

POWERBOX  
Mastering Power

A Cosel Group  
Company

Medical

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# Medical solutions

## **Power solutions for medical applications**

Patient safety is critical when it comes to medical equipment. So powering that equipment involves precision manufactured power converters, working within controlled design criteria, with high reliability as a given. Such designs require higher levels of insulation and superior EMC performance. Lean design with low component count, together with high quality components, enhances reliability. System solutions with redundancy and back-up can increase availability. Convection cooling increases reliability and eliminates fan noise.

Our product range for medical applications covers AC/DC and DC/DC converters, from single units to complex systems, from watts to kilowatts. We have been solving complex challenges in power for the medical market for more than 30 years. In addition to meeting regulatory and specification requirements, every Powerbox medical power solution has this experience built-in.

## **Standards for medical applications**

Safety and quality, and with this the corresponding standards, are for obvious reasons paramount for medical equipment. The IEC60601-1 (ANSI/AAMI60601-1 in North America) is the main electro-medical safety standard. With the release of AM1:2012 for the 3rd edition of 60601-1 risk management file and process in line with ISO14971 are mandatory. External medical power supplies are considered stand alone equipment and therefore a risk management file is performed as a part of the safety approval process, whereas for internal power supplies that are integrated into the medical device system. The risk management is performed on system level by the medical device manufacturer. For quality ISO13485, generally harmonizing with ISO9001, is the quality management system standard for design and manufacture of medical devices. At Powerbox we not only meet what is required, but also prepare for what is to come. We support our customers in keeping their products in line with standards and related requirements.

## **Core strengths**

Powerbox excels in designing power converters with low leakage currents, whilst providing superior EMC performance in lean design concepts. One of our recognized core strengths involves designing medical power products featuring low component count designs, ensuring long life products, with low stand-by power and high efficiency. Another core strength is designing advanced systems such as high voltage generator systems.

## **Powerbox experience in medical power supply**

In our 30+ years of designing and selling medical power supplies we have gathered experience from a large variety of medical applications. As in all other fields where we are active we are primarily focusing on applications with some more demanding aspects. This could be in electrical specification, reliability requirements, space restrictions, environmental aspects, to mention a few. Some medical applications where we have carried out several projects and thereby accumulated specific experience are:

- Imaging
- Monitoring and display
- Therapy and home health care
- Bio Life science and diagnostics
- Surgical
- Dental
- Laser
- Ventilators
- Infusion pumps

# Medical solutions

## Standard products

Our extensive range of standard converters for medical applications comprises of both our own products, designed by our engineers and manufactured at world class manufacturing facilities, as well as products from our leading product partners. After working in the medical market for 30+ years chances are good we have a standard power supply to meet your needs.

## Custom products

If a suitable product cannot be found from our standard product range, we can consider providing modified standard, semi or full custom solutions. Our custom design capability and reputation is second to none. We have completed more than 3,500 custom design projects to date, whereof 2,000 at our Gnesta, Sweden, design center.

## Services

The right product is essential, but it is not everything. In addition to product offerings we include a comprehensive range of services, from analysis and qualification in the development stage, demand planning and special logistics in the production phase, to RMA handling and end user support in the after-market. We aim to serve you with simplicity to ensure your customers return time and again.

## Systems

An application might require more than a single converter. We then use our product range and our custom capability to build systems. These can feature multiple standard, semi-custom, and/or full-custom converters, battery backup, communications, remote control, intelligent charging, distribution panels, sub racks, enclosure etc., and maybe also a number of value-added services. We lean confidently on over 40 years of experience and subject matter expertise to identify the best means of solving every particular power conversion challenge. Together with our customers we find the optimized solution.

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## Some defining qualities of our medical power supplies



### Reliability

- Low component count
- Extra long life components
- Superior EMC/EMI
- Convection cooling
- Intelligent over temperature protection
- Fanless cooling



### Personal safety

- Isolation barrier
- 2 x MOPP
- Class I and II double isolation
- Integrated IP21
- Low leakage current



### Environment

- High efficiency
- Low standby power
- Lean design - reducing material use
- High power density reducing footprint
- Withstand shock and vibrations



### Standards and processes

- IEC60601-1 Ed3.1
- IEC61000
- EN55011
- RoHS, RoHS 2, RoHS III, China
- RoHS, REACH
- ISO 9001
- ISO 14971 RMF
- ISO 13485

# Standard products – Medline



**Medline 40**  
**OBH07 Series**  
 30-48W Open frame 2" x 4"  
 Universal input 90-264VAC  
 Multiple output 5, 12, 15, 24  
 or 48VDC



**Medline 60**  
**OBJ07 Series**  
 37.5-64W Open frame 2" x 4"  
 Universal input 90-264VAC  
 Multiple output 5, 12, 15, 24  
 or 48VDC



**Medline 100**  
**OFM100 Series**  
 100W Open frame 2" x 4"  
 Universal input 90-264VAC  
 Low leakage 75uA  
 EN55011/22 Class B  
 Single output 12, 15, 18 or 24VDC



**Medline 110**  
**OBL04 Series**  
 72-110W Open frame  
 Universal input 90-264VAC  
 Multiple output 3.3, 5, 12, 15, 24  
 or 30VDC



**Medline 150**  
**OBM03 Series**  
 150W Open frame  
 Universal input 90-264VAC  
 Single output



**Medline 200**  
**OBN01, OBM08 Series**  
 200W Open frame  
 Universal input 90-264VAC  
 Single and Multi output



**Medline 225**  
**OFM225 Series**  
 225W Open frame 3" x 5"  
 Universal input 90-264VAC  
 Single output 12.3, 15.3 or  
 24.4VDC



**Medline 300**  
**OBP03 Series**  
 300W Open frame/L bracket/  
 Enclosed 3" x 6"  
 Universal input 90-264VAC  
 Single output



**Medline 400**  
**OBP07 Series**  
 400W Open frame 7" x 4"  
 Universal input 90-264VAC  
 Single output 12, 15, 18, 24, 28, 36  
 or 48VDC



**Medline 450**  
**OBQ05 Series**  
 350-480W Open frame 10" x 4.5"  
 Universal input 90-264VAC  
 Multiple output 12, 15, 24, 27, 30,  
 40, 48VDC



**Medline 650**  
**OBR03 Series**  
 650-700W Open frame 10.5" x 5"  
 Universal input 90-264VAC  
 Multiple output 12, 15, 24, 27, 30,  
 36, 48VDC



**Medline 1100**  
**OBS01 Series**  
 1100W Open frame 5.91" x 9.25"  
 Universal input 90-264VAC  
 Low leakage 220uA at 264VAC  
 EN55011/22 Class B  
 Variable fan speed control  
 Single output 24, 28, 32, 36 or  
 48VDC

# Standard products – Medline



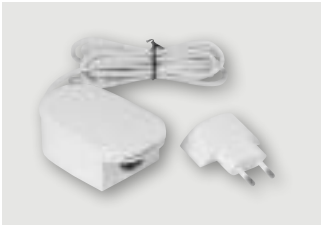
**Medline 03**  
**PMP/PMM03 Series**  
3.3W DC/DC converter  
2:1 or 4:1 input voltage range  
Single output  
Galvanically isolated versions  
up to 6 kVDC



**Medline 06**  
**PMP/PMM06 Series**  
Up to 6W DC/DC converter  
2:1 or 4:1 input voltage range  
Single output  
Galvanically isolated versions  
up to 6 kVDC



**Medline 10**  
**PMP/PMM10 Series**  
Up to 10W DC/DC converter  
2:1 or 4:1 input voltage range  
Single and dual output  
Galvanically isolated versions  
up to 6 kVDC



**Medline 30**  
**EXM30 Series**  
30W adaptor  
Universal input 90-264VAC  
Ultra low leakage <10 $\mu$ A  
Single output 12.2, 15.2 or  
24.4VDC



**Medline 80**  
**EXM80 Series**  
80W adaptor  
Universal input 90-264VAC  
Low leakage <50 $\mu$ A  
Single output 12, 15, 18 or 24VDC



**Medline 150**  
**EXM150 Series**  
150W floor top adaptor  
Universal input 90-264VAC  
Low leakage <100 $\mu$ A  
Single output 12, 15 or 24VDC



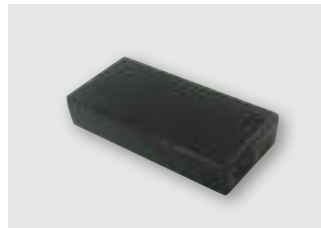
**Medline 225**  
**EXM225 Series**  
225W floor top adaptor  
Universal input 90-264VAC  
Low leakage <100 $\mu$ A  
Single output 24VDC



**Medline 65, 90, 105**  
**EBK01, EBM01, EBM02 Series**  
30-105W desktop adaptor  
Universal input 90-264VAC  
Low leakage  
Class I/II isolation  
Single output models from  
5-48VDC



**Medline 135, 150, 180, 220**  
**EBM03, EBM04, EBM05, EBN01 Series**  
135-220W desktop adaptor  
Universal input 90-264VAC  
Low leakage  
Class I/II isolation  
Single output models from  
5-48VDC



**Medline 400**  
**EBP01 Series**  
400W desktop adaptor  
Universal input 90-264VAC  
Low leakage <300 $\mu$ A  
Single output 18-48VDC

# Cosel standard products

Established in Japan 1969, COSEL is one of the world's leading designers and manufacturers of high performance AC-DC Power Supplies, DC-DC Converters and EMI Filters. With quality, reliability & flexibility as our main focus, we pride ourselves on developing some of the

highest quality and most reliable products seen anywhere in the world today. The Cosel Group is a global company with sales offices throughout Japan, Asia, Europe and North America.



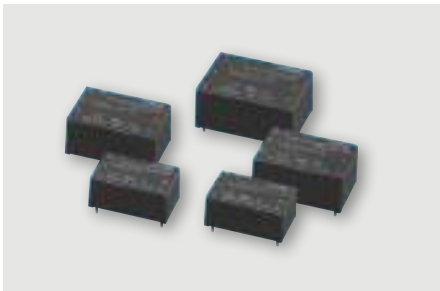
Enclosed  
10W - 10KW



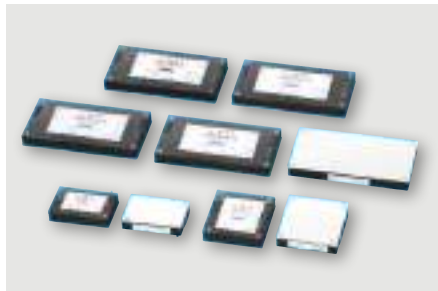
Configurable  
300W - 1200W



Open Frame  
10W - 300W



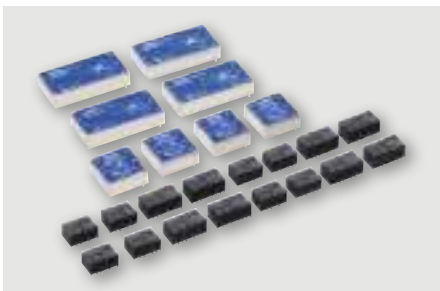
PCB  
3W - 25W



PCB  
50W - 700W



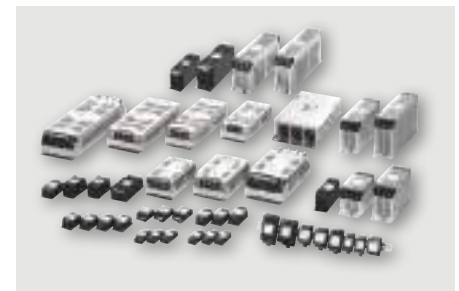
DIN-Rail  
30W - 480W



Low power series  
1.5W - 80W



High power series  
50W - 700W



EMI filters

# Custom products

Here are examples of customized products we have provided to medical customers in the past. Powerbox has to date completed more than 2500 custom design projects.



200W AC/DC open frame customized to deliver 385W output power supply for ultra welding of medical consumables.



670W coreless technology DC/DC power supply, fully DSP-regulated converter for use in strong magnetic fields such as in MRI systems. 2.4 MHz switching frequency.



80W AC/DC external adaptor customized to deliver up to 180W for respiratory/ventilation application.



400W AC/DC open frame quad output power supply for diagnostic system.



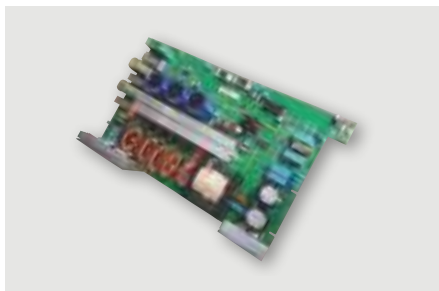
900W AC/DC enclosed multi output power supply for printing of diagnostic images.



650W AC/DC enclosed single output power supply customized for peak power, low noise and improved heat management powering surgical displays.



1000W DC UPS system built to ensure patient safety during critical applications.



2250W AC/DC capacitor charger for laser applications, certified to comply with the medical safety standards.



Power system designed for Mobile Medical Electrical Equipment (MEE) applications and for use within professional healthcare environments.



# Power solutions examples

## **X-ray**

The challenge: An X-ray application required 35 kV for the x-ray, together with several other voltages for feeding other parts of the equipment (as filament current, anode rotation and other auxiliary). Available space for the power equipment was limited.

The solution: Powerbox developed a 35 kV high voltage generator where the input converter also supplied a bus voltage feeding converters for all other loads.

Added value: This architecture reduced the number of converters required, which in turn:

- Reduced space requirement, due to fewer converters
- Reduced heat dissipation due to fewer conversion steps, which in turn further reduced space requirement
- Increased system availability due to fewer units involved
- Optimized system cost by reducing both the number of converters and the space required

## **Folio printer for images**

The Challenge: A folio image printer required 14 different power outputs, and the space available for converters was very limited. As it was for use in sensitive medical environment strict EMC requirements, as well as other typical medical requirements, applied. The application involved several DC motors with frequent starts and stops which made the EMC aspect especially challenging. An additional challenge was that in order to maximize image quality the power to the printing head had to follow a logic signal from the printer, adapting the thermal profile to both what was printed in each instance, and to what had previously been printed.

The solution: Powerbox custom designed two new converters supplying the 14 voltages and meeting all other requirements. We also assisted the customer with EMC verification of the complete end product.

Added value: Meeting all requirements while minimizing the number of converters contributed both to on-time launch and a competitive end product.

## **Gamma knife surgical system**

The challenge: A surgical "gamma-knife" requires exceptionally high power availability. Especially crucial is power for being able to remove the patient out of the unit under all conditions, including total loss of external power (as hospital standby UPS).

The solution: Powerbox designed a custom power system tailored to the application, including battery back-up and redundant power supplies to secure battery charge.

Added value: Fast-tracked design enabled on-time launch of the system and to date, after 8 years in the field, there is not a single fault reported or unit claimed.

## **Powering high demanding MRI with efficiency**

The challenge: Magnetic resonance imaging (MRI) uses a magnetic field and pulses of radio wave energy to make pictures of organs and structures inside the body. The magnetic field generated by the coil is in a range of 2 to 4 Tesla, which is a huge magnetic field with direct effect on some of the electrical equipment such as power supplies getting their transformers saturated and impossible to operate in such environment. For safety and patient comfort during the MRI session, some equipment require the power supply to be as close as possible to the load, meaning the power-unit must operate safely while exposed to the high magnetic field generated by the coil.

The solution: We developed a 670W coreless power solution, using the principle of transferring energy from an inductance to inductance. To guarantee the highest performance, we implemented a DSP control and advanced power topologies switching at 2.5 MHz and higher. To protect the complete power supply from electromagnetic leakage, we shielded the power unit with a 80dB screen.

Added value: Primarily developed for MRI systems, the platform Coreless power supply platform developed by Powerbox (PRBX) is also suitable for other demanding industrial applications and research industry where electronic systems operated under high magnetic field environment.

# About Powerbox

## **Who we are**

The combination of our extensive standard product range, our custom design capability, and our service offering, is truly unique. 40+ years of designing power supplies for demanding applications has built a rock solid experience. Our "Making the complex simple" business idea runs throughout our operation, from our customer interface and cooperation to how we design our products.

## **Improving your competitiveness**

The power solution chosen for any electronics has an impact on competitiveness. Function and reliability are given basics. Size, weight and audible noise might be important. Cost is always a consideration. Standards fulfillment can open up new markets. Time to market might be critical. Well executed supply chain management can generate savings. Aftermarket support has a lasting long term impact. The list goes on.

Our extensive experience and market awareness makes it simple to explain to us what you need. Together we define which power solution will serve your application the best.

## **Making the complex simple**

With our global presence we are close to you, and our knowledge and experience of working with so many different applications helps to make life easier for you. We can assist at all stages of product development, including evaluations, validations, and the writing of specifications. We aim for simplicity in design, referring both to lean design with fewer components and to a modular approach reusing proven circuits and building blocks, maybe with some modifications.

## **Quality assurance and follow-up**

Quality is an integrated part of everything we do. Our design process includes extensive testing, internal as well as external. Tests are also frequently run by our customers in their respective applications. In addition to the information we gain by tracking repairs and service requests, we also do regular quality follow up together with our customers, all to ensure a long and trouble-free life for our products. Powerbox is also certified by DNV according to ISO 9001:2008.

## **Manufacturing**

We manufacture at selected CEMs (Contract Equipment Manufacturer), where we apply rigorous process and quality requirements. We aim for long-term relationship with our manufacturing partners. A dedicated team for CEM Management and Quality Assurance work closely with them.

## **Caring for the environment**

At Powerbox we take an active role in protecting our environment. Our contribution includes:

Streamlined solutions and lean design using fewer components reduces material used. RoHS, WEEE and REACH are among the standards governing choice of materials.

High efficiency reduces energy consumption both directly by reducing losses and indirectly by reducing the need for cooling.

Energy efficient transportation and well developed use of online meetings are important elements in our determination to meet or exceed international standards by sustaining ISO-14001 compliance or the equivalent.

## **Providing peace of mind**

Even the best designed power solutions might require midlife support. Components involved in the design might be discontinued, or the application might be modified or changed, requiring changes in the power solution. In situations like this Powerbox' stability and endurance, and long term approach to customer relations, are true comforts.

## **About Cosel**

Established in Japan 1969, COSEL is one of the world's leading designers and manufacturers of high performance AC-DC Power Supplies, DC-DC Converters and EMI Filters. With quality, reliability & flexibility as our main focus, we pride ourselves on developing some of the highest quality and most reliable products seen anywhere in the world today. Our product range is aimed mostly at demanding applications within the Industrial, Factory Automation, Medical, Telecoms, Lighting, Audio/ Broadcast & Renewable Energy sectors. A flexible approach with full in-house design means we deliver products using the very latest technology meeting the growing demands of our customers.

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