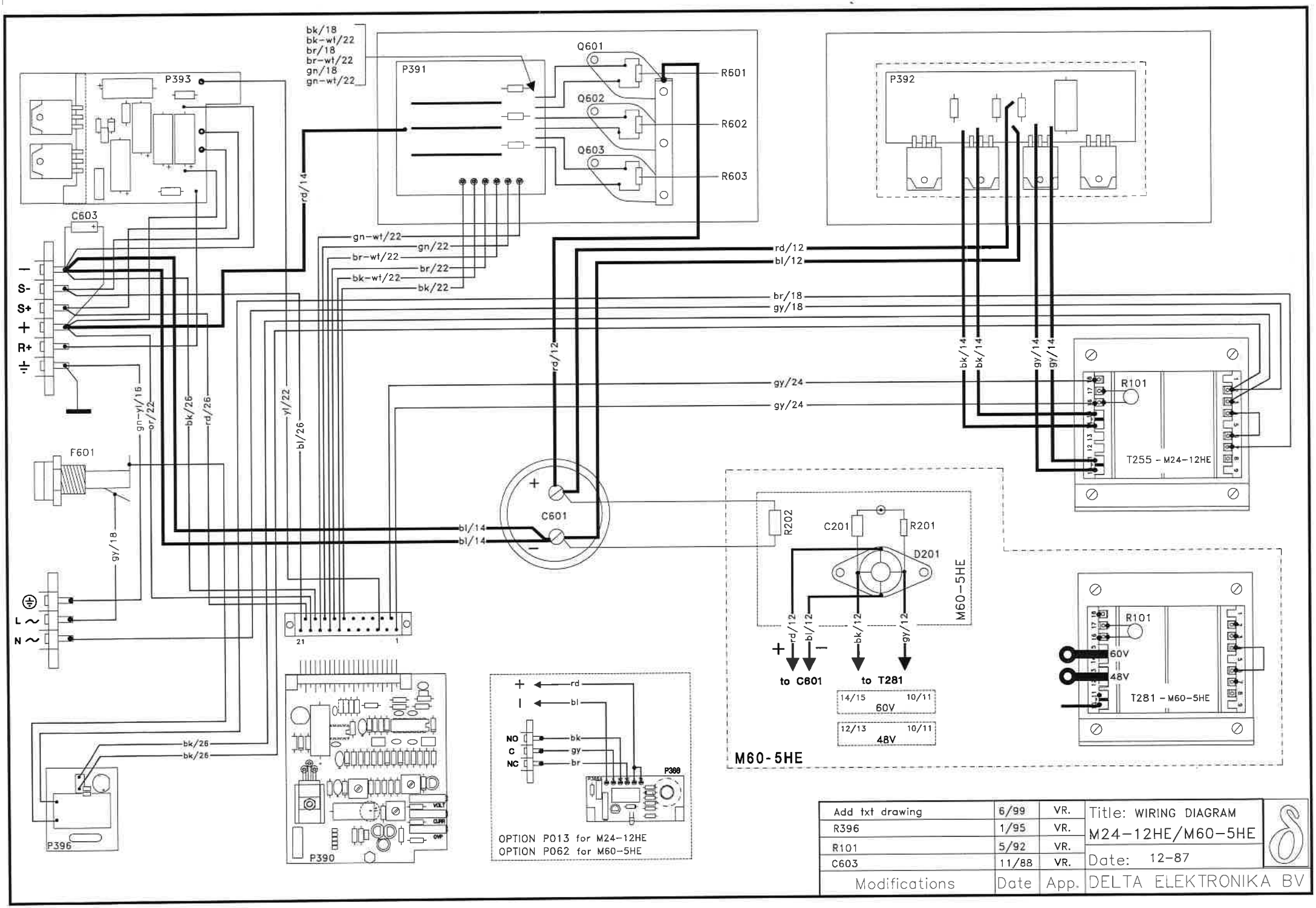
T601 = T255 DELTA

M60-5 HE

JULY 2002

C101	=	100UF 63V	ROE
C102	=	2.2UF 25V	SOLID ALU
C103	=	2.2UF 25V	SOLID ALU
C104	=	100PF 1000V	CERAMIC
C105	=	470PF 100V	POLYPROP
C106	=	100PF 1000V	CERAMIC
C107	=	680PF 100V	POLYPROP
C108	=	2.2UF 25V	SOLID ALU
C109	=	47UF 63V	ERO
C110	=	0.01UF 100V	MULT LAYER
C110	=	0.01UF 100V	MULT LAYER
C111	=	47NF 100V	MULT LAYER
C112	=	100PF 1000V	CERAMIC
C113	=	100PF 1000V	CERAMIC
C114	=	1000PF 100V	POLYPROP
C201	=	1UF 250V	MET POLYES
C301	=	1000UF 10V	ROE
C302	=	100UF 100V	ROE
C303	=	100UF 100V	ROE
C304	=	100UF 100V	ROE
C306	=	220NF 100V	MULT LAYER
C601	=	7000UF 100V	CHEMIC-CON
C603	=	100UF 100V	ROE
D101	=	B250C1500R	GEN.INSTR.
D102	=	ZPD 6.2V	ITT
D103	=	1N4148	PHILIPS
D104	=	1N4148	PHILIPS
D105	=	ZPD 6.2V	ITT
D106	=	1N825	MICROSEMI
D107	=	BZX85-C12	ITT
D108	=	BZX85-C6V2	ITT
D109	=	1N4148	PHILIPS
D111	=	1N4148	PHILIPS
D112	=	BZX55-C30V	GSI
D113	=	BZX85-C39	ITT
D201	=	VT200-T	VARO
D301	=	1N4004GP	PHILIPS
D302	=	BYS28-90	SIEMENS
D303	=	BTA41	ST
D600A	=		
F501	=	FUSE PICO 10F	
F502	=	FUSE PICO 10F	
F503	=	FUSE PICO 10F	
F601A	=	FUSE 5X20 4T	220V
F601B	=	FUSE 5X20 6.3T	110V
IC101	=	TLO84BCN	TI
IC102	=	TL431	TEXAS
Q101	=	BD242B	POW
Q102	=	BFP22	SIEMENS
Q103	=	BFP23	SIEMENS
Q601	=	FET 200V 0.085R TO3	
Q602	=	FET 200V 0.085R TO3	
Q603	=	FET 200V 0.085R TO3	

R101	=	PTC 25	A70 SIEMENS
R102	=	182	MF/0.6W/350V
R103	=	15K	MF/0.6W/350V
R104	=	3.92K	MF/0.6W/350V
R105	=	475	MF/0.6W/350V
R106	=	475	MF/0.6W/350V
R107	=	1.21K	MF/0.6W/350V
R108	=	475	MF/0.6W/350V
R109	=	475	MF/0.6W/350V
R110	=	2.21K	MF/0.6W/350V
R111	=	100	MF/0.6W/350V
R112	=	100K	MF/0.6W/350V
R113	=	47.5	MF/0.6W/350V
R114	=	2.21K	MF/0.6W/350V
R115	=	1K	MF/0.6W/350V
R116	=	10K	MF/0.6W/350V
R117	=	2.74K	MF/0.6W/350V
R118	=	5K TRIMPOTM 20 TURNS	
R119	=	15K	MF/0.6W/350V
R120	=	681	MF/0.6W/350V
R121	=	4.75K	MF/0.6W/350V
R122	=	2.21K	MF/0.6W/350V
R123	=	12.1K	MF/0.6W/350V
R124	=	10	MF/0.6W/350V
R125	=	5K TRIMPOTM 15 TURNS	
R126	=	1.5K	MF/0.6W/350V
R127	=	10K	MF/0.6W/350V
R128	=	10K TRIMPOTM 15 TURNS	
R129	=	681	MF/0.6W/350V
R130	=	2.21K	MF/0.6W/350V
R131	=	1K	MF/0.6W/350V
R132	=	82.5	MF/0.6W/350V
R133	=	20K TRIMPOTM 1 TURN	
R134	=	20K TRIMPOTM 1 TURN	
R135	=	20K TRIMPOTM 1 TURN	
R136	=	475	MF/0.6W/350V
R137	=	475	MF/0.6W/350V
R138	=	475	MF/0.6W/350V
R141	=	4.75K	MF/0.6W/350V
R142	=	4.75K	MF/0.6W/350V
R143	=	4.75K	MF/0.6W/350V
R201	=	22.1	MF/0.6W/350V
R202	=	10K	MF/2.0W/500V
R301	=	560	MF/2.0W/500V
R302	=	560	MF/2.0W/500V
R303	=	5.6K	MF/2.0W/500V
R304	=	2.21	MF/0.6W/350V
R501	=	1.12 R/M	
R502	=	1.12 R/M	
R503	=	1.12 R/M	
R600A	=	6R8/5%/0.25W	PHILIPS
R601	=	22.1K	MF/0.6W/350V
R601A	=	NTC C70	KEYSTONE
R602	=	22.1K	MF/0.6W/350V
R602A	=	6R8/5%/0.25W	PHILIPS
R603	=	22.1K	MF/0.6W/350V
RY600	=	RELAIS 5VDC 16A	
T601	=	XT281	DELTA

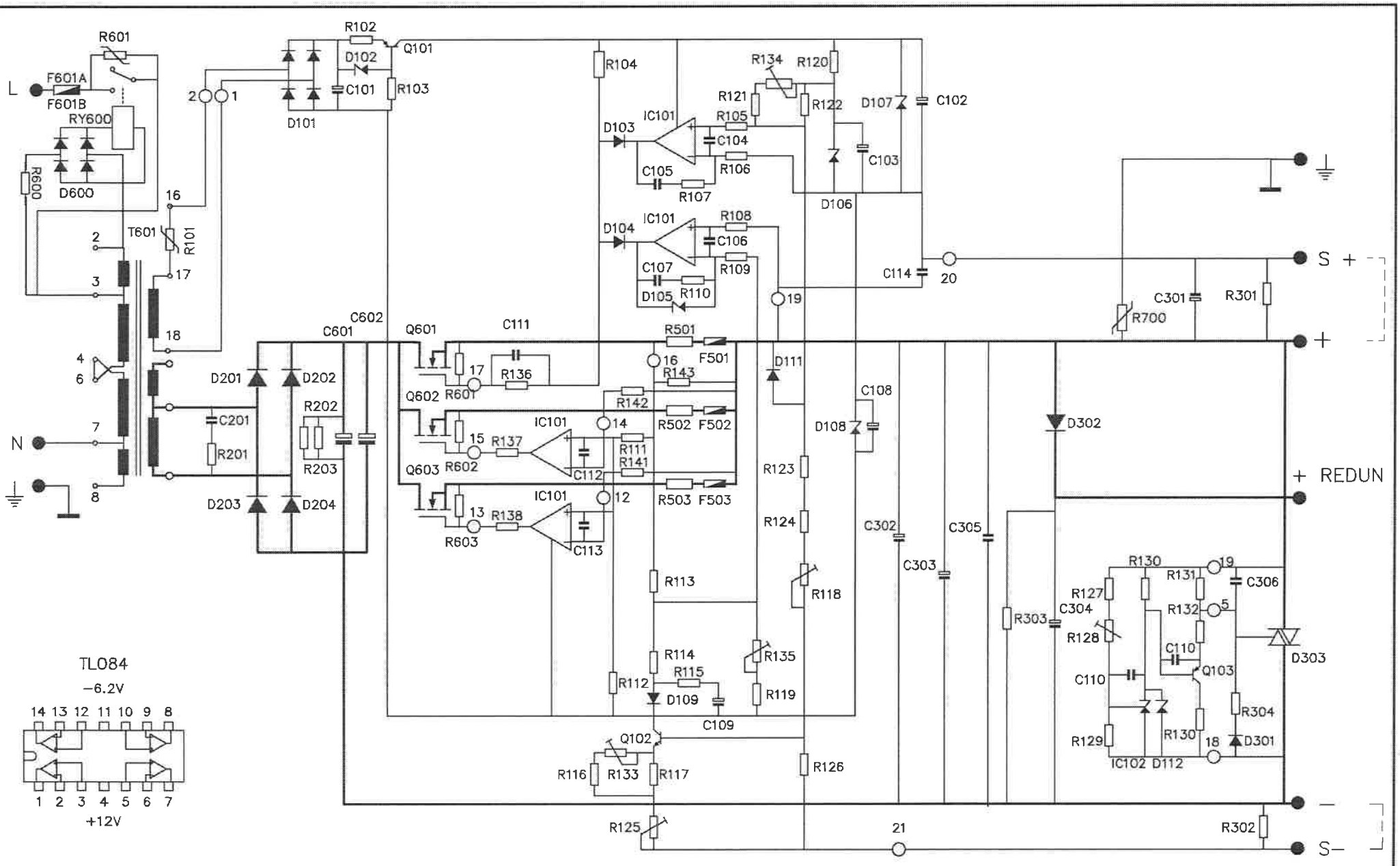


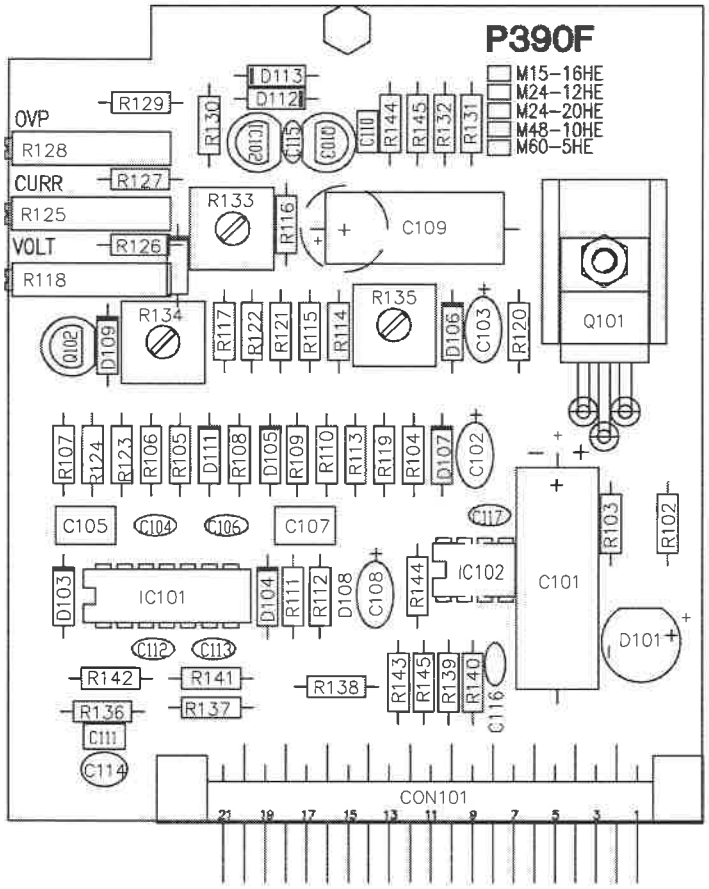
Modifications	Date	App.
Add txt drawing	6/99	VR.
R396	1/95	VR.
R101	5/92	VR.
C603	11/88	VR.

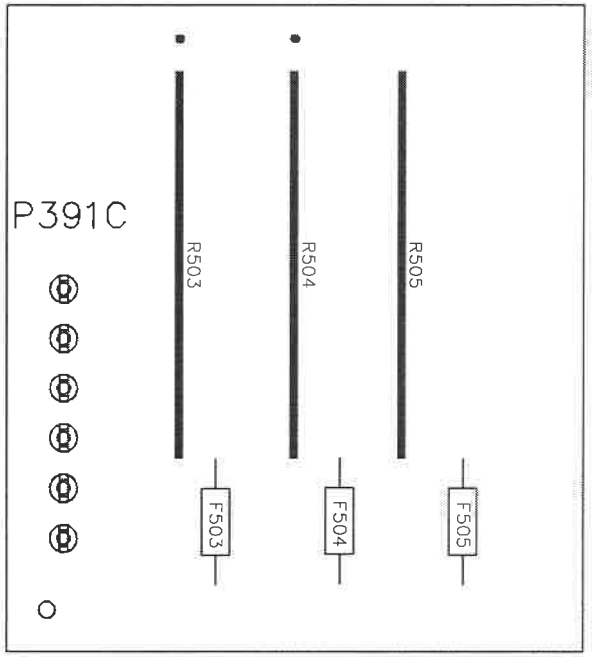
Title: WIRING DIAGRAM
M24-12HE/M60-5HE

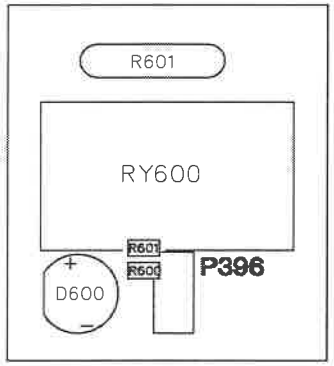
Date: 12-87

DELTA ELEKTRONIKA BV

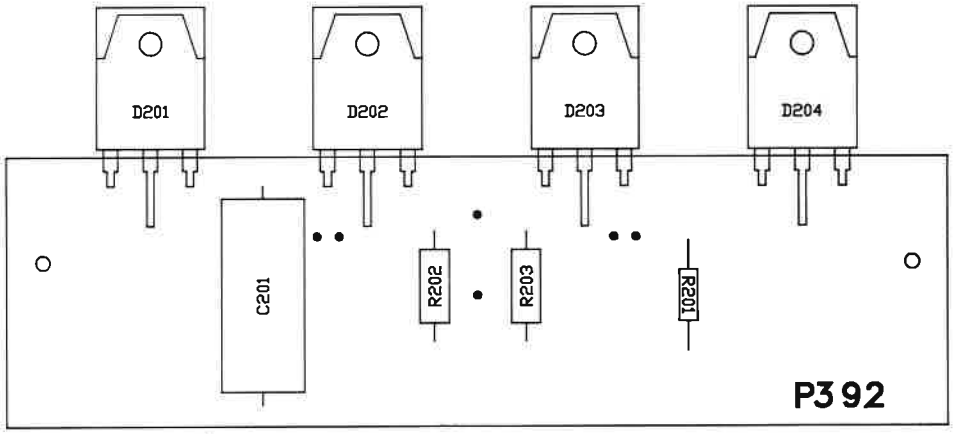

R601
F601A
F601B
L
RY600
R600
D600
T601
R101
R102
D102
Q101
C101
R103
D101
R104
IC101
R105
C104
R106
C105
R107
R134
R120
R121
R122
D107
C102
C103
D106
D103
R108
C106
R109
C107
D105
R110
D104
C114
20
19
S +
+
C301
R301
R700
C601
C602
Q601
C111
R501
F501
R136
R143
D111
C108
D108
D302
R142
R502
F502
R111
R141
C112
R123
R124
R503
F503
C113
R113
R118
C302
C303
C305
R130
R131
C306
R127
C304
R303
R128
R132
C110
Q103
D303
R304
R129
R130
D301
IC102
D112
R114
R115
R112
D109
R135
R119
C109
Q102
R116
R133
R117
R126
R125
21
R302
S−
−
+ REDUN
D201
D202
R202
C201
R201
R203
D203
D204
N
R602
R603
R137
R138
R601
Q602
Q603
TL084
−6.2V
+12V
14 13 12 11 10 9 8
1 2 3 4 5 6 7
○ 17 = contact No 17 of 21−p connector P390
Title:
M24−12HE, M60−5HE.
Date: 1 DEC 87
DELTA ELEKTRONIKA BV



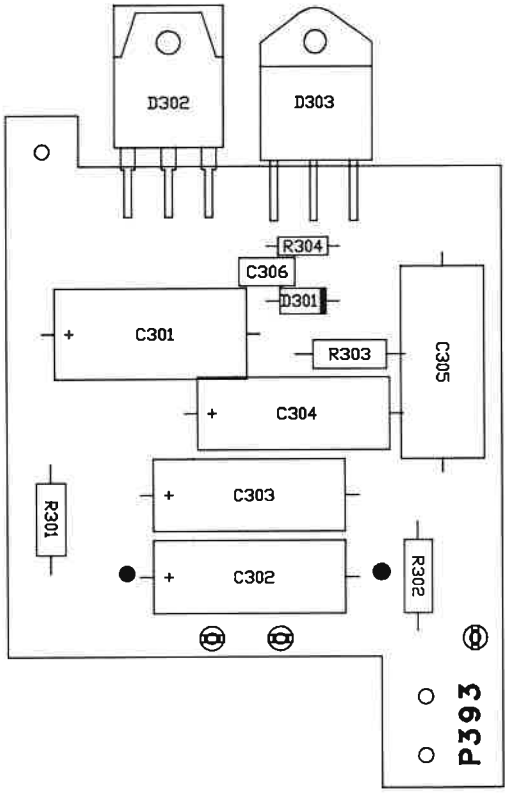




Title:	M24-12HE, M60-5HE.
Date:	1 DEC 87
	DELTA ELEKTRONIKA BV

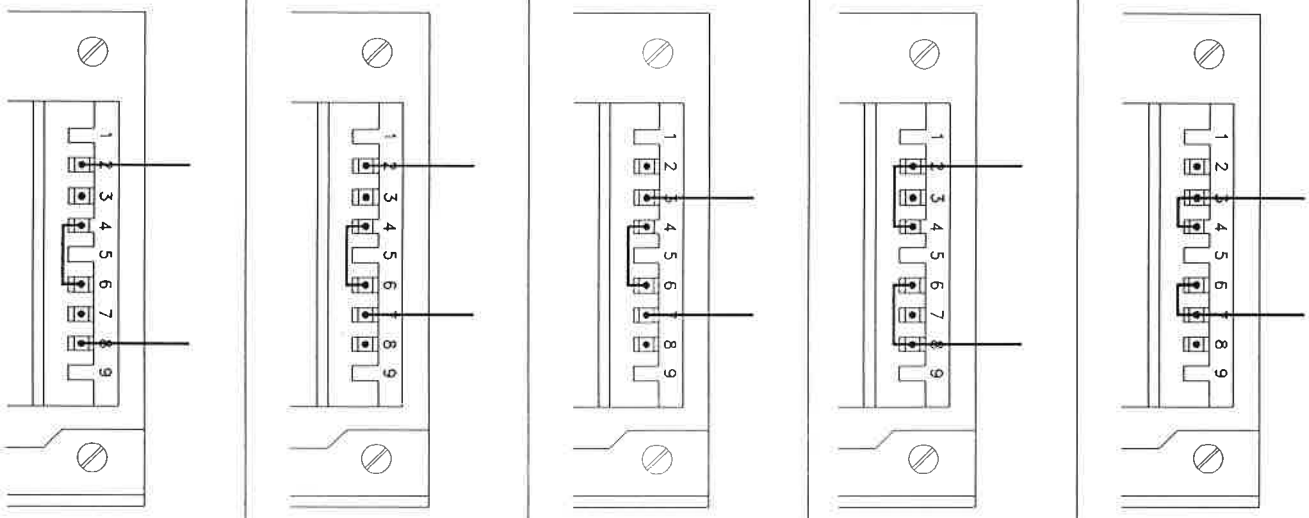


P392 used in M24-12HE only!

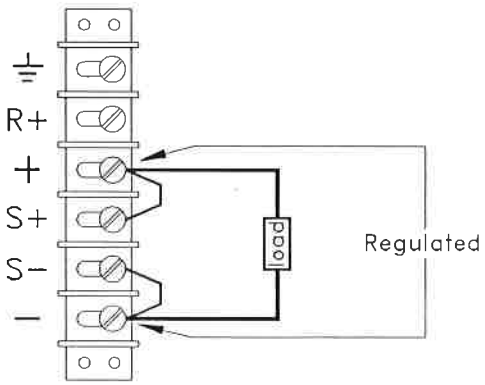


			Title: M24-12HE M60-5HE
ADD TEXT IN DRAWING	6/99	JvS	Date: 07/06/1999
Modifications	Date	App	delta elektronika bv

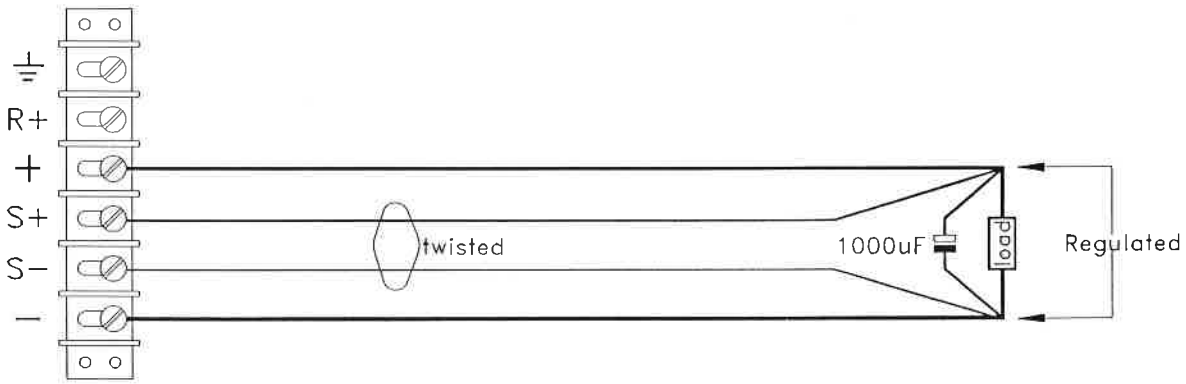
Transformer connections



240VAC	230VAC	220VAC	117VAC	110VAC
fuse 4A	fuse 4A	fuse 4A	fuse 6.3A	fuse 6.3A



Normal operation with sense points connected to the + and − output terminals



Remote sensing to compensate voltage drop over load line

			Title: M24−12HE −M60−5HE
			Date: 10−93
Modifications	Date	App.	DELTA ELEKTRONIKA BV

M24-20HE

JULY 2002

C101	=	100UF 63V	ROE
C102	=	2.2UF 25V	SOLID ALU
C103	=	2.2UF 25V	SOLID ALU
C104	=	100PF 1000V	CERAMIC
C105	=	1000PF 100V	POLYPROP
C106	=	100PF 1000V	CERAMIC
C107	=	1000PF 100V	POLYPROP
C108	=	2.2UF 25V	SOLID ALU
C109	=	220UF 16V	ROE
C110	=	0.01UF 100V	MULT LAYER
C110	=	0.01UF 100V	MULT LAYER
C111	=	47NF 100V	MULT LAYER
C112	=	100PF 1000V	CERAMIC
C113	=	100PF 1000V	CERAMIC
C114	=	1000PF 100V	POLYPROP
C115	=	2200PF 100V	CERAMIC
C116	=	100PF 1000V	CERAMIC
C301	=	1000UF 10V	ROE
C302	=	220UF 40V	ROE
C303	=	220UF 40V	ROE
C304	=	220UF 40V	ROE
C305	=	220UF 40V	ROE
C306	=	0.22UF 63V	MET POLYES
C601	=	36000UF 40V	CHEMI-CON
C602	=	36000UF 40V	CHEMI-CON
C603	=	4.7UF 63V	MET POLYES
C604	=	1000UF 40V	ERO
D101	=	B250C1500R	GEN.INSTR.
D102	=	ZPD 6.2V	ITT
D103	=	1N4148	PHILIPS
D104	=	1N4148	PHILIPS
D105	=	ZPD 6.2V	ITT
D106	=	1N825	MICROSEMI
D107	=	BZX85-C12	ITT
D108	=	BZX85-C6V2	ITT
D109	=	1N4148	PHILIPS
D111	=	1N4148	PHILIPS
D112	=	BZX55-C30V	GSI
D301	=	1N4004GP	PHILIPS
D302	=	BYS28-45	SIEMENS
D303	=	BTA41	ST
D600A	=	B250C1500R	GEN.INSTR.
D601	=	85HQ045	IR
D602	=	85HQ045	IR
D603	=	85HQ045	IR
D604	=	85HQ045	IR
F501	=	FUSE PICO 20F	
F502	=	FUSE PICO 20F	
F503	=	FUSE PICO 20F	
F504	=	FUSE PICO 20F	
F505	=	FUSE PICO 20F	
F601A	=	FUSE 5X20 6.3T	220V
F601B	=	FUSE 5X20 10T	110V
IC101	=	TLO84BCN	TI
IC102	=	TL431	TEXAS
IC102	=	TL431	TEXAS
Q101	=	BD242B	POW
Q102	=	BFP22	SIEMENS
Q103	=	PH2907A	PHILIPS
Q601	=	IRF150	HARRIS
Q602	=	IRF150	HARRIS
Q603	=	IRF150	HARRIS
Q604	=	IRF150	HARRIS
Q605	=	IRF150	HARRIS

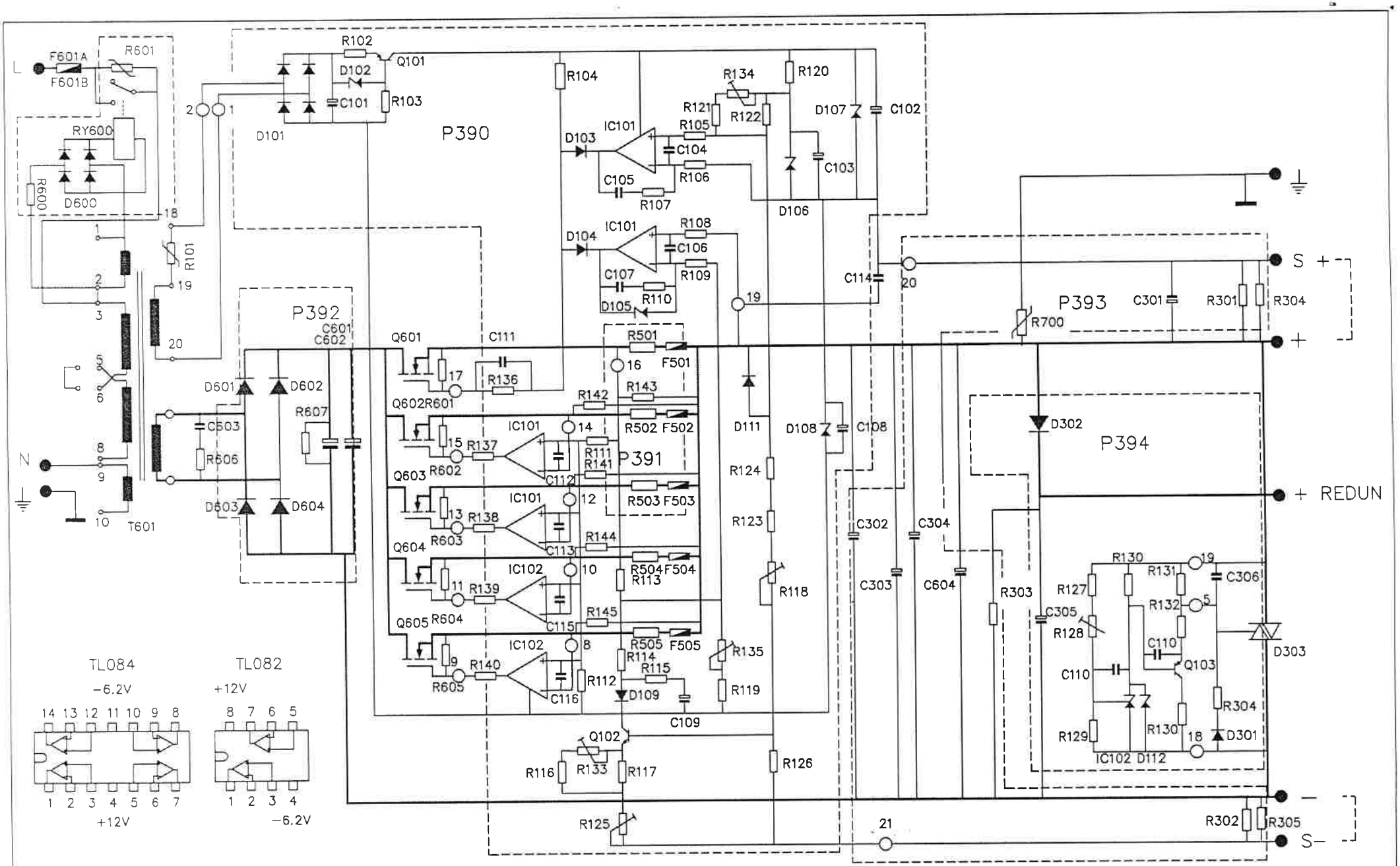
R101	=	PTC 25	A70 SIEMENS
R102	=	182	MF/0.6W/350V
R103	=	15K	MF/0.6W/350V
R104	=	3.92K	MF/0.6W/350V
R105	=	475	MF/0.6W/350V
R106	=	475	MF/0.6W/350V
R107	=	1.5K	MF/0.6W/350V
R108	=	475	MF/0.6W/350V
R109	=	475	MF/0.6W/350V
R110	=	3.92K	MF/0.6W/350V
R111	=	100	MF/0.6W/350V
R112	=	100K	MF/0.6W/350V
R113	=	47.5	MF/0.6W/350V
R114	=	2.21K	MF/0.6W/350V
R115	=	1K	MF/0.6W/350V
R116	=	4.75K	MF/0.6W/350V
R117	=	2.74K	MF/0.6W/350V
R118	=	2K TRIMPOTM 15 TURNS	
R119	=	12.1K	MF/0.6W/350V
R120	=	562	MF/0.6W/350V
R121	=	4.75K	MF/0.6W/350V
R122	=	2.74K	MF/0.6W/350V
R123	=	5.62K	MF/0.6W/350V
R124	=	681	MF/0.6W/350V
R125	=	5K TRIMPOTM 20 TURNS	
R126	=	1.82K	MF/0.6W/350V
R127	=	4.75K	MF/0.6W/350V
R128	=	5K TRIMPOTM 15 TURNS	
R129	=	681	MF/0.6W/350V
R130	=	2.21K	MF/0.6W/350V
R131	=	1K	MF/0.6W/350V
R132	=	82.5	MF/0.6W/350V
R133	=	20K TRIMPOTM 1 TURN	
R134	=	20K TRIMPOTM 1 TURN	
R135	=	20K TRIMPOTM 1 TURN	
R136	=	475	MF/0.6W/350V
R137	=	475	MF/0.6W/350V
R138	=	475	MF/0.6W/350V
R139	=	475	MF/0.6W/350V
R140	=	475	MF/0.6W/350V
R141	=	4.75K	MF/0.6W/350V
R142	=	4.75K	MF/0.6W/350V
R143	=	4.75K	MF/0.6W/350V
R144	=	4.75K	MF/0.6W/350V
R145	=	4.75K	MF/0.6W/350V
R301	=	1.5K	MF/2.0W/500V
R302	=	1.5K	MF/2.0W/500V
R303	=	2.2K	MF/2.0W/500V
R304	=	1.5K	MF/2.0W/500V
R304	=	1.5K	MF/2.0W/500V
R305	=	1.5K	MF/2.0W/500V
R501	=	0.380 R/M	
R502	=	0.380 R/M	
R503	=	0.380 R/M	
R504	=	0.380 R/M	
R505	=	0.380 R/M	
R600A	=	6R8/5%/0.25W	PHILIPS
R601	=	22.1K	MF/0.6W/350V
R601A	=	NTC C70	KEYSTONE
R602	=	22.1K	MF/0.6W/350V
R602A	=	6R8/5%/0.25W	PHILIPS
R603	=	22.1K	MF/0.6W/350V
R604	=	22.1K	MF/0.6W/350V
R605	=	22.1K	MF/0.6W/350V
R606	=	10	MF/2.0W/500V
R607	=	2.2K	MF/2.0W/500V
R700	=	VARISTOR 510V 190J	
RY600	=	RELAIS 5VDC 16A	
T601	=	XT256	DELTA

M48-10HE

JULY 2002

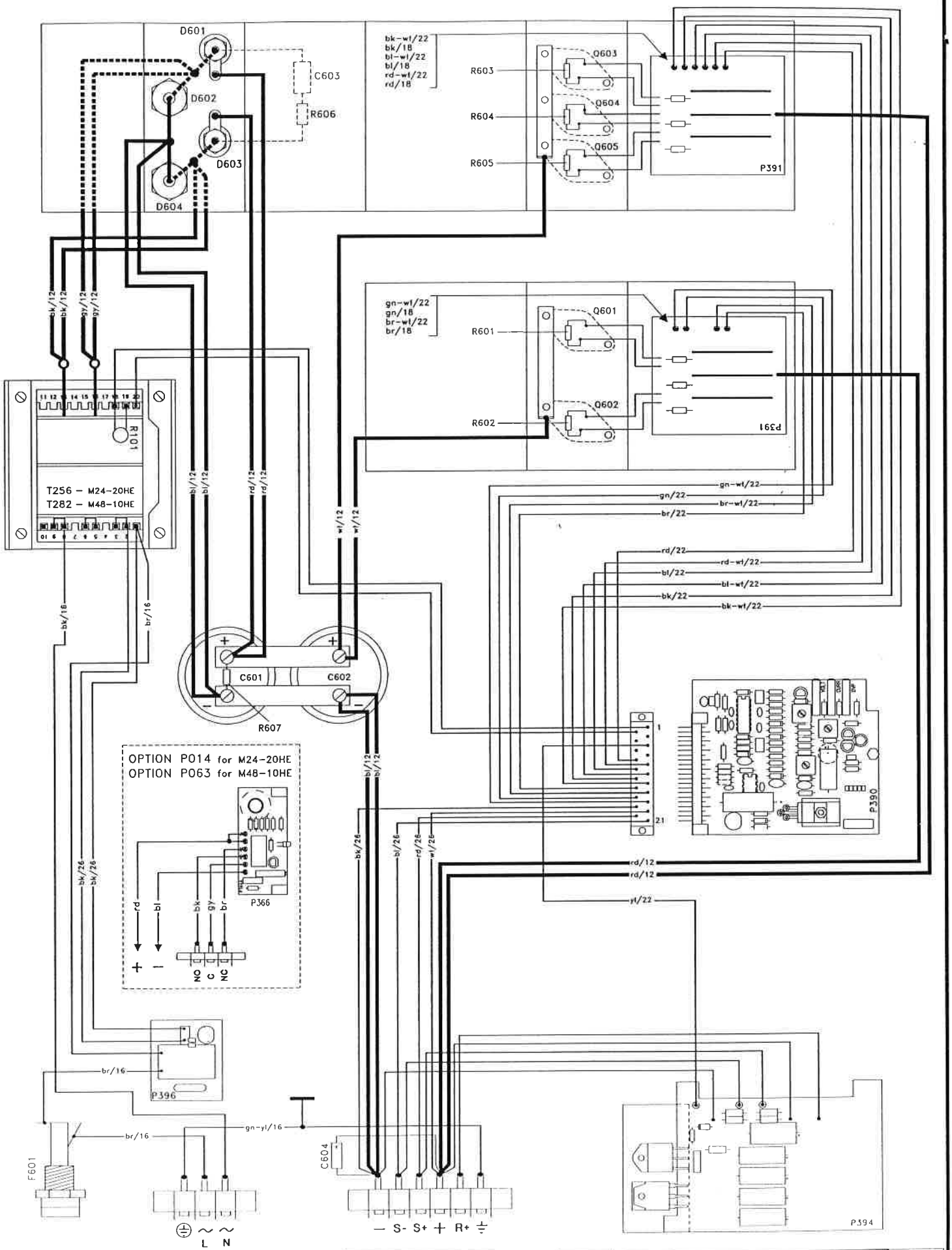
C101	=	100UF 63V	ROE
C102	=	2.2UF 25V	SOLID ALU
C103	=	2.2UF 25V	SOLID ALU
C104	=	100PF 1000V	CERAMIC
C105	=	470PF 100V	POLYPROP
C106	=	100PF 1000V	CERAMIC
C107	=	2200PF 100V	CERAMIC
C108	=	2.2UF 25V	SOLID ALU
C109	=	47UF 63V	ERO
C110	=	0.01UF 100V	MULT LAYER
C110	=	0.01UF 100V	MULT LAYER
C111	=	47NF 100V	MULT LAYER
C112	=	100PF 1000V	CERAMIC
C113	=	100PF 1000V	CERAMIC
C114	=	1000PF 100V	POLYPROP
C115	=	2200PF 100V	CERAMIC
C116	=	100PF 1000V	CERAMIC
C301	=	1000UF 10V	ROE
C302	=	220UF 63V	ERO
C303	=	220UF 63V	ERO
C304	=	220UF 63V	ERO
C305	=	220UF 63V	ERO
C306	=	0.22UF 63V	MET POLYES
C601	=	15000UF 75V	CHEMI-CON
C603	=	1UF 250V	MET POLYES
C604	=	220UF 63V	ERO
D101	=	B250C1500R	GEN.INSTR.
D102	=	ZPD 6.2V	ITT
D103	=	1N4148	PHILIPS
D104	=	1N4148	PHILIPS
D105	=	ZPD 6.2V	ITT
D106	=	1N825	MICROSEMI
D107	=	BZX85-C12	ITT
D108	=	BZX85-C6V2	ITT
D109	=	1N4148	PHILIPS
D111	=	1N4148	PHILIPS
D112	=	BZX55-C30V	GSI
D113	=	BZX55-C30V	GSI
D301	=	1N4004GP	PHILIPS
D302	=	BYS28-90	SIEMENS
D303	=	BTA41	ST
D600A	=	B250C1500R	GEN.INSTR.
D601	=	40HF20	IR
D602	=	40HF20	IR
D603	=	40HF20	IR
D604	=	40HF20	IR
F501	=	FUSE PICO 10F	
F502	=	FUSE PICO 10F	
F503	=	FUSE PICO 10F	
F504	=	FUSE PICO 10F	
F505	=	FUSE PICO 10F	
F601A	=	FUSE 5X20 6.3T	220V
F601B	=	FUSE 5X20 10T	110V
IC101	=	TLO84BCN	TI
IC102	=	TL431	TEXAS
IC102	=	TL431	TEXAS
Q101	=	BD242B	POW
Q102	=	BFP22	SIEMENS
Q103	=	BFP23	SIEMENS
Q601	=	FET 200V 0.085R TO3	
Q602	=	FET 200V 0.085R TO3	
Q603	=	FET 200V 0.085R TO3	
Q604	=	FET 200V 0.085R TO3	
Q605	=	FET 200V 0.085R TO3	

R101	=	PTC 25	A70 SIEMENS
R102	=	182	MF/0.6W/350V
R103	=	15K	MF/0.6W/350V
R104	=	3.92K	MF/0.6W/350V
R105	=	475	MF/0.6W/350V
R106	=	475	MF/0.6W/350V
R107	=	1.5K	MF/0.6W/350V
R108	=	475	MF/0.6W/350V
R109	=	475	MF/0.6W/350V
R110	=	1.82K	MF/0.6W/350V
R111	=	100	MF/0.6W/350V
R112	=	100K	MF/0.6W/350V
R113	=	47.5	MF/0.6W/350V
R114	=	2.21K	MF/0.6W/350V
R115	=	1K	MF/0.6W/350V
R116	=	4.75K	MF/0.6W/350V
R117	=	2.21K	MF/0.6W/350V
R118	=	2K TRIMPOTM 15 TURNS	
R119	=	6.81K	MF/0.6W/350V
R120	=	562	MF/0.6W/350V
R121	=	5.62K	MF/0.6W/350V
R122	=	2.21K	MF/0.6W/350V
R123	=	12.1K	MF/0.6W/350V
R124	=	10	MF/0.6W/350V
R125	=	5K TRIMPOTM 20 TURNS	
R126	=	1.5K	MF/0.6W/350V
R127	=	10K	MF/0.6W/350V
R128	=	10K TRIMPOTM 15 TURNS	
R129	=	681	MF/0.6W/350V
R130	=	2.21K	MF/0.6W/350V
R131	=	1K	MF/0.6W/350V
R132	=	82.5	MF/0.6W/350V
R133	=	20K TRIMPOTM 1 TURN	
R134	=	20K TRIMPOTM 1 TURN	
R135	=	20K TRIMPOTM 1 TURN	
R136	=	475	MF/0.6W/350V
R137	=	475	MF/0.6W/350V
R138	=	475	MF/0.6W/350V
R139	=	475	MF/0.6W/350V
R140	=	475	MF/0.6W/350V
R141	=	4.75K	MF/0.6W/350V
R142	=	4.75K	MF/0.6W/350V
R143	=	4.75K	MF/0.6W/350V
R144	=	18.2	MF/0.6W/350V
R145	=	4.75K	MF/0.6W/350V
R301	=	1.5K	MF/2.0W/500V
R302	=	1.5K	MF/2.0W/500V
R303	=	5.6K	MF/2.0W/500V
R304	=	1.5K	MF/2.0W/500V
R304	=	1.5K	MF/2.0W/500V
R305	=	1.5K	MF/2.0W/500V
R501	=	1.12 R/M	
R502	=	1.12 R/M	
R503	=	1.12 R/M	
R504	=	1.12 R/M	
R505	=	1.12 R/M	
R600A	=	6R8/5%/0.25W	PHILIPS
R601	=	22.1K	MF/0.6W/350V
R601A	=	NTC C70	KEYSTONE
R602	=	22.1K	MF/0.6W/350V
R602A	=	6R8/5%/0.25W	PHILIPS
R603	=	22.1K	MF/0.6W/350V
R604	=	22.1K	MF/0.6W/350V
R605	=	22.1K	MF/0.6W/350V
R606	=	27	MF/2.0W/500V
R607	=	8.2K	MF/2.0W/500V
RY600	=	RELAIS 5VDC 16A	
T601	=	XT282	DELTA

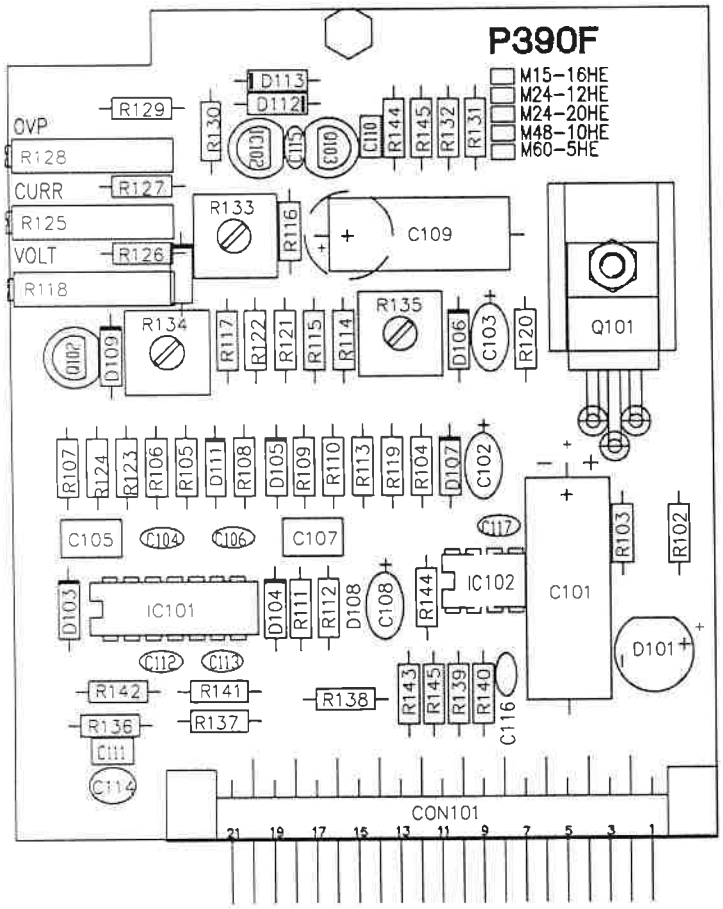


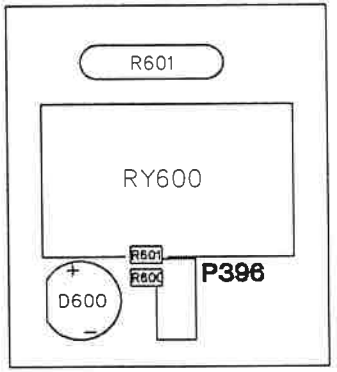
○ 17 = contact No 17 of 21–p connector P390

Title: M24–20HE, M48–10HE	δ
Date: 2 DEC 87	
DELTA ELEKTRONIKA BV	

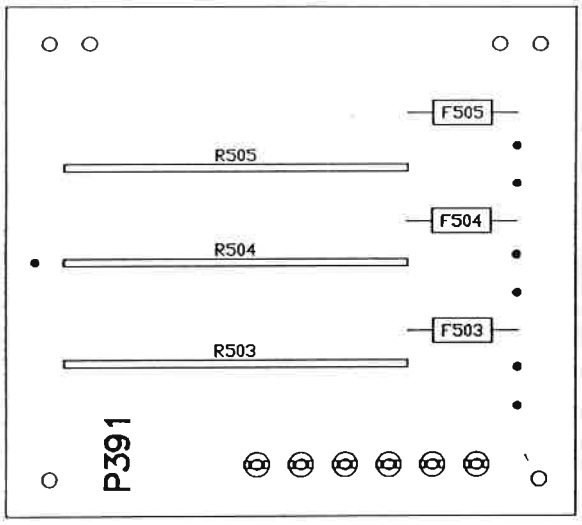


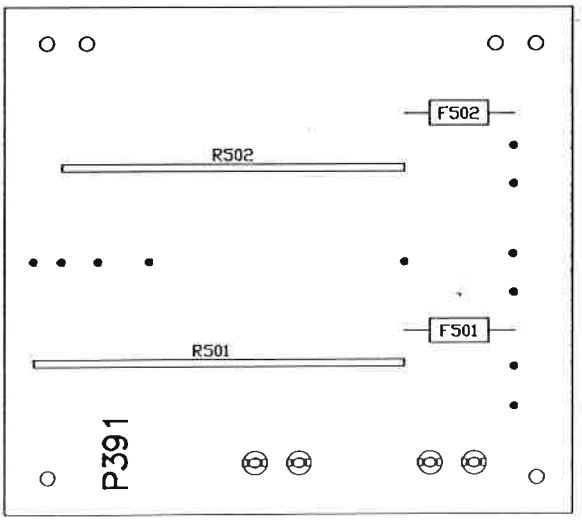
P396	1/95	VR.	Title WIRING DIAGRAM
R101	5/92	VR.	M24-20HE/M48-10HE
P390A	2/89	VR.	Date 12-87
Modifications	Date	App	DELTA ELEKTRONIKA BV





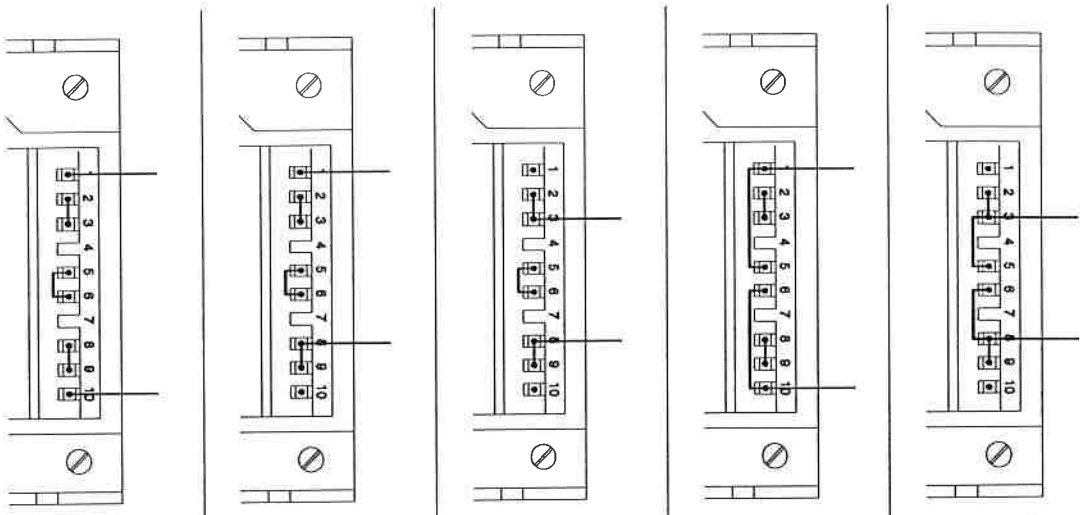
Title: M24–20HE, M48–10HE.	
Date: 1 DEC 87	
DELTA ELEKTRONIKA BV	



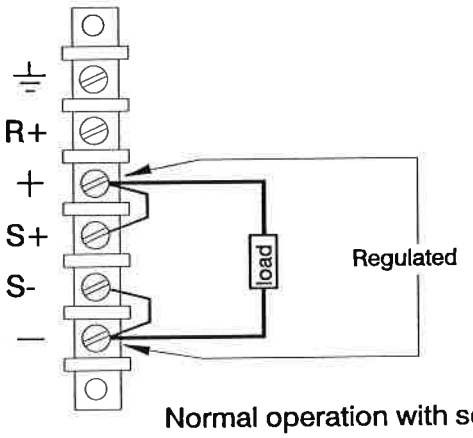


Title: M 24 - 20 HE M 48 - 10 HE			Date: 12-'87		delta elektronika bv
				App	
				Date	
				Modifications	

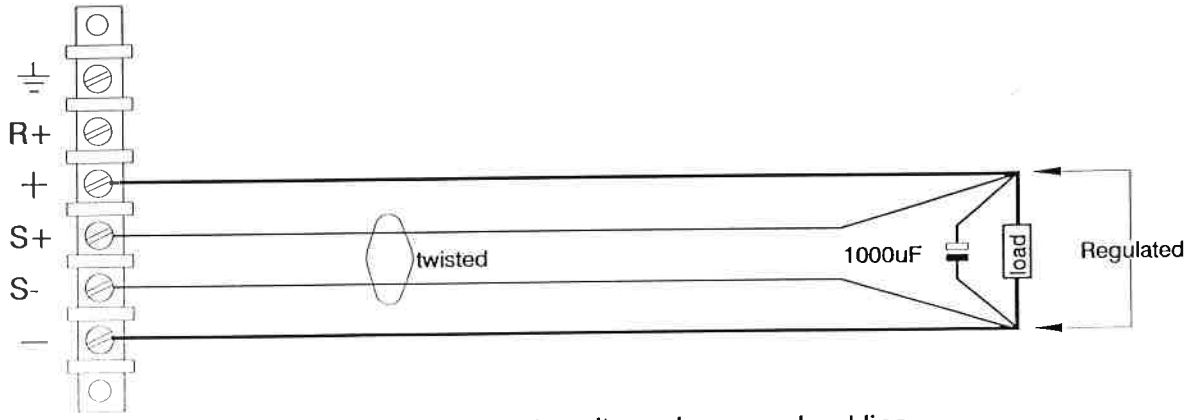
Transformer connections



240VAC	230VAC	220VAC	120VAC	110VAC
fuse 6.3A	fuse 6.3A	fuse 6.3A	fuse 10A	fuse 10A



Normal operation with sense points connected
to the + and - output terminals



Remote sensing to compensate voltage drop over load line

			Title: M24-20 HE M48-10 HE
			Date: 10-93
Modifications	Date	App.	DELTA ELEKTRONIKA BV

DELTA ELEKTRONIKA BV

P.O. BOX 27
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EC Declaration of Conformity

We
Delta Elektronika
P.O. BOX 27
4300 AA Zierikzee
The Netherlands

declare under sole responsibility that the following Power Supplies:

M 15 - 16 HE
M 24 - 12 HE
M 60 - 5 HE

meet the intent of Directives 89/336/EEC; 92/31/EEC; 93/68/EEC for Electromagnetic Compatibility and
Directives 73/23/EEC; 93/68/EEC regarding Electrical Safety. (Low Voltage Directive)
Compliance was demonstrated to the following specification as listed in the official Journal of the European Communities:

EN 61204-3 EMC, low voltage power supplies

EN 61000-6-3 Generic Emissions: (residential, light industrial)

EN 55022	Radiated and conducted, Class B
EN 61000-3-2	Power Harmonics
EN 61000-3-3	Voltage fluctuation and flicker

EN 61000-6-1 Generic Immunity: (residential, light industrial)

EN 61000-6-2 Generic Immunity: (industrial environment)

EN 61000-4-2	Electrostatic Discharge
EN 61000-4-3	Radiated electromagnetic fields
EN 61000-4-4	Electrical Fast Transients / Bursts
EN 61000-4-5	Surge immunity
EN 61000-4-6	RF common mode, conducted
EN 61000-4-11	Voltage variations and dips

EN 60950 Safety of IT equipment

EN 61010 Safety of electrical equipment for measurement, control and laboratory use

Managing director

DELTA ELEKTRONIKA BV

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EC Declaration of Conformity

We
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4300 AA Zierikzee
The Netherlands

declare under sole responsibility that the following Power Supplies:

M 24 - 20 HE
M 48 - 10 HE

meet the intent of Directives 89/336/EEC; 92/31/EEC; 93/68/EEC for Electromagnetic Compatibility and
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EN 61000-4-3	Radiated electromagnetic fields
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EN 61000-4-5	Surge immunity
EN 61000-4-6	RF common mode, conducted
EN 61000-4-11	Voltage variations and dips

EN 60950 Safety of IT equipment

EN 61010 Safety of electrical equipment for measurement, control and laboratory use

Managing director