

SynQor[®]

MINV MINV-4000-1U-28

MILITARY-GRADE INVERTER

4000 W / 5000 VA Output Power	28 V Nominal DC Input Voltage	20 V - 33 V DC Input Voltage	115 Vrms or 230 Vrms 50 Hz, 60 Hz, or 400 Hz AC Output Voltage Options	89% Full Load Efficiency
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Sealed Construction, Ultra Low Weight, Compact Size



N+M REDUNDANCY

DESIGNED & MANUFACTURED IN USA

SynQor's Military Inverter units are designed for the extreme environmental and demanding electrical conditions of Military/Aerospace applications. SynQor's MINV "Field-Rugged" family of rack-mount products incorporates field proven high efficiency designs and rugged packaging technologies. This MINV will accept a DC input voltage while delivering a well-conditioned AC output to the load. It is designed and manufactured in SynQor's USA facilities to comply with a wide range of military standards. Options include a selection of output voltage amplitudes, frequencies, configurations that provide a single output, three single-phase outputs, or a 3-Phase output, and an electronic breaker on the AC output to permit fault-tolerant parallel operation for higher power and/or N+M redundant systems.

Combine units for Higher Power, Voltage, 3-Phase AC output, and/or Redundancy

Features

- Sealed, weather-proof, shock-proof construction
- 4000 W (5000 VA) output power
- Full power operation: -40 °C to +55 °C
- 28 V nominal DC input
- 20 V - 33 V input range
- 18 V - 40 V transient input range
- Pure sinusoidal AC output voltage (115 Vrms, 60 Hz)
- Handles 0.0—1.0 power factor loads and non-linear loads
- Up to 3 units can be combined for higher power, voltage or a 3-Phase AC output
- Low-power sleep state draws < 500 uA from source
- 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
- 1U high rack mount unit (17.00 "W x 22.43 "D x 1.73 "H)
- Low weight: 32 lbs.

Specification Compliance

MINV-4000 units are designed to meet:

- MIL-STD-1399-300B - Interface Std for Shipboard Systems
- MIL-STD-810G - Environmental Engineering Considerations
- MIL-STD-461F - Electromagnetic Interference
- MIL-STD-704F - Aircraft Electrical Power Characteristics
- MIL-STD-1275D - Vehicle Elec. Power Characteristics

Options

- 115 Vrms or 230 Vrms AC output
- 50 Hz, 60 Hz, or 400 Hz AC output
- Multiple single-phase outputs and 3-Phase output units
- Shipboard version with floating neutral wire

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Technical Specification

DC INPUT CHARACTERISTICS

Steady State Operating Voltage	20 - 33 V
Continuous Maximum Input Current	240 A (full load, 20 V)
Transient Operating Voltage	18 - 40 V (500ms @ 18 V)
Transient Maximum Input Current	275 A

AC OUTPUT CHARACTERISTICS

Total Output Power Continuous	4000 W (5000 VA)
AC Output Waveform	Pure Sinusoidal
Voltage Line-Neutral	115 Vrms ± 3% 230 Vrms ± 3%
Frequency	60 Hz ± 0.5% 50 Hz ± 0.5% 400 Hz ± 0.5%
Load Power Factor	0-1.0 (leading or lagging)
Total Harmonic Distortion	2% (3000 W resistive load)

Single-Phase Output

Steady State Load Current	43.5 Arms (115 Vrms) 21.7 Arms (230 Vrms)
Peak Load Current	78 Apk (115 Vrms) 39 Apk (230 Vrms)

Multi-Phase Output

Steady State Load Current per Phase	14.5 Arms (115 Vrms L-N) 7.3 Arms (230 Vrms L-N)
Peak Load Current per Phase	26 Apk (115 Vrms L-N) 13 Apk (230 Vrms L-N)

Specifications subject to change without notice.

* Regarding MIL-STD-461 CE-101, the 50 uH series inductance of a standard LISN adversely affects the input ripple of the MINV. Such a large series source inductance (50 uH in each power lead) is not generally encountered in a 28 V DC source of such high power rating. Therefore, testing for CE-101 (DC input) was conducted with 3 different configurations: two using 50 uH LISNs and a 54 mF capacitor connected across the input to the MINV, and one using 5 uH LISNs for which no additional capacitor was added. These configurations all passed CE-101 for all frequencies.

ENVIRONMENTAL CHARACTERISTICS MIL-STD-810G

Temperature Methods 501.5, 502.5

Operating Temperature	Full Rated Power	-40 °C — +55 °C
	Reduced Power per Figure B	-40 °C — +70 °C
Storage Temperature		-40 °C — +70 °C

Altitude Method 500.5

Operating	0 - 18,000 ft
Non-operating	0 - 40,000 ft

Environmental Tests

Shock/Drop	Method 516.6, Procedures 1,4,6
Temperature Shock	Method 503.5, Procedure 1
Vibration	Method 514.6, CAT 5, 7, 8, 9, 24
Fungus	Method 508.6
Salt Fog	Method 509.5
Sand and Dust	Method 510.5, Procedures 1,2
Rain	Method 506.5 Procedure 1
Humidity	Method 507.5 Procedure 2
Mechanical Vibrations of Shipboard Equipment	Method 528 Procedure 1

RELIABILITY CHARACTERISTICS MIL-HDBK-217F

MTBF	468 kHrs	MIL-217F Ground Benign, Ta=25 °C
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ELECTROMAGNETIC CAPABILITY MIL-STD-461F

CE101*	30 Hz - 10 kHz
CE102	10 kHz - 10 MHz
CS101	30 Hz - 150 kHz
CS106	10 kHz - 40 GHz
CS114	10 kHz - 200 MHz
CS116	10 kHz - 100 MHz
RE101	30 Hz - 100 kHz
RE102	10 kHz - 18 GHz
RS101	30 Hz - 100 kHz
RS103	2 MHz - 40 GHz

MECHANICAL CHARACTERISTICS

1U Standard Chassis

Chassis Size (W x D x H)	17.00 "W x 22.43 "D x 1.73 "(1U)H
Case Material	Aluminum
Total Weight	32 lbs.

DC Input Connectors

DC (-) Input Connector	CGE2E18H5ZNB-16
DC (+) Input Connector	CGE2E18H5ZWB-16

AC Output Connectors

115 V Single Phase	CB2-20-19SXS
230 V Single Phase	CB2-20-19SXS
115 V Multi Single Phase	CB2-20-15SXS
230 V Multi Single Phase	CB2-20-15SXS
115 V L-N 3-Phase	CB2-20-15SXS
230 V L-N 3-Phase	CB2-20-15SXS

I/O Ports

User I/O Ports	HD DB15 Female
Configuration I/O Port	HD DB15 Male
Ethernet Port	Amphenol RJF22N00, Code B

Cooling Exhaust Fans

Sound Pressure Level (SPL)	64 dB(A)
Air Flow	0.92 (m ³ /min) 32.5 CFM

Two fans in system, above specs are for each fan separately.



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Technical Specification

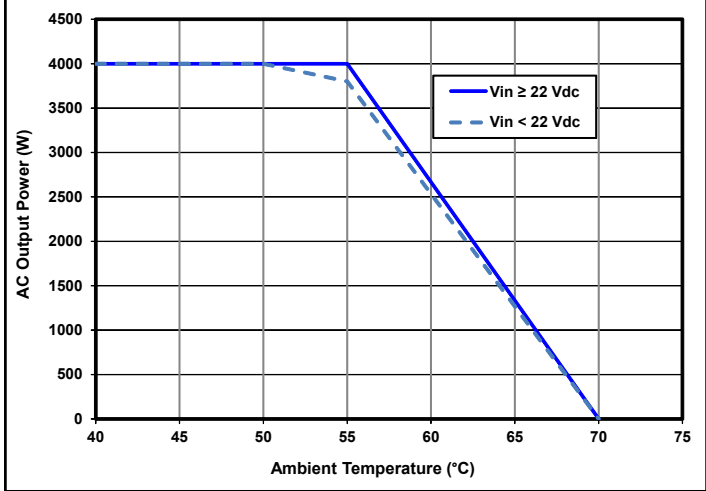
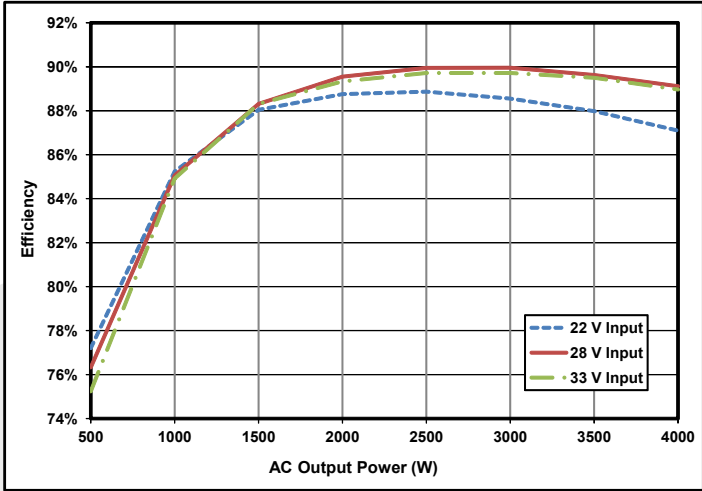


Figure A: Typical efficiency curves for All Output Configurations

Figure B: Thermal Derating Curve (output power vs. ambient temperature)



High Density DB15 Female (15 Pin Connector)

Signal	PIN	Function
TX	2	RS232 DCE Device Transmit
RX	3	RS232 DCE Device Receive
GND	4, 5	Ground reference for all digital inputs and outputs
BATTLE_MODE	6	TTL-Input*, pull "low" to engage Battle Mode to disable internal over temperature protection, has internal pull-up to +5 V.
DCIN_GOOD	7	Open collector* output where "low" indicates DC Input voltage is within range
+5 V	8	Vout with minimal current drive usable as a pull-up voltage for open collector output signals. Load must be < 35 mA
BLACKOUT_MODE	9	TTL-Input*, pull "low" to engage Blackout Mode to disable front-panel LEDs and audible alarms, has internal pull-up to +5 V.
REMOTE_START	12	Drive this line "high" with ≥ 5 mA to enable MINV outputs
SHUTDOWN	13	Drive this line "high" with ≥ 5 mA to disable MINV outputs
OUT_OK	14	Open collector* output where "low" indicates AC Output voltage is within range
OVER_TEMP	15	Open collector* output where "low" indicates that the MINV is at or above its maximum temperature

*With an internal 50 k Pull-up Resistor to 5 V and ESD Protection Diodes.

Safety & Qualifications (Pending)

- CAN/CSA C22.2 No.60950-1
- UL 60950-1
- EN 60950-1

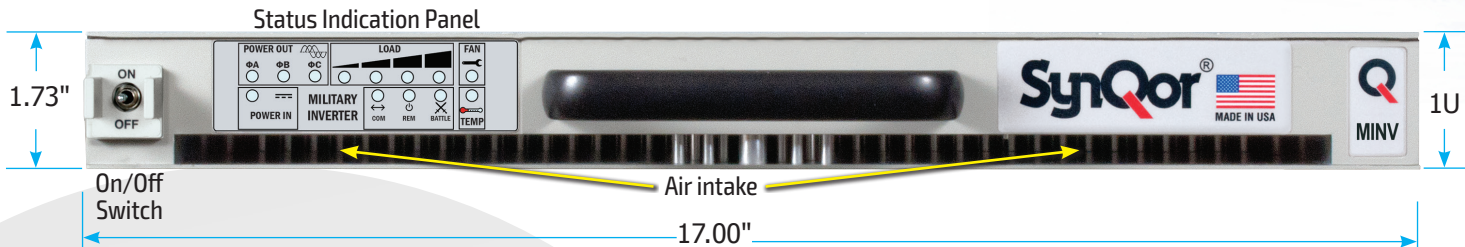


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Mechanical Diagrams

MINV-4000-1U-28 Front Panel



MINV-4000-1U-28 Rear Panel



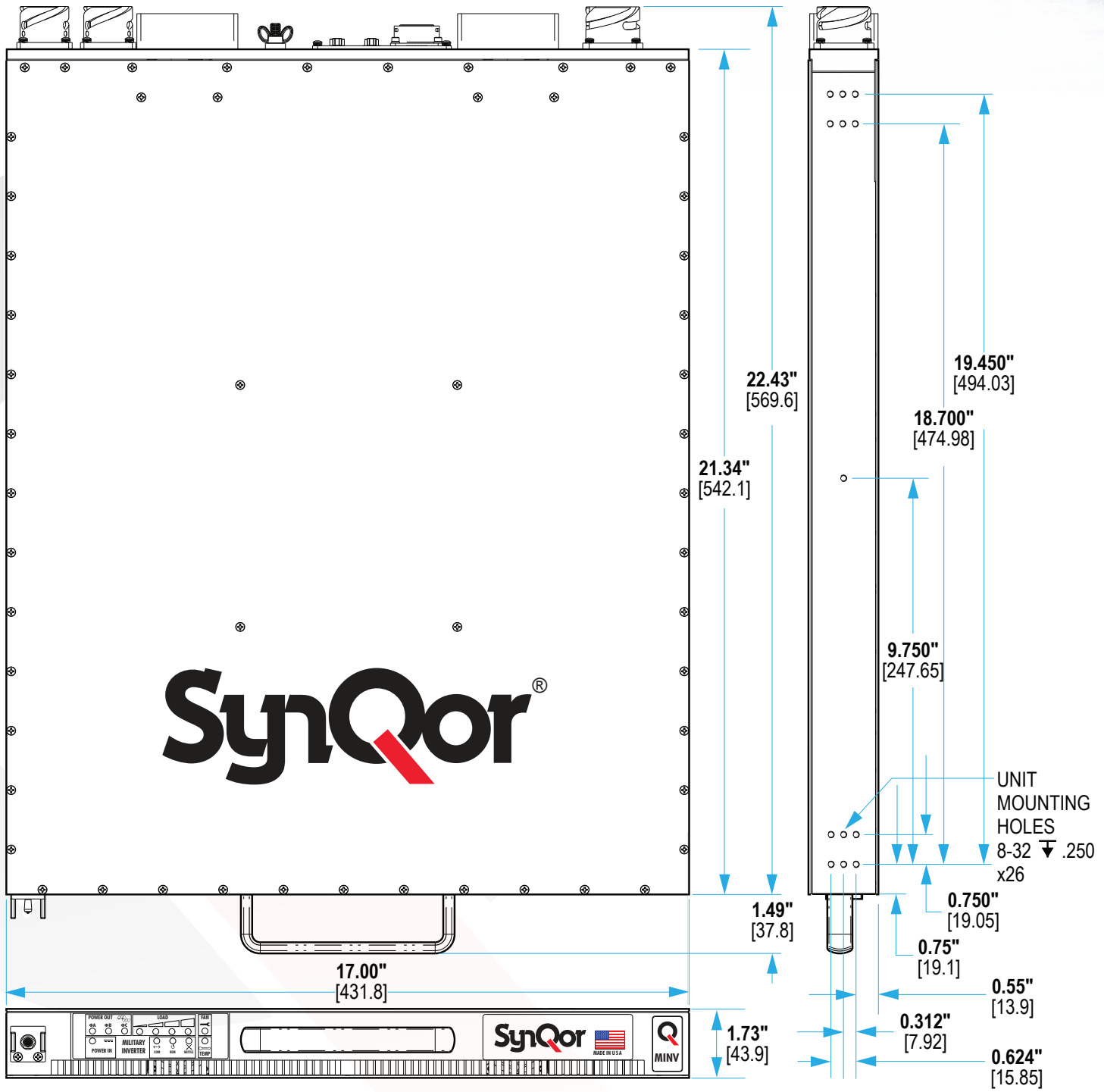
*AC Output pin out is shown for one single-phase output.



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Mechanical Diagrams





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Application Section

AC Output Hot-Side Electronic Breaker

Fault Tolerant, Glitch-Free Operation

The “R” option adds an electronic breaker to the AC output of the MINV to permit fault-tolerant, glitch-free parallel operation. With this option, when several MINV units are connected in parallel at their AC outputs and one unit has an internal fault that might otherwise have pulled down the AC output bus, the electronic breaker will disconnect the failed unit so that the remaining paralleled units can continue to power the bus. This “disconnect” occurs very quickly so that the ac output voltage will remain within its specified parameters as long as the remaining paralleled units can deliver the total load power.

The electronic breaker is a single-pole breaker present in the hot-side output wire only. The neutral output wire is left floating from the MINV case with the “R” option to facilitate the paralleling of units into various configurations.

Sharing And Redundancy

The “R” option also increases the total number of MINV units that can be paralleled to a maximum of 32. AC output current sharing among the paralleled units is accomplished with a high speed digital configuration cable. The units will share the total load current to within $\pm 2\%$, and for a split-phase or 3-phase system the AC voltages and AC currents will have phase balance within ± 2 degrees.

Besides allowing a higher number of MINV units to be paralleled, the “R” option also makes it possible to set up N+1, or more generally N+M, redundant systems with a total of up to 32 MINV units. In such a system the failure of one (or M) MINV unit(s) will not cause the overall system to fail. A failed unit can then be replaced to return the redundancy level to its original design. The replacement unit can be installed into a live, operating system with proper precautions, but it is recommended that the system be turned off first.

Configuration Cables

The diagrams on the following page give examples of how multiple MINV units with the “R” option can be connected to create higher output power single-phase, split-phase, and 3-phase AC systems that will have N+M redundancy as long as the total number of units is more than is needed for the maximum load power per phase. Note, again, that the maximum total number of units that can be arranged in any of these configurations is 32.

Any system of “R” option MINV units requires a specific configuration cable that defines the purpose of each MINV. Configuration cables for 1+1 redundant and 2+1 redundant single-phase systems are available as standard products. Please contact the factory to purchase configuration cables for systems larger than three MINV units, or systems that are split-phase or 3-phase.

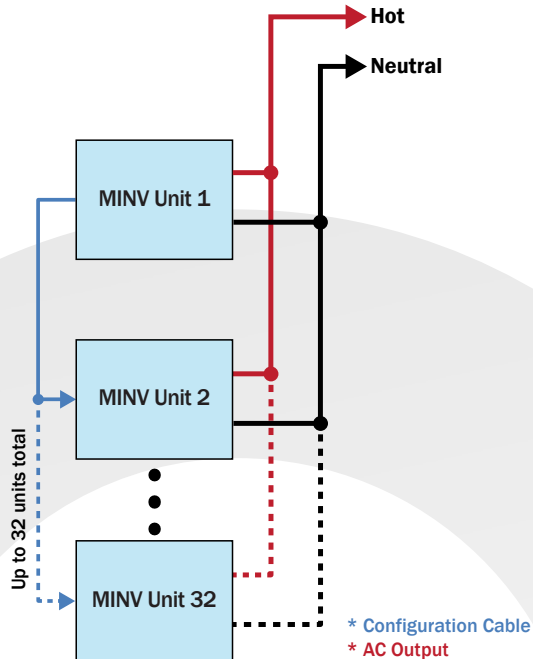


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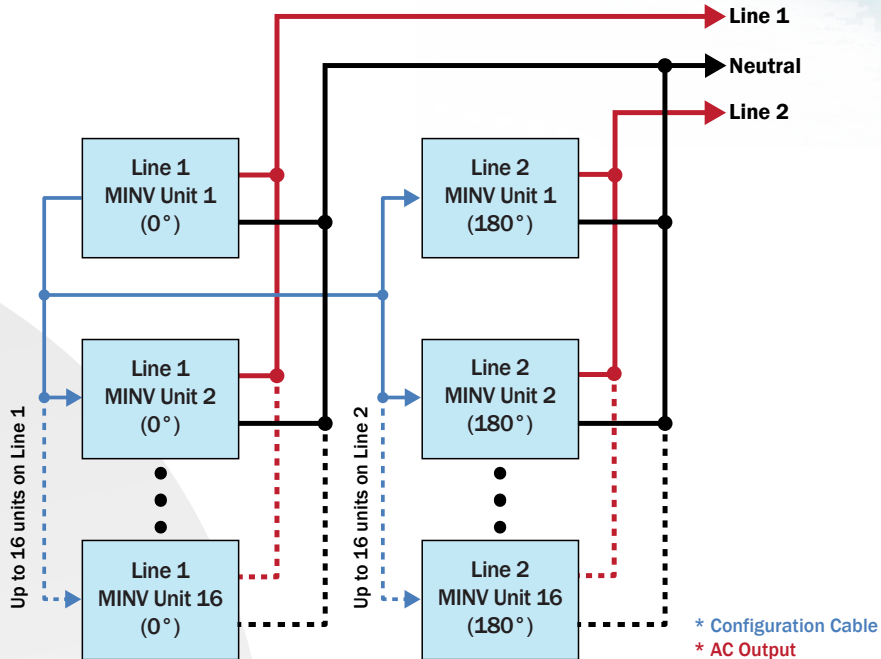
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Application Section

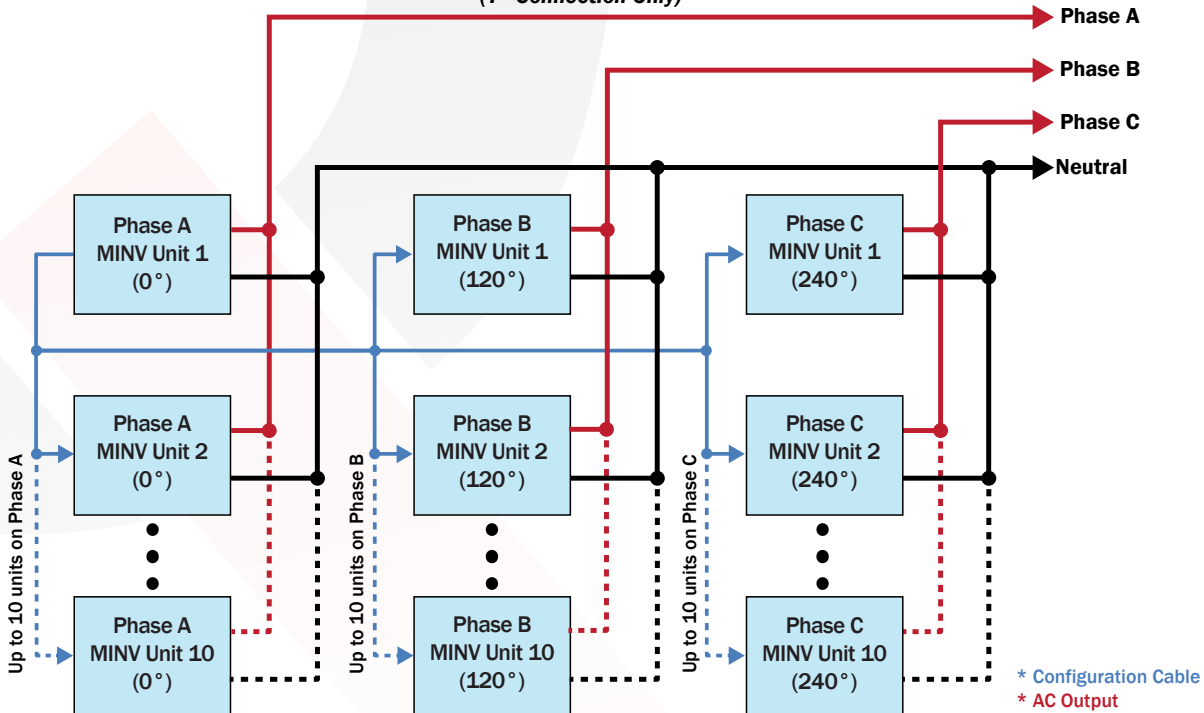
Single Phase Output System



Split Phase Output System



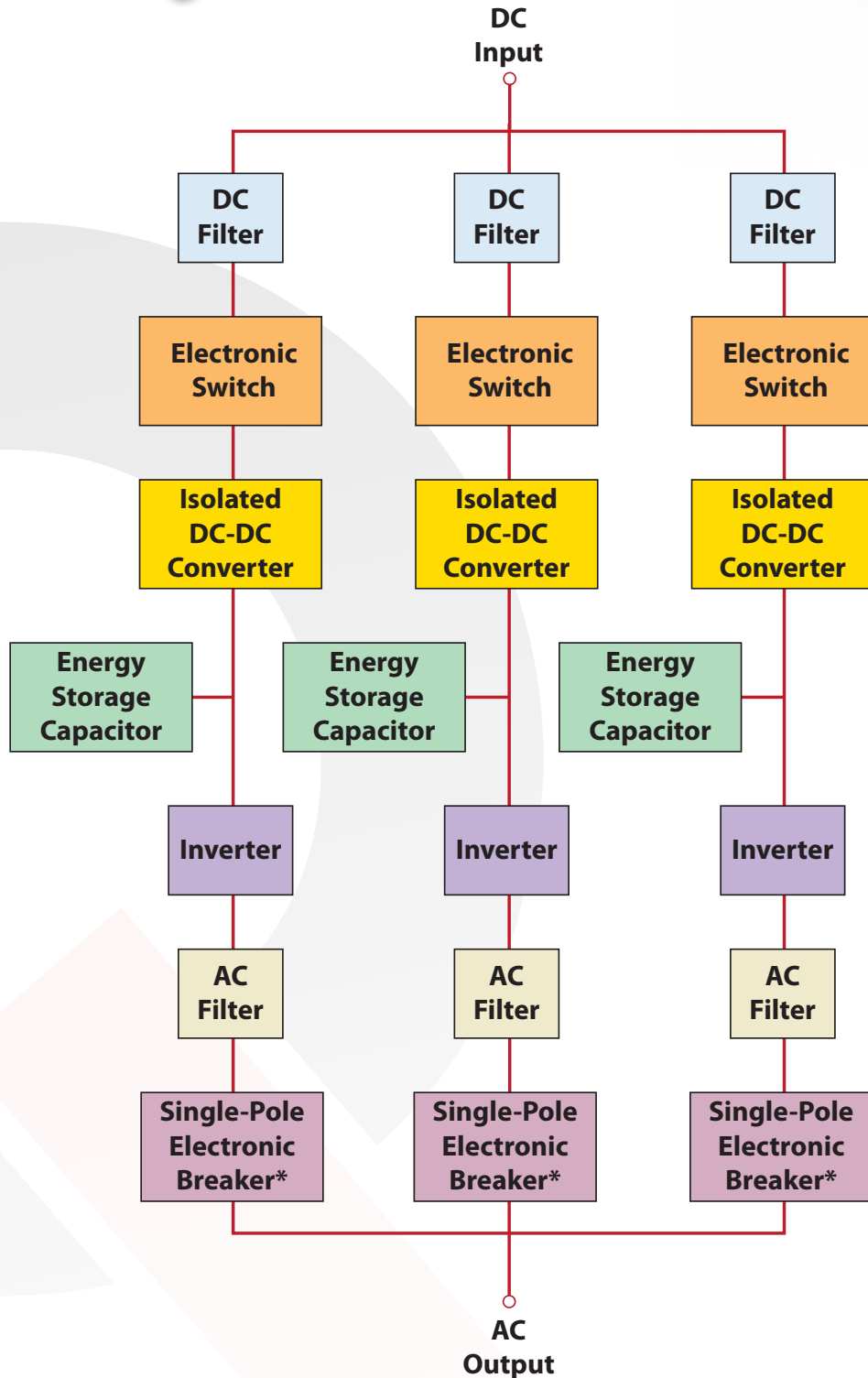
3-Phase Output System (Y - Connection Only)



* Contact factory for system specific configuration cables.



Block Diagram



The unit can also be configured to provide 1 or 3 isolated single-phase outputs or one 3-phase output.

* Single-Pole Electronic Breaker installed on all AC output filter modules when ordering "R" option



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Accessory Options

Rail Kits	
Slide Rail Kit ²	SYN-9002
Fixed Bracket Kit ³	SYN-9031
Power Cables (10' long)	
AC Output (Hardwire)	SYN-9630
DC Input Negative (Hardwire)	SYN-9652
DC Input Positive (Hardwire)	SYN-9651
Power Cables (3' long)	
DC Output (MPS), DC Input (MINV), 3', Negative	SYN-9180
DC Output (MPS), DC Input (MINV), 3', Positive	SYN-9181
Power Cables (2' long)	
DC Output (MPS), DC Input (MINV), 2', Negative	SYN-9180-2
DC Output (MPS), DC Input (MINV), 2', Positive	SYN-9181-2
Rackmount Transit Cases	
Transit Case, 3U, Gray, with Casters ³	SYN-9410
Transit Case, 3U, Gray, No Casters ³	SYN-9412
Fan Replacement Kit	
Counter-Rotating Replaceable Fan Module	SYN-9452

Notes:

- 1: Other Options also available, check the website or contact power@synqor.com for further information.
- 2: Slide Rail Kit (SYN-9002) is not recommended for transit and ruggedized use.
- 3: Fixed Bracket Kit (SYN-9031) with Transit Case (SYN-9410 or SYN-9412) is required for transit and ruggedized use (qualified to pass MIL-STD-810G Loose Cargo and Transit Drop requirements).

User Communications (I/O) Cables	
HD DB15M to DB9F (RS232, 10')	SYN-9301
HD DB15M to DB15M (RS232 and Digital I/O, 10')	SYN-9305
Mil-Circular to RJ45 (Ethernet, 10')	SYN-9321
Configuration Cables	
HD DB15F to DB15F (2 Units Parallel, Expanded Paralleling, 3')	SYN-9341
HD DB15F to DB15F (3 Units Parallel, Expanded Paralleling, 6')	SYN-9343
HD DB15F to DB15F (2 Units Series, 3')	SYN-9613
HD DB15F to DB15F (3 Units 3-Phase, 6')	SYN-9617



Optional
Rackmount Transit Case



6 NEMA Receptacles with Breaker



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Ordering Information

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	1U	28	1	G	6	S	E00
MINV	4000: 4000 W 5000 VA	1U: 1.73"	28: 20 - 33 V	1: 115 Vrms 2: 230 Vrms	G: Grounded F: Floating * R: AC Output Electronic Breaker *	5: 50 Hz 6: 60 Hz 4: 400 Hz	S: One Single-Phase Output T: Three Single-Phase Outputs Y: One 3-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 3 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

Example: MINV-4000-1U-28-1G6S-E00

Contact SynQor for further information and to order:

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PATENTS

SynQor holds numerous U.S. patents, one or more of which apply to most of its power conversion products. Any that apply to the product(s) listed in this document are identified by markings on the product(s) or on internal components of the product(s) in accordance with U.S. patent laws. SynQor's patents include the following:

5,999,417	6,222,742	6,545,890	6,594,159	6,894,468	6,896,526
6,927,987	7,050,309	7,072,190	7,085,146	7,119,524	7,269,034
7,272,021	7,272,023	7,558,083	7,564,702	7,765,687	7,787,261
8,023,290	8,149,597	8,493,751	8,644,027	9,143,042	

WARRANTY

SynQor offers a one (1) year limited warranty. Complete warranty information is listed on our website or is available upon request from SynQor.