



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 $2.3 \hat{U}_N 1.3 \text{ ms}$ 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

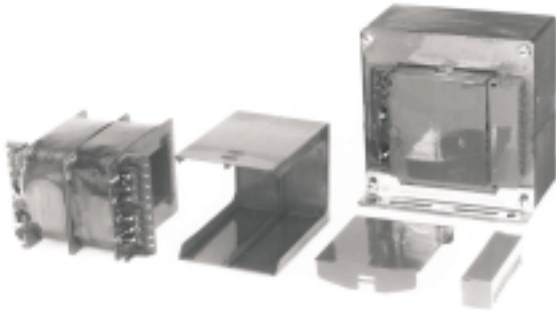
Fuses, 5 x 20 mm, slow blow

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.

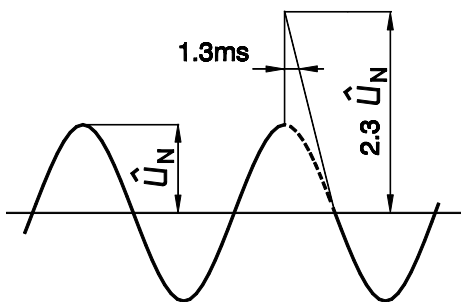
Safety EN 60950, EN 61010
SELV/PELV (for M15-16HE, M24-12HE, M24-20HE)

EMC

EN 50081-1 EN 50082-1 and -2
EN 55022-B
EN 61000-3-2/-4-2/-4-4/-4-5/-4-11
ENV 50140 ENV 50141 ENV 50204

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

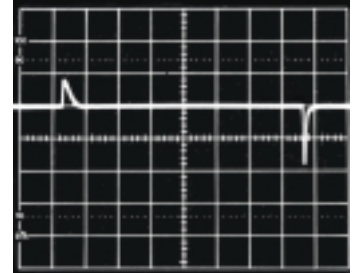
Less than 0.1% per 8 hours under constant ambient and load conditions after 1 hour warm-up.

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

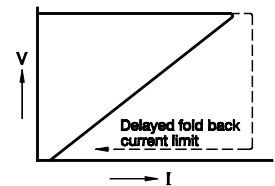


Recovery time:
M 24-12 HE

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

Current limit

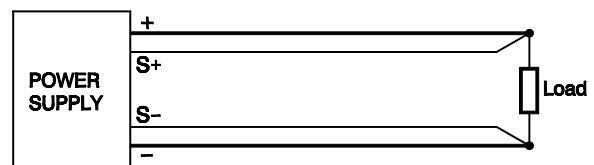
The linear M-models have a fold back overload characteristics (a constant current characteristic would overheat the series pass transistors when the output is short circuited).



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 useful to lower the impedance caused by long load leads.

Output voltage adjustment range

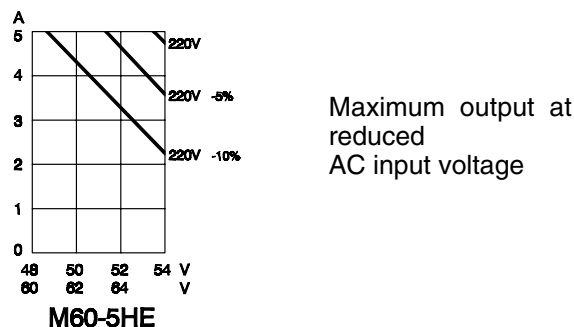
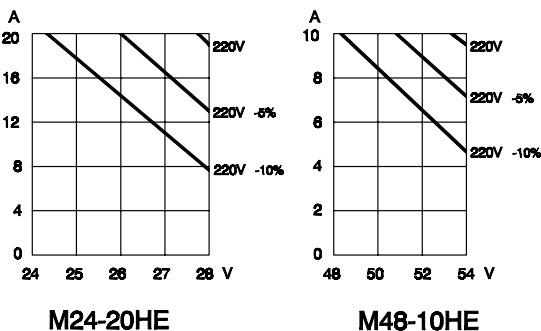
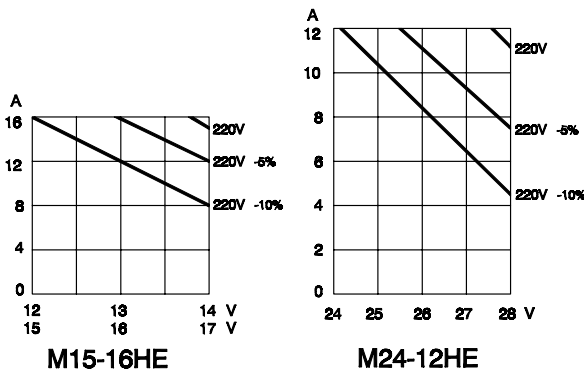
The M-series is meant for use at a fixed output voltage. However it can be used over a larger range at a lower output current or with a smaller AC input variation (see graphs). The adjustment ranges are given below.

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.

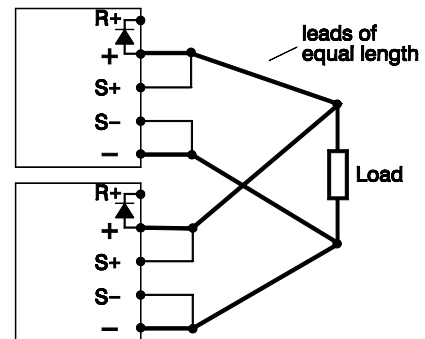


Efficiency

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.

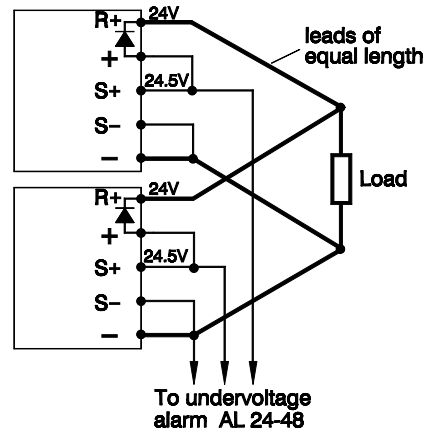


Parallel operation

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

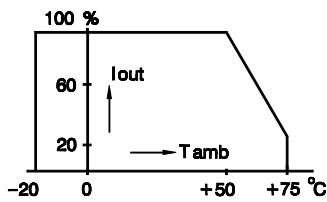
Built-in P366 is optional.

Cooling

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

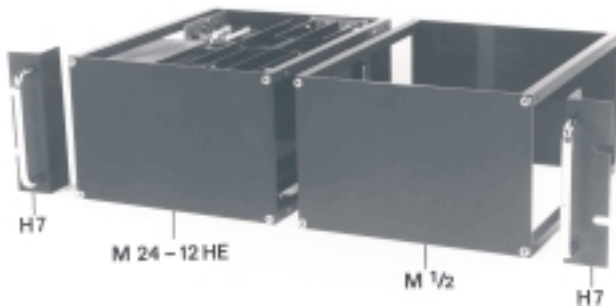
Ambient temperature

-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

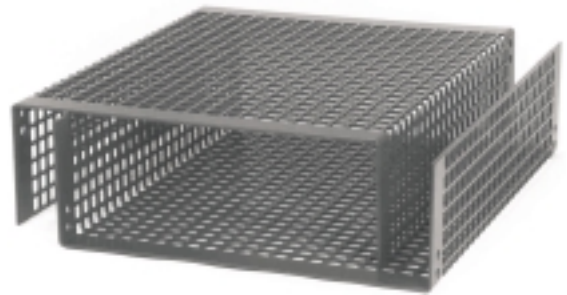
Optional

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

