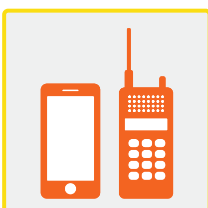
SOLAR STIK®

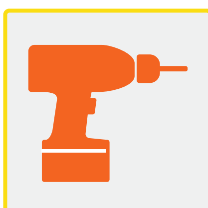
System Diagram Examples

Small
(Loads ≤ 3 kW)


Satcom

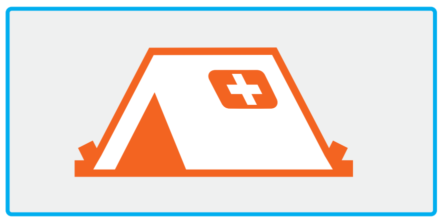

Laptops

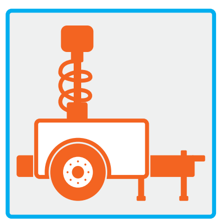

Cell/Radio

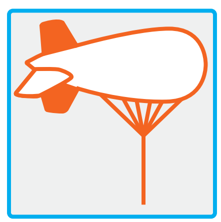

Rechargable Power Tools

Page 5

Medium
(3 kW < Loads ≤ 10 kW)


Medical Station


ISR Trailer


Aerostat

Page 12

Large
(Loads > 10 kW)


ISR Tower, Command Shelter with ECU

Page 16

How a System Works

Step 1
Determine Loads

A load is anything and everything that consumes power from an electrical system. If it gets plugged into a wall outlet to work, or if a device's battery requires a charge to function, it's the load. Step 1 in designing a portable hybrid power system is knowing the load's power demand (average, peak, surge) and voltage requirements (AC, DC, or both).

Step 2
Energy Storage

Adding a battery bank, or energy storage modules (ESMs), turns a low-efficiency system into a high-efficiency hybrid system. The load's power demands determine the energy storage capacity for a high-efficiency system. Choosing a battery chemistry (lithium-ion or lead-acid) that's the best fit for the application is part of the energy storage equation.

	Cycle Life	Cost	Charge Time	Energy Density	Weight
LFP **Lithium (LiFePO$_4$)**	*3000+	$$$	Fast	High	
VRLA **Lead-acid**	*500+	$$	Slow	Low	

**Depends on storage temperature*

Step 3
Power Generation

Energy is everywhere! Power generation involves converting power from available sources (solar, wind, fuel-driven generators, water, fuel cells, vehicles, or grid) into usable electricity. Where and how a portable hybrid power system will be used helps determine the power generation best suited for supporting the load. Power generated in the system must be greater than the power consumed by the load.

	Cost	Life Span	Build	Weight
Rigid Solar	$$$$	25-30 Years		
Rigid, Foldable Solar	$$$	10-15 Years		
Flexible Solar	$$$$	5-8 Years		
Wind	$$	10-15 Years		

Step 4
Power Management

Power management components are needed to get usable power from a portable hybrid power system. These components efficiently collect, convert, and distribute AC and/or DC power. Power management enables all technologies (energy storage and power generation) in a portable hybrid power system to operate efficiently and deliver power to the load.

The Inter-Connect Network

Components from each of the categories in a Solar Stik System are connected via Inter-Connect Cables and Inter-Connect Strips. The Inter-Connect network allows the system components to coordinate their functions, providing seamless operation for the application. This DC bus connection is a feature unique to the Solar Stik System.

Voltage is communicated through the common bus to all points in the network. Because the Inter-Connect is a voltage-based operational system, even if the cables are connected incorrectly, the network will still function—but at a reduced level—without damaging individual components. The Inter-Connect plugs on each end are polarized to ensure proper orientation. Plugs specific to each of the 12 VDC and 24 VDC network ensure that only compatible components can be integrated into a network.

The 24VDC Inter-Connect Strip 7 is a tool for expanding the energy storage capacity of a 24 VDC system. It is a common bus for connecting up to seven components.

Safety

The Inter-Connect network promotes safety within the circuit by minimizing the potential for a reverse-polarity connection. It protects from overloads and short circuits with a network of breakers placed strategically throughout the circuit.

System Scaling

Operators who use Solar Stik Systems might have limited experience using battery-based electrical circuits. The Inter-Connect network's Plug & Play connectors allow for rapid setup, modification, and configuration of system architecture, and serve as the electrical skeleton within the system's architecture.

12VDC Inter-Connect Cable

- 100 A maximum current
- Used in 12 VDC applications
- Snap-in plug with button release
- Crimp connectors
- Cannot be modified in the field

24VDC Inter-Connect Cable

- 200 A maximum current
- Used in 24 VDC applications
- Twist-lock plug
- Mechanical connectors—ring terminals
- Can be modified in the field

Hybrid System, High Efficiency

A hybrid power system utilizes a bank of batteries to capture all of the energy produced by the power generation source (fuel-driven generator, solar, wind). Batteries and fuel-driven generators are natural complements to one another.

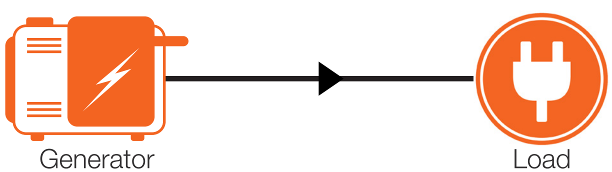
Benefits of Pairing Batteries and Generators

1. **Reduced Generator Runtime**
   Installing a battery in a system relegates a fuel-driven generator to a support role (recharging) for a battery bank, allowing it to be used only when the battery state of charge (SOC) is low. This reduces runtime, maintenance, and fuel consumption.

2. **Power Stability and Security**
   Installing a battery in the system provides power stability and security (continuity of operations) in the event of a generator shutdown because the batteries serve as an uninterruptible power supply (UPS), bridging the gap when generators are shut down due to failure, maintenance, refueling, or upgrade.

Low Efficiency

Traditional Power Systems

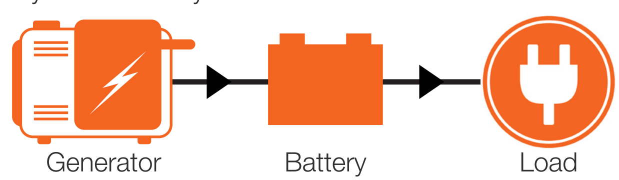


Energy Wasted

Energy from fuel is **wasted** if not consumed by the load.

High Efficiency

Hybrid Power Systems



No Energy Wasted

Energy from fuel is consumed by the load or **stored** as potential energy in the battery.

Small System Diagram
(Loads ≤ 3 kW)
Example #1

Example #1 Lead-acid

Legend	
(orange)	DC Solar Circuit
(green)	AC Circuit
▶	Direction of flow
----	Component types

Benefits

- 0.5–0.75 kWh daily power generation from 125 W solar array (assuming 4–6 hours of solar irradiance)
- 0.5 kWh of lead-acid AGM energy storage (750 cycle life)
- 24 VDC and 120 VAC 60 Hz or 230 VAC 50 Hz configuration
- Ability to process and accept solar, grid, and generator power
- Built and designed to MIL-STD-810G
- Scalable and modular system architecture (all components are two-person portable)
- Customizable inputs and outputs (NATO, CLA, USB, NEMA, etc.)

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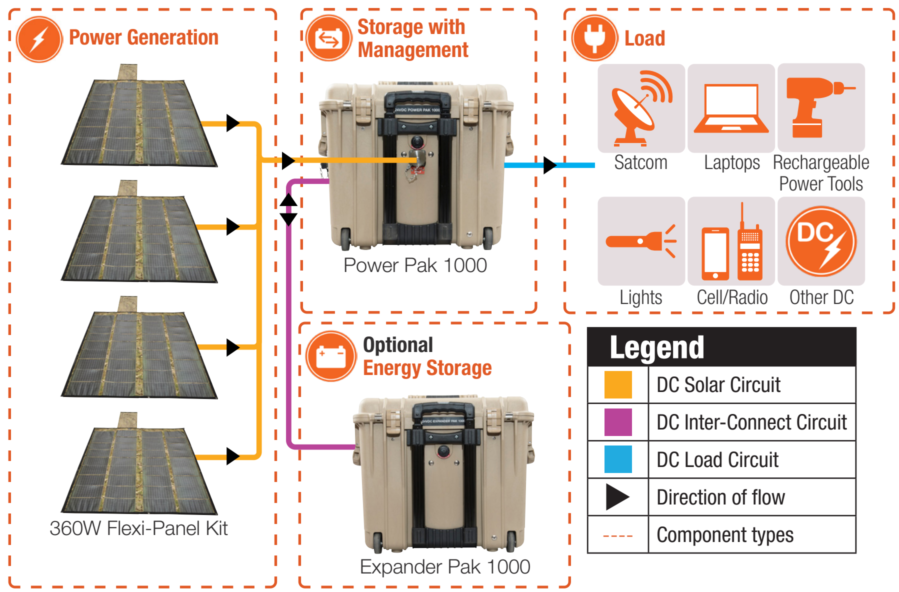
Small System Diagram
(Loads ≤ 3 kW)
Example #2

Example #2 Lead-acid



Features

- 2.1 kWh daily power generation from 360 W solar array (assuming 6 hours of solar irradiance)
- 1.0 kWh of lead-acid AGM energy storage
  - 2.0 kWh of storage with optional Expander Pak 1000
- Ability to run 150-watt load for over 6 hours from energy storage alone
- Optional inverter to support AC load
- Optional remote monitoring of system status
- Ability to process and accept solar power
- Transportable by land, sea, and air cargo
- Open architecture
- Built and designed to MIL-STD-810G
- Scalable

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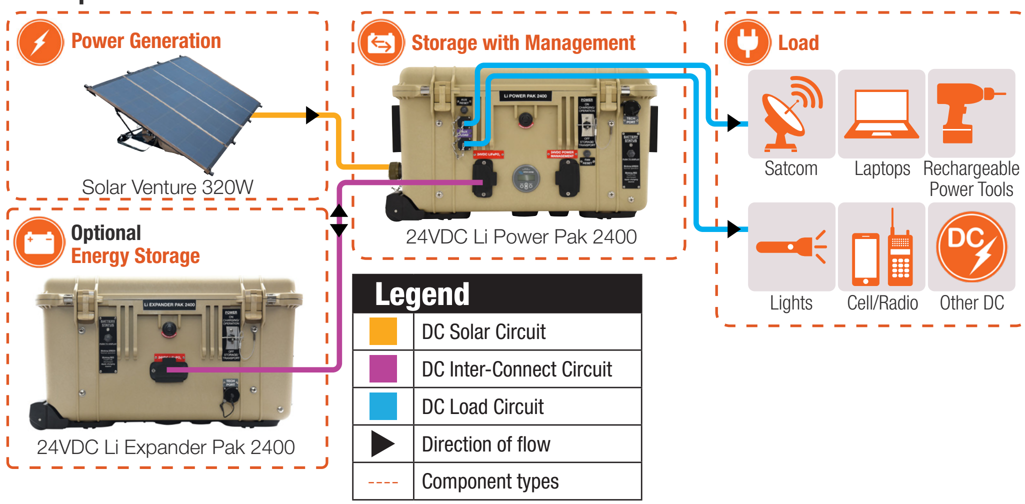
Small System Diagram (Loads ≤ 3 kW)

Example #3

Example #3 Lithium-ion



Features

- 2.1 kWh daily power generation from 320 W solar array (assuming 6 hours of solar irradiance)
- 2.4 kWh of LiFePO$_4$ energy storage
  - 4.8 kWh of LiFePO$_4$ energy storage with optional 24VDC Li Expander Pak 2400
- Ability to run 150-watt load for over 16 hours from energy storage alone
- Optional inverter to support AC load
- Optional remote monitoring of system status
- Ability to process and accept solar power
- Transportable by land, sea, and air cargo
- Open architecture
- Built and designed to MIL-STD-810H
- Scalable

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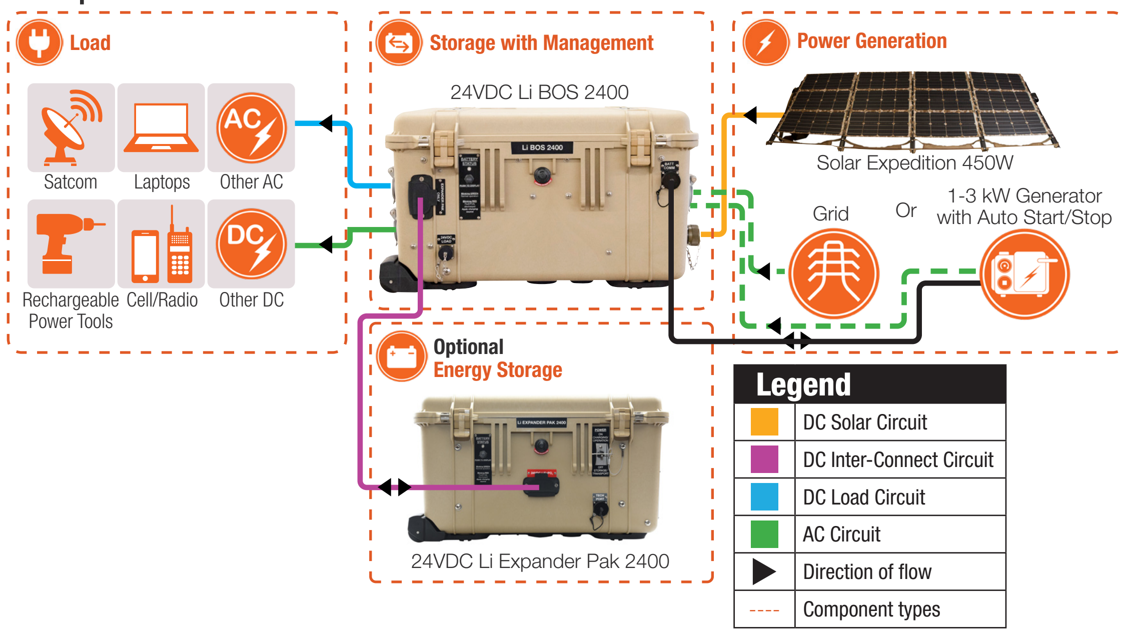
Small System Diagram
(Loads ≤ 3 kW)
Example #4

Example #4 Lithium-ion



Features

- 2.7 kWh daily power generation from 450 W solar array (assuming 6 hours of solar irradiance)
- 2.4 kWh of $LiFePO_4$ energy storage
  - 4.8 kWh of $LiFePO_4$ energy storage with optional 24VDC Li Expander Pak 2400
- Ability to run 150-watt AC or DC load for over 16 hours from energy storage alone
- Ability to process and accept solar, vehicle, grid, and generator power
- Transportable by land, sea, and air cargo
- Open architecture
- Built and designed to MIL-STD-810H
- Scalable

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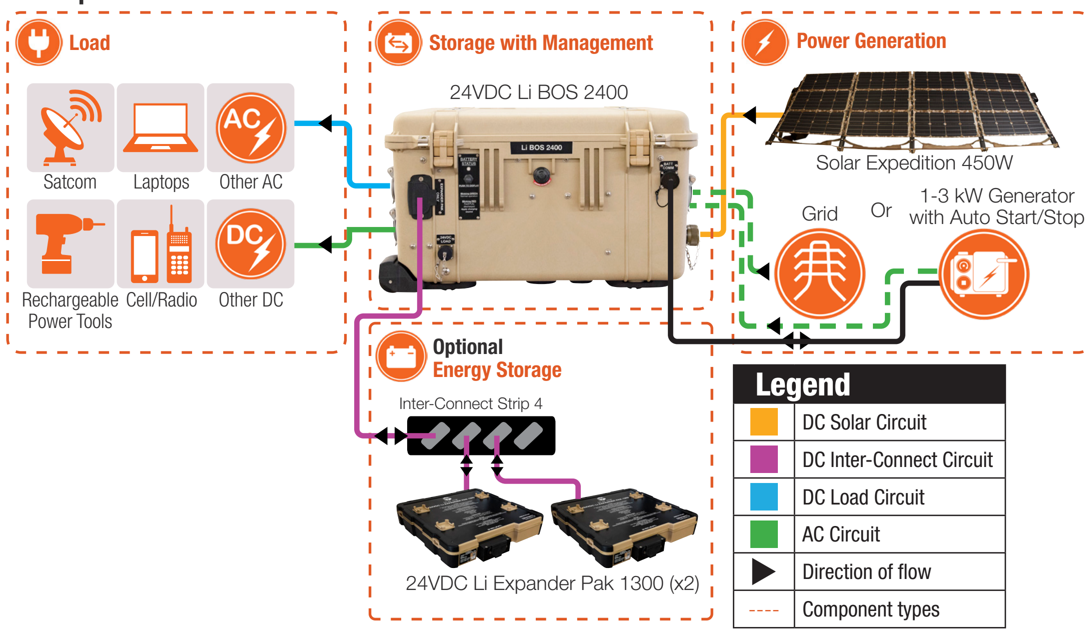
Small System Diagram
(Loads ≤ 3 kW)
Example #5

Example #5 Lithium-ion



Features

- 2.7 kWh daily power generation from 450 W solar array (assuming 6 hours of solar irradiance)
- 2.4 kWh of $LiFePO_4$ energy storage
  - 5.0 kWh of $LiFePO_4$ energy storage with optional 24VDC Li Expander Pak 1300s
- Ability to run 150-watt AC or DC load for over 16 hours from energy storage alone
- Ability to process and accept solar, vehicle, grid, and generator power
- Transportable by land, sea, and air cargo
- Open architecture
- Built and designed to MIL-STD-810H
- Scalable

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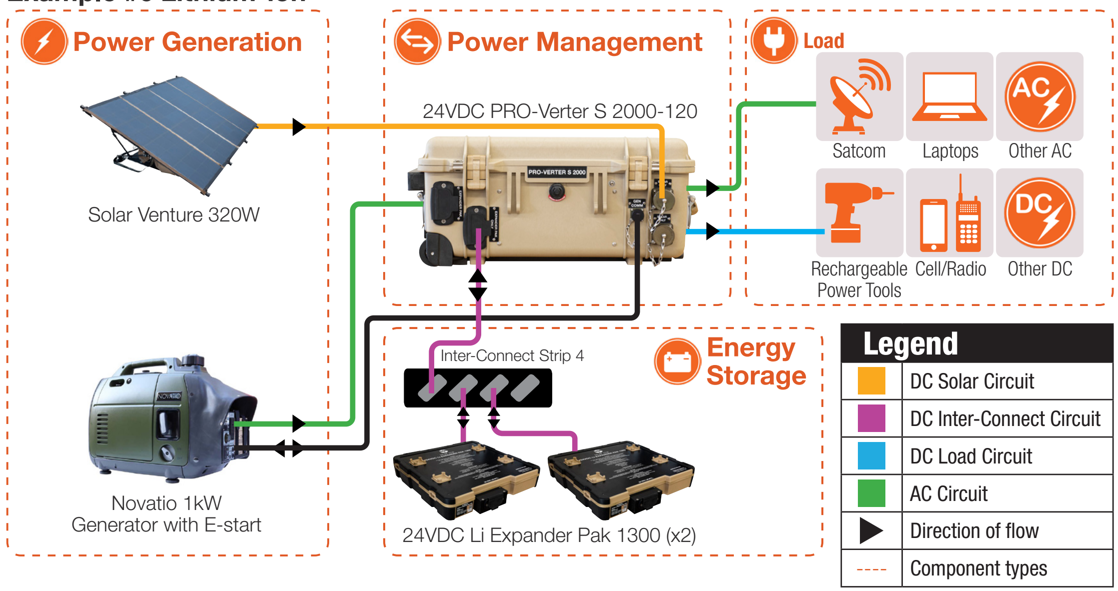
Small System Diagram
(Loads ≤ 3 kW)
Example #6

Example #6 Lithium-ion



Features

- 1,200 W continuous 120 VAC output
- 2,000 W surge 120 VAC output
- 2.1 kWh daily power generation from 320 W solar array (assuming 6 hours of solar irradiance)
- 2.6 kWh of $LiFePO_4$ energy storage
- Ability to run 150-watt AC or DC load for over 17 hours from energy storage alone
- Ability to process and accept solar, grid, and generator power
- Auto-Generator Start (AGS) capability
- Transportable by land, sea, and air cargo
- Open architecture
- Built and designed to MIL-STD-810H
- Scalable

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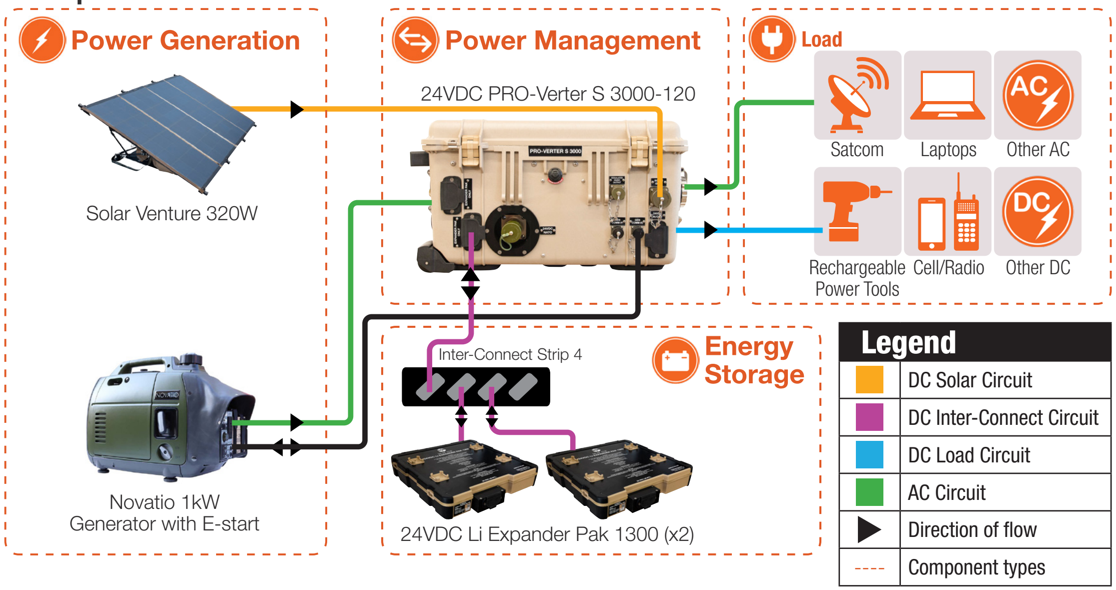
Small System Diagram
(Loads ≤ 3 kW)
Example #7

Example #7 Lithium-ion



Features

- 2,000 W continuous 120 VAC output
- 4,000 W surge 120 VAC output
- 2.1 kWh daily power generation from 320 W solar array (assuming 6 hours of solar irradiance)
- 2.6 kWh of $LiFePO_4$ energy storage
- Ability to run 150-watt AC or DC load for over 17 hours from energy storage alone
- Ability to process and accept solar, grid, and generator power
- Auto-Generator Start (AGS) capability
- Transportable by land, sea, and air cargo
- Open architecture
- Built and designed to MIL-STD-810H
- Scalable

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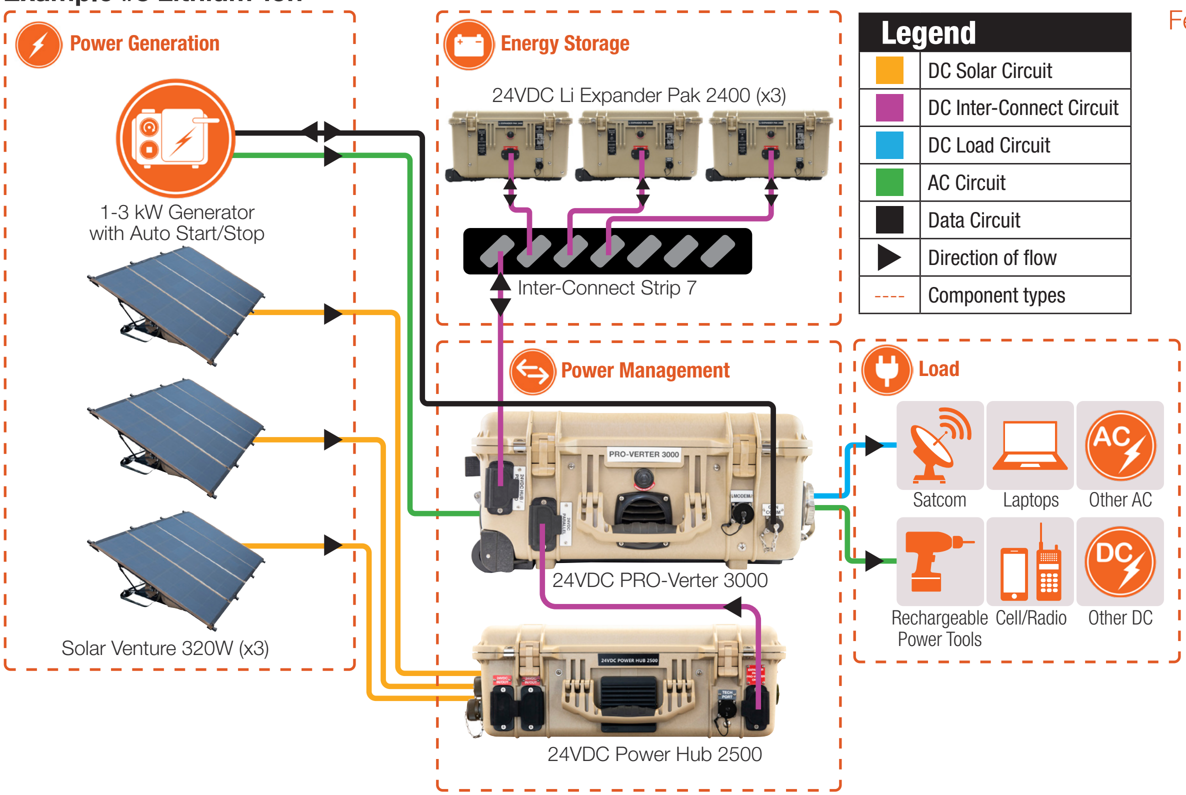
Small System Diagram
(Loads ≤ 3 kW)
Example #8

Example #8 Lithium-ion



Features

- 6.3 kWh daily power generation from 1,050 W solar array (assuming 6 hours of solar irradiance)
- 7.2 kWh of $LiFePO_4$ energy storage
- Ability to run 150-watt AC or DC load for over 48 hours from energy storage alone
- Ability to process and accept solar, grid, and generator power
- Auto-Generator Start (AGS) capability
- Transportable by land, sea, and air cargo
- Open architecture
- Built and designed to MIL-STD-810H

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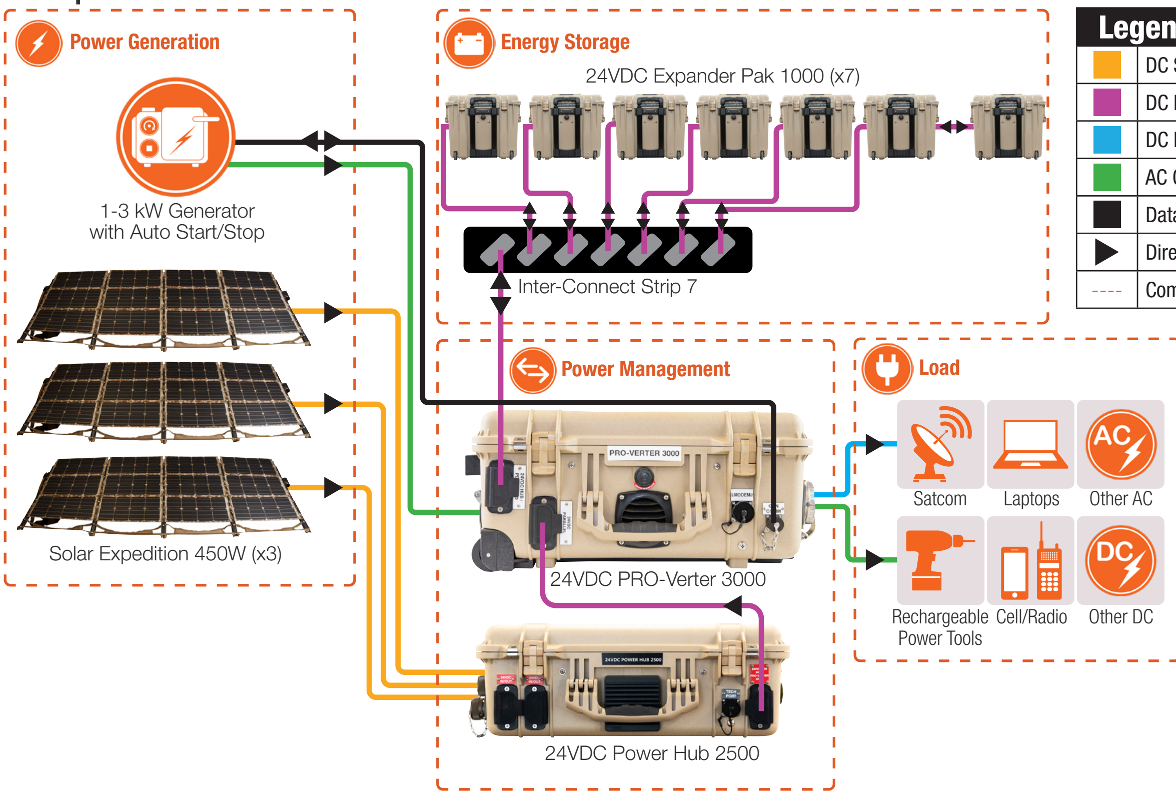
Small System Diagram
(Loads ≤ 3 kW)
Example #9

Example #9 Lead-acid



Legend

(orange)	DC Solar Circuit
(magenta)	DC Inter-Connect Circuit
(blue)	DC Load Circuit
(green)	AC Circuit
(black)	Data Circuit
▶	Direction of flow
----	Component types

Features

- 8.1 kWh daily power generation from 1,350 W solar array (assuming 6 hours of solar irradiance)
- 7.0 kWh of lead-acid AGM energy storage
- Ability to run 150-watt AC or DC load for over 46 hours from energy storage alone
- Ability to process and accept solar, grid, and generator power
- Auto-Generator Start (AGS) capability
- Transportable by land, sea, and air cargo
- Open architecture
- Built and designed to MIL-STD-810H
- Scalable

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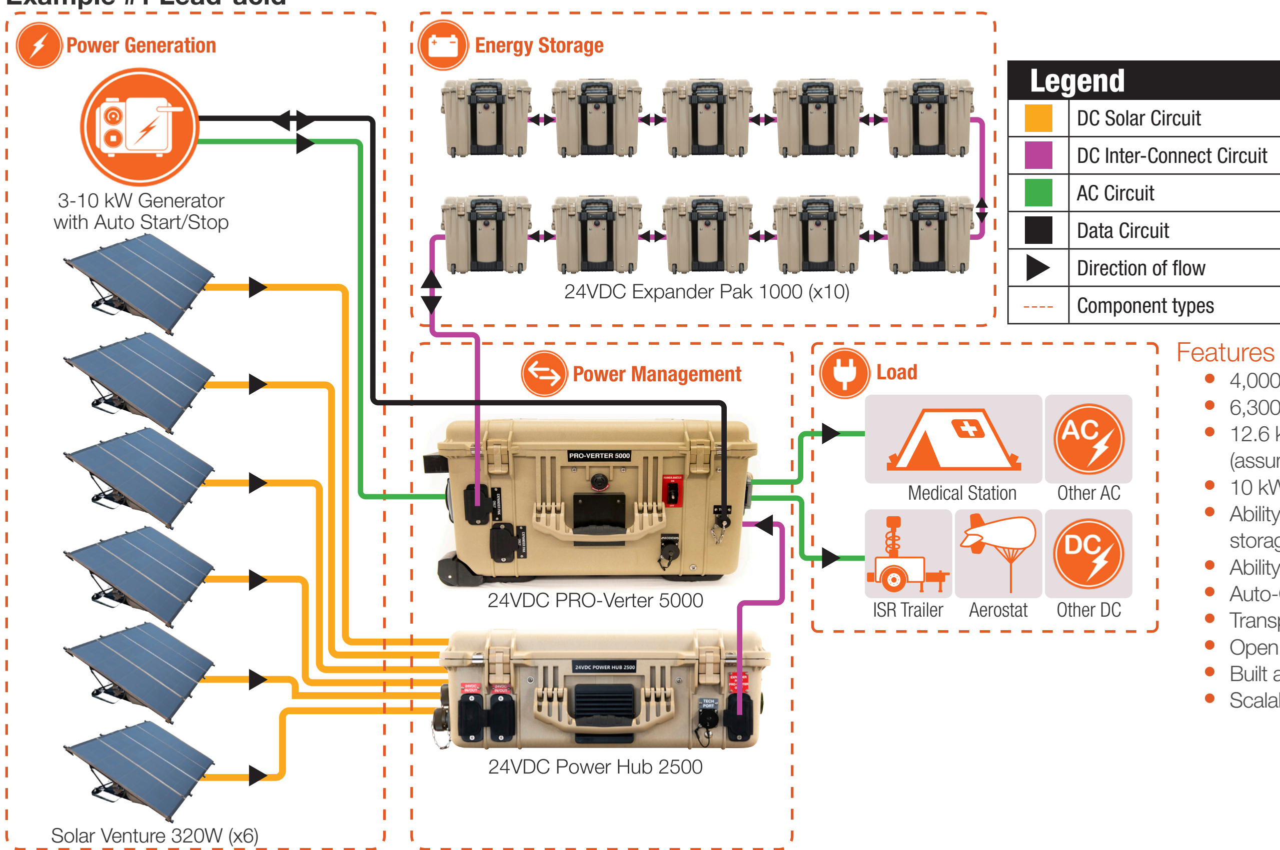
Medium System Diagram
(3 kW < Loads ≤ 10 kW)
Example #1

Example #1 Lead-acid



Features

- 4,000 W continuous 120 VAC output
- 6,300 W surge 120 VAC output
- 12.6 kWh daily power generation from 2,100 W solar array (assuming 6 hours of solar irradiance)
- 10 kWh of lead-acid AGM energy storage
- Ability to run 3,500-watt AC or DC load for over 2.8 hours from energy storage alone
- Ability to process and accept solar, grid, and generator power
- Auto-Generator Start (AGS) capability
- Transportable by land, sea, and air cargo
- Open architecture
- Built and designed to MIL-STD-810G
- Scalable

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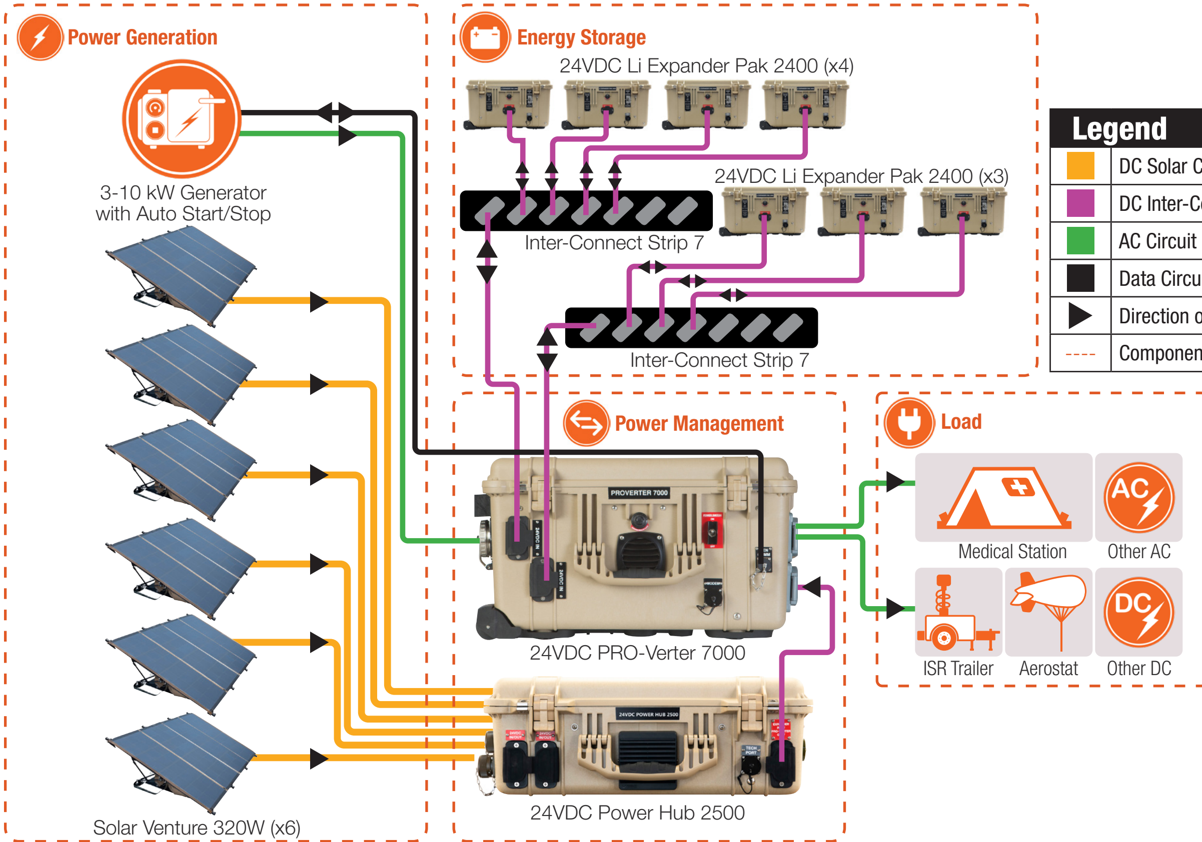
Medium System Diagram
(3 kW < Loads ≤ 10 kW)
Example #2

Example #2 Lithium-ion



Legend	
Orange	DC Solar Circuit
Magenta	DC Inter-Connect Circuit
Green	AC Circuit
Black	Data Circuit
▶	Direction of flow
----	Component types

Features

- 4,000 W continuous 120 VAC output
- 7,000 W surge 120 VAC output
- 12.6 kWh daily power generation from 2,100 W solar array (assuming 6 hours of solar irradiance)
- 16.8 kWh of $LiFePO_4$ energy storage
- Ability to run 3,500-watt AC or DC load for over 4.8 hours from energy storage alone
- Ability to process and accept solar, grid, and generator power
- Auto-Generator Start (AGS) capability
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- Open architecture
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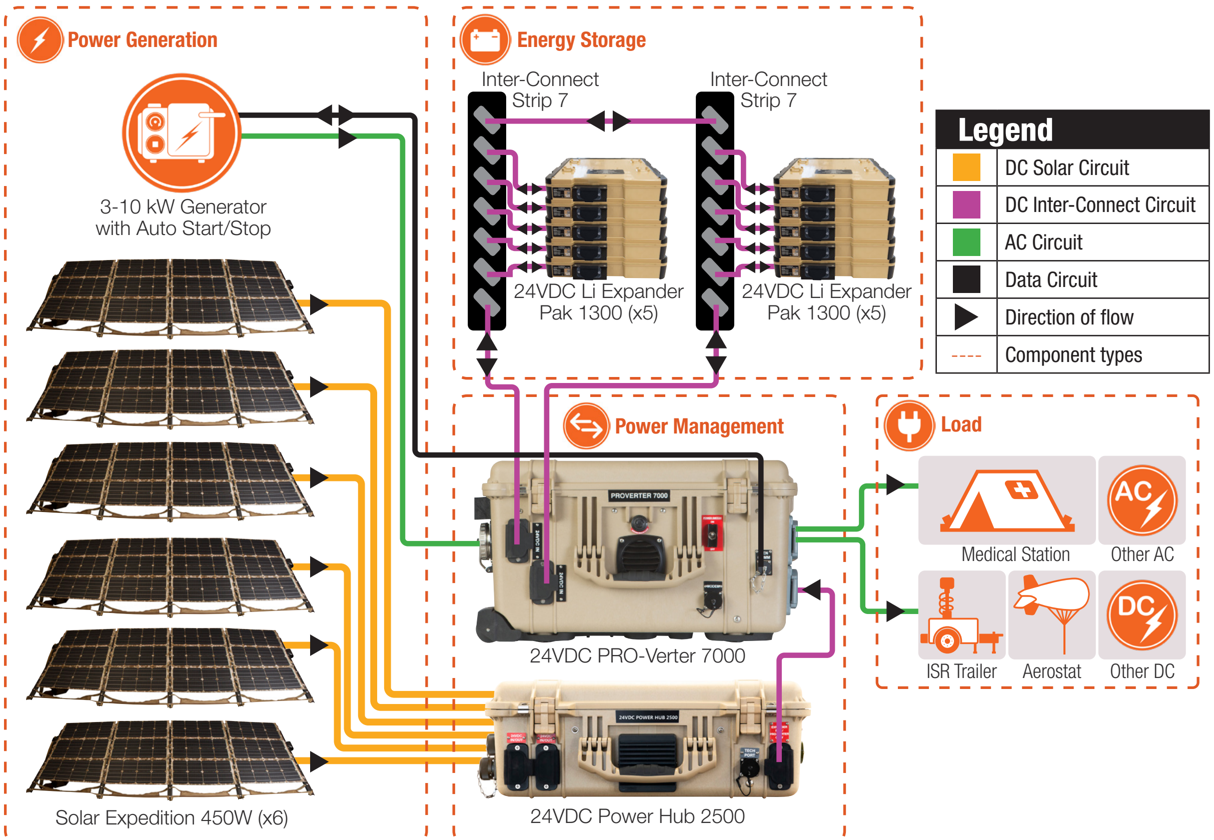
Medium System Diagram
(3 kW < Loads ≤ 10 kW)
Example #3

Example #3 Lithium-ion



Features

- 4,000 W continuous 120 VAC output
- 7,000 W surge 120 VAC output
- 16.2 kWh daily power generation from 2,700 W solar array (assuming 6 hours of solar irradiance)
- 13.0 kWh of $LiFePO_4$ energy storage
- Ability to run 3,500-watt AC or DC load for over 3.7 hours from energy storage alone
- Ability to process and accept solar, grid, and generator power
- Auto-Generator Start (AGS) capability
- Transportable by land, sea, and air cargo
- Open architecture
- Built and designed to MIL-STD-810H
- Scalable

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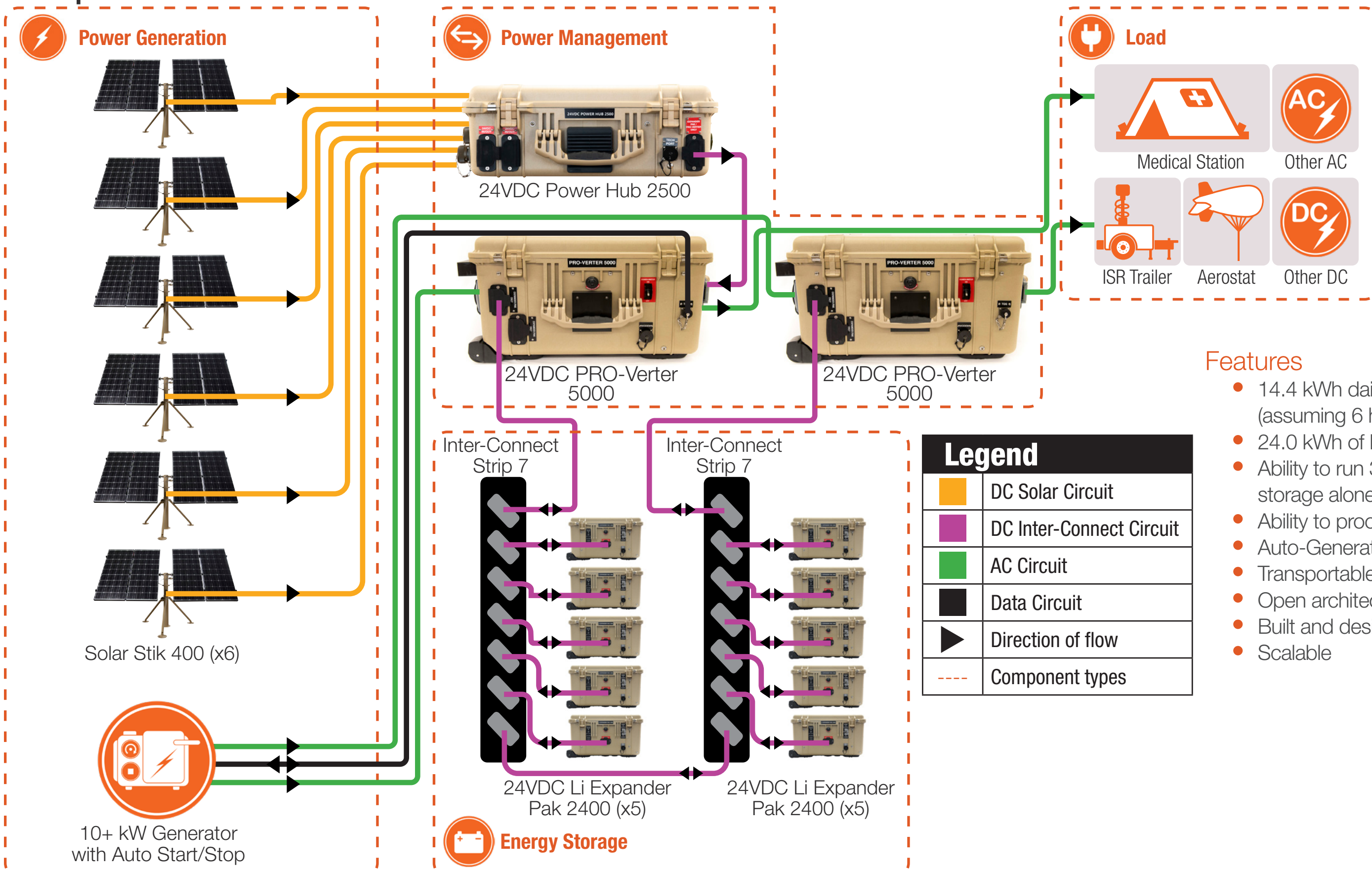
Medium System Diagram
(3 kW < Loads ≤ 10 kW)
Example #4

Example #4 Lithium-ion



Features

- 14.4 kWh daily power generation from 2,400 W solar array (assuming 6 hours of solar irradiance)
- 24.0 kWh of $LiFePO_4$ energy storage
- Ability to run 3,500-watt AC or DC load for over 6.8 hours from energy storage alone
- Ability to process and accept solar, grid, and generator power
- Auto-Generator Start (AGS) capability
- Transportable by land, sea, and air cargo
- Open architecture
- Built and designed to MIL-STD-810G
- Scalable

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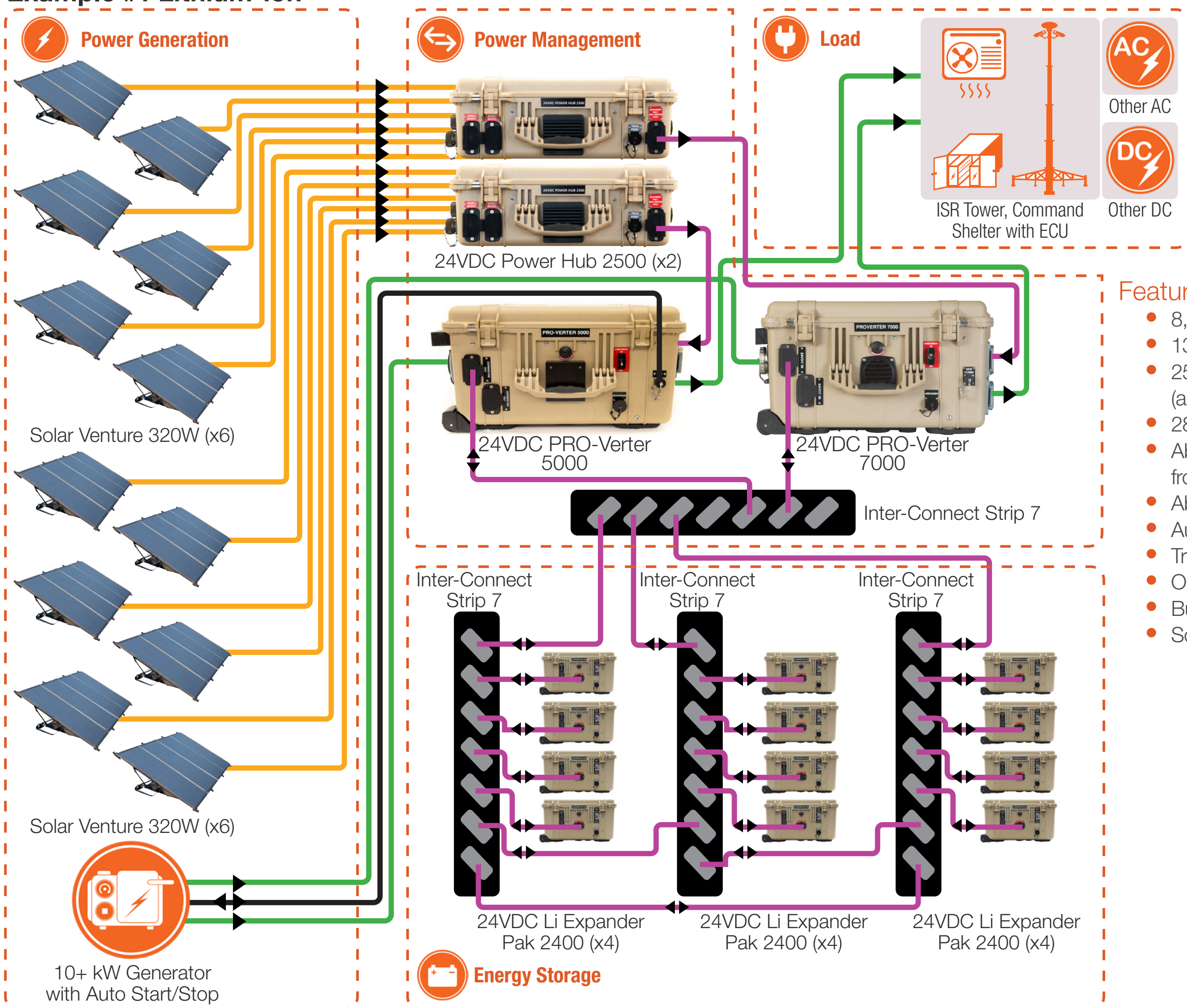
Large System Diagram
(Loads > 10 kW)
Example #1

Example #1 Lithium-ion



Legend	
(orange)	DC Solar Circuit
(purple)	DC Inter-Connect Circuit
(green)	AC Circuit
(black)	Data Circuit
▶	Direction of flow
----	Component types

Features

- 8,000 W continuous 120 VAC output
- 13,000 W surge 120 VAC output
- 25.2 kWh daily power generation from 4,200 W solar array (assuming 6 hours of solar irradiance)
- 28.8 kWh of $LiFePO_4$ energy storage
- Ability to run 3,500-watt AC or DC load for over 8.2 hours from energy storage alone
- Ability to process and accept solar, grid, and generator power
- Auto-Generator Start (AGS) capability
- Transportable by land, sea, and air cargo
- Open architecture
- Built and designed to MIL-STD-810H
- Scalable

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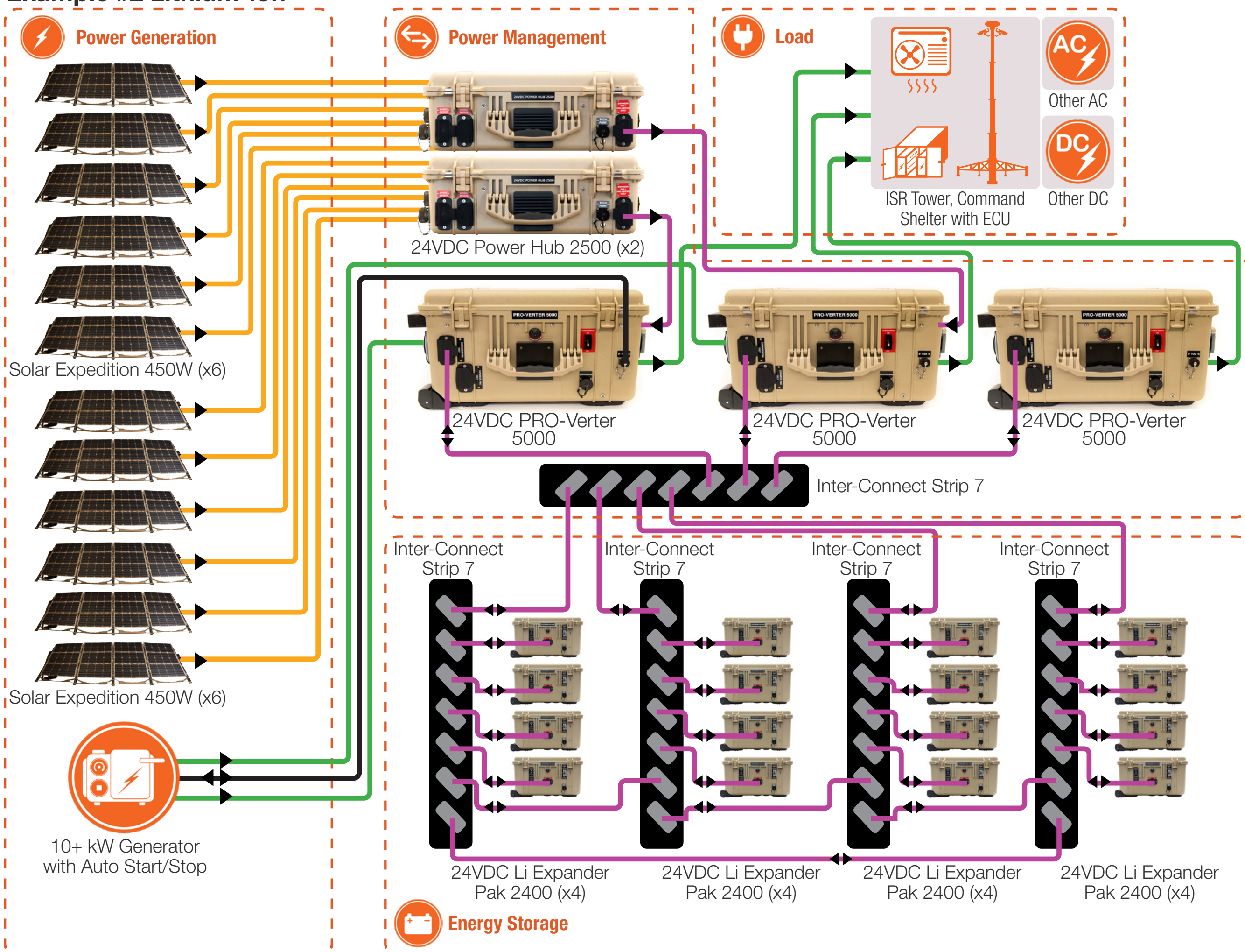
Large System Diagram
(Loads > 10 kW)
Example #2

Example #2 Lithium-ion



Legend	
(orange)	DC Solar Circuit
(magenta)	DC Inter-Connect Circuit
(green)	AC Circuit
(black)	Data Circuit
▶	Direction of flow
----	Component types

Features

- 12,000 W continuous 120 VAC output
- 19,000 W surge 120 VAC output
- 32.4 kWh daily power generation from 5,400 W solar array (assuming 6 hours of solar irradiance)
- 38.4 kWh of $LiFePO_4$ energy storage
- Ability to run 3,500-watt AC or DC load for over 10.9 hours from energy storage alone
- Ability to process and accept solar, grid, and generator power
- Auto-Generator Start (AGS) capability
- Transportable by land, sea, and air cargo
- Open architecture
- Built and designed to MIL-STD-810H
- Scalable

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Large System Diagram
(Loads > 10 kW)
Example #3

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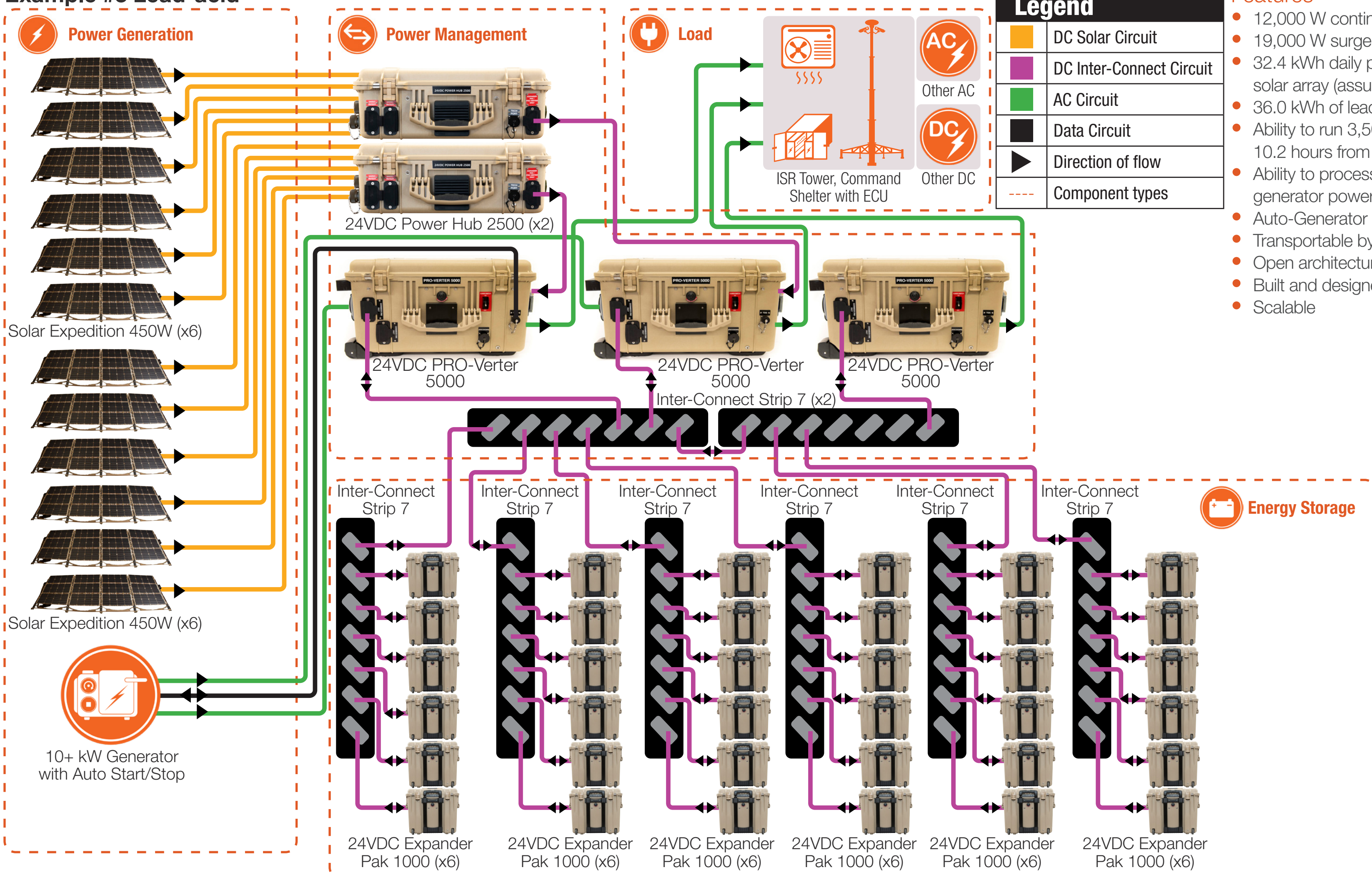
Example #3 Lead-acid



Features

- 12,000 W continuous 120 VAC output
- 19,000 W surge 120 VAC output
- 32.4 kWh daily power generation from 5,400 W solar array (assuming 6 hours of solar irradiance)
- 36.0 kWh of lead-acid AGM energy storage
- Ability to run 3,500-watt AC or DC load for over 10.2 hours from energy storage alone
- Ability to process and accept solar, grid, and generator power
- Auto-Generator Start (AGS) capability
- Transportable by land, sea, and air cargo
- Open architecture
- Built and designed to MIL-STD-810H
- Scalable

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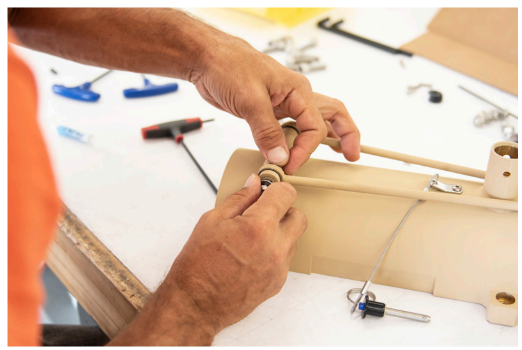

Why Solar Stik

Solar Stik is the premier manufacturer of portable hybrid power systems for military applications in the 1 to 15 kW power spectrum. It pioneered the design and manufacturing of scalable, modular system architectures used to alleviate the logistical burdens of providing power in remote, off-grid locations.

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