



**6 and 12 Pulse  
Series 70 Modular Anode Control (MAC) Rectifier**



**For Automotive and General E-Coat Systems,  
As Well As Other Metal Finishing Operations.**

## THE UNIQUE & PROVEN SOLUTION

### Experience, Quality, And Field Reliability

Trystar engineers and manufactures the industry's highest quality **industrial DC power supplies (rectifiers)**, capitalizing on many years of expertise. This quality is reflected in the design, material, workmanship, and operating performance of each rectifier we build. The result is a rugged, reliable rectifier system that will stand up to the rigors of 24x7 operation, even in harsh industrial environments.

Our rectifiers' durability and performance maximize end-user productivity and minimize downtime. If / when field service is necessary, Trystar will provide available parts and service for the life of each rectifier we manufacture, which is often 20+ years!

Trystar is ISO 9001:2015 certified, which assures quality and customer satisfaction — from quoting, throughout the design, manufacturing, delivery, system startup, and beyond!

#### OEM's & System Integrators

As a leading manufacturer of **industrial DC power supplies (rectifiers)**, Trystar understands and strictly adheres to each OEM's and system integrator's rectifier specifications. A custom rectifier design reflects job-specific requirements including voltage and current levels, NEMA ratings, monitoring and controls, and dimensions / footprint. OEM-specific features often include air filters, 24VDC control circuitry, color-coded wires, custom paint color, top or bottom entry of AC and DC power cables, and PLC control.

- Each rectifier is designed and manufactured for simple installation, start-up, and service. Input and output terminations, component placement, and wiring connectivity are all configured to keep installation costs to a minimum, and to eliminate the need for any field customization during the installation process.
- Many design methods are available to help the engineer integrate the rectifier into the production line, with proper personnel safety. This includes fail-safe emergency power off logic to AC input breakers for safe, quick, and convenient isolation of power from production areas.
- Trystar's sales, design, and application engineers, as well as product manufacturing staff, work together to make sure job requirements are satisfied ... most team members have 25+ years of e-coat product experience, and "knowledge-transfer" ensures that younger staffers will continue to design and build the highest quality e-coat rectifier systems! Expertise is always on-hand to assist with future product expansions and enhancements. All of these factors translate into a perfect product!.

#### Customer Support & Field Service

- All Trystar industrial DC power supplies (rectifiers), are designed and manufactured to have a low MTTR (mean time to repair). Components and sub-assemblies can be easily field-tested, removed, and serviced without excessive and costly hours of maintenance and downtime.



- Each Trystar rectifier is backed by 24/7 customer service and support. Experienced, knowledgeable staff and technicians are familiar with e-coating and other metal finishing applications, and are ready to assist with service contracts, rectifier startup, training, and phone support. Replacement parts and components can be quickly and easily shipped to a customer's site. When requested, a factory technician is dispatched and can most-often be onsite within 24 hours.

## MODULAR ANODE CONTROL (MAC) RECTIFIERS

### Modular Anode Control (MAC) Systems

#### Continuous Conveyor E-Coat Process

A **Modular Anode Control (MAC)** rectifier system is comprised of a pair or small groups of anodes connected to individual rectifiers for the purpose of gaining more precise control of the painting process. Similar to but more precise than a 2- or 3-zone continuous conveyor process, the **MAC** system maintains specific control over the voltage of each anode pair (or groups of anodes) to maximize coating efficiency and flexibility. All control and monitoring functions are performed by a centralized PLC, which can be programmed and monitored via an "HMI" (human-machine interface) or through the plant monitoring system.

**Note:** The "HMI" might also be referred to as the "operator interface terminal" (OIT).

In a standard 2- or 3-zone continuous conveyor process, there is usually (1) one rectifier per zone, as well as another rectifier which serves as a backup. In comparison, the **MAC** system brings the multi-zone concept to a new level. Now instead of having 2 or 3 zones, there are 10 or more zones — see the illustration below. This approach provides the flexibility to control the voltage at every 2 - 4 anodes, which gives the e-coat operator the ability to address any film-build issues at any anode group as a part passes through the tank.

Besides the capability to fine-tune the e-coat process, the MAC system eliminates the need for zone transfer switches and DC.

switchgear. Anode current monitoring is built into the rectifier, and the information can be monitored via the "HMI" or the plant monitoring system — therefore a separate anode monitoring system is not required.

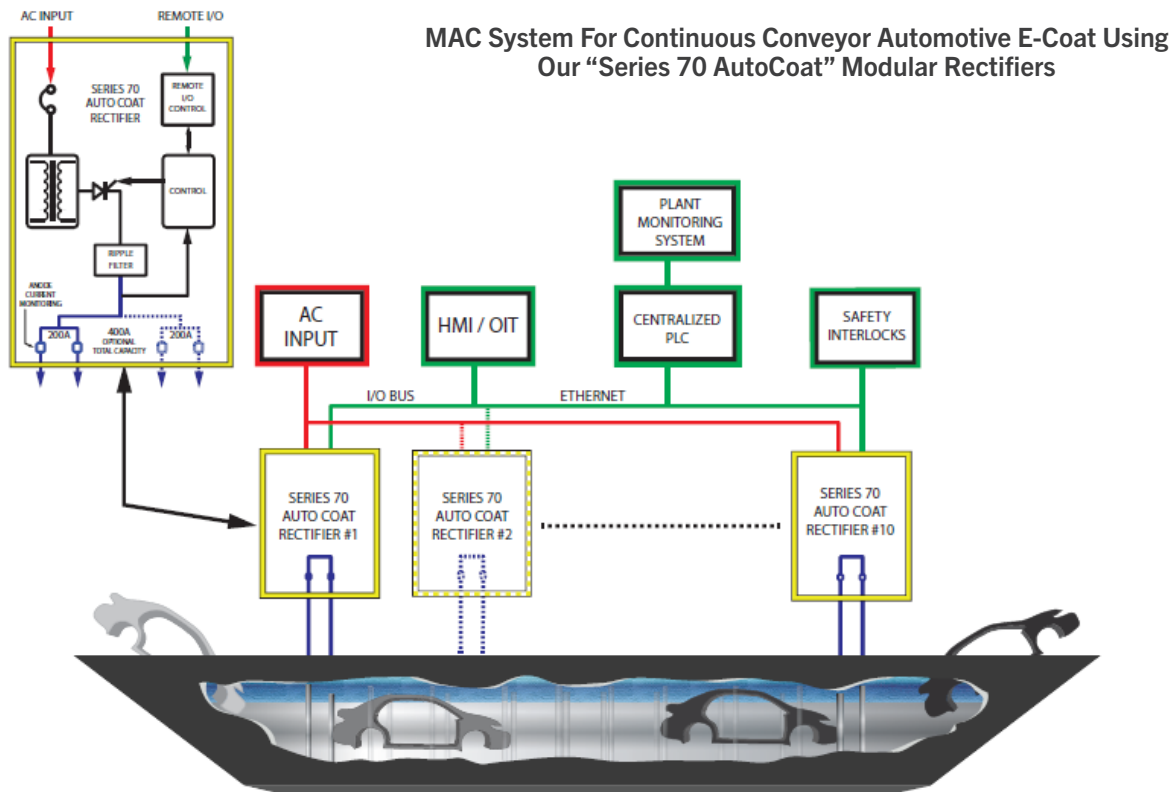
Note that in a **MAC** system, separate backup rectifiers are not required. If there is a rectifier failure, the MAC system PLC will automatically adjust the voltages of the operating rectifiers to compensate for the lost / down rectifier. When the rectifier is returned to service, the voltage levels will automatically re-adjust. Depending on the configuration, it is possible to lose up to (4) four rectifiers at once, and still run production.

#### Batch E-Coat Process

In a batch process, the rectifier output voltages are set based on the proximity of the part to the anodes. In a single rectifier configuration, the voltages set for the largest part can over-coat the smaller parts. When using a MAC system, different anodes can be set to different voltages to eliminate any over- or under-coating of the smaller and difficult-to-coat

parts. Voltages can be ramped up / down as needed, per the part's proximity to the anodes

Batch processes are “cold entry” — voltages are therefore controlled and monitored by the PLC, which itself can be programmed and monitored via an “HMI / OIT” or through the plant monitoring system.



For the sake of illustration, we have only shown (10) ten rectifiers, each powering (2) two anodes. (Note that most automotive continuous conveyor e-coat lines will have more than (10) rectifiers.) Hard-wired safety interlocks are not shown here, but note that they are available.

## SERIES 70 AUTOCOAT RECTIFIER

### “Series 70 AutoCoat” — Product Overview

Trystar’s “Series 70 AutoCoat” rectifier has a front-access, single transformer, secondary thyristor design, which can be used as both a stand-alone rectifier or in an MAC system. The “Series 70 AutoCoat” rectifier is offered in two models. The Model 706 utilizes a 6-pulse SCR configuration, and the Model 7012 utilizes a 12-pulse SCR configuration. Both models are available with DC output ratings of 400V - 450V and 200A - 400A.

Compatible with today’s advanced e-coat processes, the “Series 70 AutoCoat” rectifier is specifically designed for automotive and general e-coat applications which require greater voltage and current control of each anode. Designed for optimum, reliable performance in harsh industrial

environments, the “Series 70 AutoCoat” rectifier is an ideal choice for MAC e-coat applications, as well as smaller single rectifier systems.

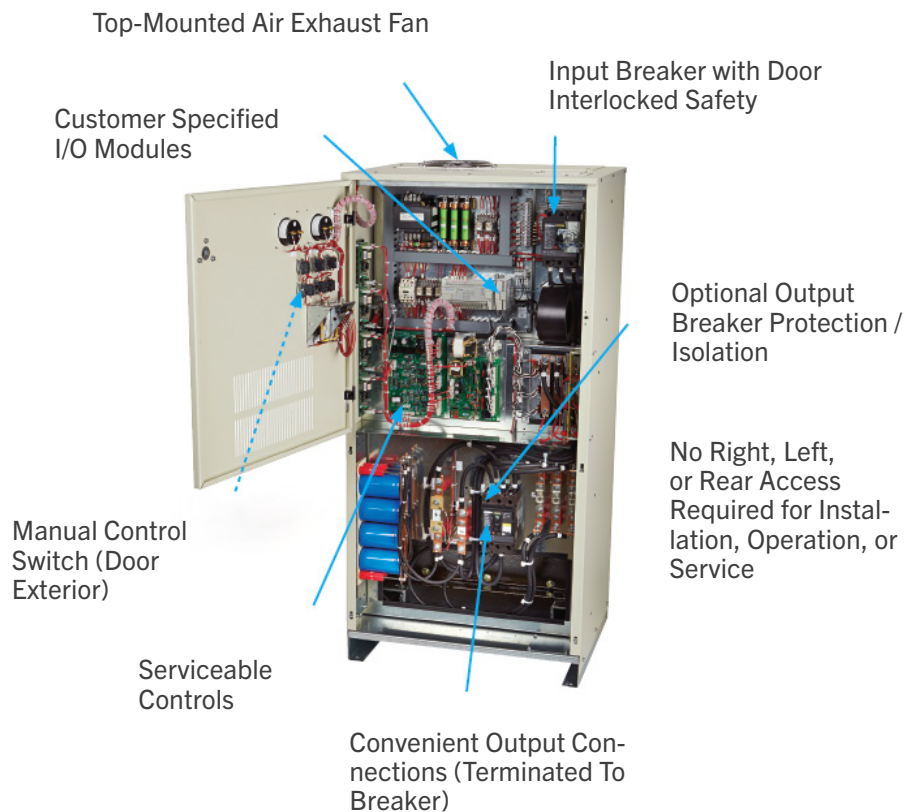
### Cabinet Design

Designed and constructed to endure the rugged industrial environments associated with e-coating and metal finishing, each “Series 70 AutoCoat” features a front-access, NEMA 1, industrial-grade steel enclosure with a durable, scratch-resistant powder-coat finish. By opening the cabinet door and removing the bottom-front panel, virtually all necessary maintenance can be performed from the front of the rectifier.

Cabinet options include the following — consult factory for details:

- Specially-formulated, corrosion-resistant paint for caustic environments.
- Stainless steel or galvanized enclosures.
- Drip-shields.

## Advantages of the “Series 70 AutoCoat”



200A unit shown. Bottom enclosure panel removed for illustration purposes.

## Transformers

Designed for high-efficiency, low inrush current, durability, and dynamic loading, the “Series 70 AutoCoat” transformers are constructed from high-grade steel and copper to ensure maximum conductivity and minimal loss. These transformers are convection-cooled for maximum reliability. They also have a low temperature rise, and are mechanically and electrically designed to withstand the stress that occurs under fault conditions.

## Thyristor SCR Control

In the “Series 70 AutoCoat” rectifier, fully-synchronized, phase lock loop gating circuitry is used to control the thyristors, eliminate gate mis-firing, and ensure that all phases are present before gating commences. Thyristors in each phase are surge-protected using metal oxide varistor (MOV) suppression and a resistor capacitor (RC) snubber circuit.

## PLC Control & Monitoring

The “Series 70 AutoCoat” may be provided with internal I/O modules, which allow communication with a centralized PLC that digitally controls the rectifier. This PLC may be provided by Trystar or others, and may also communicate with a plant’s centralized monitoring system.

The PLC instructs the rectifier(s) at which voltage level to operate; and monitors both the voltage and current output of the rectifier(s), as well as any alarm conditions. The PLC’s programming can also be customized to whatever type of control and monitoring is desired for the system.

The “Series 70 AutoCoat” also has the flexibility to communicate with virtually any manufacturer’s PLC. In the event of a PLC failure, the “Series 70 AutoCoat” can be operated in manual mode with just the turn of a switch, located on the front door of the rectifier.

## FEATURES, SPECIFICATIONS, & OPTIONS

### “Series 70 AutoCoat” Features

- Small footprint
- Front-access system; back or side access and clearance are not required
- Built-in anode monitoring
- Dedicated outputs — up to (2) for 200A, (4) for 400A (Consult factory for other configurations.)
- AC distribution systems are available for easy installation
- Flexibility to use PLC’s from various manufacturers
- Flexible PLC I/O configurations

### Standard Controls & Monitoring

- Output voltage and current meters

- AC Power “On” and DC “On” lights
- DC Power “On” and “Off” pushbuttons
- Output voltage and current control potentiometers for manual control when selected
- Voltage or current regulation mode switch
- Voltage or current limit control potentiometer
- Voltage ramping (slope) potentiometer
- Holding voltage potentiometer
- Emergency power “Off” pushbutton
- Automatic DC overload shutoff
- Door interlocks for safety / shutdown.

**Note:** Optional local or remote controls are available to suit almost every application.

## Performance Specifications.

- Input Voltage: Standard 208V, 240V, 480V or 600V; 3 phase \*
- Input Line Variation:  $\pm 5\%$  from nominal \*
- DC Output Voltages: 400V - 450V \*
- DC Output Current Ratings: 200A or 400A \*
- Frequency: 60 Hz; optional 50 Hz
- Efficiency: 95% typical; size dependent and at full load
- Power Factor: 0.90 typical, at full output
- % AC Output Ripple:

**Model 706** — 5% when operating within 25% to 100%  
of full voltage and current

**Model 7012** — 3% (full voltage and current); optional  
filter provides 1% when operating within 25% to 100% of full voltage and  
current

- Voltage Regulation:  $\pm 0.5\%$
- Current Regulation:  $\pm 0.5\%$
- Ambient Temperature: 0° C (32° F) to 40° C (104° F) maximum
- Humidity: 95% non-condensing
- Elevation: Maximum elevation 1524 meters (5000 feet) without  
de-rating

\* Consult factory for other optional input voltages, input line variations,  
output voltages, and output current ratings.



## OPTIONAL EQUIPMENT

The “**Series 70 AutoCoat**” has many available options to meet the requirements of today’s e-coat systems. This brochure details some of these options — consult factory for details, additional options not listed here, and for any special requirements.

### Automatic Average Current Density (AACD)

When used in an MAC system, the “**Series 70 AutoCoat**” can be provided with optional, proprietary “AACD” (**Automatic Average Current Density**) technology.

In a continuous conveyor e-coat process, different parts enter the tank at different times. As each part passes across pairs / groups of anodes, the “**Series 70 AutoCoat**” automatically adjusts the anodes’ voltage, based upon the size of the part. Larger parts receive more voltage; smaller parts receive less voltage. In a batch e-coat process, the voltage is automatically selected based upon the size of the parts at initial submersion. Different anodes can be set for different voltage levels, to eliminate any over- or under-coating of smaller or difficult-to-coat parts.

In both processes, the “**AACD**” adjusts the voltage dynamically to ensure that the current density is consistent for each part, and that paint film range thicknesses are within a specified tolerance.

If the “**AACD**” system is not desired, the “**Series 70 Auto-Coat**” has the capability to interface with another PLC for part detection and voltage level settings.

### AC Distribution

The “**Series 70 AutoCoat**” MAC systems are available with a dedicated AC distribution system to provide power to each individual rectifier. This AC distribution system features a main circuit breaker and dedicated individual circuit breakers.

### I/O Modules

The “**Series 70 AutoCoat**” features I/O modules for PLC control and rectifier communications. I/O module options include: analog (4-20 mA, 0-10V) and digital (Ethernet) communications. I/O modules are compatible with PLC’s from various manufacturers.

## Additional Options

- Fuse-blown indication, via the MAC system’s PLC
- Kirk Key / Fortress interlocks for rectifier and plant safety
- Fan Failure Indication via the fan monitor, which senses airflow from either (or both) of the cooling fans
- AC Contactor, which serves as a positive means of disconnect to shut off DC power
- AmpHour Counters / Pump Controllers
- Flexible PLC I/O configurations
- Blocking diode on all MAC rectifier systems



CABINET DIMENSIONS

SERIES 70 AUTOCOAT			
MODEL	RECTIFIER CURRENT RATING	WEIGHTS lbs)	CABINET DIMENSIONS (inches)
706	200A	1630	29"W x 25"D x 60"H
706	400A	1920	32"W x 31"D x 70"H

**Note:** Depending on the options ordered, the 200A cabinet dimensions may be the same as those of the 400A product.

\* Optional drip-shield (not shown) adds 0.5" W, 4" D, and 8" H to each Model 706 cabinet.

Model 706 data and cabinet outline drawing shown.

Consult factory for Model 7012.

**Warranty:** Trystar guarantees the unit to be free from defects in material and workmanship for a period of (1) year following shipment from the factory.

