



REDHAWK
ENERGY



Stirling Engines

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RH - Stirling Engines

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RedHawk Energy Systems, LLC

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PowerGen Series

Pioneered in space and designed for rugged and remote operation, Qnergy's PowerGen Series Stirling Engine Generators provide reliable electrical power supply to the most demanding and mission-critical loads. Based on Qnergy's no-maintenance and highly reliable PCK series Stirling Engines, these generators can work seamlessly with a variety of fuel supplies to generate clean power from **1.8kW to 5.6kW**. By means of its flexible and modular design, these generators can be tailored to provide a broad range of power output architectures (standard 120/240 VAC) to meet the electrical requirements of each specific site load.

How It Works?

Qnergy's Free-Piston Stirling Engine (FPSE) generator can transform virtually any heat source into electricity. Once heat is applied to the FPSE the heat exchangers maintain a temperature differential across the engine causing the helium to shuttle back-and-forth inside the engine, expanding and contracting. The oscillating helium drives the linear reciprocating motion of the piston, which by means of an integral linear alternator, directly converts the reciprocating motion of the piston into electrical power.

The Qnergy engine has fewer moving parts than traditional kinematic Stirling engines, and no direct-contact points that cause wear and require lubrication.

Why PowerGen?

The conventional approach to prime and backup power generation has long been the use of diesel/gas generators due to their wide power range, mass market availability and low initial cost. What's often overlooked is the on-going maintenance needs and associated expenses to keep diesel/gas generators operational. You have to change the oil every few hours, rebuild the engine or even replace the generator entirely after 1,000-3,000 hours. In addition diesel/gas generators are noisy, have dirty emissions and are inefficient.

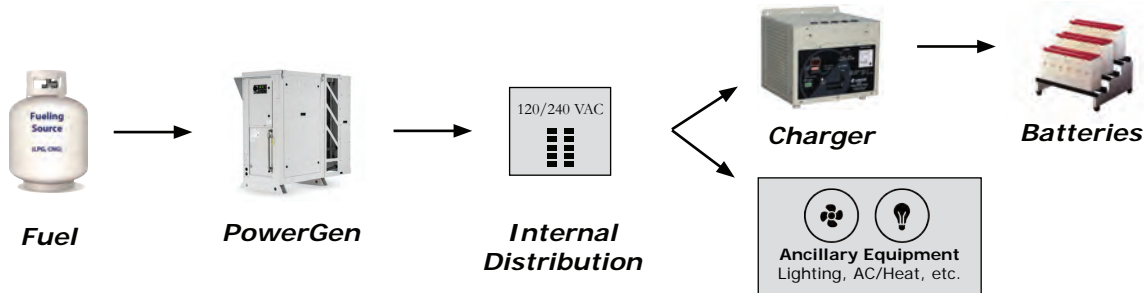
The PowerGen is truly a **maintenance-free** solution that offers **80,000+ hours** of reliable performance, two key features that make it an ideal and cost-effective power source in lieu of maintenance-intensive diesel/gas generators.

Qnergy



Prime Off-Grid Power

The PowerGen can be used as a prime power generator for remote locations where utility power connection is unavailable and/or too costly. Powered by propane or natural gas, the PowerGen's standard 120/240 VAC output feeds the sites distribution panel to feed a charger to charge batteries and/or feed power to ancillary equipment.



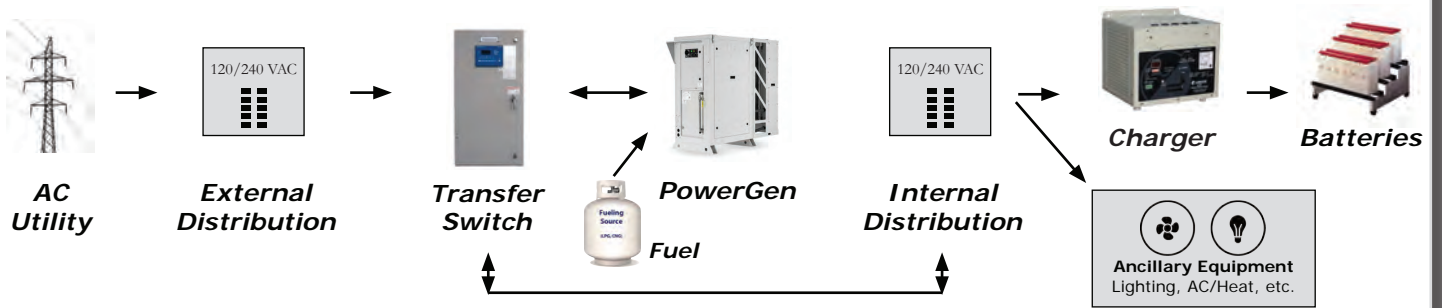
Rail Applications

PowerGen Series: 1.8kW - 5.6kW



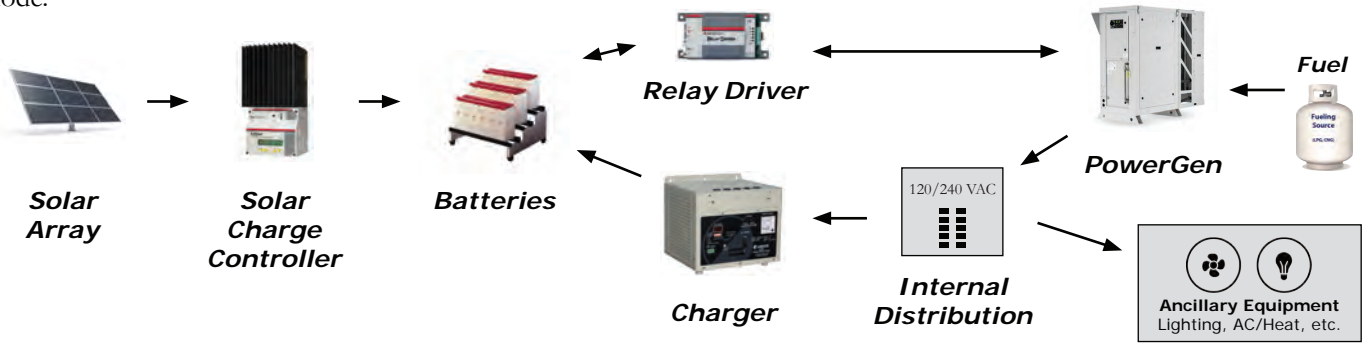
Backup Power

The PowerGen can be used as a backup power generator for locations with AC utility power connection. A transfer switch will signal the PowerGen to start and provide power during an AC power outage. The PowerGen's standard 120/240 VAC output feeds into the sites distribution panel to feed a charger to charge batteries and/or feed power to ancillary equipment. Once AC utility power is restored, the PowerGen will return to standby mode.



Solar Hybrid

The PowerGen is well suited to provide supplemental power to charge batteries at new or existing Solar Power System locations. When batteries dip below a certain lower threshold voltage, the PowerGen will be triggered to start via a relay driver. The PowerGen's standard 120/240 VAC output feeds into the site's distribution panel to feed a charger to charge batteries and/or feed power to ancillary equipment (if applicable). Fueling requirements and runtime of the PowerGen can be greatly reduced when used in a solar hybrid configuration as the PowerGen is only periodically called upon during winter months and/or times of limited solar production. Once batteries are fully charged, the PowerGen will return to standby mode.



Features & Benefits

PowerGen Series: 1.8kW - 5.6kW



Fuel Efficient



The PowerGen can operate seamlessly and efficiently with a variety of readily available, easily transportable and low cost fuels like propane or natural gas.

Minimal Maintenance



The PowerGen has few moving parts and no direct contact points that cause wear and require lubrication; minimizing maintenance needs and site visits.

Low Emissions



Compared to diesel/gas generators that require special permitting, the PowerGen features efficient, low-emission combustion (100x lower than EPA CO and NOx limits).

Plug & Play Integration



The PowerGen can easily be integrated with new or existing power infrastructure including batteries, solar & wind, solar controllers, rectifiers and much more.

Design Life



The PowerGen's design life is conservatively estimated at **80,000+ hours** with zero engine maintenance.

Load Following Capability



The PowerGen is capable of matching power output to real-time load demand to help conserve fuel.

Low Temperature Package



The PowerGen can be optionally outfitted with the Low Temperature Operation Package to extend starting capability and operation down to -40°F (-40°C) for standby systems in cold climates. The Low Temperature Operation Package may not be necessary for continuous-run (prime power) applications in cold climates. Please inquire for more information.

Heat Recovery Options

Heat Rejection Unit (HRU)

The PowerGen can be provided with an optional Heat Rejection Interface to capture and use clean dry air heat. The heat-supply ratio is 2.5-3.5X that of the electrical power,

- 5 Meter (16ft) HRU
- 10 Meter (32ft) HRU



Glycol Heat Trace (GHT) Module

The Glycol Heat Trace (GHT) feature is an optional heat recovery system that allows for the waste heat from the PowerGen and its exhaust to be used. A plate heat exchanger is used to separate the engine coolant and the GHT media. The GHT media is circulated using a rotary vane pump on a variable speed motor. The PowerGen monitors the supply and return temperatures of the GHT media and adjusts the units operation to match the heat load and meet the return temperature setpoint.

Indoor Mounting Kit



The PowerGen can be mounted inside of a shipping container or equipment house with the optional indoor mounting kit. This solution provides protection for sites regardless of the weather or season. This solution is also optimized for shipping and can reduce system fuel consumption.

Remote Monitoring

Qnergy's optional SmartView Remote Monitoring Package (yearly subscription-based service) is a web based monitoring solution that allows the end user to view operational status of their PowerGen system(s).

Benefits include:

- Secure Login
- Call Out Capabilities
- Auto Notification
- Access All Units with Status
- No Software to Download
- System Performance Details
- Event Log Details-Export Data
- Analytics (Charts and Graphs)

PowerGen N+ Solutions

Qnergy's Power Interface Package (PIP) allows the paralleling of multiple power sources with flexible AC and DC output options. The PIP allows for scalable power outputs from 5kW to 10kW to 15kW.

Technical Specifications

*Specifications subject to change

PowerGen 1800 Series - Product Operational Data



Series	Configuration	Output	Phase Angle	Connection	Max Power
Standard	120 / 240 VAC Split Phase	Output A: 120VAC 60Hz Output B: 120VAC 60Hz	A: 0° B: 180°	3 Wire: L1, L2 & Common/Neut.	1.8kW

Optional Configurations:

A	± HVDC (±332 to ±365)	Output A: +HVDC Output B: -HVDC	A: 0° B: 180°	3 Wire: +ve, -ve & Common	1.8kW
B	120 / 240 VAC 2 Phase	Output A: 120VAC 60Hz Output B: 240VAC 50/60Hz	A: 0° B: 0°	3 Wire: L1, L2 & Common/Neut.	1.8kW
C	240V / 480V Split Phase	Output A: 240VAC 50/60 Hz Output B: 240VAC 50/60 Hz	A: 0° B: 180°	3 Wire: L1, L2 & Common/Neut.	1.8kW
D	± HVDC / 120VAC	Output A: +HVDC Output B: 120VAC 60Hz	A: 0° B: 0°	3 Wire: +ve, L2 & Common	1.8kW
E	± HVDC / 240VAC	Output A: +HVDC Output B: 240VAC 50/60Hz	A: 0° B: 0°	3 Wire: +ve, L2 & Common	1.8kW

Low voltage DC outputs (24VDC / 48VDC) requires the use of the Qnergy Power Interface Package (PIP) or Inverter

Fuel Operational Specifications

Fuel Consumption	Natural Gas (max)	1300 ft ³ /day
Fuel Consumption	Propane (max)	10 gal/day
Fuel Pressure Range	Natural Gas	3-50 PSI
Fuel Pressure Range	Propane	2-10 PSI
Wobbe Index	Min / Max	832 BTU/ft ³ / 1,470 BTU/ft ³
Caloric Value	Min / Max	751 BTU/ft ³ / 1,215 BTU/ft ³

Emissions

NOx @ 5% O ₂	30.0 ppm	66 mg/kWh
CO @ 5% O ₂	45.0 ppm	60 mg/kWh
VOC	--	Negligible, Lean Combustion

Heat Recovery Unit Operational Specification

Thermal Heat Rejection	Max Available	x2.5-3.5 of Electric Power Output
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Environmental Condition Specifications

Sound	Max dBA	< 75 dBA @ 1m
Ambient Temp Continuous Operation*	Min / Max	-13°F to 122°F
Ambient Temp Rated (Startup)*	Min / Max	5°F to 122°F
Altitude	Derate	5% derate every 1,000 ft (above 5,000 ft)

Low Temperature Package (down to -40°F)

Technical Specifications

*Specifications subject to change

PowerGen 5650 Series - Product Operational Data



Series	Configuration	Output	Phase Angle	Connection	Max Power
Standard	120 / 240 VAC Split Phase	Output A: 120VAC 60Hz Output B: 120VAC 60Hz	A: 0° B: 180°	3 Wire: L1, L2 & Common/Neut.	5.65kW

Optional Configurations:

A	± HVDC (±332 to ±365)	Output A: +HVDC Output B: -HVDC	A: 0° B: 180°	3 Wire: +ve, -ve & Common	5.65kW
B	120 / 240 VAC 2 Phase	Output A: 120VAC 60Hz Output B: 240VAC 50/60Hz	A: 0° B: 0°	3 Wire: L1, L2 & Common/Neut.	5.65kW
C	240V / 480V Split Phase	Output A: 240VAC 50/60 Hz Output B: 240VAC 50/60 Hz	A: 0° B: 180°	3 Wire: L1, L2 & Common/Neut.	5.65kW
D	± HVDC / 120VAC	Output A: +HVDC Output B: 120VAC 60Hz	A: 0° B: 0°	3 Wire: +ve, L2 & Common	5.65kW
E	± HVDC / 240VAC	Output A: +HVDC Output B: 240VAC 50/60Hz	A: 0° B: 0°	3 Wire: +ve, L2 & Common	5.65kW

Low voltage DC outputs (24VDC / 48VDC) requires the use of the Qnergy Power Interface Package (PIP) or Inverter

Fuel Operational Specifications

Fuel Consumption	Natural Gas (max)	3,964 ft ³ /day
Fuel Consumption	Propane (max)	44.4 gal/day
Fuel Pressure Range	Natural Gas	3-50 PSI
Fuel Pressure Range	Propane	2-10 PSI
Wobbe Index	Min / Max	832 BTU/ft ³ / 2,163 BTU/ft ³
Caloric Value	Min / Max	751 BTU/ft ³ / 3,382 BTU/ft ³

Emissions

NOx @ 5% O ₂	30.0 ppm	66 mg/kWh
CO @ 5% O ₂	9.0 ppm	12 mg/kWh
VOC	--	Negligible, Lean Combustion

Heat Recovery Unit Operational Specification

Thermal Heat Rejection	Max Available	x2.5-3.5 of Electric Power Output
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Environmental Condition Specifications

Sound	Max dBA	< 75 dBA @ 1m
Ambient Temp Continuous Operation*	Min / Max	-13°F to 122°F
Ambient Temp Rated (Startup)*	Min / Max	5°F to 122°F
Altitude	Derate	5% derate every 1,000 ft (above 5,000 ft)

Low Temperature Package (down to -40°F)

Technical Specifications

*Specifications subject to change

Product Application & Engineering

Qnergy's PowerGen is a thermal-powered generator suitable to meet remote power needs utilizing virtually any combustible gaseous fuel. All Qnergy PowerGen generators feature patented QB80 Series Stirling Engines.

General	
Make	Qnergy
Model	QRP 2A-LNS
Engine	QB80
Engine Type	Stirling Engine
Engine Controller	QEC 3.5

Electrical System	
System Output Power	See Configuration
Power Max Gauge Wire Interface	6-20 AWG
Cable Gland Input	3/4" Std
Ignition/Standby Battery (Standard)	Sealed AGM Deep Cycle, 12V DC 40Ah
Battery Capacity (Optional: for increased standby)	Up to 160 Ah
Safety	E-Stop (Normally Closed)

Fuel System	
Fuel Type	Dry Natural Gas, Propane (C1-C4)
Burner	Pre-mix
Ignition	Direct
Gas Regulator	2-Stage
Gas Pressure Monitor	Transducer
Fuel Port	1/2" NPT Male

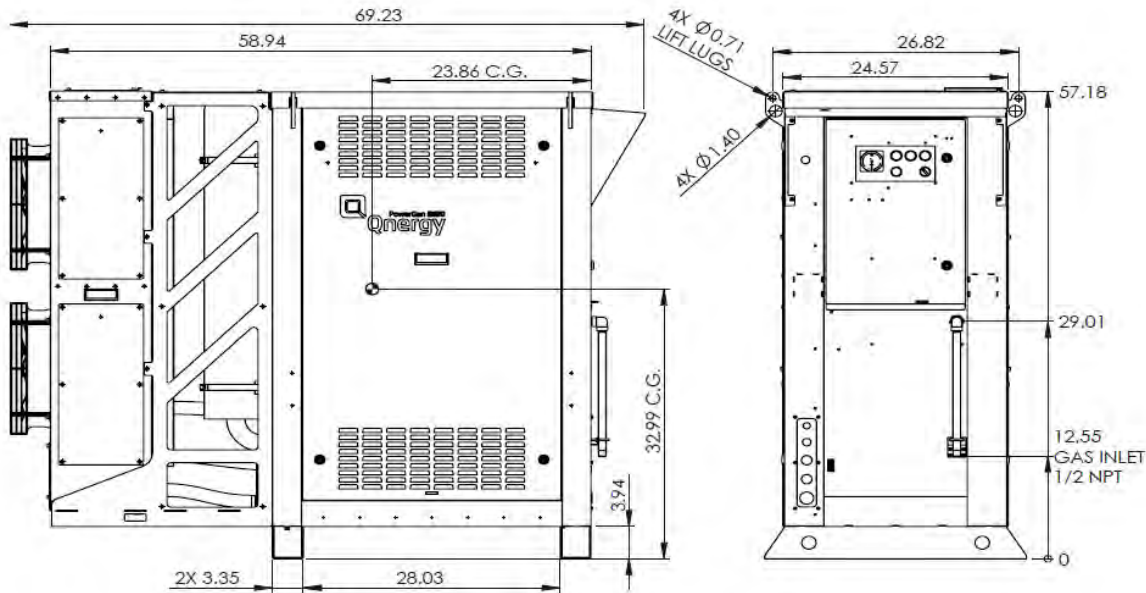
Cooling System	
Cooling System Type	Closed Loop
Pump Type	High Efficiency Grundfos Circulating Pump
Cooling Fan Type	EC Fan (Qty. 2)
Coolant Type Required	Prestone Cor-Guard or equivalent
Coolant Ratio	50/50 (EG)
Max Coolant Volume	4.2 gal

Communication	
Ethernet	RJ45
Protocol	Modbus RTU
Internet Infrastructure	TCP/IP
Data Viewer	Qnergy SmartView (C)
Discrete I/O's	Configurable
Inputs (Dry Contact)	x6 (16-20 AWG)
Outputs (Relay)	x8 (16-20 AWG)(Max 250 V/1A)

Technical Specifications

*Specifications subject to change

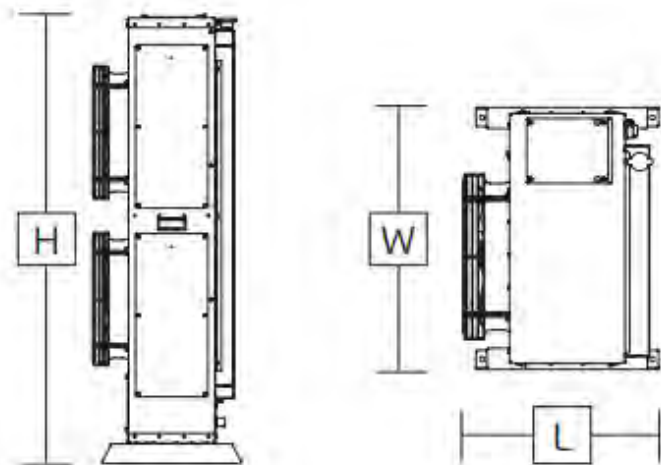
PowerGen Dimension / Weight



PowerGen Description	Measurement
PowerGen Dry Weight	866 lbs
PowerGen Length (L)	69.4"
PowerGen Width (W)	28.5"
PowerGen Height (H)	57.2"

Foundation	Measurement
Recommended Pad Length (L)	6 ft
Recommended Pad Width (W)	3 ft
Recommended Pad Base	gravel / concrete / rail ties

HRU Standalone Dimensions



HRU Description	Measurement
HRU Floor Standing Length (L)	19"
HRU Floor Standing Width (W)	25.4"
HRU Floor Standing Height (H)	54"
HRU Wall Mounted Length (L)	28.8"
HRU Wall Mounted Width (W)	24.9"
HRU Wall Mounted Height (H)	53.3"
HRU Max Placement Distance	65.5"



REDHAWK ENERGY



About

RedHawk Energy Systems, LLC is a value-added manufacturing subsidiary of the Arthur N. Ulrich Company. Since the early 1980's, we've helped hundreds of commercial and industrial customers tackle their critical prime and back-up power challenges with innovative solutions ranging from a few watts to several kilowatts. Our innovative power solutions include:

- Solar Power Systems
- RP Series Retractable Mast
- Solid Oxide Fuel Cells
- Alkaline Fuel Cells
- Stirling Engine Generators
- Micro-Wind Turbines
- Hybrid Power Systems
- Batteries
- Battery Boxes & Enclosures
- Switch Boost™ 120V, 24V & 12V Systems

Qnergy

Qnergy (q-ner-gy) is a company focused on providing ultra-reliable power solutions. Qnergy's technology is rugged, cost-effective, and efficient. With more than 40 years of expertise and proven reliability, Qnergy brings proprietary, high-performance Free-Piston Stirling Engine technology to the marketplace to integrate within commercial and industrial applications.

***RedHawk Energy Systems** is the exclusive sales distributor for Qnergy's PowerGen Stirling Engine Generators for the rail/transit market in the US & Canada.



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