

MEC-50 and MEC-100

Mini Electronic Chokes
for valve amplifiers
with 50 or 100 mA current capability

user manual



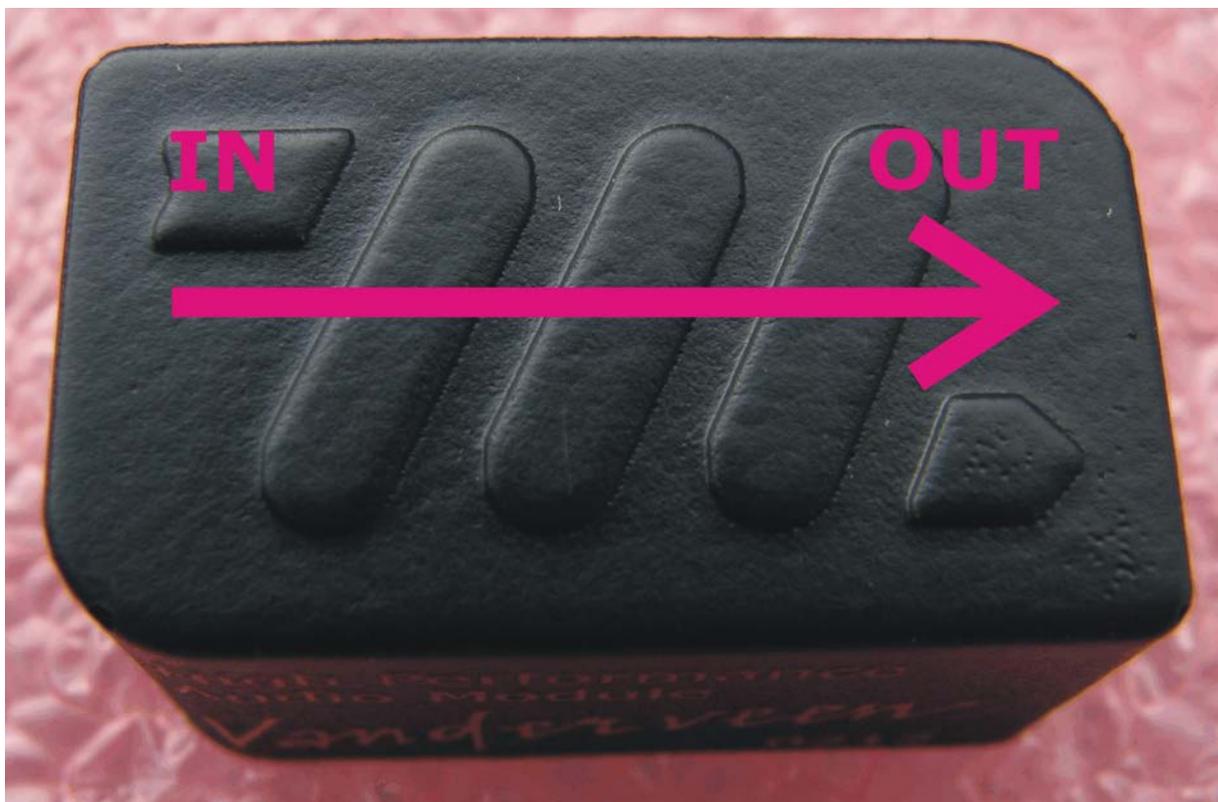
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See for more info:
www.mennovanderveen.nl
www.tentlabs.com

1- Introduction

In the power supply of valve amplifiers we have noticed that chokes suppress hum and noise better than the standard configuration with capacitors plus resistor. Chokes sound softer and milder, you can hear more details in the sound stage. This observation was the reason why ir. bureau Vanderveen and Tentlabs decided to develop new miniature electronic chokes for valve pre amplifiers and small power amplifiers.

The MEC-50 and MEC-100 are very small electronic chokes which remove hum and distortions from the high voltage supply lines in valve amplifiers. The MEC-50 can handle 50 mA maximum while the MEC-100 can handle 100 mA. The maximum high supply voltage should be below 800 Vdc.



There is an arrow on the MEC's indicating the direction of current flow. Reverse connection does not damage the MEC's; at the output the high voltage is present. However, without the reduction of hum.

See the schematic below for a standard application.

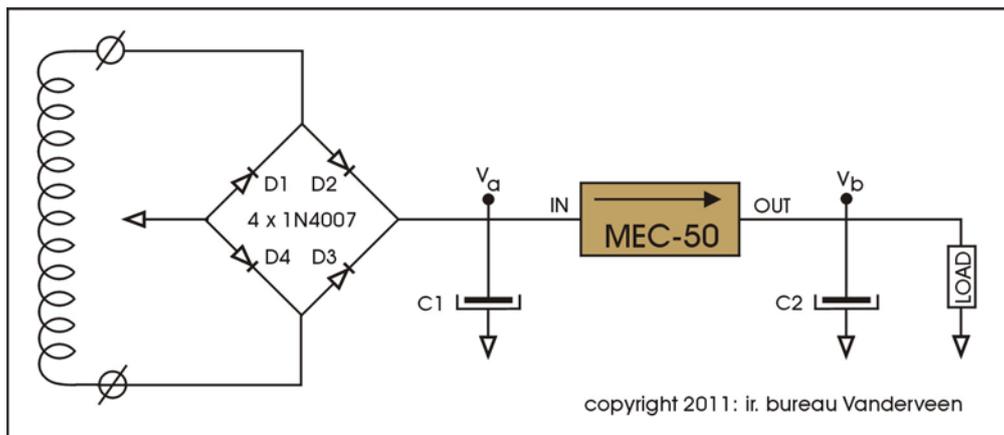


figure 1: connections on the MEC + current direction arrow

The MEC-50 is meant for pre amplifier and driver stages while the MEC-100 is designed for small class A SE amplifiers with the 300B or 2A3 or EL84 power valves as examples. Small push-pull power amplifiers with maximum current demand below 100 mA are also possible, like 2 x EL84 or 2 x ECL86. For currents larger than 100 mA we earlier designed the E-choke.

The MEC's have only two taps: their input and output. There is no connection to ground. They fit in the standard pi-circuit, where after rectification the supply voltage is buffered in $C1$, followed by the MEC and $C2$. This application is as with standard chokes. However, the MEC's are much smaller than standard transformer core based chokes. They have no magnetic leakage fields and they do not hum or rattle. Besides these important advantages, they reject noise and hum much better than with old fashioned chokes. The hum rejection equals a factor 1000 with the MEC-50 and a factor 250 with the MEC-100. Read the specs for more detailed information.

In function the MEC's produce little heat, less than 1 W. Some air flow cooling is enough to remove this heat.

The effective inductance of the MEC-50 equals 78 H and for the MEC-100 it is 10 H. These large inductances suppress hum and interference signals with a factor of 1000 (60 dB) and a factor of 250 (48 dB) respectively.

See figure-2 for $C1 = C2 = 47 \mu\text{F}$ and $I = 48 \text{ mA}$. The upper curve shows the voltage ripple at $C1$ while the lower proves the reduction at $C2$. At higher frequencies the ripple becomes smaller than the noise floor (-140dBV) of the measurement equipment.

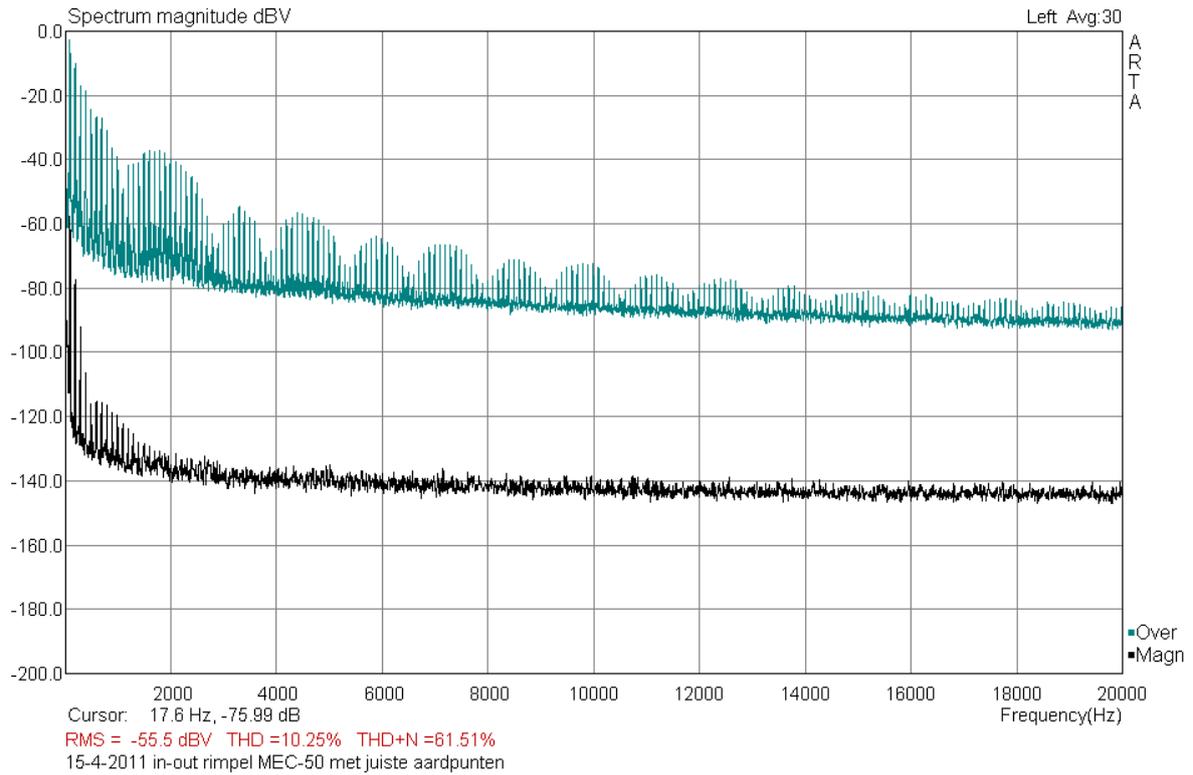


figure 2: input (upper curve) and output (lower curve) ripple voltages.
The reduction is at least a factor 1000 for the MEC-50

The MEC's are designed for so called C-L-C supplies and not for L-C supplies. Neither they are meant for transformer anode load applications.

2- Application

Figure 3 shows the first application of the E-choke plus MEC's in the Vanderveen UL40-S2 valve amplifier.

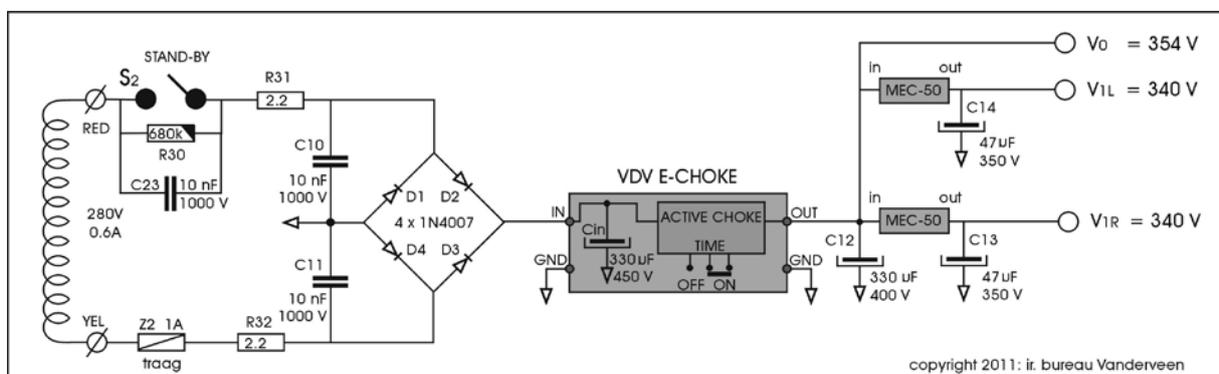


figure 3: E-choke and MEC in the UL40-S2 amplifier.

Figure 4 explains how to apply the MEC-50 in the Vanderveen MVML05 pre amplifier.

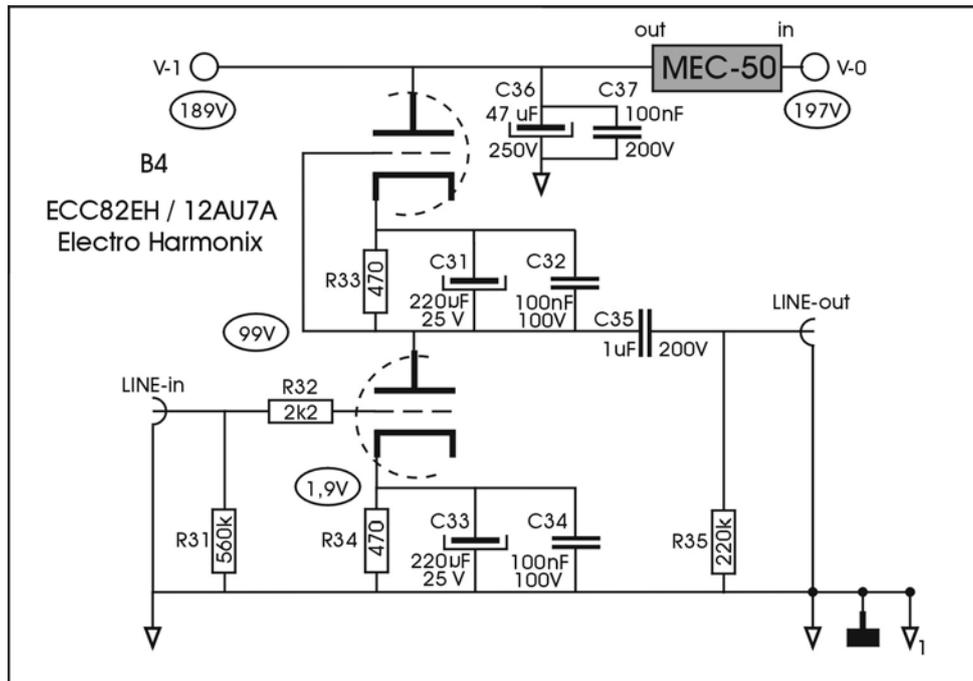
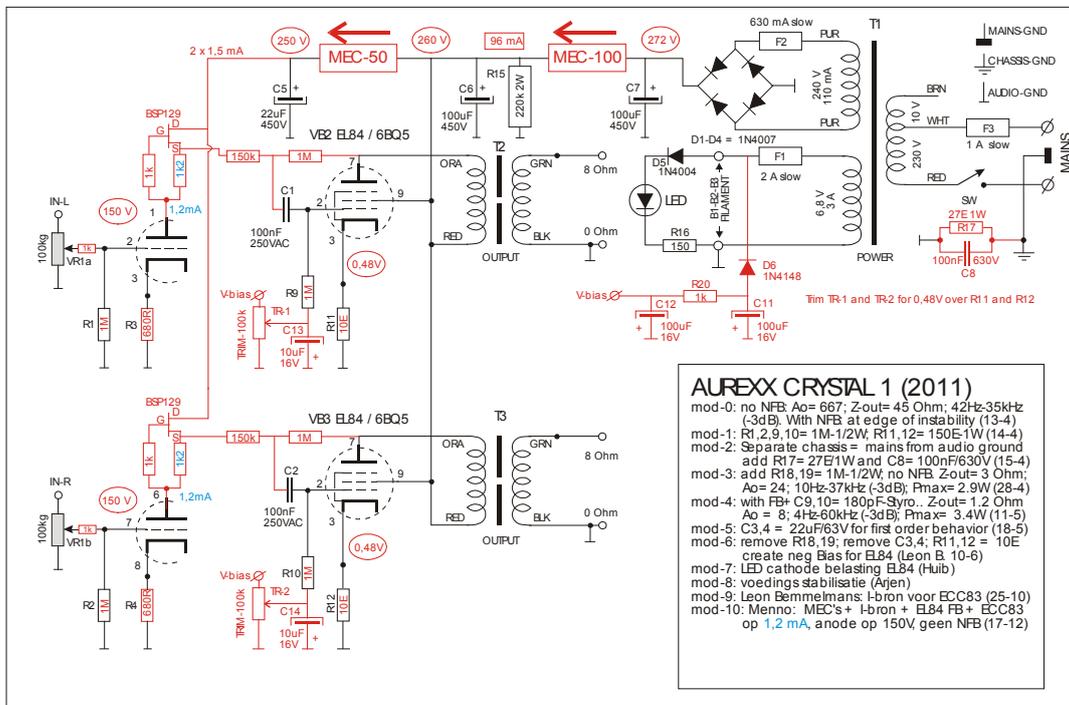


figure 4: MEC-50 in the MCML05 pre amplifier

All that changed is that the C-R-C network has been replaced by a far more effective C-MEC-C pi-filter network with much larger hum suppression.



Application of the MEC's in the Aurexx Crystal 1 TubeSociety 2011 project.

3- Maximum Specifications

The table below shows the important specifications and limits.

Item	MEC-50	MEC-100	Eenheid
maximum current	50	100	mA
maximum Vdc	800	800	V
internal limit for I larger than	68	no	mA
inductance	78	10	H
maximum voltage drop @ I _{max}	12	9	V
short circuit protection	no	no	(1)
protected for inverse connection	yes	yes	
maximum heat production	0,7	0,9	W
minimum capacity C1	27	47	μF (2)
optimal capacity C1 = C2	47	100	μF
dimensions (l-d-h)	27-16-15	27-16-15	mm
pin distance	14.2/.56"	14.2/.56"	mm/"
pin length	9	9	mm
pin diameter	1.0	1.0	mm
mass	12	12	gram
price 19 % TAX inclusive	29	34	Euro

(1): Charging C2 too fast can be interpreted as short circuiting the output of the MEC. Therefore guarantee slow charging of C2 to prevent such a condition.

(2): See chapter 4 for detailed information.

4- Selecting C1 and C2

After rectification the high voltage is buffered in C1 to bring the ripple voltage magnitude in the working area of the MEC.

The best choice is to make C1 and C2 equally large. For a current of 50 mA $C1 = C2 = 47 \mu\text{F}$ is the optimal capacity. For currents I smaller than 50 mA you can select $C1 = C2 = I \cdot 47 / 50$ (μF , with I in [mA]). Example: I = 10 mA, then $C1 = C2 = 10 \mu\text{F}$.

The MEC-100 behaves equally with $C1 = C2 = 100 \mu\text{F}$ and for I smaller than 100 mA: $C1 = C2 = I \cdot 100 / 100$ (μF , with I in [mA])

Under certain current demand and values of C1 and C2, a kind of switching on resonance might occur, as shown in figure 5.

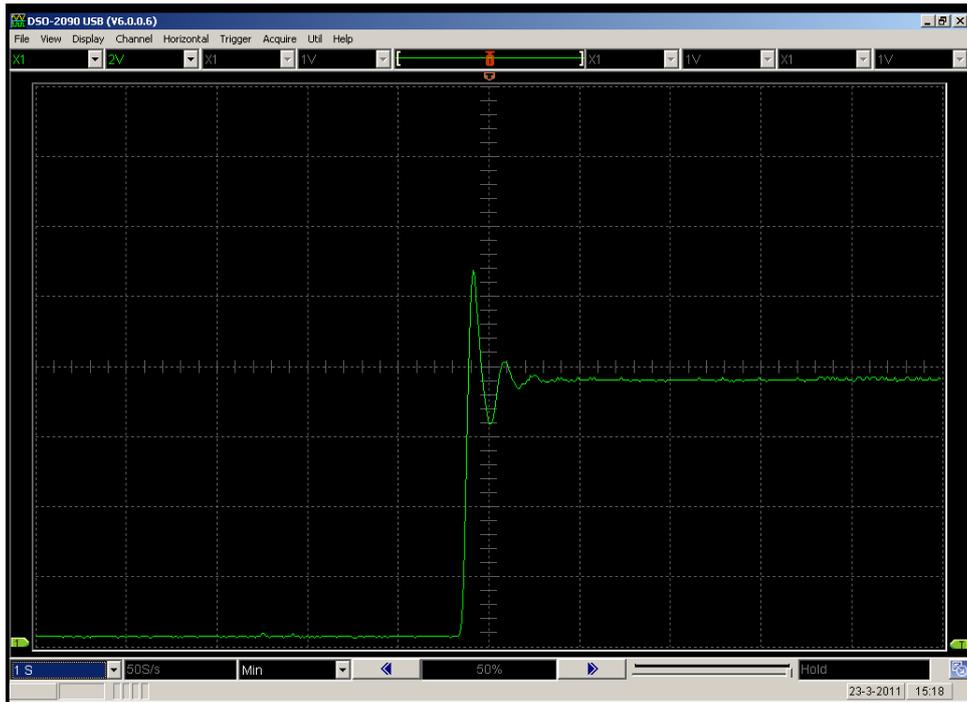


figure 5: time behavior MEC is not optimal tuned.

To compensate for this, apply an extra resistor at the input or output of the MEC. This resistance of the extra damping resistor easily can be determined by experiment. Try 10, 47, 100 or 220 Ohm to determine with the oscilloscope the right damping effect.

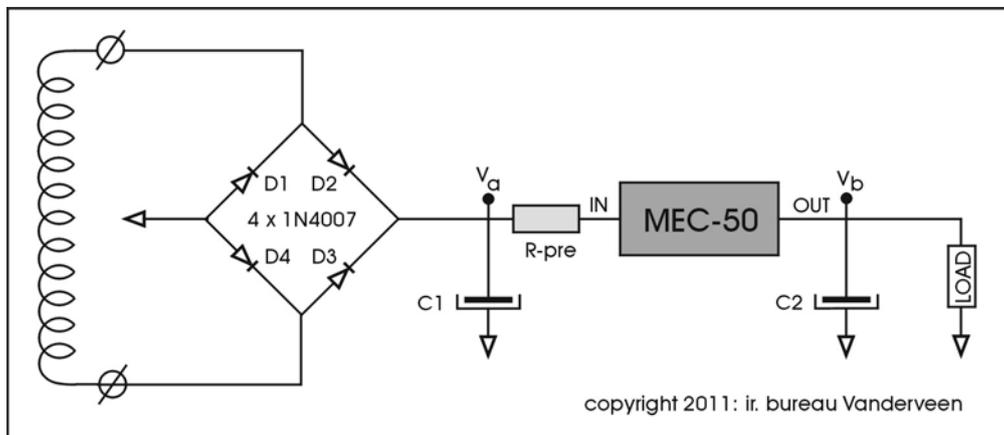


figure 6: how to connect a damping resistor (can also be at the MEC output).

5- Safety and helpful application remarks

- a) Hum reduction (measured up to 1 kHz) a factor of 1000 (MEC-50) and a factor of 250 (MEC-100)
- b) Voltage drop maximum 12 V (Mec-50) and 9 V (MEC-100)
- c) Use $C1=C2=47\ \mu\text{F}$ as optimal capacitors for the MEC-50
Use $C1=C2=100\ \mu\text{F}$ as optimal capacitors for the MEC-100
- d) For smaller I, apply $C1=C2=47*I/50$ (μF , I in [mA], MEC-50)
- e) For smaller I, apply $C1=C2=100*I/100$ (μF , I in [mA], MEC-100).
- f) The MEC's are designed for class A amplifiers with constant current demand. C-L-C oscillations as calculated with "PSU designer II) occur, however, they dampen much faster than calculated. If problematic, apply a series resistor.
- g) $V_{in,max} + \text{ripple} = 800\ V_{DC}$. Charge C1,2 slowly at such high voltages, for instance by means of a rectifier valve which filament heats slowly.
- h) The MEC's are not protected for shortcut outputs
- i) The MEC's are protected for inversed connection. However, the hum reduction does not function then.
- j) The MEC's are not designed as inductive anode load, nor for so called L-C application without C1, because the input voltage ripple should be rather small ($< 10\ V_{pp}$) to stay inside the SOA of the MEC's.

6- Subjective observations

Applying the MEC's has a profound influence. Hum is absent, even with your ears close to the loudspeakers. The measurements show an impressive hum reduction over a wide frequency range. This largely reduces mains intermodulation interference with audio signals, and consequently the sound character is much friendlier. As an example, in the piano you now can hear and follow the sounds much longer and deeper. Without the MEC you were not able to hear down to such a micro detail level, as if a curtain was between you and the piano. The higher harmonic components of instrument tones are separately recognizable. Much more details can be heard, even the CD starts to sound mild, because no digital disturbance is found on the mains high voltage supply lines. The music sounds more dynamic with the MEC, even low tones sound stronger and better controlled.

In summary: the sounds are cleaner and clearer, with much more natural warmth.



The producers: Guido Tent (L) and Menno van der Veen (R)

For more information:

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7- Appendix: Comparing C-MEC-C with C-R-C filters

Suppose the mains frequency $f = 50$ Hz and a current demand equals I . Then the voltage ripple V_a (see figure 1, peak to peak value) is given by:

$$V_a = \frac{I}{(2 \cdot n \cdot f \cdot C_1)}$$

where $n=1$ for single and $n=2$ for double sided rectification (like in figure 1).

Suppose the inductance of the MEC equals L , then the peak to peak ripple voltage V_b over C_2 is given by the next formula:

$$V_b = \left(\frac{0.7}{4 \cdot \pi^2} \right) \cdot \frac{I}{(2^3 \cdot f^3 \cdot L \cdot C_1 \cdot C_2)}$$

Our measurements showed that V_b is a factor 1000 smaller than V_a . When we calculate V_a/V_b , we find (for $n=2$):

$$\frac{V_a}{V_b} = \frac{(4 \cdot \pi^2 \cdot 2 \cdot f^2 \cdot C_2 \cdot L)}{0.7}$$

Using $C_1 = C_2 = 47 \mu\text{F}$ and $f = 50\text{Hz}$, we find $L = 78 \text{ H}$.

Now imagine, we remove our MEC and replace it by a standard resistor R , and we wish the same ripple rejection as in the example above. How large should R be, how much heat in R and how much voltage drop would occur? Now we use a so called C-R-C network, and there the ripple ratio is given by:

$$\frac{V_a}{V_{b,R}} = \frac{(2 \cdot \pi^2 \cdot f \cdot R \cdot C_2)}{0.7}$$

Lets apply $V_a/V_{b,R} = 1000$, then we find $R = 15,1 \text{ kOhm}$. At 50 mA the voltage drop over R equals 755 V and the heat inside R is 38 Watt .

Must we say more? The MEC looses 10 V maximum with an internal heat less than 1 Watt ; far more better than the C-R-C solution as discussed above, which proves our case.