

# DELTA ELEKTRONIKA BV



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## M - SERIES

LINEAR POWER SUPPLIES WITH HIGH EFFICIENCY AND HIGH RELIABILITY

Model	DC output voltage	Output current	Efficiency	Size
M 15-16 HE	12V/15V	16 A	70 %	Half rack
M 24-12 HE	24 V	12 A	74 %	Half rack
M 60-5 HE	48V/60V	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 new M-series with the addition HE (high efficiency) is an improvement on the old M-series. The efficiency has been improved by about 10 %. For example the efficiency of the old M 24-20 was about 64 %. The new M 24-20 HE has an efficiency of 74 %. This means about 100W less in heat dissipation. All models have an extra output via a diode for use in redundant operation.

Also all models have a built-in overvoltage protector.

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

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 15 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.

Other advantages are the very low output ripple, fast response to load transients and no generation of RFI. The only disadvantages compared with switchers are the relatively larger weight and dimensions.

## Output voltage adjustment range

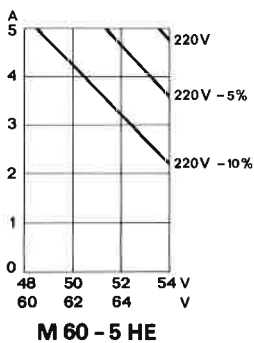
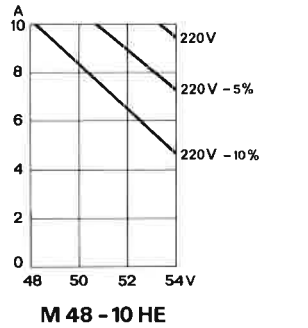
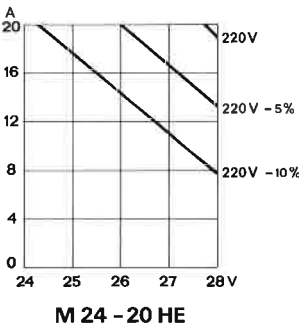
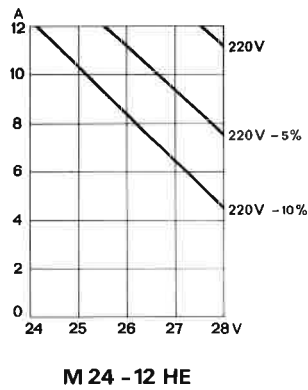
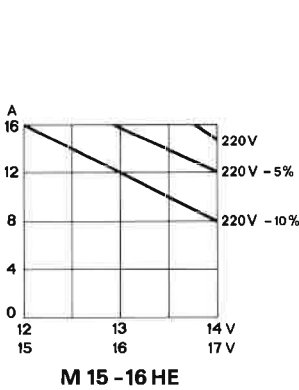
The M-series is meant for use at a fixed output voltage. However it can be used over a larger range at a lower output current or with a smaller AC input variation (see graphs). The adjustment ranges are given below.

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 12V: 12 - 14 V  
 if connected for 15V: 15 - 17 V

M 60-5 HE  
 if connected for 48V: 48 - 54 V  
 if connected for 60V: 60 - 64 V

The M15-16HE has a tap on the transformer secondary for use at 12V instead of 15V. 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 12V. The same applies for the M60-5HE for 60 and 48V.



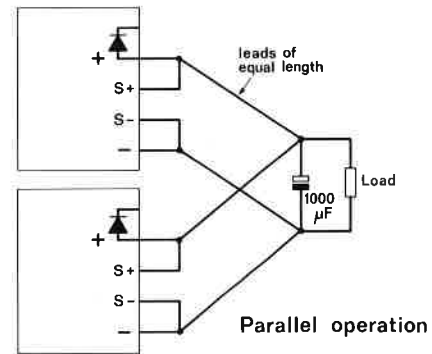
Maximum output at reduced AC input voltage

## 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 198VAC input (220V-10%). However if the line voltage is already stabilized and never drops below 215V, the input can be connected to the 234V tap of the transformer. This will still increase the efficiency of the M24-20HE from 74 to 79%, saving considerable heat.

## Parallel operation

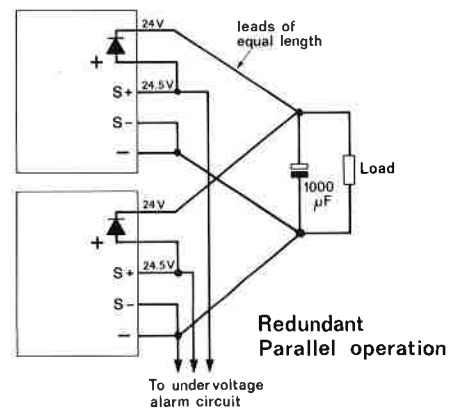
With parallel operation the current will not be shared equally but the current limit of each unit will avoid overloading. The current sharing is better if the load wires are of equal length. Remote sensing is not recommended with parallel operation. The electrolytic capacitor at the summing point avoids oscillations.



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 an in-built diode is available.



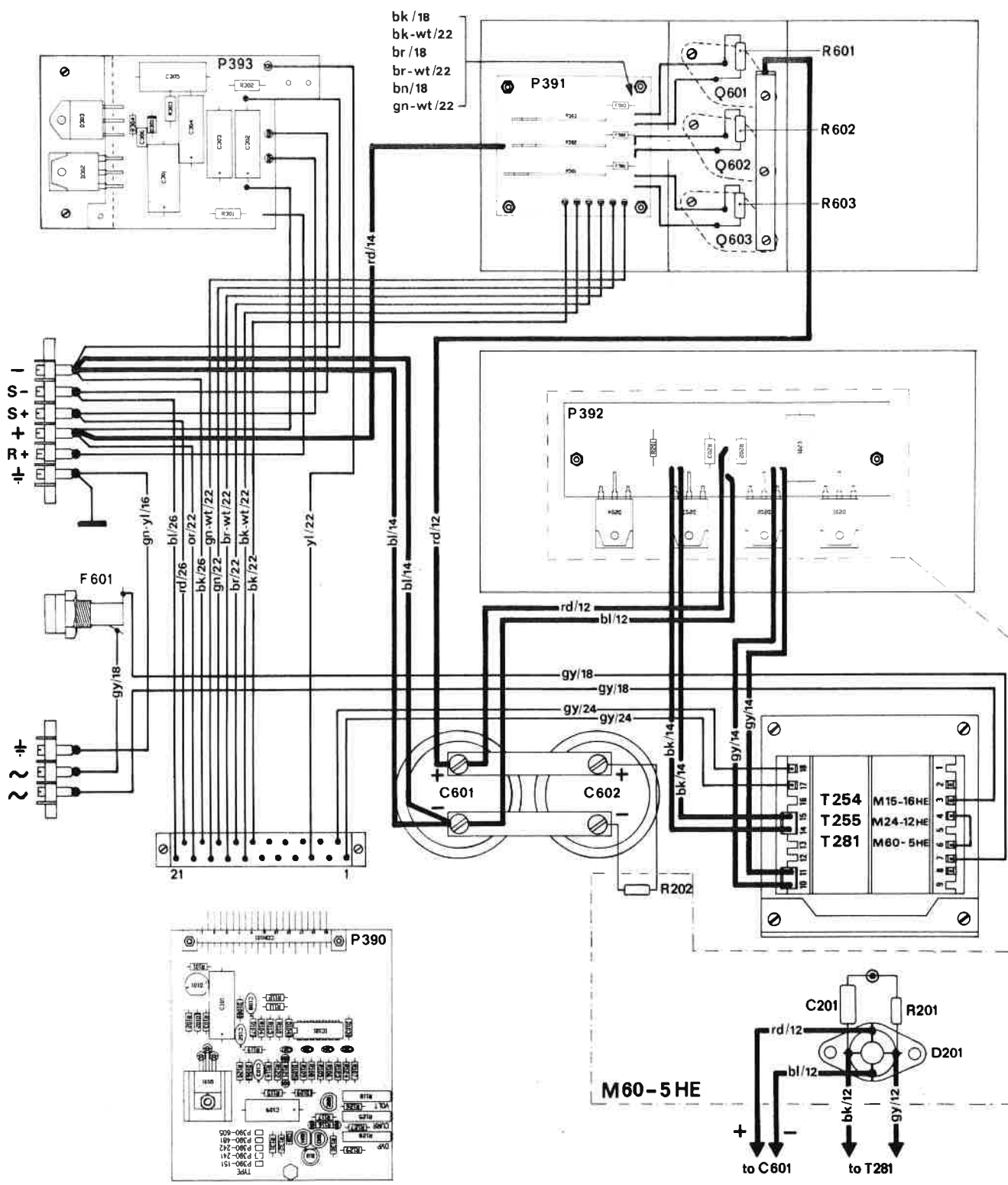
## M15-16HE

			R101	= 1.0	MF/0.6W/250V
			R102	= 182	MF/0.6W/250V
			R103	= 15K	MF/0.6W/250V
			R104	= 3.92K	MF/0.6W/250V
C101	= 100UF 63V		R105	= 475	MF/0.6W/250V
C102	= 2.2UF 25V	SOLID ALU	R106	= 475	MF/0.6W/250V
C103	= 2.2UF 25V	SOLID ALU	R107	= 475	MF/0.6W/250V
C104	= 100PF 500V	CERAMIC	R108	= 475	MF/0.6W/250V
C105	= 1000PF 100V	POLYPROP	R109	= 475	MF/0.6W/250V
C106	= 100PF 500V	CERAMIC	R110	= 10	MF/0.6W/250V
C107	= 470PF 500V	CERAMIC	R111	= 100	MF/0.6W/250V
C108	= 2.2UF 25V	SOLID ALU	R112	= 100K	MF/0.6W/250V
C109	= 220UF 16V		R113	= 47.5	MF/0.6W/250V
C110	= 10NF 100V	MULT LAYR	R114	= 2.21K	MF/0.6W/250V
C201	= 4.7UF 63V		R115	= 1K	MF/0.6W/250V
C301	= 1000UF 16V		R116	= CR	MF/0.6W/250V
C302	= 220UF 40V		R117	= 2.74K	MF/0.6W/250V
C303	= 220UF 40V		R118	= 2K TRIMPOTM 20 TURNS	
C304	= 220UF 40V		R119	= 18.2K	MF/0.6W/250V
C305	= 4.7UF 63V		R120	= 562	MF/0.6W/250V
C306	= 0.22UF 100V	MULT LAYR	R121	= CR	MF/0.6W/250V
C601	= 36000UF 40V	SPRAGUE	R122	= 2.21K	MF/0.6W/250V
C602	= 36000UF 40V	SPRAGUE	R123	= 2.21K	MF/0.6W/250V
D101	= KB10B250-C1000	HERMANN	R124	= 10	MF/0.6W/250V
D102	= ZPD6.2	ITT	R125	= 5K TRIMPOTM 20 TURNS	
D103	= 1N4148	THOMSON	R126	= 1.5K	MF/0.6W/250V
D104	= 1N4148	THOMSON	R127	= 1K	MF/0.6W/250V
D105	= ZPD6.2	ITT	R128	= 2K TRIMPOTM 20 TURNS	
D106	= 1N825A	IR	R129	= 332	MF/0.6W/250V
D107	= ZPY12	ITT	R130	= 12.1K	MF/0.6W/250V
D108	= ZPY6.2	ITT	R131	= 1K	MF/0.6W/250V
D109	= 1N4148	THOMSON	R132	= 82.5	MF/0.6W/250V
D110	= ZN404	FERRANTI	R201	= 5.62	MF/0.6W/250V
D201	= BYS28-45	SIEMENS	R202	= 2.2K	MF/1.6W/500V
D202	= BYS28-45	SIEMENS	R203	= 2.2K	MF/1.6W/500V
D203	= BYS28-45	SIEMENS	R301	= 560	MF/1.6W/500V
D204	= BYS28-45	SIEMENS	R302	= 560	MF/1.6W/500V
D301	= 1N4004G	PHILIPS	R303	= 2.2K	MF/1.6W/500V
D302	= BYS28-45	SIEMENS	R304	= 2.21	MF/0.6W/250V
D303	= BTA41	THOMSON	R501	= SHUNT 80MV 5.3A DELTA	
F501	= FUSE PICO 20F		R502	= SHUNT 75MV 5.3A DELTA	
F502	= FUSE PICO 20F		R503	= SHUNT 75MV 5.3A DELTA	
F503	= FUSE PICO 20F		R601	= 22.1K	MF/0.6W/250V
F601A	= FUSE 5X20 4T	220V	R602	= 22.1K	MF/0.6W/250V
F601B	= FUSE 5X20 6.3T	110V	R603	= 22.1K	MF/0.6W/250V
IC101	= TL084IN	TEXAS	T601	= XT254	DELTA
Q101	= BD240A	RCA			
Q102	= BFP22	SIEMENS			
Q103	= BFP23	SIEMENS			
Q104	= BFP22	SIEMENS			
Q601	= IRF153	IR			
Q602	= IRF153	IR			
Q603	= IRF153	IR			

M60-5HE

C101 = 100UF 63V  
 C102 = 2.2UF 25V SOLID ALU  
 C103 = 2.2UF 25V SOLID ALU  
 C104 = 100PF 500V CERAMIC  
 C105 = 470PF 500V CERAMIC  
 C106 = 100PF 500V CERAMIC  
 C107 = 470PF 500V CERAMIC  
 C108 = 2.2UF 25V SOLID ALU  
 C109 = 47UF 25V  
 C110 = 10NF 100V MULT LAYR  
 C201 = 4.7UF 63V  
 C301 = 1000UF 16V  
 C302 = 100UF 100V  
 C303 = 100UF 100V  
 C304 = 100UF 100V  
 C306 = 0.22UF 100V MULT LAYR  
 C601 = 3000UF 100V SPRAGUE  
 C602 = 3000UF 100V SPRAGUE  
  
 D101 = KB10B250-C1000 HERMANN  
 D102 = ZPD6.2 ITT  
 D103 = 1N4148 THOMSON  
 D104 = 1N4148 THOMSON  
 D105 = ZPD6.2 ITT  
 D106 = 1N825A IR  
 D107 = ZPY12 ITT  
 D108 = ZPY6.2 ITT  
 D109 = 1N4148 THOMSON  
 D110 = ZN404 FERRANTI  
 D201 = VT200-T VARO  
 D301 = 1N4004G PHILIPS  
 D302 = BYS28-90 SIEMENS  
 D303 = BTA41 THOMSON  
  
 F501 = FUSE PICO 10F  
 F502 = FUSE PICO 10F  
 F503 = FUSE PICO 10F  
 F601A = FUSE 5X20 4T 220V  
 F601B = FUSE 5X20 6.3T 110V  
  
 IC101 = TL084IN TEXAS  
  
 Q101 = BD240A RCA  
 Q102 = BFP22 SIEMENS  
 Q103 = BFP23 SIEMENS  
 Q104 = BFP22 SIEMENS  
 Q601 = IRF252 IR  
 Q602 = IRF252 IR  
 Q603 = IRF252 IR  
  
 R101 = 1.0 MF/0.6W/250V  
 R102 = 182 MF/0.6W/250V  
 R103 = 15K MF/0.6W/250V  
 R104 = 3.92K MF/0.6W/250V

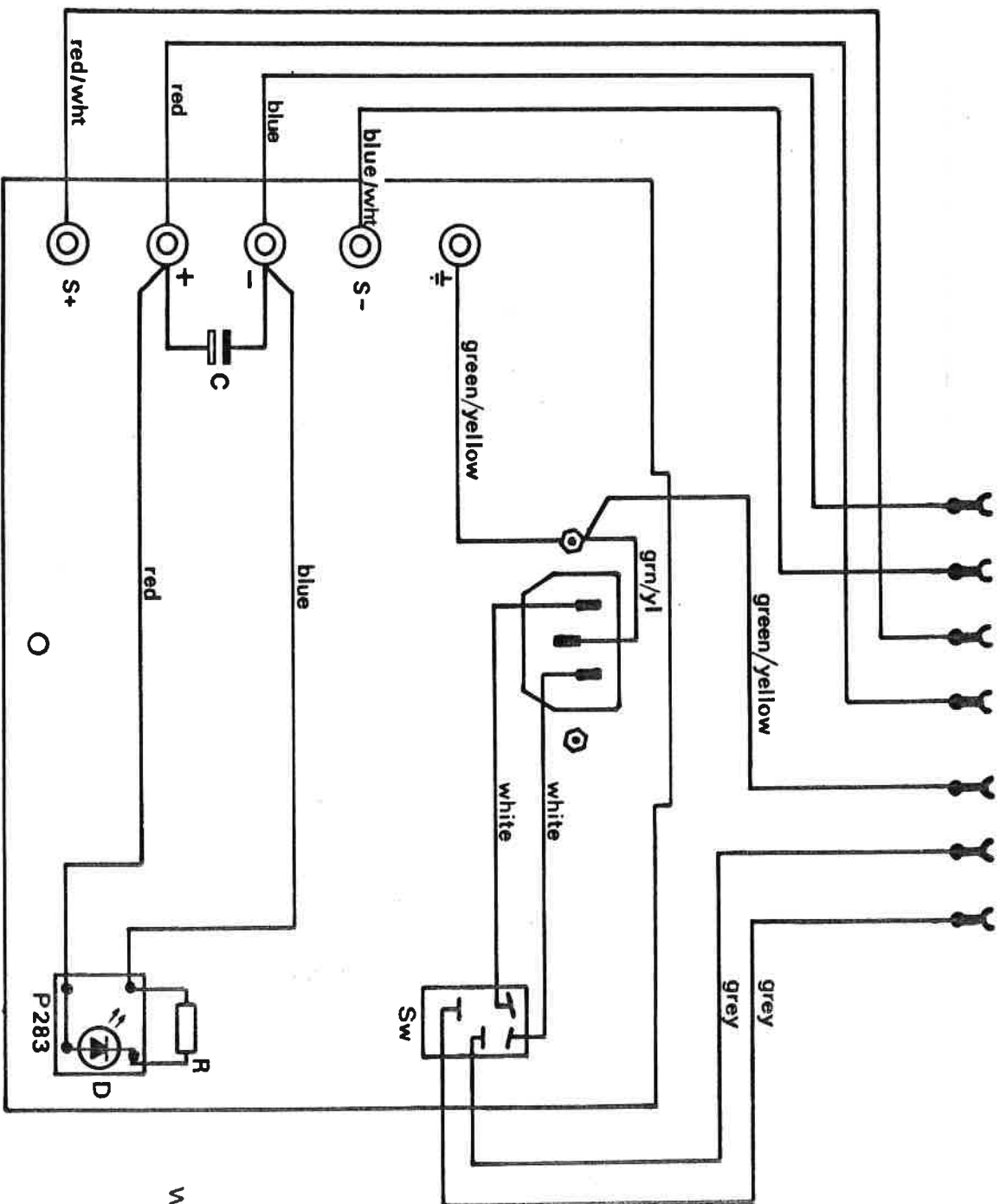
R105 = 475 MF/0.6W/250V  
 R106 = 475 MF/0.6W/250V  
 R107 = 2.21K MF/0.6W/250V  
 R108 = 475 MF/0.6W/250V  
 R109 = 475 MF/0.6W/250V  
 R110 = 10 MF/0.6W/250V  
 R111 = 100 MF/0.6W/250V  
 R112 = 100K MF/0.6W/250V  
 R113 = 47.5 MF/0.6W/250V  
 R114 = 2.21K MF/0.6W/250V  
 R115 = 1K MF/0.6W/250V  
 R116 = CR MF/0.6W/250V  
 R117 = 2.21K MF/0.6W/250V  
 R118 = 5K TRIMPOTM 20 TURNS  
 R119 = 18.2K MF/0.6W/250V  
 R120 = 562 MF/0.6W/250V  
 R121 = CR MF/0.6W/250V  
 R122 = 1.82K MF/0.6W/250V  
 R123 = 12.1K MF/0.6W/250V  
 R124 = 10 MF/0.6W/250V  
 R125 = 5K TRIMPOTM 20 TURNS  
 R126 = 1.5K MF/0.6W/250V  
 R127 = 4.75K MF/0.6W/250V  
 R128 = 5K TRIMPOTM 20 TURNS  
 R129 = 332 MF/0.6W/250V  
 R130 = 12.1K MF/0.6W/250V  
 R131 = 1K MF/0.6W/250V  
 R132 = 82.5 MF/0.6W/250V  
 R201 = 22.1 MF/0.6W/250V  
 R202 = 10K MF/1.6W/500V  
 R301 = 560 MF/1.6W/500V  
 R302 = 560 MF/1.6W/500V  
 R303 = 5.6K MF/1.6W/500V  
 R304 = 2.21 MF/0.6W/250V  
 R501 = SHUNT 80MV 1.7A DELTA  
 R502 = SHUNT 75MV 1.7A DELTA  
 R503 = SHUNT 75MV 1.7A DELTA  
 R601 = 22.1K MF/0.6W/250V  
 R602 = 22.1K MF/0.6W/250V  
 R603 = 22.1K MF/0.6W/250V  
  
 T601 = XT281 DELTA



			Title: M15-16HE M24-12HE M60-5HE
			Date: 12-'87
Modifications	Date	App	delta elektronika bv







C = 220µF 40V

D = Led 133 HR

R = 4.7 k

blue/wht } twisted  
red/wht }

Wiring diagram M24 - 12 HE - MT24 - 12 HE

Title:		MT 24 - 12 HE	
Date:		8-'88	
Modifications	Date	App	delta elektronika bv

