

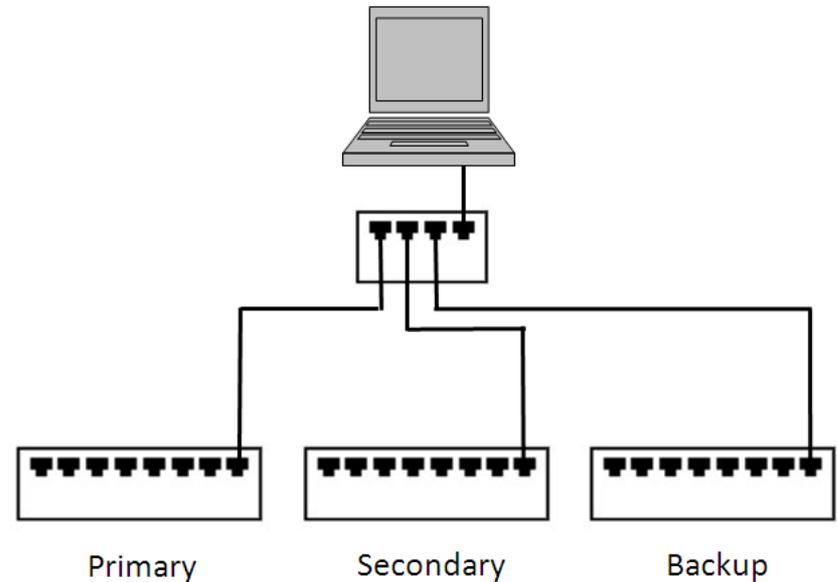
# Designing a Redundant Network

March 28, 2011

# What is Redundancy?

A redundant network is a system that can lose a network cable or Network Interface Card and still continue to function flawlessly.

The primary cable runs to the primary router and then to a the primary modem that goes to the ISP. The secondary cable runs to the secondary router and then to a the secondary modem that goes to the ISP. Like the first two links, the backup link goes through its own router and modem.

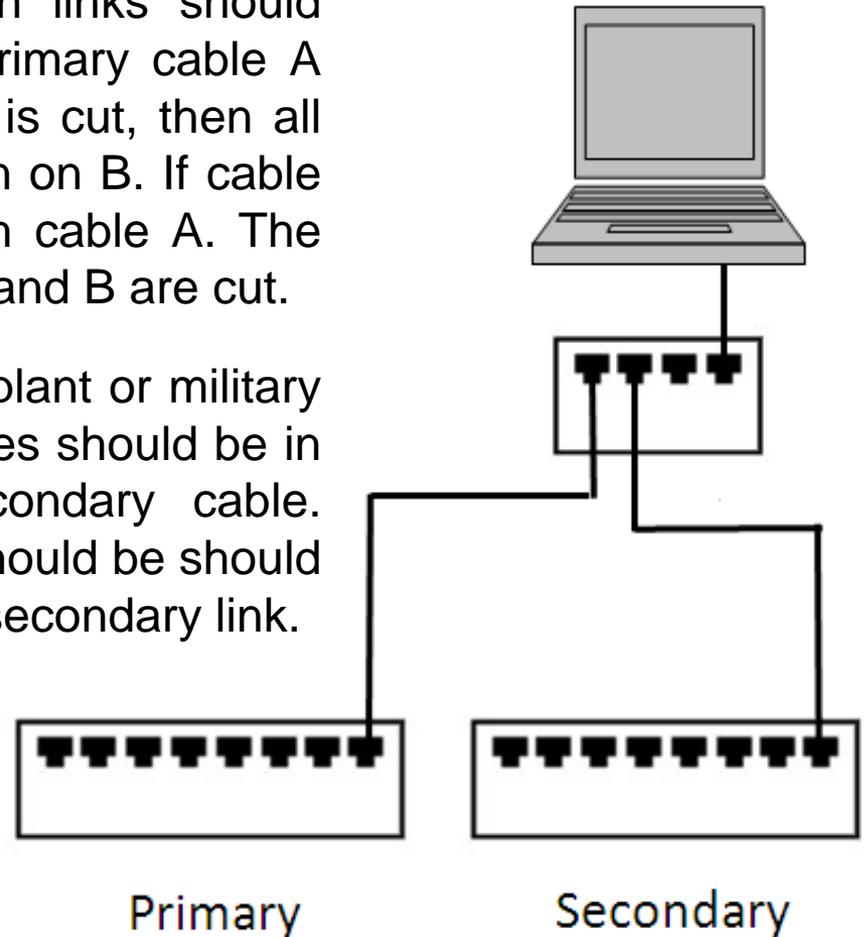


# Primary and Secondary Links

Primary and secondary communication links should have the same speed. Let's call the primary cable A and the secondary cable B. If cable A is cut, then all the computers will exchange information on B. If cable B is sliced, then we would talk through cable A. The system will not function if both cables A and B are cut.

In a building, such as a network center, the primary cables should be in a separate cable tray than the secondary cable. Outside the building, the primary links should be routed in the ground differently than secondary link.

Businesses have lost their connections from construction workers who have accidentally cut both cables in the same place when digging around the building.

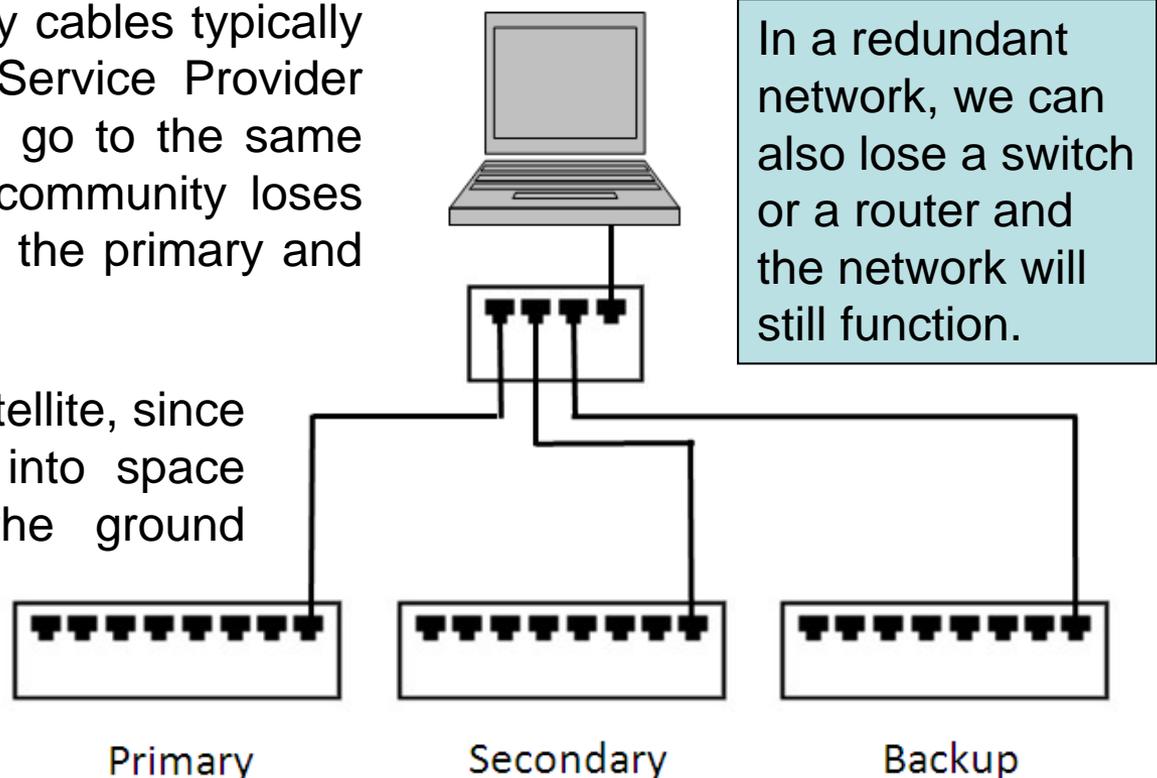


# Triple Redundancy

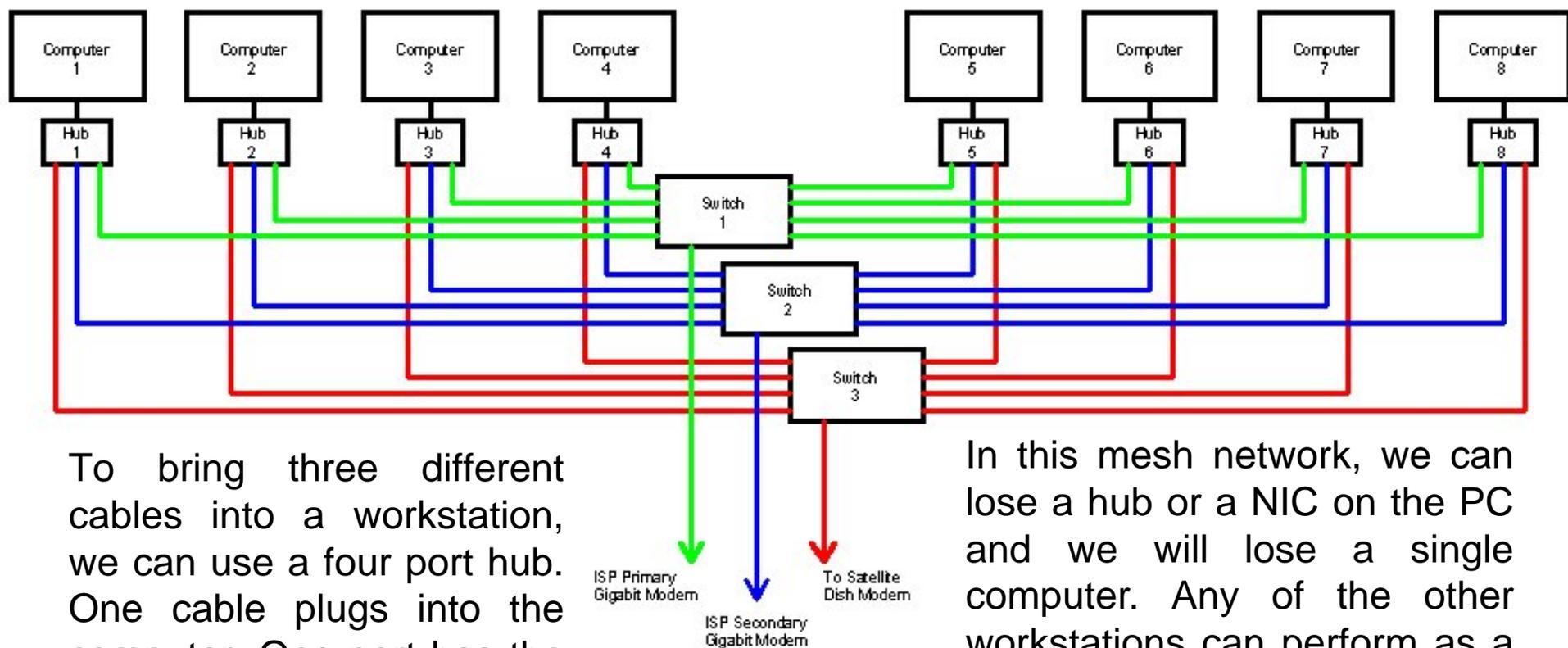
In a triple redundancy network, we have a our primary and secondary network cables that are operating in the Gigabit per second range and then we have a third line that is communicating using a different technology.

The primary and secondary cables typically go to the same Internet Service Provider (ISP) which will eventually go to the same building or station. If the community loses that connection point, both the primary and secondary links will be lost.

A good backup link is a satellite, since the connection is going into space and is not buried in the ground around the building.



# Redundant Diagram



To bring three different cables into a workstation, we can use a four port hub. One cable plugs into the computer. One port has the primary link. One port has the secondary link. The last port has the backup link.

In this mesh network, we can lose a hub or a NIC on the PC and we will lose a single computer. Any of the other workstations can perform as a backup to any of the others, so redundancy is still functioning.

# Redundant Power

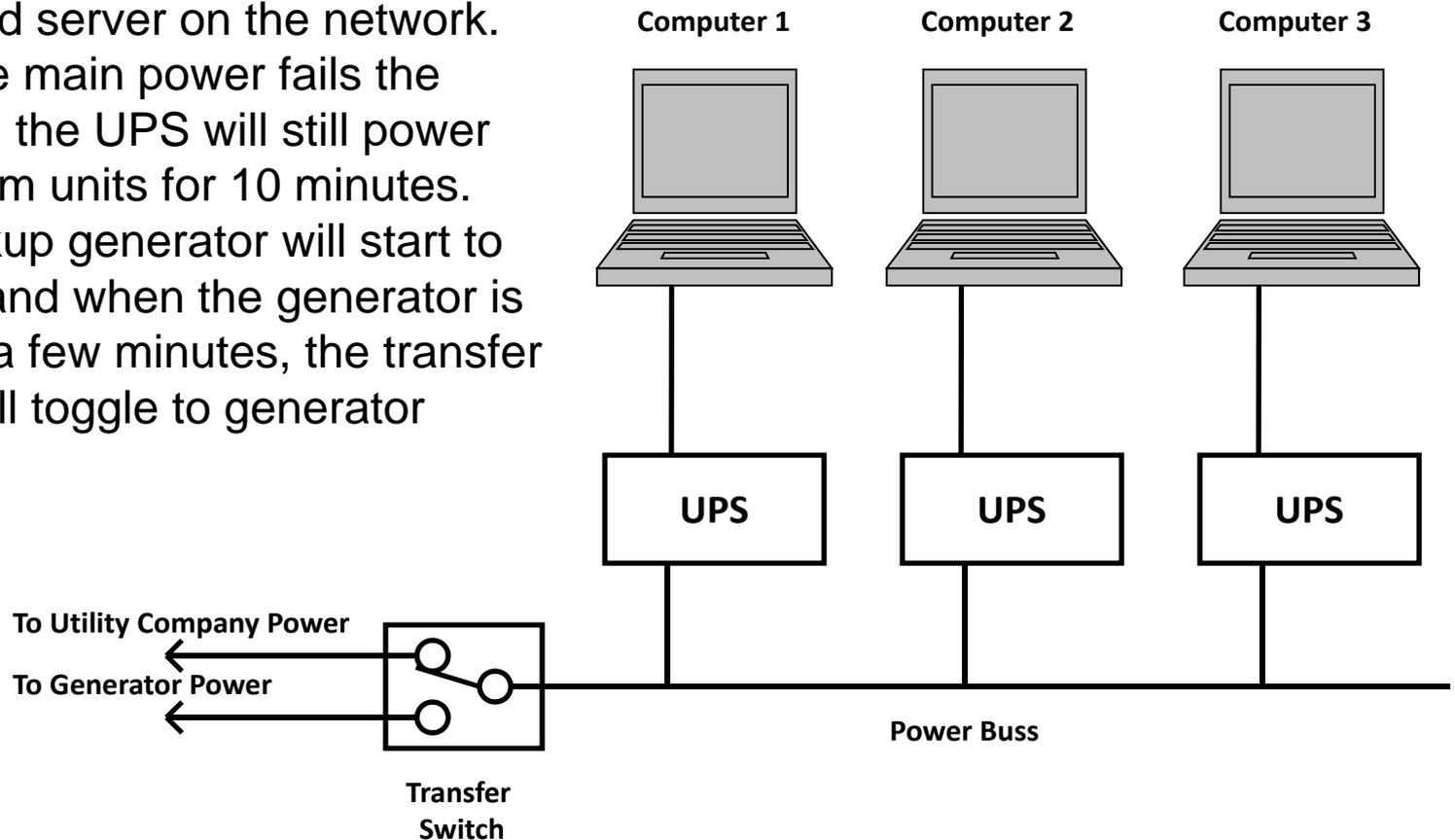
We also design a redundant network to have backup power. We utilize a Uninterruptable Power Supply (UPS) to act as a buffer between our primary and standardized AC power circuit in the building and a backup system such as a generator.

Some companies are using diesel or natural gas powered generators. Others are using a greener solution such as wind or solar power to provide electricity to the system.



# Backup Power System

A typical backup power system has a UPS for each computer, switch, router and server on the network. When the main power fails the battery in the UPS will still power the system units for 10 minutes. The backup generator will start to operate and when the generator is ready in a few minutes, the transfer switch will toggle to generator power.



# Backup Power Items

When we design a backup power system, we will need either Uninterruptible Power Supplies (UPS) on every electrical device on the network or we will supply backup power to the entire building, so the battery backup is built into the architecture of the complex.

## **Backup Power Items**

Uninterruptible Power Supply (UPS)  
Generator  
Generator Pad or Room  
Transfer Switch

Many companies choose to just put an individual UPS on each device that will be backed up. So, we will learn how to choose a UPS. Network designers will also pick a generator and transfer switch. The largest cost of the project is the installation of the equipment, so we want to size the generator adequately, so we can utilize the backup system for many years. If we choose a power rating close to our existing power load, we will have to replace the generator or install a second one.

Another consideration is where to put the generator pad on the outside of the building or we can have a room in our building for the generating unit.

# UPS Selector Program

We will use a computer program to pick our UPS that was made by the American Power Conversion Corp (APC). Open their web site at [http://www.apc.com/tools/ups\\_selector/index.cfm](http://www.apc.com/tools/ups_selector/index.cfm) and we selected the United States in the list box and press Next. At the second web page, we will pick the Configure Now command button under PC or Workstation.

The image displays two screenshots of the APC UPS Selector website. The top screenshot shows the initial selection screen where 'UNITED STATES' is chosen in a dropdown menu. The bottom screenshot shows the 'Select your protection needs' screen with three categories: 'Server Room or Data Center', 'Servers, Telecom., Storage Arrays', and 'PC or Workstation'. The 'PC or Workstation' category has a 'Configure Now' button highlighted.

# UPS Selector Program

We will answer the prompts in the program from our list in the table. Then, we will scroll down and answer more questions. In this exercise, all the computers are the same. In some installations, we can have multiple UPS based upon the power ratings.

<b>Computer Type</b>	Tower
<b>Monitor Type</b>	16-21 inch LCD
<b>Processor Type</b>	Intel Core I3-500
<b>Internal Hard Drive</b>	1
<b>Predominant Hard Drive Type</b>	High RPM hard drive
<b>User Voltage</b>	120V
<b>Printer Type</b>	Laser
<b>External Peripherals</b>	CD/CD-R/CD-RW/DVD/DVD-R
	Power Speakers

APC United States [ Change ]

by Schneider Electric

Home Products Support Services Selectors How to Buy Learning

Home >> Product Selectors >> UPS Selector

## UPS Selector

Step 1: User Inputs > Step 2: Recommended Solutions

Please describe your PC workstation and submit this form in order to get recommendations for a compatible UPS. Some fields are filled out with the typical default values. Please check each field for accuracy.

### System Description

- Computer type: Tower
- Monitor type: 16-21 inch LCD
- Processor type: Intel Core i3-500
- Internal Hard Drives: 1
- Predominant Hard Drive Type: High RPM hard drive
- User Site Voltage:  100  120  200  208  230
- Printer type: Laser

**Please Note:**  
Do not plug your printer into an outlet that provides battery backup power. Please click [here](#) for more information.

### External Peripherals

- Additional Peripherals
- CD/CD-R/CD-RW/DVD/DVD-R
- Powered Speakers
- Wireless Access Point
- Cable/DSL Modem
- Hub/Switch
- Scanner
- Zip/Jazz Drive
- Cable/DSL Router
- ISDN Adapter
- Seagate 3.5 External Storage HD

# Peripherals and Performance

We will plan the UPS to have 50% more capacity and that it will supply power for 10 minutes in battery backup power before the generator will start.

We will pick the Show UPS Solution button.

### External Peripherals

<input type="checkbox"/> Additional Peripherals	<input type="checkbox"/> Cable/DSL Modem	<input type="checkbox"/> Cable/DSL Router
<input checked="" type="checkbox"/> CD/CD-R/CD-RW/DVD/DVD-R	<input type="checkbox"/> Hub/Switch	<input type="checkbox"/> ISDN Adapter
<input checked="" type="checkbox"/> Powered Speakers	<input type="checkbox"/> Scanner	<input type="checkbox"/> Seagate 3.5 External Storage HD
<input type="checkbox"/> Wireless Access Point	<input type="checkbox"/> Zip/Jazz Drive	

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### Preferences

Extra Power for future expansion: 50%

Desired run time during power fail: 0  : 10  (Hours : Minutes)

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### Disclaimer

The information provided in the APC UPS Selector is provided for general informational purposes only. It is subject to change without notice and is provided "as is" without warranty of any kind, express or implied. Different solutions address different needs; please contact an APC sales representative to discuss the best solution for your specific needs.

### Submit Feedback

Use the [feedback form](#) to inform us of errors or send suggestions on how to improve our UPS Selector.

### UPS Selector FAQ

Our [Frequently Asked Questions](#) page addresses the most common sizing questions.

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# Summary of Choices

We can see three choices that are either 750 or 1000 VA. We will pick the APC BE750G, so we click on the BE750G hyperlink to investigate the unit's capabilities.

The screenshot shows the APC website's 'UPS Selector' page. The page is titled 'UPS Selector' and is part of a 'Recommended Solutions' section. It displays three product options:

Best Price	Best Value	Best Performance
		
<a href="#">More Images</a>	<a href="#">More Images</a>	<a href="#">More Images</a>
<b>APC Power Saving Back-UPS 750</b>	<b>APC Smart-UPS 750VA LCD 120V</b>	<b>APC Smart-UPS 1000VA LCD 120V</b>
Price*: <b>\$99.99</b>	Price*: <b>\$319.99</b>	Price*: <b>\$459.00</b>
Runtime: <b>11 minutes</b>	Runtime: <b>18 minutes</b>	Runtime: <b>37 minutes</b>
Part Number(s): <a href="#">BE750G</a>	Part Number(s): <a href="#">SMT750</a>	Part Number(s): <a href="#">SMT1000</a>

UPS Selector, 2011, American Power Conversion Corp, March 31, 2011,  
<[http://www.apc.com/products/resource/include/techspec\\_index.cfm?base\\_sku=BE750G&tab=models](http://www.apc.com/products/resource/include/techspec_index.cfm?base_sku=BE750G&tab=models)>

# APC Power Saving UPS 750

The APC Power Saving UPS 750 has an output capacity of 450 watts (750VA). The program was able to take the major components that we will plug into the UPS and it computed the amount of power needed. This unit has a 50% expansion capability in our design.

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## Back-UPS

### APC Power Saving Back-UPS 750



[More Images](#)

The Back-UPS ES now incorporates a variety of features to make it the "greenest" battery backup in its class. Click [here](#) to find out more.

**Includes:** CD with software, USB cable, User Manual

**Standard Lead Time:** Usually in Stock

**Average Customer Review** ★★★★★ 4.6

64 of 67 (96%) customers would recommend this product to a friend.

[Read all reviews](#) | [Write a review](#)

Share this Product:

**BE750G**  
Price \*: \$99.99

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Output	
Output Power Capacity	450 Watts / 750 VA
Max Configurable Power	450 Watts / 750 VA

# Output and Input

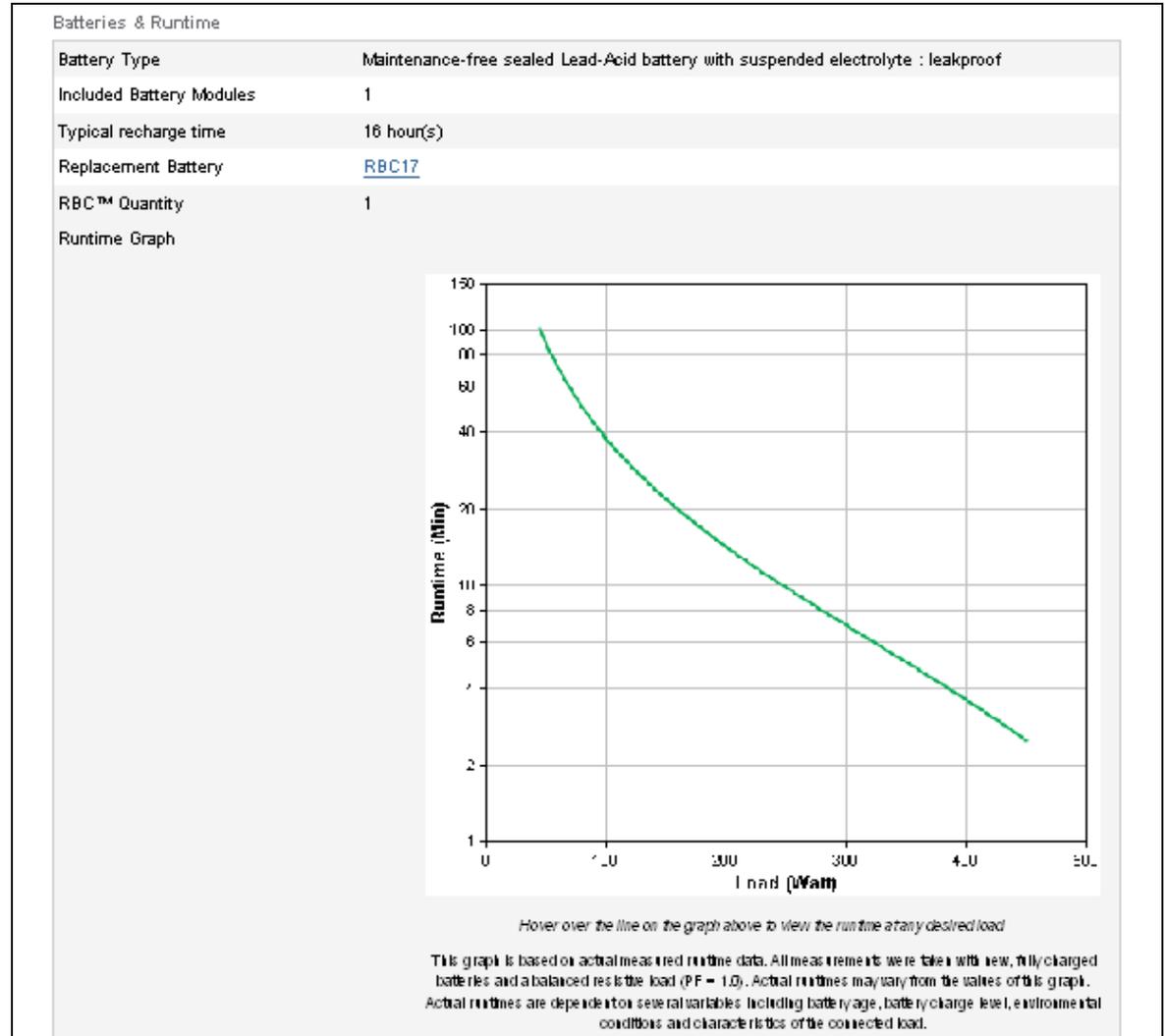
The nominal input voltage is 120 volts (88 to 139 volts) and the unit will autosense for whether it is running on 50 or 60 hertz. The power cord is 6 feet long. The wide range in input voltage is okay since the output to our computer is 120 volts from the battery.

Output	
Output Power Capacity	450 Watts / 750 VA
Max Configurable Power	450 Watts / 750 VA
Nominal Output Voltage	120V
Output Frequency (sync to mains)	60Hz +/- 3 Hz
Waveform Type	Stepped approximation to a sinewave
Output Connections	(5) NEMA 5-15R (Battery Backup) 
	(5) NEMA 5-15R (Surge Protection) 
Input	
Nominal Input Voltage	120V
Input Frequency	50/60 Hz +/- 3 Hz (auto sensing)
Input Connections	NEMA 5-15P 
Cord Length	6 feet (1.83 meters)
Input voltage range for main operations	88 - 139V

# Battery Runtime

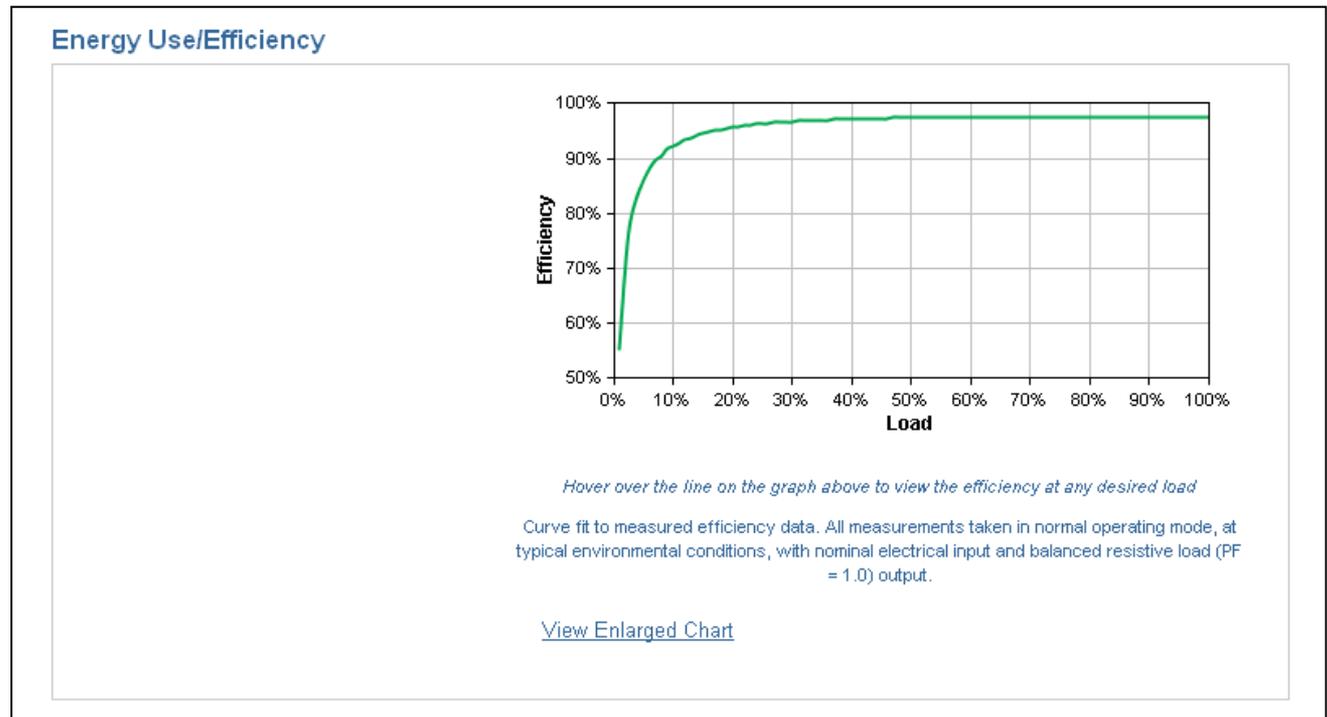
The battery is a maintenance free sealed lead acid with suspended electrolyte. The recharge time is 16 hours

In the graph, we see the runtime on the left and the load across the bottom. The 250 watt load can run for 10 minutes when the battery is fully charged and relatively new. As the unit ages, the performance can degrade.



# Energy Efficiency

The UPS's efficiency is below 90% when the unit is supporting very small loads such as a single switch or router. The efficiency is above 90% when the load is around or above 10%.



# Physical Size and Weight

The control panel will display that the unit is online, that the battery is on, or that we should replace the battery. UPS units are heavy since they have a battery, so most network technicians place the units on the ground next to a computer tower. This small unit weighs almost 30 pounds (12.4 kg).

Communications & Management	
Control panel	LED status display with On Line : On Battery : Replace Battery and Building Wiring Fault
Surge Protection and Filtering	
Surge energy rating	354 Joules
Filtering	Full time multi-pole noise filtering : 5% IEEE surge let-through : zero clamping response time : meets UL 1449
Data Line Protection	Analog phone line for phone/fax/modem/DSL (RJ-45 connector),Network line - 10/100 Base-T Ethernet (RJ-45 connector),Coaxial cable for CATV/SATV/modem/Audio-Video (coax connector)
Physical	
Maximum Height	3.48 inches (88 mm)
Maximum Width	7.09 inches (180 mm)
Maximum Depth	13.49 inches (343 mm)
Net Weight	10.34 lbs. (4.70 kg)
Shipping Weight	12.96 lbs. (5.89 kg)
Shipping Height	5.94 inches (151 mm)
Shipping Width	10.16 inches (258 mm)
Shipping Depth	17.80 inches (452 mm)
Master Carton Units	2.00
Master Carton Weight	27.28 lbs. (12.40 kg)
Color	Black
SCC Codes	1073130425660 8
Units per Pallet	72.00

# Environmental Conditions

The unit is able to perform its functions from 32 degrees to 104 degrees Fahrenheit and between 5 to 95% humidity. This units is made to run in normal office conditions.

Environmental	
Operating Environment	32 - 104 °F (0 - 40 °C)
Operating Relative Humidity	5 - 95%
Operating Elevation	0-10000 feet (0-3000 meters)
Storage Temperature	5 - 113 °F (-15 - 45 °C)
Storage Relative Humidity	5 - 95%
Storage Elevation	0-50000 feet (0-15000 meters)
Audible noise at 1 meter from surface of unit	45.00 dBA
Online Thermal Dissipation	47.00 BTU/hr

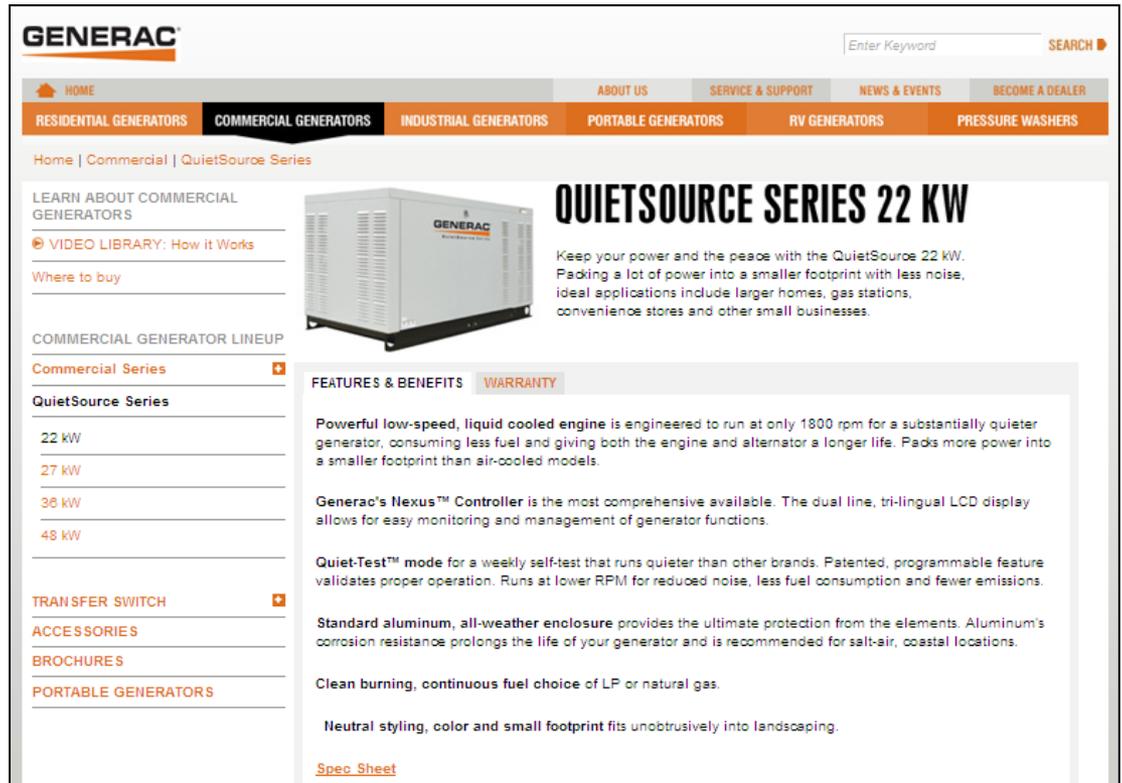
Conformance	
Regulatory Approvals	FCC Part 15 Class B,FCC Part 68,NOM,UL 1778
Standard Warranty	3 years repair or replace
Equipment protection policy	Lifetime : \$75000
Environmental Compliance	RoHS

\*Except where noted, all prices are Estimated Resale Price (ERP) - Without Tax/VAT. Pricing in other locations and sites may vary.  
\*\*The time to recharge to 90% of full battery capacity following a discharge to shutdown using a load rated for 1/2 the full load rating of the UPS.

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# Backup Generator

If we have 24 computers, 3 switches, 24 hubs, a network printer, and 3 routers, we would look at the entire power budget to run the system. If we multiply the 450 watts of the UPS times 24, we get 10800 watts. The switches, hubs, and routers might account for another 200 watts, and if we want 50% expansion, we will estimate that we need just over 20,000 watts of power. The Generac generator is rated at 22 kilowatts.



The screenshot displays the Generac website's product page for the QuietSource Series 22 KW generator. The page features a navigation menu with categories like Residential, Commercial, Industrial, Portable, RV, and Pressure Washers. The main content area includes a product image of the generator, a description highlighting its quiet operation and compact size, and a list of features and benefits such as low-speed liquid-cooled engine, Nexus™ Controller, Quiet-Test™ mode, and standard aluminum enclosure. A 'Spec Sheet' link is also visible.

**GENERAC**

Enter Keyword  **SEARCH**

**HOME** **ABOUT US** **SERVICE & SUPPORT** **NEWS & EVENTS** **BECOME A DEALER**

**RESIDENTIAL GENERATORS** **COMMERCIAL GENERATORS** **INDUSTRIAL GENERATORS** **PORTABLE GENERATORS** **RV GENERATORS** **PRESSURE WASHERS**

Home | Commercial | QuietSource Series

LEARN ABOUT COMMERCIAL GENERATORS

VIDEO LIBRARY: How it Works

Where to buy

COMMERCIAL GENERATOR LINEUP

Commercial Series

QuietSource Series

22 kW

27 kW

36 kW

48 kW

TRANSFER SWITCH

ACCESSORIES

BROCHURES

PORTABLE GENERATORS

**QUIETSOURCE SERIES 22 KW**

Keep your power and the peace with the QuietSource 22 kW. Packing a lot of power into a smaller footprint with less noise, ideal applications include larger homes, gas stations, convenience stores and other small businesses.

**FEATURES & BENEFITS** **WARRANTY**

Powerful low-speed, liquid cooled engine is engineered to run at only 1800 rpm for a substantially quieter generator, consuming less fuel and giving both the engine and alternator a longer life. Packs more power into a smaller footprint than air-cooled models.

Generac's Nexus™ Controller is the most comprehensive available. The dual line, tri-lingual LCD display allows for easy monitoring and management of generator functions.

Quiet-Test™ mode for a weekly self-test that runs quieter than other brands. Patented, programmable feature validates proper operation. Runs at lower RPM for reduced noise, less fuel consumption and fewer emissions.

Standard aluminum, all-weather enclosure provides the ultimate protection from the elements. Aluminum's corrosion resistance prolongs the life of your generator and is recommended for salt-air, coastal locations.

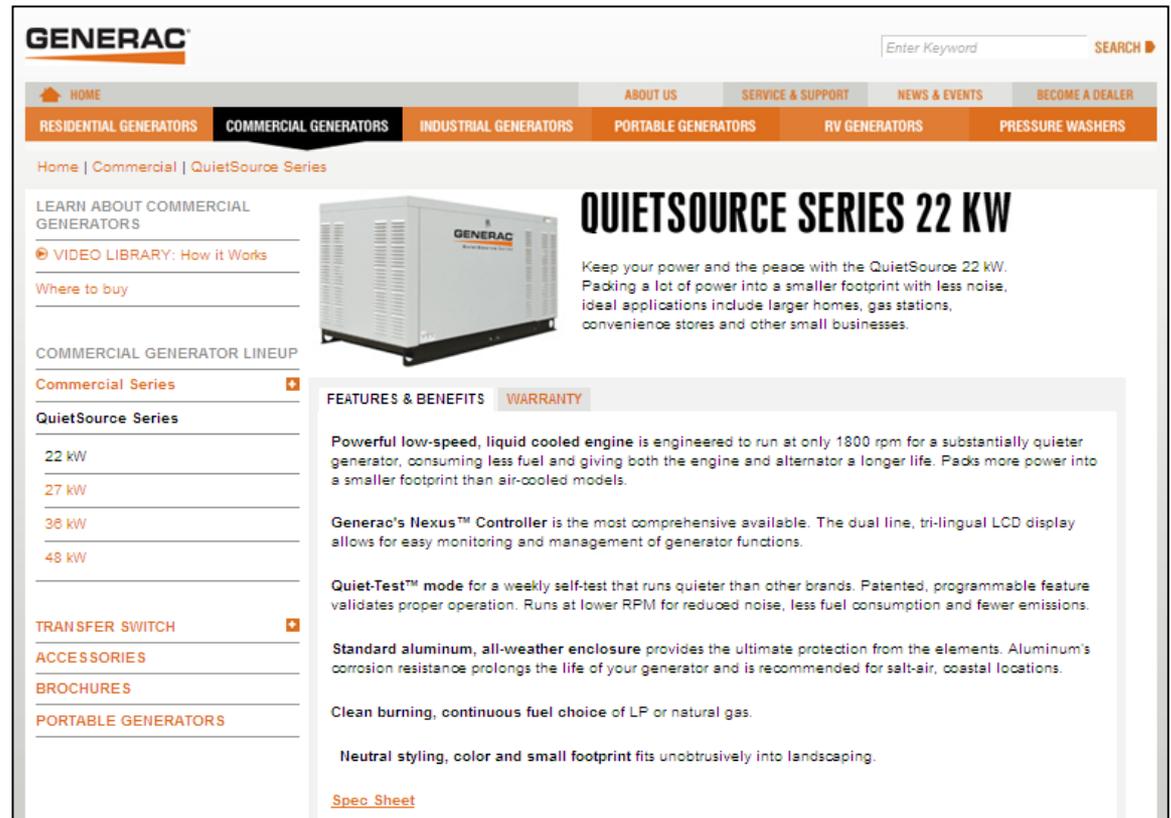
Clean burning, continuous fuel choice of LP or natural gas.

Neutral styling, color and small footprint fits unobtrusively into landscaping.

[Spec Sheet](#)

# Backup Generator

Some of the considerations we will mull over is the enclosure material such as aluminum, the type of fuel, which we selected natural gas and that the unit will run quietly. We need to have a contractor quote a concrete pad to put the 3 ft by 3 ft by 5 ft long unit on.

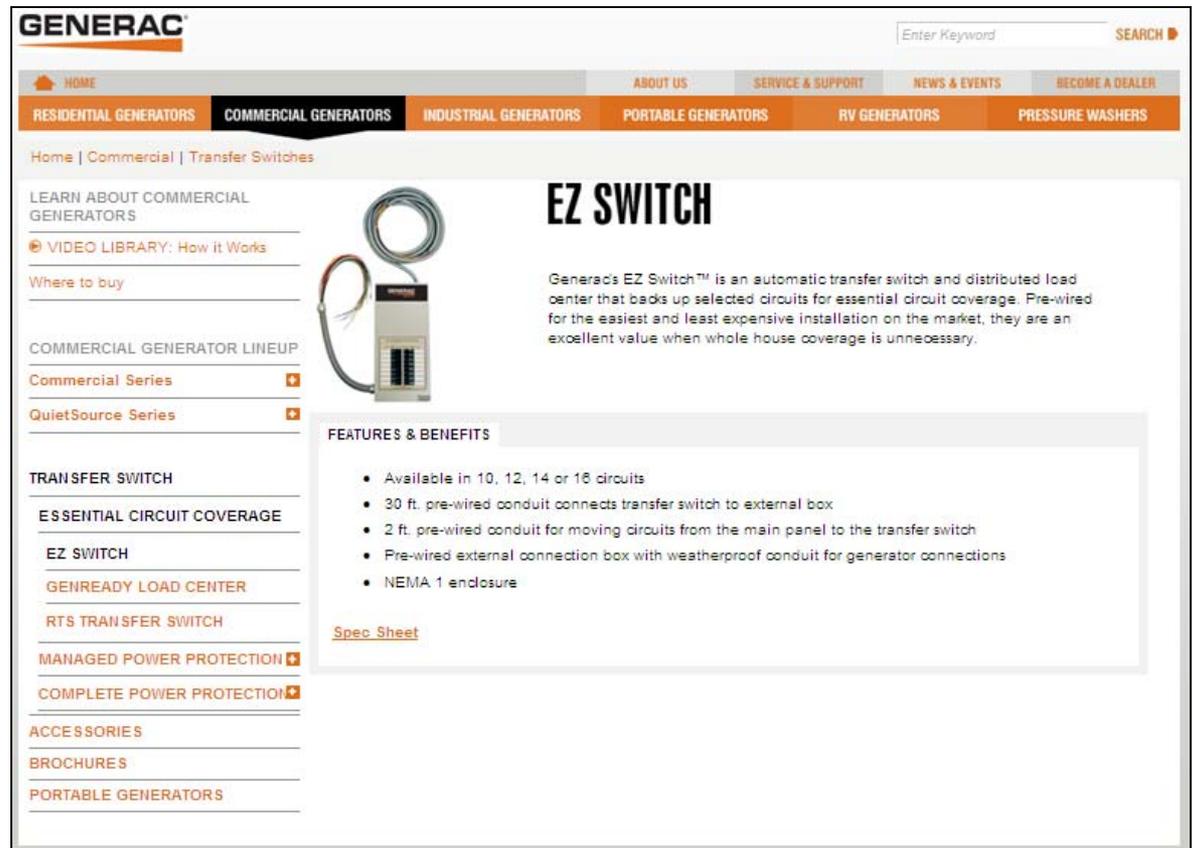


The screenshot shows the Generac website for the QuietSource Series 22 kW generator. The page features a navigation bar with links for HOME, ABOUT US, SERVICE & SUPPORT, NEWS & EVENTS, and BECOME A DEALER. Below the navigation bar, there are tabs for RESIDENTIAL GENERATORS, COMMERCIAL GENERATORS (selected), INDUSTRIAL GENERATORS, PORTABLE GENERATORS, RV GENERATORS, and PRESSURE WASHERS. The main content area includes a search bar, a breadcrumb trail (Home | Commercial | QuietSource Series), and a section titled "LEARN ABOUT COMMERCIAL GENERATORS" with a video library link "How it Works" and a "Where to buy" link. A "COMMERCIAL GENERATOR LINEUP" section lists various models, with the "QuietSource Series" expanded to show options for 22 kW, 27 kW, 36 kW, and 48 kW. A "TRANSFER SWITCH" section is also visible. The main product section features a large image of the generator and the heading "QUIETSOURCE SERIES 22 KW". The text describes the generator's low-speed, liquid-cooled engine, its quiet operation, and its compact footprint. A "FEATURES & BENEFITS" section highlights the powerful engine, the Nexus™ Controller, Quiet-Test™ mode, standard aluminum enclosure, clean burning fuel choice, and neutral styling. A "WARRANTY" section is also present. A "Spec Sheet" link is provided at the bottom of the product description.

# Transfer Switch

To switch from regular commercial power to backup power, we need a transfer switch. The switch will be installed by an electrician.

We should schedule a test each month to check the functionality of the transfer switch.

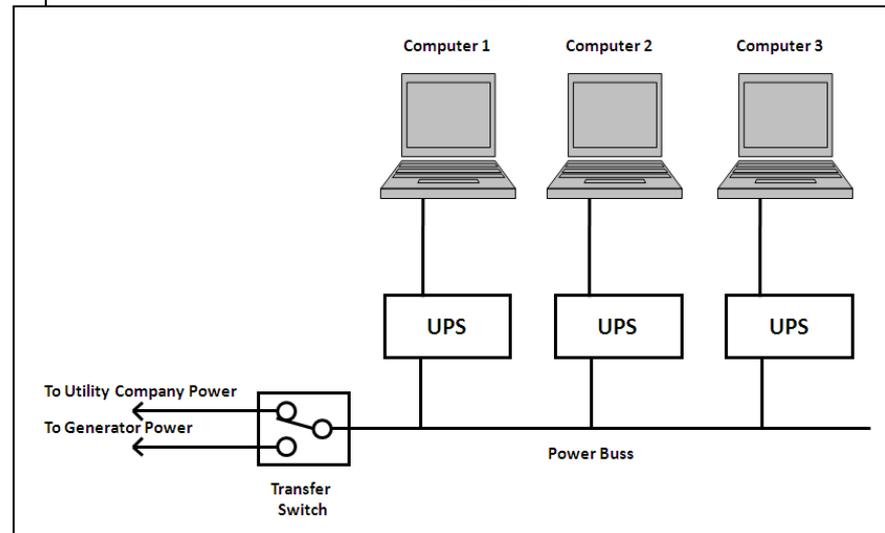
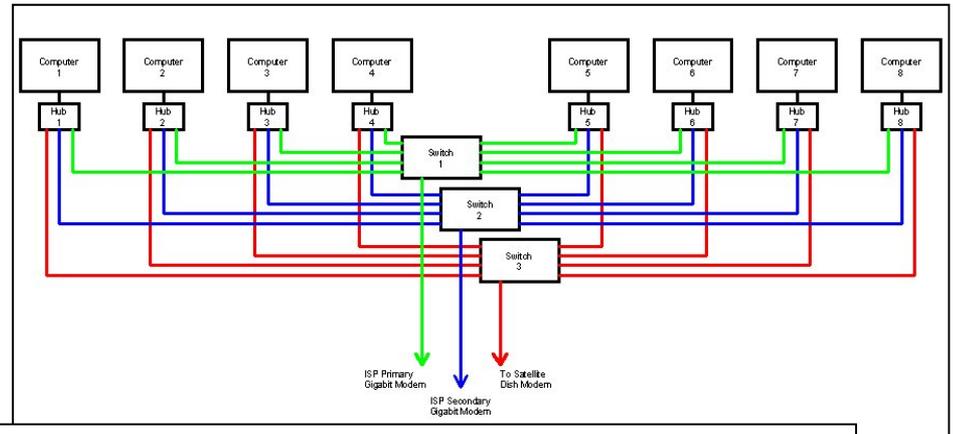


The screenshot displays the Generac website's product page for the EZ Switch. The page features a navigation menu with categories like Residential Generators, Commercial Generators, Industrial Generators, Portable Generators, RV Generators, and Pressure Washers. The main content area is titled "EZ SWITCH" and includes a description: "Generac's EZ Switch™ is an automatic transfer switch and distributed load center that backs up selected circuits for essential circuit coverage. Pre-wired for the easiest and least expensive installation on the market, they are an excellent value when whole house coverage is unnecessary." A list of features and benefits is provided, including availability in 10, 12, 14, or 16 circuits, 30 ft. pre-wired conduit, 2 ft. pre-wired conduit for moving circuits, a pre-wired external connection box with weatherproof conduit, and a NEMA 1 enclosure. A "Spec Sheet" link is also visible. The left sidebar contains a navigation menu with links to "LEARN ABOUT COMMERCIAL GENERATORS", "VIDEO LIBRARY: How it Works", "Where to buy", "COMMERCIAL GENERATOR LINEUP", "TRANSFER SWITCH", "ESSENTIAL CIRCUIT COVERAGE", "EZ SWITCH", "GENREADY LOAD CENTER", "RTS TRANSFER SWITCH", "MANAGED POWER PROTECTION", "COMPLETE POWER PROTECTION", "ACCESSORIES", "BROCHURES", and "PORTABLE GENERATORS".

# Design a Redundant Network

Design a wired network to have 24 computer, 24 hubs, 3 switches , a network printer, and 3 routers. The primary and secondary link will connect to 1 Gigabit lines to the ISP and the backup link will connect to a satellite link to another ISP. We will have a backup generator with 50% expansion.

Create a diagram, spreadsheet quote and cover letter for the job and send the documents to your instructor with attachments. Make an informative PowerPoint presentation highlighting the features of the redundant network you designed.



# Review Questions

1. What is an Uninterruptible Power Supply (UPS)?
2. Why is a UPS heavy? How does the device work?
3. What size UPS do we need for a Core I-7 tower with a 17 inch LCD, a printer, and speakers?
4. In a critical network installation such as military command post, how many links do we have to the larger network? Describe each one?
5. What is a backup generator? How long should we take to turn the unit on?
6. What types of fuel can we use when we pick a backup generator?
7. Describe how to use a small multiple port hub to split signals to the different links?
8. What happens if both the primary and secondary links are broken? Why would we have a contractor bury the primary and secondary links on different sides of a building?
9. How often should we test the backup system? How do we do this?
10. Who will install the transfer switch for the backup generator? Who install the concrete pad for the backup generator?