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A DIVISION OF IKONIX USA

Introduction to Power Sources

- Understanding Power – Single Phase, Split Phase and Three Phase
- Benefits of using power sources
- Selecting the appropriate power source
- Power source and Electrical Safety testing

Meet Our Team

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Webinar Notes

Please use the Q & A utility to ask us any questions concerning the material being presented.

You can find a recording of this webinar and presentation on our Video Library page, www.aptsources.com/video-library/

Please contact Amanda Boothe– on the chat line or email Amanda.boothe@ikonixusa.com if you have any connection issues.

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Introduction to Power Sources – APT : Learning Objectives

Understanding Power

- What is Power?
- Single Phase, Split Phase, and Three Phase

Benefits of using power sources

- Clean Regulated Power
- Variable Voltage and Frequency

Selecting the appropriate power source

- Current and Voltage capabilities
- Crest Factor, THD, PF an Inrush current

Power Source and Electrical Safety Testing

- Meeting the 110% input power requirement
- Run test

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Understanding Power – What is Power?

Electrical power is the rate at which electrical energy is being transferred

Converted to provide heat, motion or electromagnetic field

Units of Watt is equivalent to one Joule of energy per second

Power (P) = Voltage (V) x Current (I)

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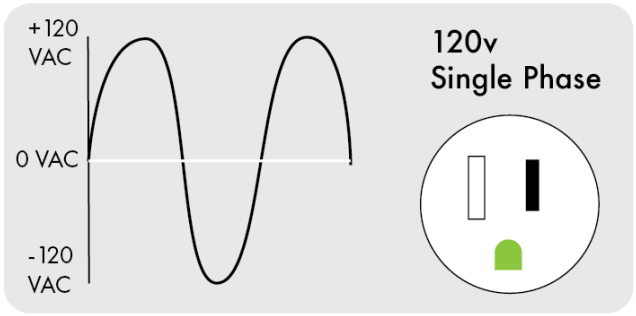
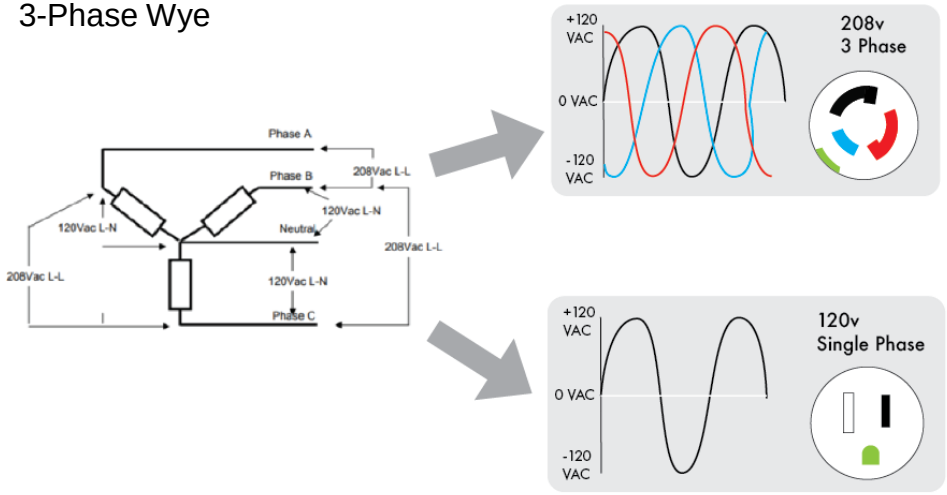
Different Types of Power Configurations

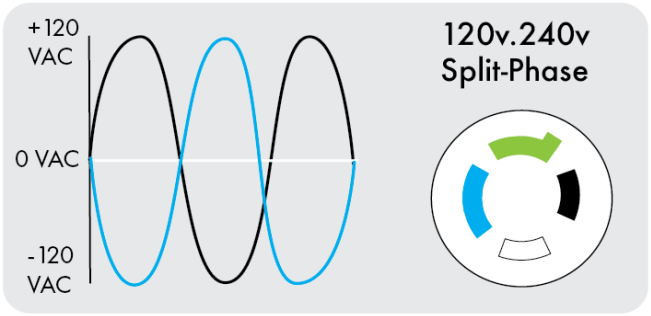
Single Phase



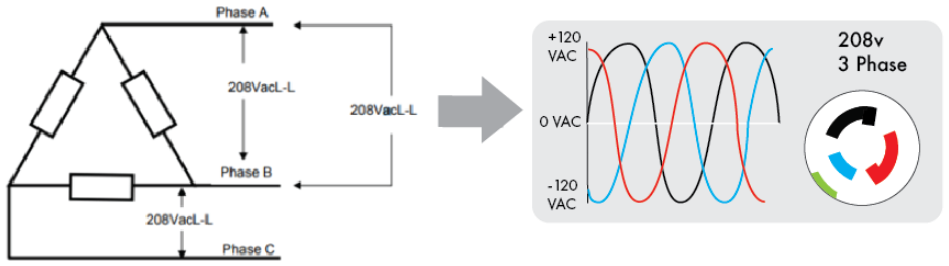
3-Phase Wye



Split Phase



3-Phase Delta



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Single Phase

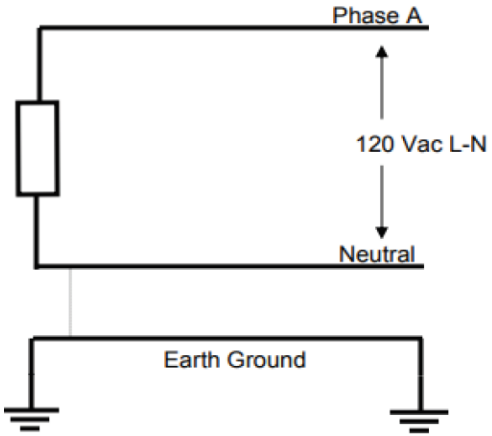
Output voltage potential between Line and Neutral wires

Ground wires provides safety

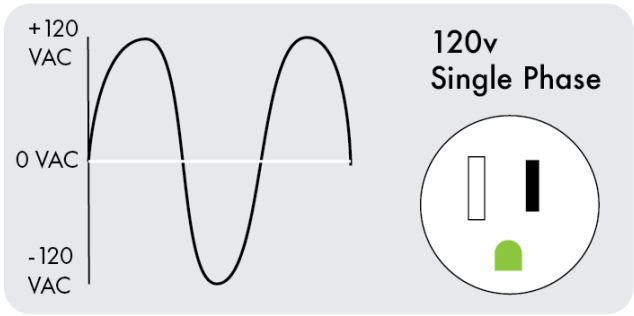
Frequency is set by power generators

Typical configuration for household and light commercial buildings outlets

Voltage and Frequency vary around the world, 50/60 Hz and 95 V – 230 V



Single Phase



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Example of Products with Single Phase Input Power

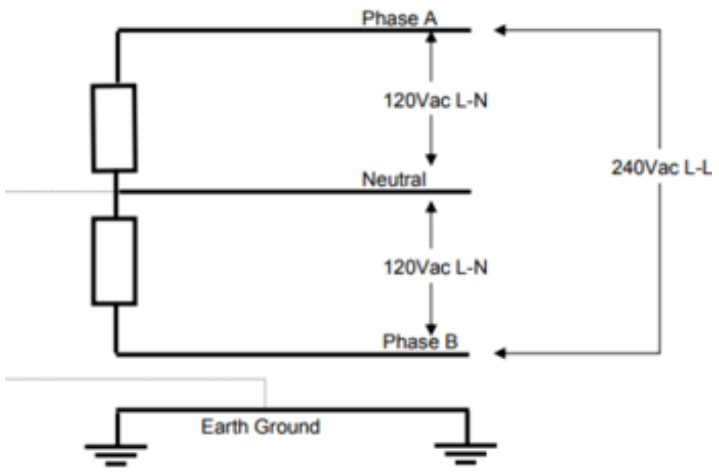
Split Phase or 3-Wire (1 Phase 3 Wire)

Output voltage potential between Line 1 and Line 2

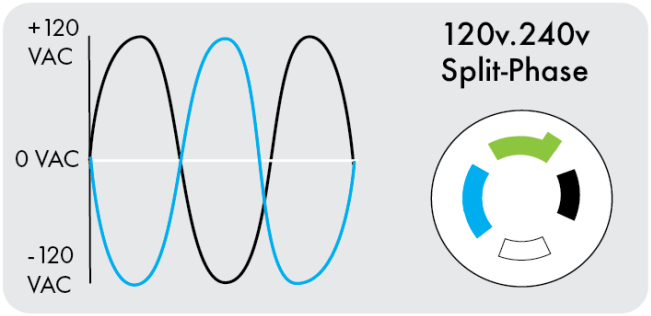
Line to Line - 240V

Line to Neutral - 120V

Sine waves of opposite polarity to create higher voltages



Single Phase



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Example of Products with Split Phase Input Power

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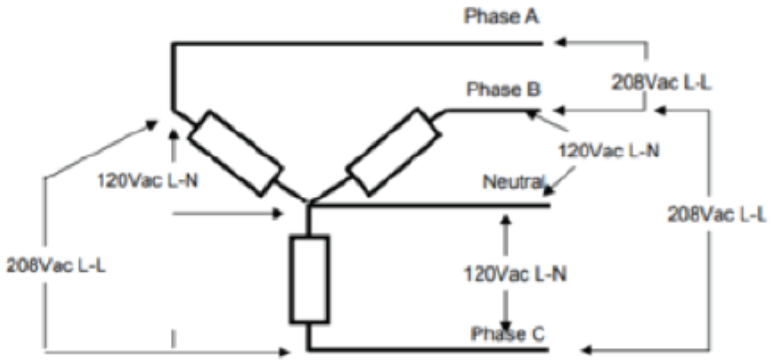
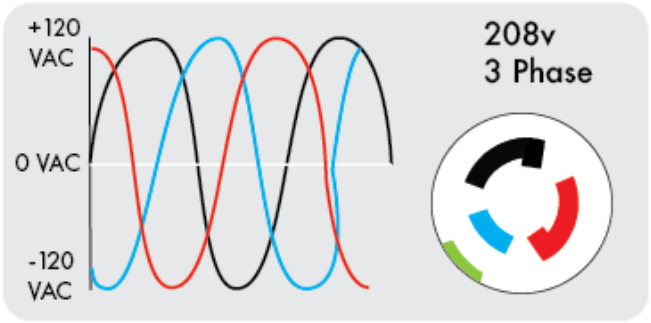
3 Phase WYE

Output voltage potential between phases A, B and C. (Line Voltage)

Voltage potential between Phase to Neutral (Phase voltage).

Sine waves are 120 degree apart





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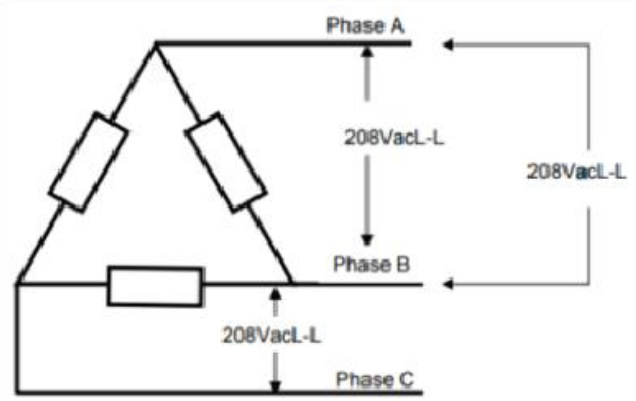
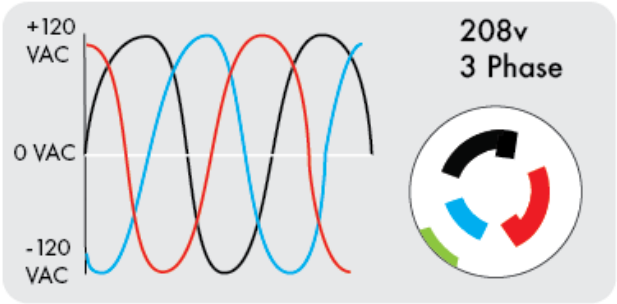
3 Phase Delta

Output voltage potential between phases A, B and C. (Line Voltage)

Commonly used as part of power generation and delivery methods

Sine waves are 120 degree apart





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Example of Products with 3 Phase Input Power

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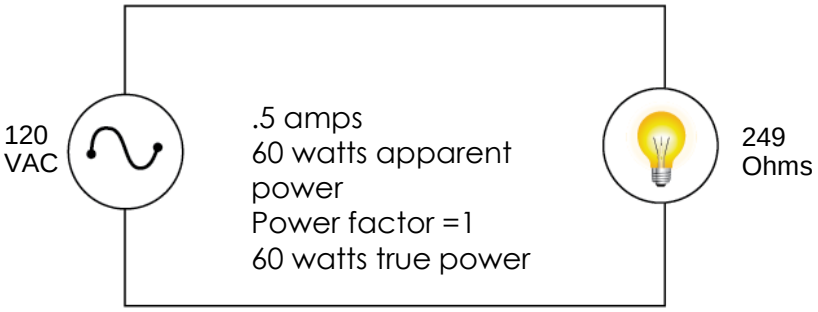
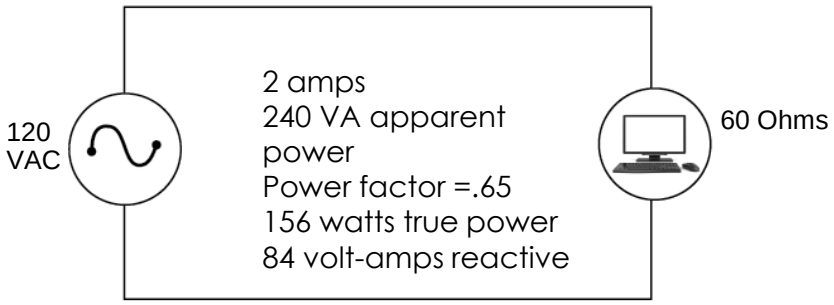
Poll Question

What are your typical power configuration requirements?

Watts vs. Volt-Amperes

	Watts	Volt-amperes
Type of Power	Real	Apparent
Abbreviation	W	VAR
Calculation	for DC: $V_{dc} \times I_{dc}$	for DC: $V_{dc} \times I_{dc}$ for AC: $V_{RMS} \times I_{RMS}$
Used for	Evaluating heat generated or dissipated & calculating cost of energy.	Properly sizing wires, circuit breakers, and fuses
Instruments needed for measurements	Wattmeter (a multimeter can't measure watts unless the V&I are both dc	Multimeter capable of measuring V_{RMS} and I_{RMS} $(VA=V_{RMS} \times I_{RMS})$





Examples of Voltage, Current and Power Requirements

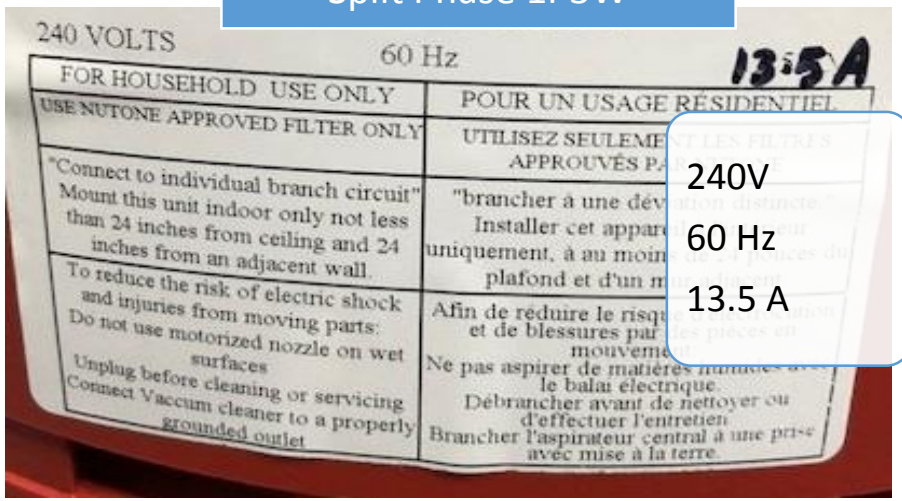
	Cell Phone Charger	Household Vacuum	Oven Range	Water Heater
Voltage Input	120/230 V	120/230 V	240 / 460 V Split Phase	240 V Split Phase
Current Draw (Approximate)	0.1 A	6 - 12 A	40 A	18 – 20 A
VA/W	10 Watts	720 - 1420 VA	9600 VA	4500 Watts

Examples of Input Labels

3 Phase Wye/Delta

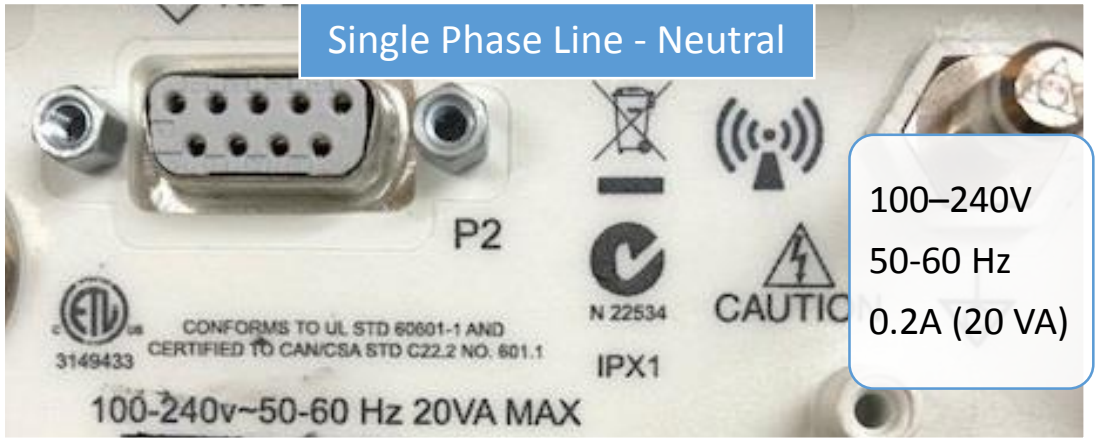
230/460V
60 Hz
18.6/9.3A

Split Phase 1P3W



240V
60 Hz
13.5 A

Single Phase Line - Neutral



100–240V
50-60 Hz
0.2A (20 VA)

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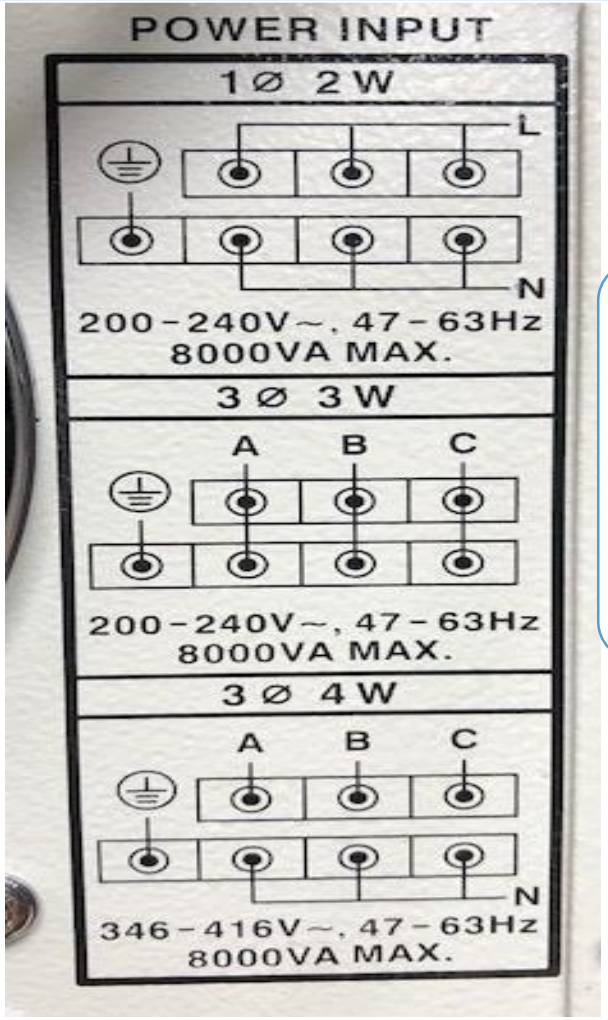
Examples of Input Labels

Multiple Input Configurations



1P2W (L-N)

1P3W (L1-L2-N)

3P3W (A,B,C)

3P4W (A,B,C,N)

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Benefits of Using Power Sources

Provides CLEAN/REGULATED power to a load.

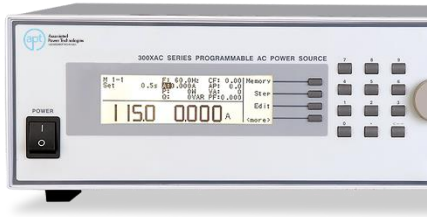
- Line and Load regulation
- Power Factor
- Crest Factor
- Low Noise (THD)

Variable input voltages/frequencies

- Range of input voltage configurations
- Range of input frequency, 47 – 63 Hz

Variable output voltages/frequencies

- Adjustable and programable voltages
- Adjustable frequencies (40 to 1000 Hz)
- 3phase from single phase



Can output multiple waveforms, line conditions and transients

- Transients (Voltage Surge or Drops)
- Brown out simulation

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Applications for AC Sources

The ability to generate worldwide voltages and frequencies to test products for global markets
Provide stable clean output power to loads versus using power from the grid
Provide stable output power that is used for precision test & measurement products
To provide power distribution to test labs, chambers, production areas & work areas
Transform 1Φ power to 3Φ power and vice versa
The ability to manipulate output power on the fly for R&D testing, lab testing, chambers, or controlled test environments
The ability to deliver voltage surges/drops, transients, harmonics, and unique waveforms to loads to monitor response of the load

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AC Power Supply Topologies

Power supplies can be divided into two groups based on the technology they use to amplify the input signal: linear and switching.

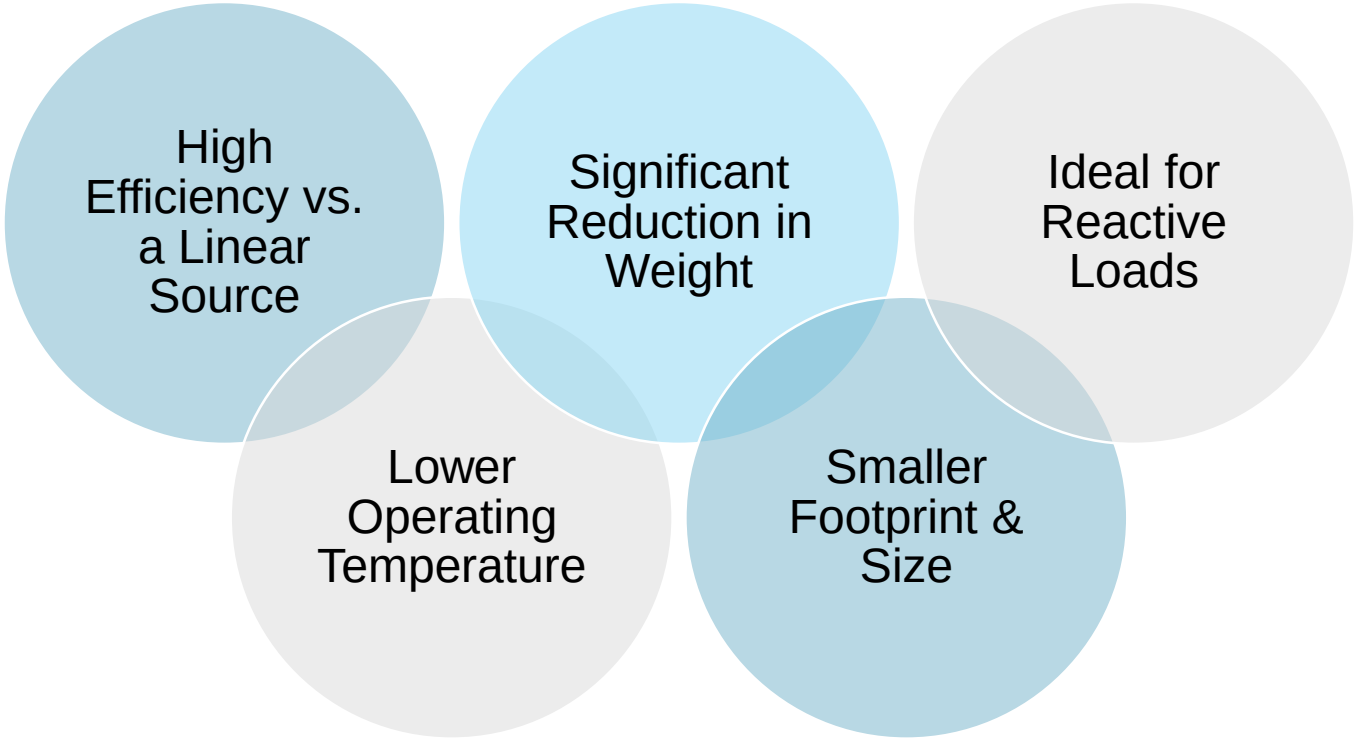
Linear Power Supply: this topology is the older of the two. A linear power supply uses a simple amplifier with a fixed gain (defined as Vout/Vin) to increase the amplitude of the input signal.

Switching Power Supply: this topology is newer and more efficient. In addition to an amplifier with a fixed gain, a switching power supply also incorporates a complex series of integrated circuits and circuit components to increase the amplitude of the input signal. This type of design usually uses Pulse Width Modulation (PWM) to convert the input signal to a square wave which is then filtered at the output.

Power Supply and Technology Comparison

Linear Power Supplies	Switching (Switch-mode) Power Supplies
Low THD	High THD
Low Efficiency	High Efficiency
High Operating Temperature-Fan Noise	Low Operating Temperature-Fan Noise
Heavy	Light
Best used with resistive loads	Best used with reactive loads
Fast Response Time	Slow Response Time

Benefits of Switch Mode Sources



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Selecting Power Sources - Items to Check

Power – Total power output capacity

- Normally listed in VA (Volts-Amps) or W (Watts)
- For example – Electric Range with Double Oven

Range Rating*	
120/240 Volts	120/208 Volts
8.8 - 16.5 KW	7.8 - 12.5 KW

Voltage – Range of voltage in particular configuration 1P2W, 1P3W, 3Phase WYE or DELTA

- 0 – 300 V in 1P2W
- 0 – 600 V in 1P3W
- 0 – 520 V in 3Phase Delta

Current – Max current output capacity

- Max current should exceed the steady state current requirements
- May current is usually listed at a particular voltage range
- High inrush current capabilities required for products that include motors and pumps.
  - Inrush could be up 10 times steady state current requirements for short durations, < 100 ms.

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Selecting Power Sources - What to Look For

Crest Factor – Ratio of peak value to RMS value of current

- Sine wave current waveform has a ratio of 1.414 for purely resistive load
- Non-sinusoidal waveform can have ratio of >3, requiring a much higher peak current then RMS

Input Power – Proper sizing of mains input voltage

- Check voltage and current requirement for power supply

THD – Low Total Harmonic Distortion

- Provides power with less noise
- Typically < 1% THD

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300XAC INPUT and OUTPUT parameters

INPUT		310XAC	320XAC	340XAC	360XAC
Phase		1Ø			1Ø or 3Ø
Voltage		100 - 240 VAC ±10%		200 - 240 VAC ±10%	1Ø: 200 - 240 VAC ±10% 3Ø3W: 200 - 240 VAC ±10% 3Ø4W: 346 - 416 VAC ±10%
Frequency		47 - 63 Hz			
OUTPUT					
Voltage		5 - 300 V			
Max Power		1 kVA	2 kVA	4 kVA	6 kVA
Max Current 1Ø	0 - 150 V	9.2 A @ ≤110 V	18.4 A @ ≤110 V	36.8 A @ ≤110 V	55.2 A @ ≤110 V
	0 - 300 V	4.6 A @ ≤220 V	9.2 A @ ≤220 V	18.4 A @ ≤220 V	27.6A @ ≤220 V
Phase		1Ø (Parallel/Poly-Phase Linking for 1Ø3W or 3Ø4W)			
Frequency		40.0 - 1000 Hz			
THD		<1% (Resistive Load)			
Crest Factor		Inrush CF ≥3 at 110 V, Continuous Current CF ≥3 at 110 V			

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Poll Question

Based on power requirement, select the appropriate AC power source to power a load of 13.40A at 230V?

Power = Voltage * Current

P = V * I

P = 230V * 13.40A

P = 3082 VA

Example of Product Requirements vs. Power Source Capabilities

3 Horsepower Single Phase Motor	
Catalog Number	CL3619TM
Enclosure	TEFC
Frame	184TC
Frame Material	Steel
Output @ Frequency	3,000HP@ 60 HZ
Synchronous Speed Frequency	1800 RPM @60HZ
Voltage @ Frequency	230.0 V @60 HZ
Current @ Voltage	13.200 A @ 230.0 V
Design Code:	L

Product Requirements	Source Capabilities
230V	0 – 300 V
60 Hz	40 – 1000 Hz
13.40A @ 230V	18.4 A @ 220 V
3036 VA	4048 VA

OUTPUT		310XAC	320XAC	340XAC	360XAC
Voltage		5 - 300 V			
Max Power		1 kVA	2 kVA	4 kVA	6 kVA
Max Current 1Ø	0 - 150 V	9.2 A @ ≤110 V	18.4 A @ ≤110 V	36.8 A @ ≤110 V	55.2 A @ ≤110 V
	0 - 300 V	4.6 A @ ≤220 V	9.2 A @ ≤220 V	18.4 A @ ≤220 V	27.6A @ ≤220 V
Phase		1Ø (Parallel/Poly-Phase Linking for 1Ø3W or 3Ø4W)			
Frequency		40.0 - 1000 Hz			

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Additional Features or Technology

OC Foldback – Over current fold back technology to allow high inrush product to power up.

- Voltage is lowered to compensate for higher than normal inrush current requirements.
- Once the product reaches steady state current draw, voltage returns to normal output.

Transients – Functionality to mimic power line conditions

- Voltage dips and surges can be programmed to simulate brownout or surge conditions.
- Simulate power interruption for the connect load.

PC Control – Ability to program and control the source using PC

- Allows greater flexibility in setting up and running test systems
- Data collection made easier

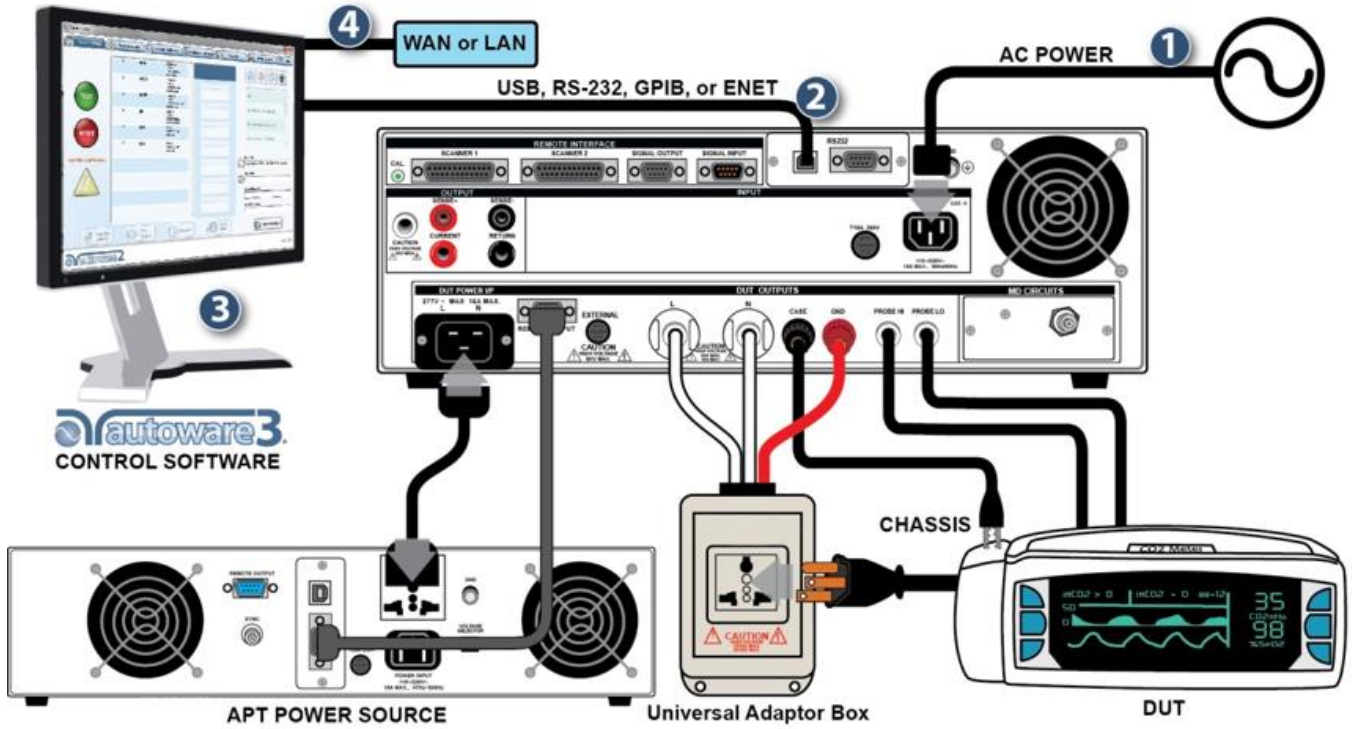
DC Output – Capability of driving DC loads

- When a product requires DC voltage same source can be used to power up the load
- Ripple and Noise level determine quality of DC power

Power source and Electrical Safety testing

Leakage Current Testing – Essential part of test requirement

- 60601-1 3rd Edition requires product to power up at 110% of rated input voltage
- Mains on Applied Part testing requires additional mains voltage applied to an Applied Part



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Other Standards Requirement

UL 508 Industrial Control Equipment – 110% of rated voltage

UL 508 Industrial Control Equipment

44.1 An assembly using one or more electromagnetic switching components shall withstand 110 percent of the rated voltage without damage to the operating coil that prevents full closure of the switched contacts and shall operate at 80 percent of its rated voltage when for use on direct current or 85 percent of its rated voltage when for use on alternating current.

IEC 60065 Audio Video and Similar Electric Apparatus 90% or 110% for Rate Supply Voltage

IEC 60065 Audio, Video and Similar Electronic Apparatus

4.2.1 The apparatus, except battery-operated apparatus, is connect to a supply voltage of 0,9 times or 1,1 times of any RATED SUPPLY VOLTAGE for which the apparatus is designed.

Section 4.2.1 of the above standard calls for the DUT to be powered up to 110% of nominal line voltage during
testing. For customers that have limited AC power source requirements and whose products require no more than 500VA, the APT model 105 VariPLUS is the perfect choice (Figure 1). The VariPLUS is a no frills alternative to a variable transformer and can output voltages at 110% of nominal operating voltage at either 50 or 60 hertz

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UL 8750 LED Equipment for Use in Lighting Products – 5% of marked rated voltage

UL 8750 Light Emitting Diode LED Equipment for Use in Lighting Products

8.1.2 All electrical measurements, unless otherwise specified, are to be conducted:

a. In a draft free room,

b. At an ambient temperature of 25 ± 5°C (77 ± 9°F unless a higher ambient temperature is specified by the manufacturer and

c. with the unit connected to supply source of a nominal frequency that is adjusted to within 5 percent of the marked rated voltage.

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Educational Resources

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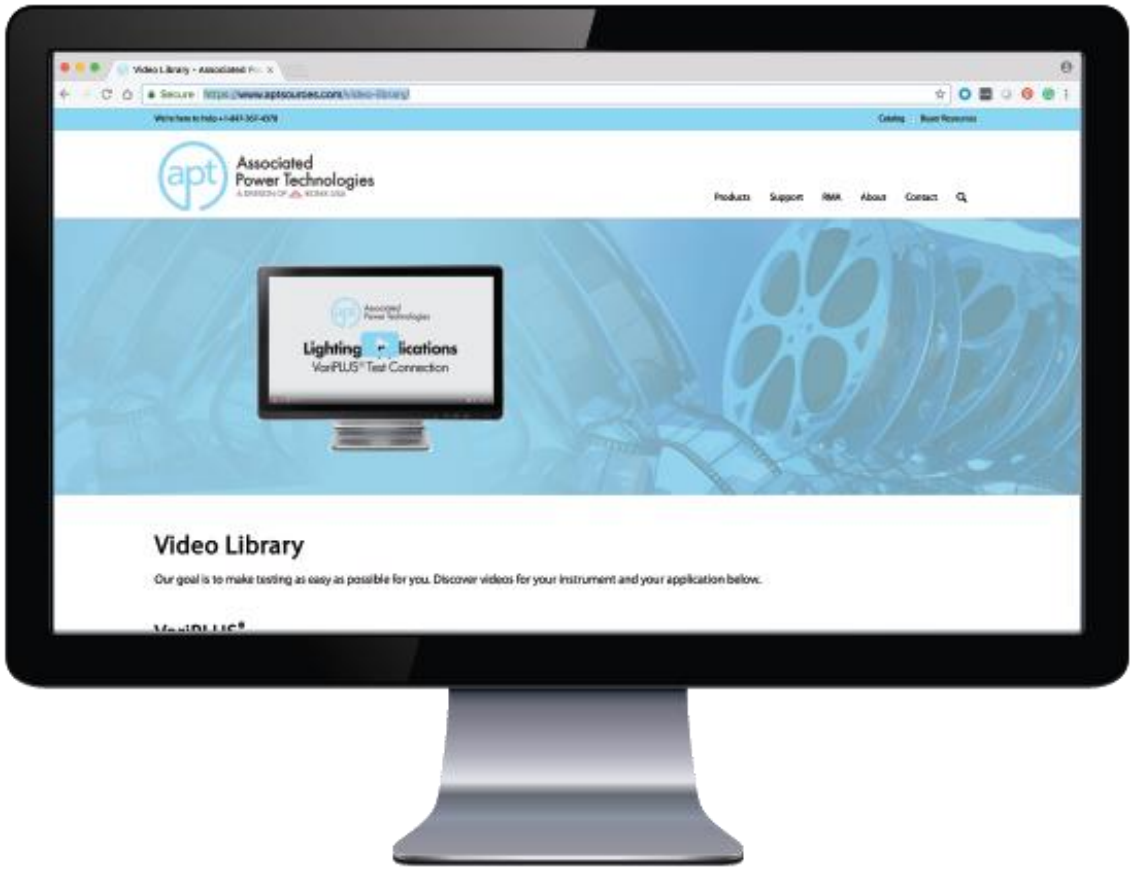

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Join Us

Our Next Webinar is

Leakage Current 101

Wednesday, October 10 at

10AM CST (GMT – 6:00)

Click the link in chat box to learn more

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