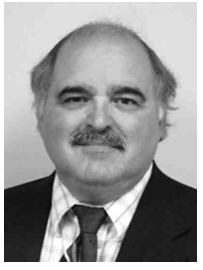
Rectifier Clinic



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Switchmode Rectifiers

One of the newest tools available to metal finishers who do not require large amperage is the switching power supply of switchmode rectifiers. These units can provide a very clean low-ripple output with very precise control. Because the rectifier uses high frequency AC before final rectification, the size of many of the components is reduced, making the rectifier very compact despite the sophistication of the circuitry.

Typical applications include: precious metal plating, printed circuit boards, connector and contact manufacture, strip lines and other applications where a smooth and stable source of DC power is required.

Design

A typical switchmode rectifier will include many of the following components:

- A cabinet, usually of stainless steel to resist corrosive environments. These are sometimes built to accommodate a rack mount system where several rectifiers can be mounted in one large frame.
- Cooling is usually forced air or water, although convection is an alternative on small units. Because it is imperative that the complex circuitry is not exposed to corrosive material, even the forced air-cooled units separate the cooling passages from the functional components. If the unit is water-cooled, there will be heat sinks with cooling tubes, heat exchangers, and thermal activated solenoids to adjust water flow and keep temperature within the desired range.
- Digital displays and controls for voltage and amperage are located on the face of the unit. Separate remote control enclosures can be added to provide control away from the rectifier.
- Overtemp thermals to protect heat sensitive components.
- A shunt on the output bus to generate a signal for the ammeter.
- A set of very fast high-power switching transistors to convert the once-rectified AC back to a high-frequency AC.
- A high-frequency transformer to reduce the switched AC to the desired output range.
- A set of circuit boards to regulate the inverter and achieve the desired output voltage.
- A diode or set of diodes to provide final rectification of the output.
- A filter capacitor to reduce ripple to 2% or less.

Operation

Single phase rectifiers will usually be 500 amps or less and 12 VDC or less. Three phase units are available up to 2000 amps or more, depending on the manufacturer. Output voltages are available from 6-48 VDC. Although the controls are usually on the front of the cabinet, standard features often include the ability to have parallel outputs and controls at a separate location.

Controls are similar to SCR rectifiers in that voltage and amperage are controlled by pots or up/down switches to set the desired levels. Constant current and voltage are standard in all units as a basic part of the function.

Many units have short circuit protection as well as internal fault diagnostics.

Some manufacturers include ramp control, cycle time, pulsing, and A/hr totalizers as part of their standard control package where others may treat these features as options. Additional options available may include multiple outputs, reversing, and 4 to 20 ma I/O to allow communication with a PLC.

Advantages

- Compact size and weight**.** If a rack mounted unit is used, several units can be stacked in the same footprint.
- Precise control, ±.5% over the full range of voltage and current output.
- High efficiency – up to 90% on some units.
- Digital displays and controls.
- Low ripple.
- Many standard features and options.

Disadvantages

- Higher cost per kA of output.
- Complexity of design precludes repairs by most users.
- Limitations in amperage output.

Although these rectifiers are expensive to purchase for their size, the precise clean power they provide is invaluable to coaters whose processes require it. This may in turn lead to significant savings in material usage, as well as improved quality. ***P&SF***

Correction to April Issue Feature

Table V – Pit Depth and Width Measurements for Stainless Steel in Different Passivation Solutions

Stainless Steel Alloy	Optimized Nitric Acid		Optimized Citric Acid		Commercially Available Citric Acid Cleaner	
	Pit Width	Pit Depth	Pit Width	Pit Depth	Pit Width	Pit Depth
303	0.001	0.005	0.0002	0.0003	0.0002	0.0009
A286	0.0004	0.0001	0.0004	0.0001	0.0003	0.0001
15-5PH	0.0008	0.0001	0.0006	0.0002	0.0006	0.0002
PH13-8Mo	0.0006	0.0001	0.0005	0.0001	0.0002	0.0001
17-7PH	0.0009	0.0002	0.0001	0.0003	0.0007	0.0004
304	0.0005	0.0002	0.0006	0.0002	0.0004	0.0002
321	0.0005	0.0002	0.001	0.0002	0.0004	0.0003
420	0.0007	0.0001	0.0009	0.0001	0.0004	0.0002
430	0.0007	0.0001	nil	nil	0.0005	0.0001
440C	0.0006	0.0002	0.0005	0.0001	0.0004	0.0002

Notes:
1/ Measurements are in inches.
2/ nil = not measureable

A key table (shown above) was inadvertently omitted from a March issue paper (p. 20) titled "Passivation of Aerospace Stainless Parts with Citric Acid Solutions" by Stephen P. Gaydos. We apologize for any confusion that this may have caused readers.