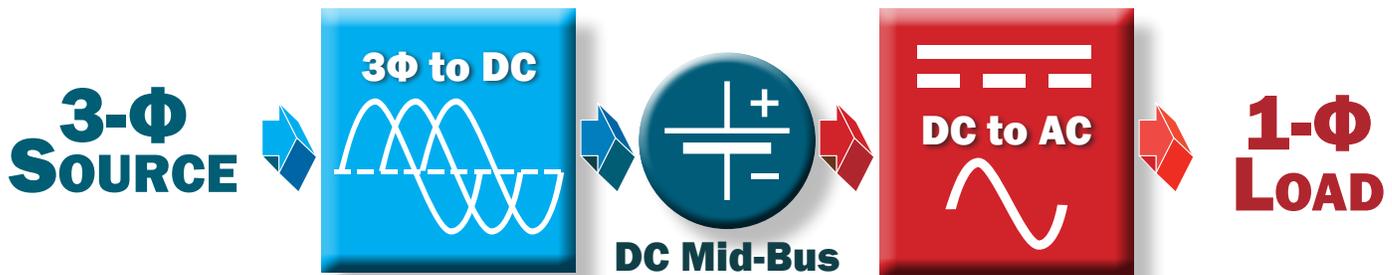




# 3-Phase to Single-Phase AC Conversion

with *Balanced 3-Phase Currents*



**Phase Current Balancing Solutions for  
440 V, 230 V and 115 V 3-Phase Systems**

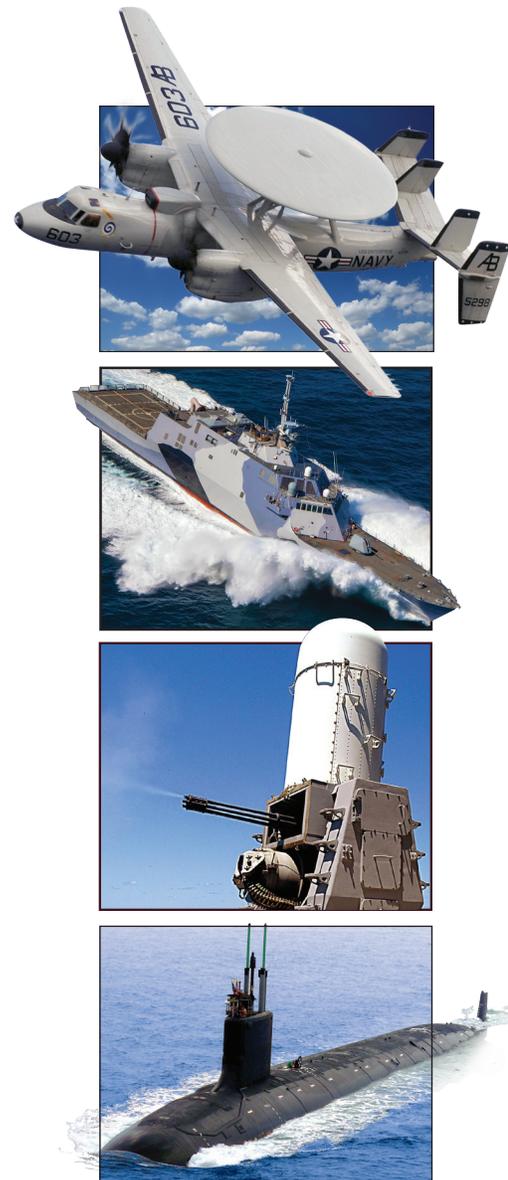


**Military-Grade 3-Phase AC Changer  
MAC-4000**

**Military-Grade Programmable Power Supply  
MPPS-4000**

**Military-Grade Power Supply  
MPS-4000**

**Military-Grade Inverter  
MINV-4000**



# 3-Phase to Single-Phase AC Conversion

with **Balanced 3-Phase Currents**

## 3-PHASE CURRENT BALANCING PROBLEM

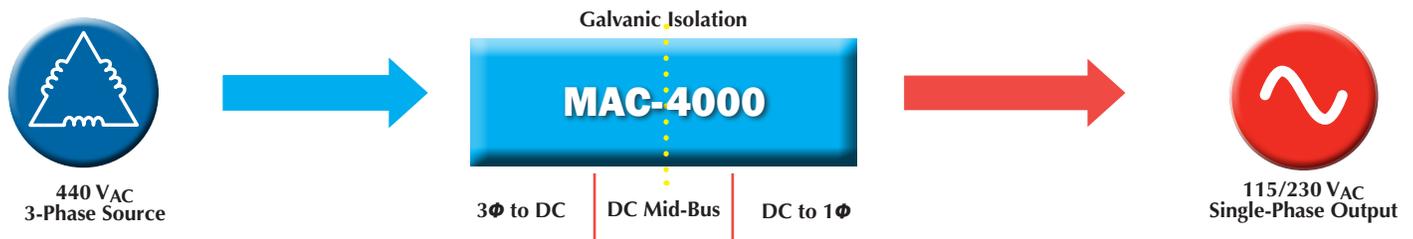
Single-Phase loads represent a complex problem for 3-Phase utilities found in aircraft and ships in that phase currents must be closely balanced. In fact, MIL-STD-1399-300B requires all phase currents to be balanced to within  $\pm 5\%$  for ships and  $\pm 3\%$  for submarines. It is impossible to achieve this degree of phase-to-phase current balance in a 3-Phase system that has significant Single-Phase electronic loads. The industrial, shipping and military sectors have therefore used UPS, electronic voltage regulators, variable shunt reactors and sophisticated transformer arrangements to try to balance 3-Phase loads. These solutions are heavy, bulky and usually do not solve the phase current balance problem.

## SYNQOR'S SOLUTION

SynQor has developed an electronic solution to solve the 3-Phase current balance problem. The conceptual approach is to isolate the input 3-Phase power source from the output Single-Phase loads through a DC Mid-Bus. An AC to DC converter converts 3-Phase power into DC at the Mid-Bus. An inverter then converts the DC power into Single-Phase. This approach allows unbalanced noisy Single-Phase loads to appear to the input 3-Phase source as, clean, well behaved, high power factor, balanced and MIL-STD-1399-300B compliant 3-Phase loads. SynQor has compact, lightweight, efficient and military rugged current balancing solutions for 440 V, 230 V and 115 V 3-Phase systems.

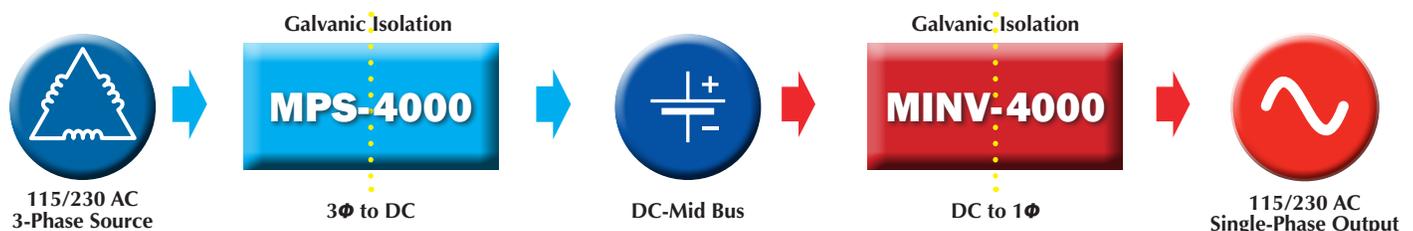
### 440 V<sub>AC</sub>

For the 440 voltage input solution, SynQor has developed the Military-Grade 3-Phase AC Changer (MAC).



### 115 OR 230 V<sub>AC</sub>

For 115 and 230 input voltages, the SynQor solution uses its field proven 115 V or 230 V universal frequency input Military Power Supply (MPS) followed by its 115 or 230 output voltage Military Inverter (MINV).



## BENEFITS OF SYNQOR'S APPROACH:

- ◆ Balanced load currents for 3-Phase sources; MIL-STD-1399-300B compliant.
- ◆ Components are compact, ultra-low weight, efficient and rugged to military standards.
- ◆ Galvanic Isolation between the input source and the output load.
- ◆ High noise and transient isolation between the input source and the output load.
- ◆ Floating or non-floating ground outputs options: 115 or 230 volts at 50, 60 or 400 Hz.
- ◆ Parallel/redundant configurations of up to 32 systems than can condition loads of up to 110 kW.
- ◆ Complex 3-Phase and Split-Phase parallel or redundant output configurations.
- ◆ Full power operation:  $-40^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$
- ◆ All devices can be remotely monitored via SNMP.

# MPS



# MINV

**Military Power Supply**

**Military Power Inverter**



**Up to 32 units can be combined for higher power or redundancy**

## MILITARY-GRADE 115 V, 230 V 3-PHASE CURRENT BALANCING SOLUTION

The MPS is a nearly perfectly 3-Phase balanced load that converts 3-Phase AC to DC in the Mid-Bus. The MINV transforms DC power in the Mid-Bus to a well-conditioned AC Single-Phase output. This system architecture can be paralleled to permit fault-tolerant parallel operation for higher power and/or N+M redundant systems.

### MPS + MINV PRODUCT FEATURES

- ◆ Sealed, weather-proof, shock-proof construction
- ◆ Two-stage, DC link isolated topology
- ◆ 4000 W (5000 VA) output power
- ◆ Phase input: 80-265 Vrms line-to-line; 47-800 Hz
- ◆ 28 V DC Input & 270 V DC Input
- ◆ Input Current Balance  $< \pm 3\%$
- ◆ Handles 0.0—1.0 power factor loads and non-linear loads
- ◆ Full power operation:  $-40\text{ }^{\circ}\text{C}$  to  $+55\text{ }^{\circ}\text{C}$
- ◆ Up to 32 units can be combined for higher power, voltage or a 3-Phase AC output
- ◆ Up to 32 units can be combined to form a higher power fault-tolerant, glitch-free system, N+M redundant systems
- ◆ Battle Mode for over-temperature events
- ◆ User I/O and Configuration signal port
- ◆ SNMP Monitoring
- ◆ MPS 1U high rack mount unit (17.00"W x 20.42"D x 1.73"H)
- ◆ MINV 1U high rack mount unit (17.00"W x 22.43"D x 1.73"H)
- ◆ Low weight: MPS - 28 lbs., MINV - 32 lbs.

### SPECIFICATION COMPLIANCE

**MPS & MINV system integration is designed to meet:**

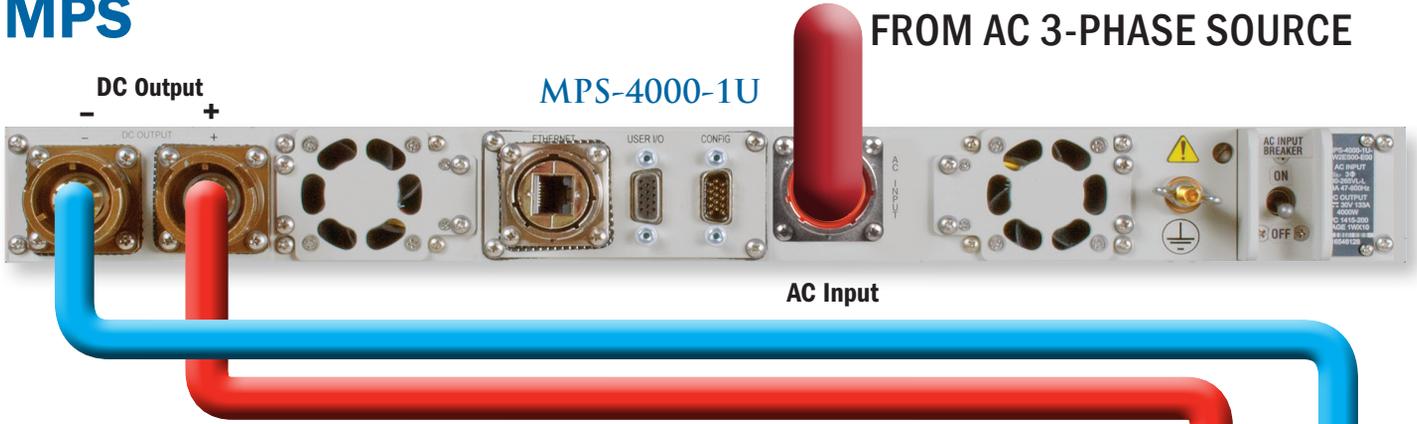
- ◆ MIL-STD-1399-300B - Interface Shipboard
- ◆ MIL-STD-810G - Environmental Engineering
- ◆ MIL-STD-461F - Electromagnetic Interference
- ◆ MIL-STD-704F - Aircraft Electrical Power
- ◆ MIL-STD-1275D - Vehicle Electrical Power

### OUTPUT OPTIONS

- ◆ Pure sinusoidal 115 Vrms or 230 Vrms AC output
- ◆ 50 Hz, 60 Hz, or 400 Hz AC output
- ◆ Shipboard version with floating neutral wire
- ◆ N+1 redundancy



# MPS



# MINV



## 3-PHASE MILITARY-GRADE AC-DC POWER SUPPLY (MPS)

Family	Output Power	Height	AC Input Phase #	AC Input Frequency	DC Output Voltage @ Full Load*	Output Regulation	Network
MPS	4000: 4000 W	1U: 1.73"	3: 3-Phase	W: 47-800 Hz	2D: 28 V 2E: 30 V 4B: 48 V	S00: Semi-regulated	E00: Ethernet/SNMP

**Part Numbering Example:** MPS-4000-1U-3W2ES00-E00 For valid part numbers, refer to the website or contact your local sales representative.  
 \*Approximate output voltage at full load, output voltage has Droop

## 3-PHASE MILITARY-GRADE AC-DC PROGRAMMABLE POWER SUPPLY (MPPS)

Family	Output Power	Height	AC Input Phase #	AC Input Frequency	DC Output Voltage @ Full Load*	Output Current Range	Network
MPPS	4000: 4000 W	1U: 1.73"	3: 3-Phase	W: 47-800 Hz	28: 0-35 V 48: 0-55 V 72: 0-80 V	150: 0-150 A 120: 0-120 A 078: 0 - 78 A	E00: Ethernet/SNMP

**Part Numbering Example:** MPPS-4000-1U-3W28-150-E00 For valid part numbers, refer to the website or contact your local sales representative.  
 \*Approximate output voltage at full load, output voltage has Droop

## MILITARY-GRADE POWER INVERTER (MINV)

Family	Output Power	Height	DC Input Voltage	AC Output Voltage	AC Output Neutral Wire	AC Output Set Point Frequency	Output Configuration	Additional Options
MINV	4000: 4000 W 5000 VA	1U: 1.73"	28: 28 V <sub>NOM</sub> 270: 270 V <sub>NOM</sub>	1: 115 V <sub>rms</sub> 2: 230 V <sub>rms</sub>	G: Grounded F: Floating* R: AC Output Electronic Breaker*	5: 50 Hz 6: 60 Hz 4: 400 Hz	S: Single-Phase Output	E00: Ethernet / SNMP ECE: Ethernet / SNMP & CE Marking

**\*Note:** Order "F: Floating" option when configuring the AC output for multi-unit combinations of up to 32 units.  
 Order "R: AC Output Electronic Breaker" option for fault-tolerant, glitch-free parallel systems of up to 32 units with N+M redundancy.  
 The AC output neutral wire will not be connected to the chassis for either the F option or R option.

**Part Numbering Example:** MINV-4000-1U-28-1G6S-E00 For valid part numbers, refer to the website or contact your local sales representative.

# MAC

## Military AC Changer



Up to 32 units can be combined for higher power or redundancy

## MILITARY-GRADE 440 V 3-PHASE AC CHANGER (MAC)

This MAC will accept a 3-Phase 440 V<sub>AC</sub> input and change it to a well-conditioned Single-Phase 115/230 V<sub>AC</sub> output using a two-stage DC link isolated topology. Options include a selection of output voltage amplitudes, frequencies and an electronic breaker on the AC output to permit fault-tolerant parallel operation for higher power and/or N+M redundant systems

### MAC PRODUCT FEATURES

- ◆ Sealed, weather-proof, shock-proof construction
- ◆ Two-stage, DC link isolated topology
- ◆ 4000 W (5000 VA) output power, 15 s transient to 5250 W (6500 VA)
- ◆ Full power operation: -40 °C to +55 °C
- ◆ 3-Phase 360-528 V<sub>rms,L-L</sub> Δ input (draws balanced current)
- ◆ 47-65 Hz input range
- ◆ Pure sinusoidal AC output voltage
- ◆ Handles 0.0—1.0 power factor loads and non-linear loads
- ◆ Up to 32 units can be combined for higher power, voltage or a 3-Phase AC output
- ◆ Up to 32 units can be combined to form a higher power fault-tolerant, glitch-free system, perhaps with N+M redundancy, by ordering with the “AC Output Electronic Breaker” option and the appropriate configuration cable
- ◆ User I/O and Configuration signal ports
- ◆ Battle Mode for over-temperature events
- ◆ 1U high rack mount unit (17.00”W x 22.42”D x 1.73”H)
- ◆ Low weight: 33 lbs.

### SPECIFICATION COMPLIANCE

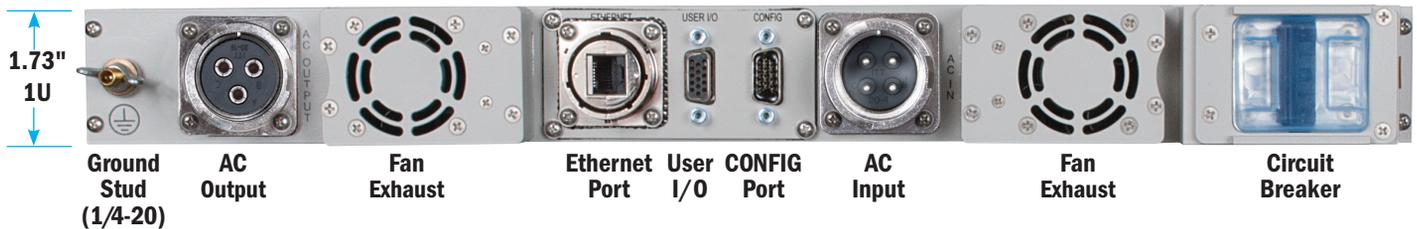
#### MAC-4000 units are designed to meet MIL-STD:

- ◆ MIL-STD-1399-300B - Interface Shipboard
- ◆ MIL-STD-810G - Environmental Engineering
- ◆ MIL-STD-461F - Electromagnetic Interference

### OPTIONS

- ◆ 115 V<sub>rms</sub> or 230 V<sub>rms</sub> AC output
- ◆ 50 Hz, 60 Hz, or 400 Hz AC output
- ◆ Shipboard version with floating output neutral wire
- ◆ N+1 Redundancy

### MAC-4000-1U



### MILITARY-GRADE AC CHANGER (MAC)

Family	Output Power	Height	Line to Line Input Voltage	Number of Input Phases	Input Frequency Range	AC Output Voltage	AC Output Neutral Wire	AC Output Set Point Frequency	Output Configuration	Additional Options
MAC	4000: 4000 W 5000 VA	1U: 1.73"	4: 360-528 V	T: 3-Phase	L: 47-65 Hz	1: 115 V 2: 230 V	G: Grounded F: Floating* R: AC Output Electronic Breaker*	5: 50 Hz 6: 60 Hz 4: 400 Hz	S: One Single-Phase Output	E00: Ethernet / SNMP ECE: Ethernet / SNMP & CE Marking

Not all combinations make valid part numbers, please contact SynQor for availability. See the Product Summary web page for more options.

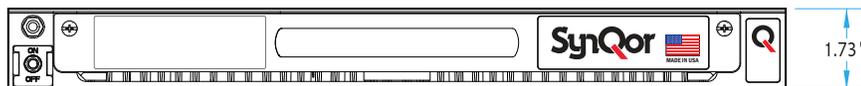
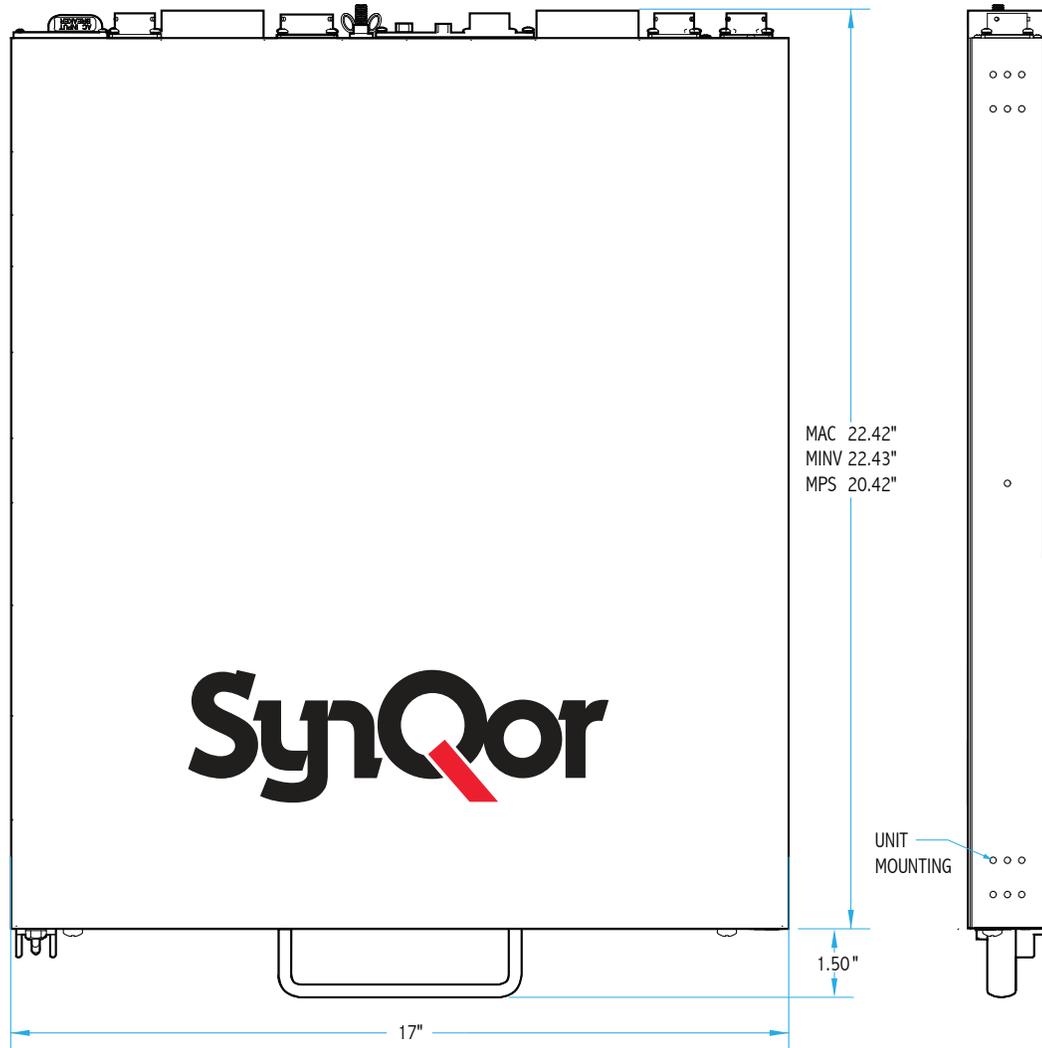
\*Note: Order “F: Floating” option when configuring the AC output for multi-unit combinations of up to 32 Units.

Order “R: AC Output Electronic Breaker” option for fault-tolerant, glitch-free parallel systems of up to 32 units with N+M redundancy.

The AC output neutral wire will not be connected to the chassis for either the F option or R option.

**Part Numbering Example:** MAC-4000-1U-4TL2G6S-E00 For valid part numbers, refer to the website or contact your local sales representative.

# MILITARY-GRADE POWER SYSTEMS 1U MECHANICALS



**SynQor, Inc.**  
155 Swanson Road  
Boxborough, MA 01719-1316  
E-mail: [power@synqor.com](mailto:power@synqor.com)  
Phone: 978-849-0600  
Fax: 978-849-0602  
[www.SynQor.com](http://www.SynQor.com)

006-0006702

09.19.2024

REV F

