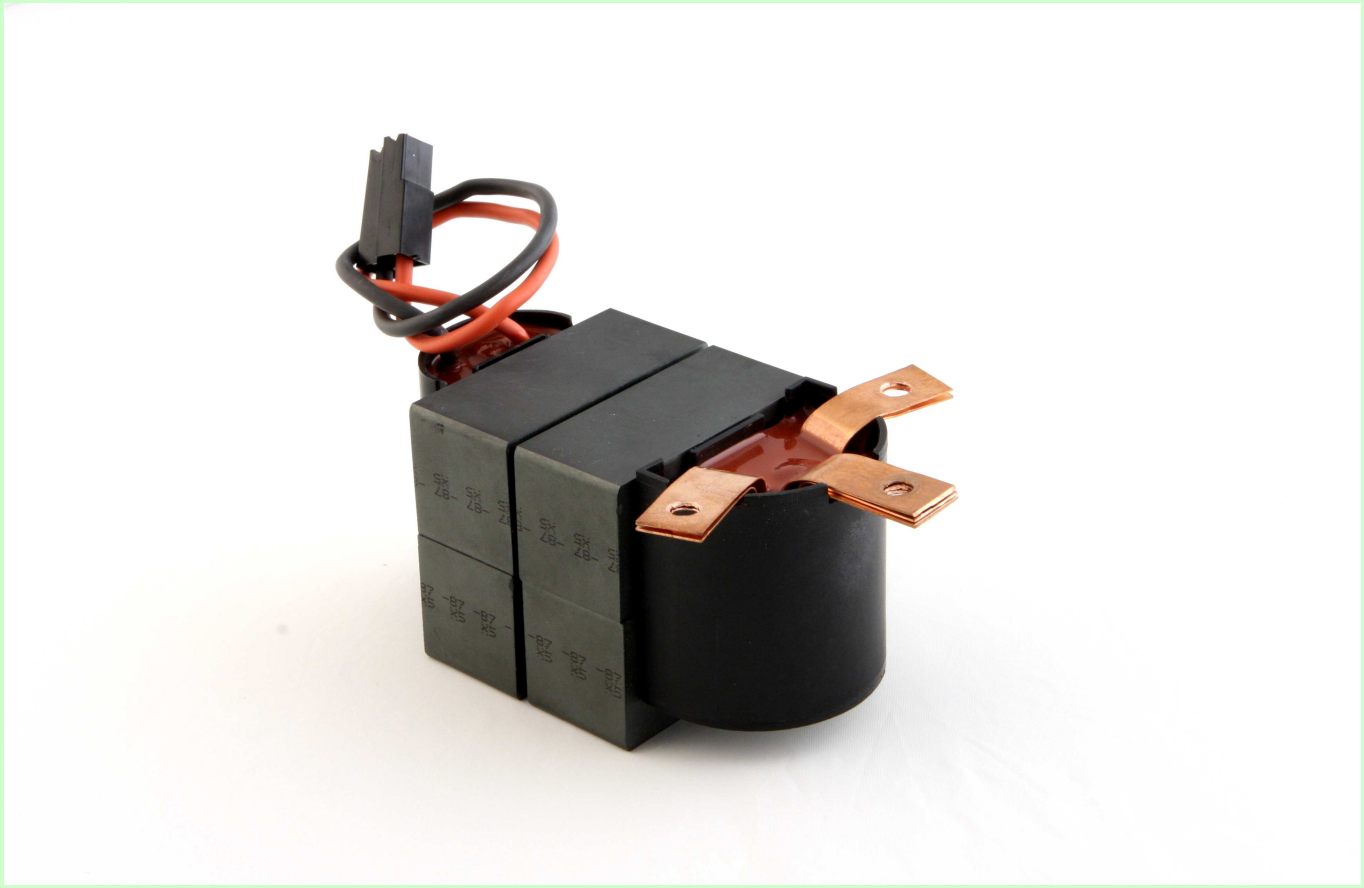
SIRIO

Inductive Components



Power Components

This brochure is a short introduction to Sirio POWER COMPONENTS. The new family has been created after more than 30 years of experience in the development and production of high frequency electromagnetic components. In order to offer customers a complete service, Sirio has steered many efforts towards the study of the whole building process of power components, from the development stage to the supply of the final product.

DEVELOPMENT

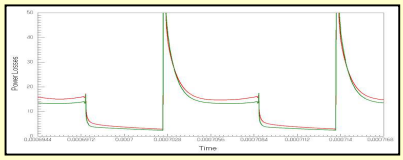
CUSTOM SPECIFICATION

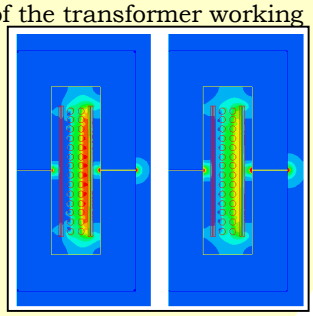
The development of a custom design power transformer begins by considering the customer specification.

SIMULATIONS

After a rough calculation, the R&D team defines few possible solutions. As one of the most important features of a power transformer is the efficiency, power losses are typically the distinguishing element at the moment of the choice of the final solution. Thanks to a dedicated software for electromagnetic simulation using the finite element method, it is possible to study the behaviour of the transformer working in the application circuit, in order to know:

- power losses
- dynamic fields' distribution
- dynamic currents' distribution



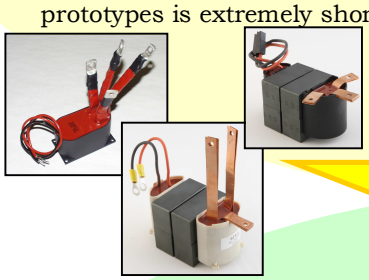


OPTIMIZATION

The highest Quality/Price ratio can be easily reached when the best technical solution and Sirio production's facilities and technologies are properly combined.

PROTOTYPING

Prototypes can be built in Sirio Laboratory. They are electrically measured and tested, even in customer's application too. By considering standard raw materials, the lead time for prototypes is extremely short.



HOMOLOGATION

The customer receives samples for testing and approval.

PRODUCTION

AUTOMATIC WINDING PROCESS

The automatic winding machine is unique to Sirio. It was developed according to Sirio specification and since 2012 the production capability has been doubled thanks to the installation of a second machine.

AUTOMATIC MECHANICAL OPERATIONS

Besides the cores assembling, power transformers construction requires some finishing operations. As always, Sirio's approach has been oriented to automation, investing in tools and machines, in order to offer customers some standard, steady-quality and cheap solutions.

VACUUM CASTING TECHNOLOGY

The vacuum casting process allows to reach high level of isolation in very thin layers of isolation. That is the typical situation in high frequency industrial applications, where high reliability, isolation and safety are required and, on the other hand, very short distances are needed to improve the coupling. More than 30 years experience in vacuum casting has made this technology one of Sirio's strong points.

AUTOMATIC FINAL INSPECTION

All Sirio products are automatically tested and the production process is continuously checked: from the raw materials incoming to the machines setting, from the winding process to the assembling phase, from the casting process to the final inspection step.

The Power Components Family follows the MILESTONES of all Sirio components:

HIGH RELIABILITY
industrial applications need long life components: every part is important for the good functioning of the whole machine

ISOLATION AND SAFETY
transformers are designed to guarantee the galvanic separation between the mains and the worker

AUTOMATIC PRODUCTION
automation allows stable construction and reduces the production costs

STANDARD RAW MATERIALS
standardization is useful to reap economies of scale and to reduce the lead time

CUSTOMIZATION
the transformer's construction has to be flexible to customer needs.

After few years from its launch, the Sirio POWER TRANSFORMER Family has become very successful in several application fields, like for example:

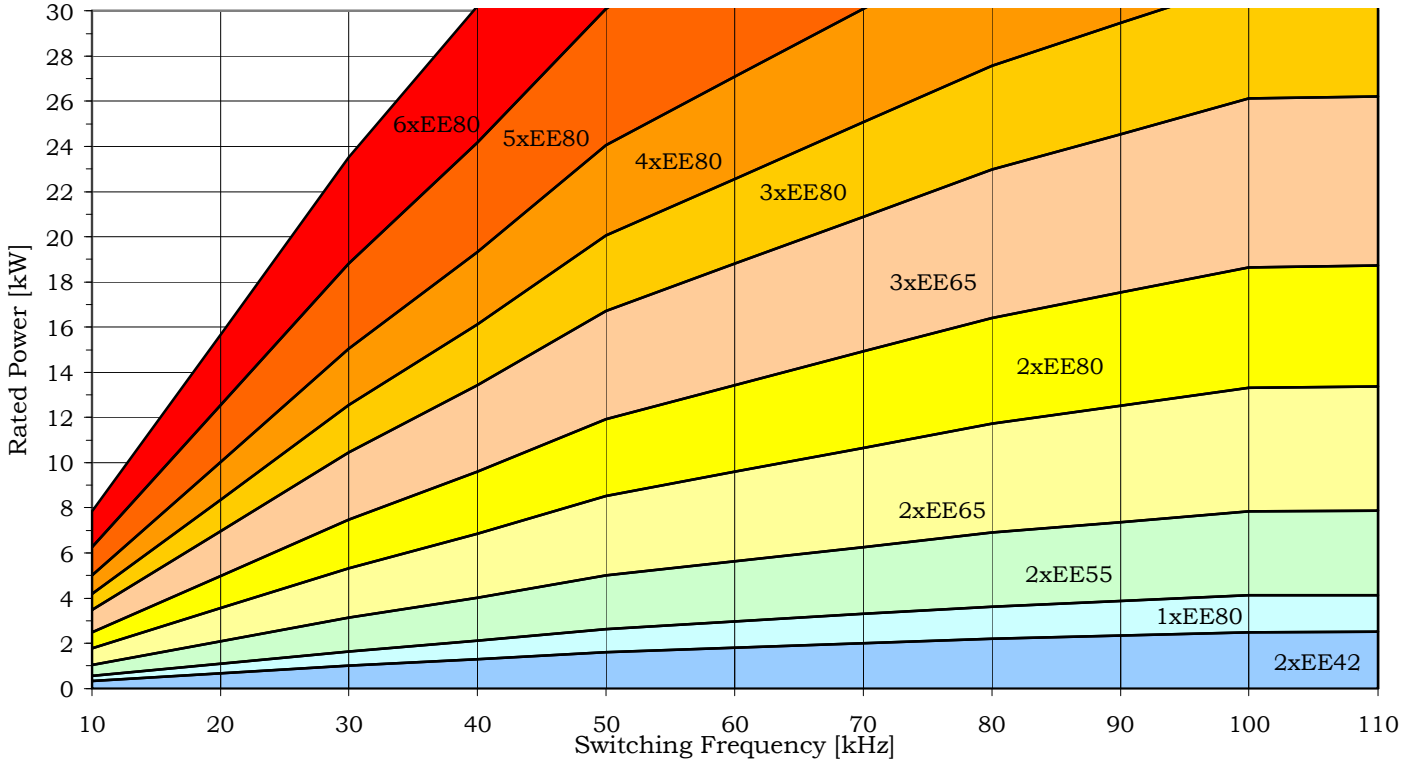
- U.P.S.
- WELDING
- GALVANIC TREATMENTS
- BATTERY CHARGERS
- SOLAR ENERGY
- POWER SUPPLIES

From theoretical point of view, transformer dimensions are related mainly to two parameter: the switching frequency and the rated power. An easy formula says that the transformer volume is directly proportional to the Power/Frequency ratio,

$$\text{Transformer Volume} \propto \frac{\text{Rated Power}}{\text{Switching Frequency}}$$

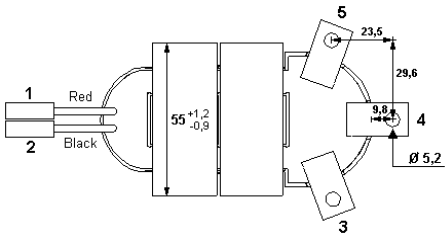
but that is just a quick way to make a first choice and to understand the approximate dimensions. By looking at the whole project, other factors are obviously involved in the final design definition, like topology, working voltage and isolation voltage, currents through the windings, expected power losses and overtemperature, cooling system, duty cycle and so on. Sirio offers a wide standard range of bobbins and boxes for Power Components, developed by Sirio in order to cover evenly the power range from 1 kW to 20 kW. The following graphic is a quick overview about the Power/Frequency ratio. It was extrapolated form our current projects and, as we have already said, it can be considered just for reference, as each converter needs an optimized transformer.

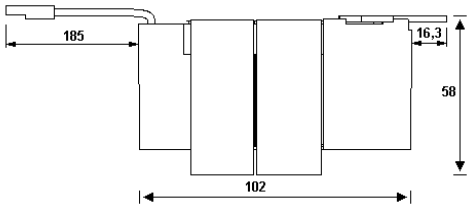
Power/Frequency Ratio Indication



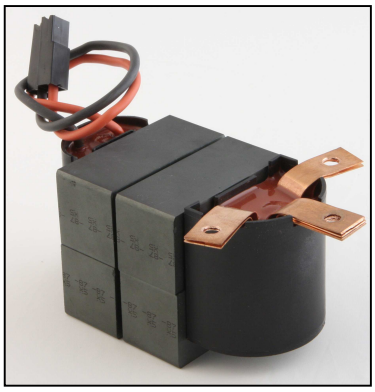
Multiple EE55/28/25

2xEE55 - Mechanical Drawing



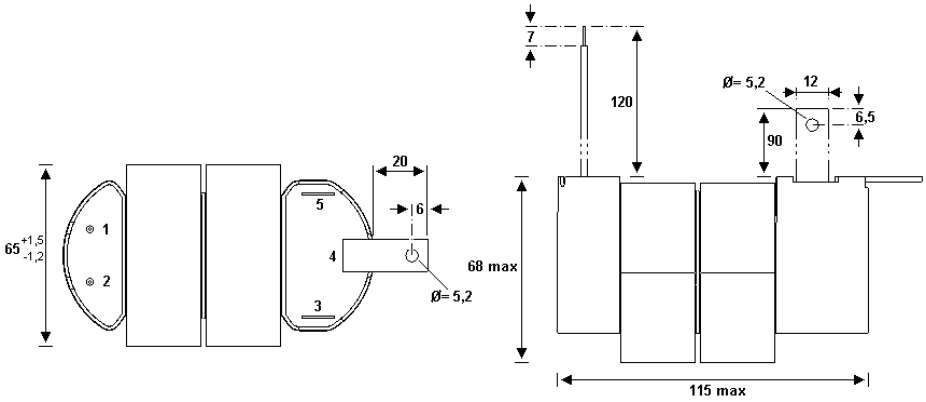


Example

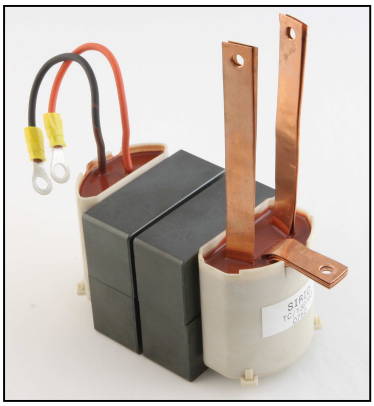


Multiple EE65/32/27

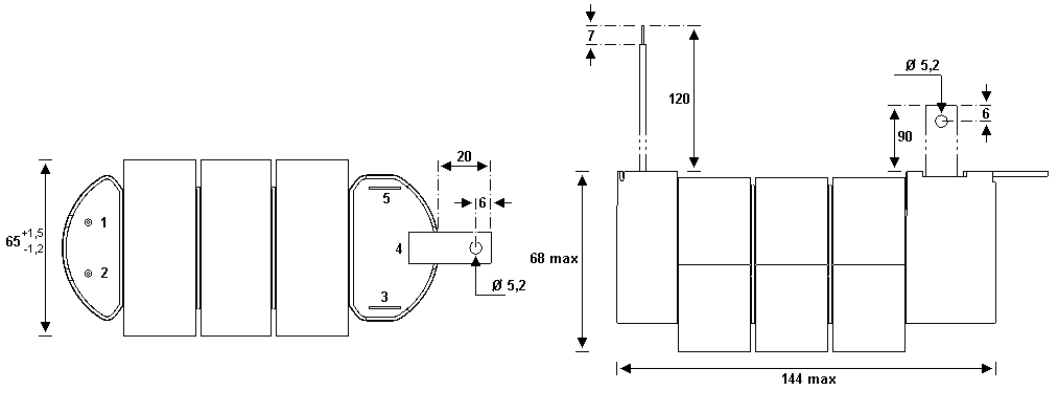
2xEE65 - Mechanical Drawing



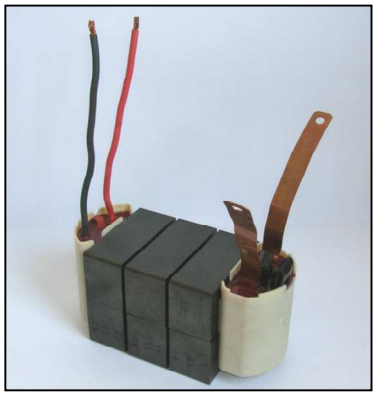
Example



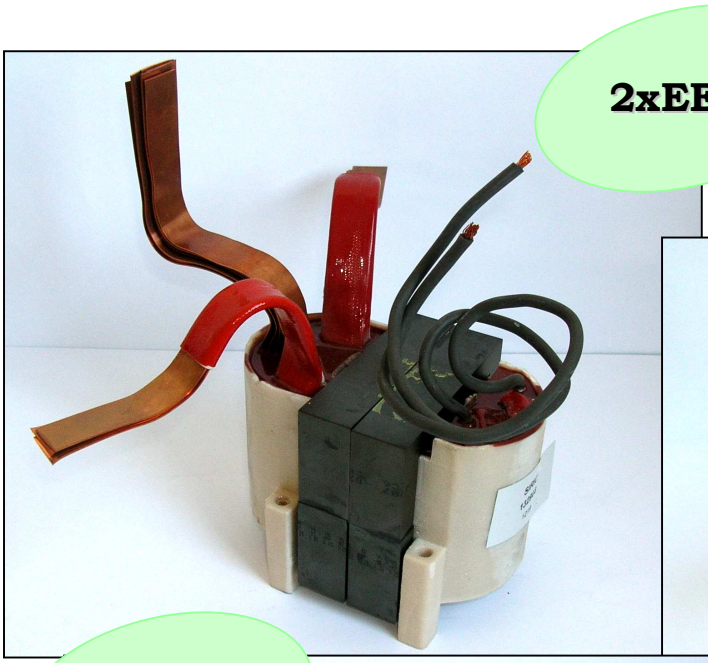
3xEE65 - Mechanical Drawing

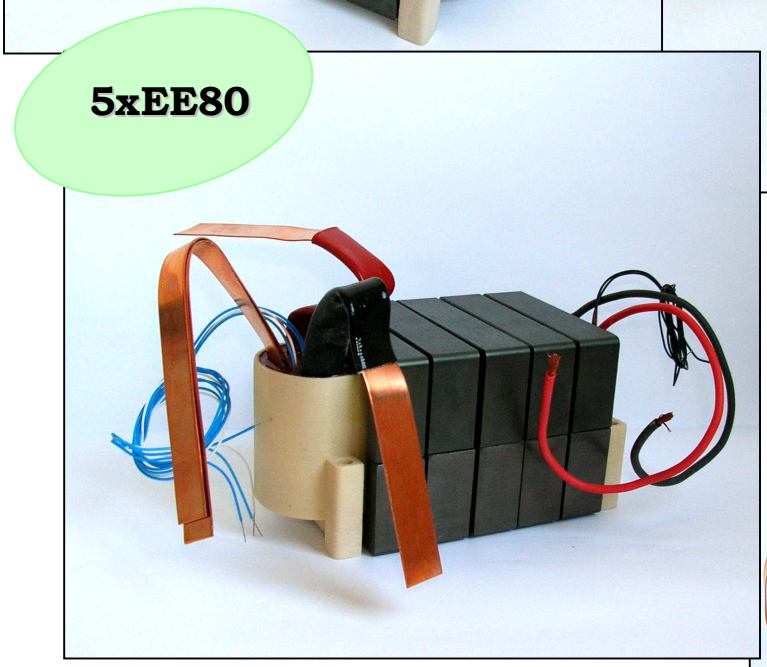


Example

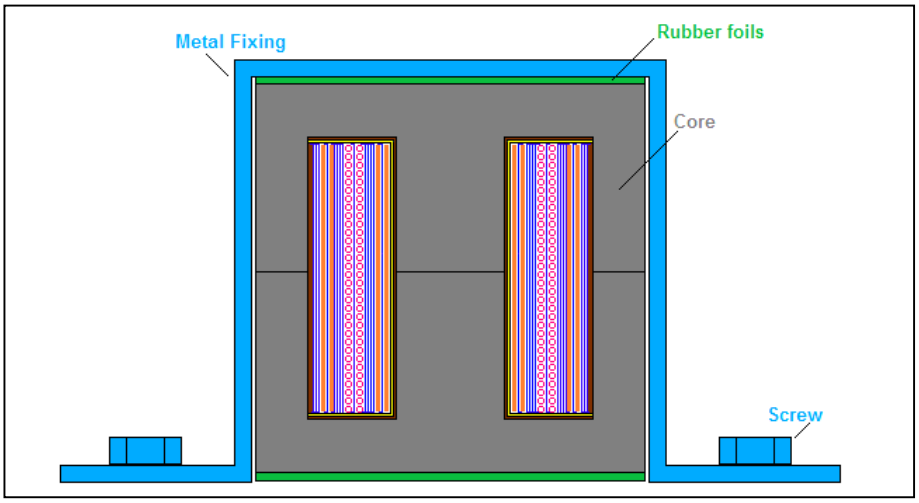


New plastic parts under development – Multiple EE80 serie





Power Transformers are relatively heavy components, therefore we always recommend our customers to design the most suitable mechanical fixing.



Several materials are available on the market, such as thermo-conductive rubber foils which help to avoid mechanical stresses on the cores and to improve, at the same time, the transfer of the heating due to core losses.

The figure shows one of the most typical solution, based on a metal bracket and two rubber foils on upper and bottom surface.

The technology considered for the development of Power Transformers can be used for Power Inductors' development as well. The term *inductor* refers to a wide inductive components category, with very different purposes and targets, but they all act like an "energy tank".

For example, by considering the filtering stage of a high frequency DC/DC converter, the output inductor continuously swaps the electrical energy with the output capacitor. As the inductor's function is to contain the variation of current, the current through the inductor is normally mainly direct current with a superimposed high frequency current ripple (at the switching frequency, or its double value, depending on the topology).

Similarly, by considering the Power Factor Correction (PFC) stage of a high frequency converter, there is a high frequency energy swap involving the inductor and the capacitor; in that case, the current through the inductor is mainly composed by the mains frequency harmonic and a superimposed current ripple at the working frequency of the PFC stage.

Similar inductors are also used in non-isolated high frequency conversion topologies (Buck, Boost, Buck-Boost), in which the current waveforms change depending on the mode of conduction, that is if the converter works in continuous or discontinuous mode.

For high frequency applications, the most used materials are:
- Soft Ferrite
- Amorphous and Nanocrystalline Laminations
- Powder (so called distributed airgap materials)

Industrial applications often require dedicated inductors, with different characteristics. For this reason, Sirio has chosen to dedicate to customized chokes' development, for automatic production and based on standard raw materials, typically available at our wharehouse.
This kind of approach makes possible a just in time production of a custom component at the same cost of a catalogue product.

Here below some examples of power inductors are shown.

The R&D Department is available to receive customer's specification and to offer the development service, in order to propose the most suitable solution.

Customer Specification Sheet for

SMPS Power Transformers

Field of application		
SMPS circuit topology (forward, half bridge, full bridge…)		
Secondary rectifier circuit (center tapped, Graetz bridge,…)		
Input voltage **[Vdc]**	Min :	Max :
Output voltage **[V]**		
Output current **[A]**		
Switching frequency **[kHz]**		
Output current ripple **[A]**		
Turns ratio Np/Ns		
Switching time **[µs]**	Max:	Min:
No load secondary voltage **[V]**		
Output filter inductance **[mH]**		
Output filter capacitance **[µF]**		
Rated output power **[kW]**		
Primary current **[Arms]**		
Max primary over current **[A]**		
Primary inductance **[mH]**		
Primary leakage inductance **[µH]**		
Secondary current **[Arms]**		
Working voltage between primary and secondary **[Vrms]**		
Test voltages between primary and secondary **[Vrms]**		
Test voltages windings and core **[Vrms]**		
Operating temperature **[°C]**		
Cooling system		
Air flow **[m³/s]**		
Size limitations LxWxH **[mm]**		
Standards to comply with		
Quantity		
Target price		

Customer Specification Sheet for

PFC and Output Inductors

Inductance value at nominal rated current **[µH]**	
Tolerance on inductance **[%]**	
Rated current **[Arms]**	
Current ripple **[A]**	
Working voltage **[Vrms]**	
Working frequency **[kHz]**	
Rated power **[VA]**	
Operating temperature **[°C]**	
Open construction or box version	
Size limitations **[mm]**	
Standards to comply with	
Quantity	
Target price	

Schematic:

Sirio Sales Network

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