Glossary - Power Definitions

What is an Amp?
An Amp (or Ampere) is the standard measure of electrical current. Much like water flowing through a pipe, the Amp is a measure of how much electricity is moving through a wire at a given time. The Amp draw of a circuit is dependent on the needs of the devices plugged into it and is limited by the branch circuit protection.

What is a Volt?
A Volt is the standard measure of electrical potential and a fixed value for every circuit. Voltage is measured with respect to a reference point (usually between the two respective conductors of the circuit). Voltage is analogous to pressure in a water pipe. Higher pressures, or higher voltages, allow more energy to flow within a given amount of time for a given wire size. Standard voltages present in most data centers are 120V and 208V in the U.S., and 230V in continental Europe. Some newer U.S. data centers are being designed to utilize 230V.

What is a Watt?
A Watt is the measure of total work performed by the energy consumed in a system. The calculation is: Watts = Volts x Amps x Power Factor.

What is Energy?
Energy is electricity as a raw material, measured in Volts and Amps available to do work.

What is AC?
Alternating Current, or AC, is energy delivered in a form that can travel the long distances necessary from generating plants to homes and businesses. The term AC reflects the fact that the voltage and current are always changing in value, or alternating between a positive and negative threshold over a centerline.

What is DC?
Direct Current, or DC, is energy that does not alternate over a fixed period of time, but rather has a steady value with reference to zero. DC does not travel great distances well.

What is RMS?
RMS stands for root mean squared. It is used in conjunction with AC Volts and AC Amps to express an average value. A true RMS calculation takes into account the shape and phases of the wave forms being delivered to a circuit. AC voltage and current are ever-changing values. Using RMS measurements provides useful values.

What is Apparent Power?
Apparent Power is the instantaneous calculation of Volts x Amps.

What is Real Power?
Real Power is the RMS value of Watts.

What is Power Factor?
Power Factor is the ratio of Real Power to Apparent Power. Its value ranges from 0 to 1. A value of 1, or 100 percent, is unity power. Lower values of Power Factor indicate that the circuit is wasting energy. Any difference between the RMS value of Watts and the Volt-Amps value indicates inefficiencies in the way power is being used by the equipment on the circuit.

What is PUE?

$$= \frac{\text{Building Watts}}{\text{IT Watts}}$$

PUE stands for power use effectiveness. PUE is a measure of how efficiently power is being used in a data center and is becoming the standard benchmarking metric in most data centers. PUE is determined by dividing the total facility power use (Building Watts) by the IT equipment load (IT Watts). The power distribution within the building has several points where losses occur (uninterruptible power source (UPS), transformers, wire runs), so the ideal place to measure the IT power load is at the cabinet level within the power strip. These readings can be collected and aggregated to determine the IT power load. Once an initial assessment of PUE has been made, efforts can be made to improve PUE by applying various methods to improve operational efficiencies in the data center.

What is EUE?

$$= \frac{\text{IT VA}}{\text{UPS VA}}$$

Unlike the commonly used power usage effectiveness metric, energy usage effectiveness (EUE) is based on energy rather than power. The EPA Energy Star program focuses measurements on energy rather than power. The new Energy Star certification is a rating for data centers and is based on EUE. A data center's EUE, normalized for a variety of the facility's characteristics, calculates the 1-100 rating for that facility. Data centers in the top 25 percentile qualify for Energy Star certification. EUE is calculated by dividing the total source energy (IT VA) by total UPS energy (UPS VA). Some factors will not be a part of the calculation, such as heating and cooling degree days, data center type (traditional, hosting, Internet, etc.) and UPS utilization.

What is DCiE?

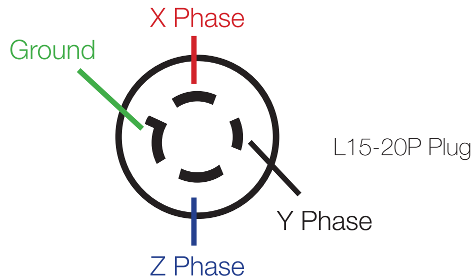
$$= \frac{\text{IT Watts}}{\text{Building Watts}}$$

DCiE stands for data center infrastructure efficiency. DCiE is IT power divided by total facility power, expressed as a percent. DCiE is the inverse of PUE.

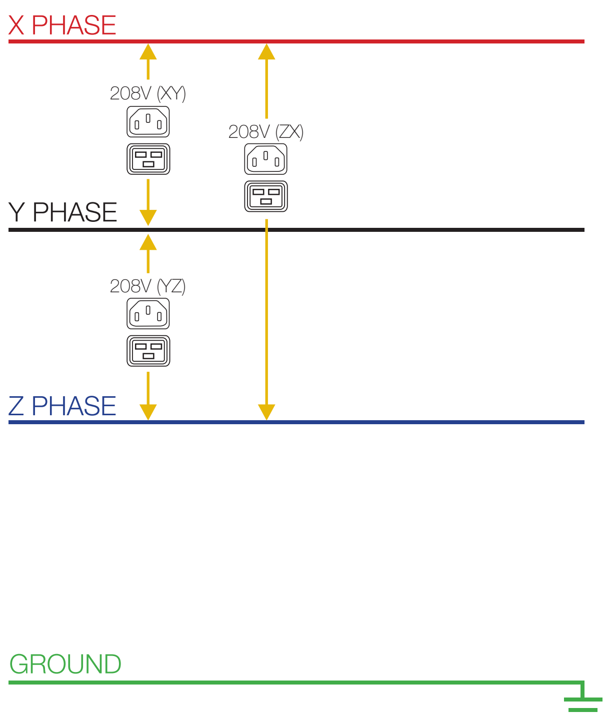
Glossary - Power Definitions

What is 3-phase delta?

3 Phase delta from 208V source

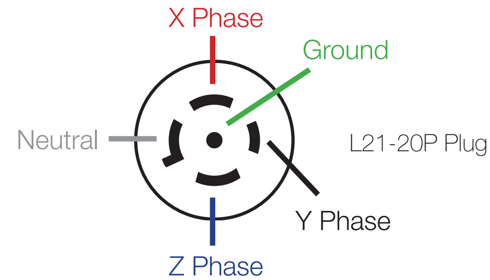


A 3-phase DELTA is a 4-wire configuration consisting of 3 phase conductors (X, Y and Z) and a ground. Without the neutral present, only phase-to-phase wiring is possible. The potential between any two-phase conductors is typically 208V.

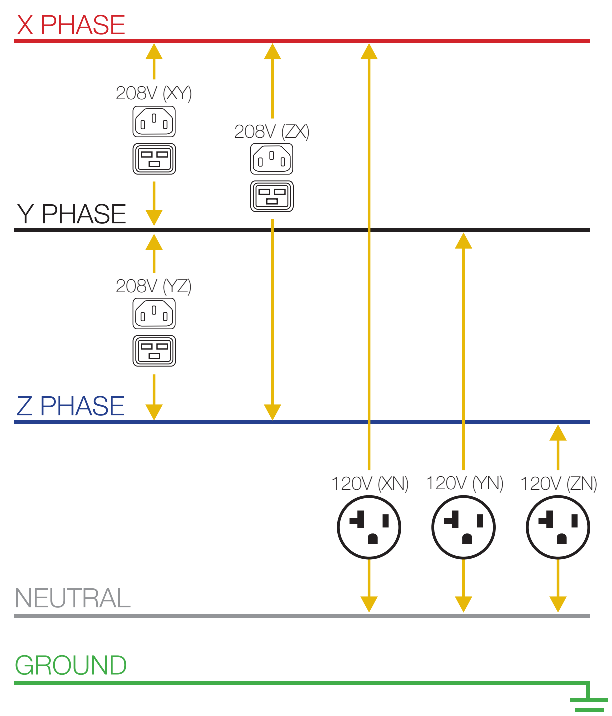


What is 3-phase wye?

3-phase wye from 120/208V source



A 3-phase 120/208V wye is a 5-wire configuration consisting of 3 phase conductors (X, Y and Z), neutral and ground. The potential between any 2-phase conductors is 208V. The potential between any phase and neutral is 120V. It can be wired to provide 120V, 208V or a combination of both voltages within one PDU.



Glossary - Conformance Definitions

What is an IEC connector?

The International Electrotechnical Commission (IEC) is a non-profit, non-governmental organization that publishes international standards for electrical and electronic products. IEC connectors are inlets and sockets used for AC mains electricity that conform to the IEC 60320 Standard (plugs fall under IEC 60309).

What is a NEMA connector?

NEMA, which stands for the National Electrical Manufacturers Association, is a standards-setting body for the North American electrical industry. NEMA connectors are plugs and receptacles used for mains electricity that conform to NEMA standards.

What is AWG?

American wire gauge is the standard measurement for the cross sectional area of an electrical conductor.

What is a plenum-rated cable?

A plenum is a compartment or chamber used for HVAC air distribution. In the data center, this is typically the space below a raised floor. A plenum-rated cable refers to structured cabling permitted by building code for use in plenum spaces. Plenum-rated cable has a slow-burning, fire-resistant casing that emits little smoke. Article 645 of the National Electric Code (NEC), titled Information Technology Equipment discusses the use of power cables under a raised floor.

What is the FCC?

The FCC, or Federal Communications Commission, is a United States government agency charged with regulating interstate and international communications by radio, television, wire, satellite and cable. FCC rules prohibit electronic equipment used in the United States from emitting any electromagnetic interference (EMI) that endangers the functioning of a radio navigation service or other safety services or seriously degrades, obstructs or repeatedly interrupts a radio communications service. The FCC has established maximum emission levels for unintentional radiators based on whether they are intended for commercial or household use. Products intended for commercial use are required to meet Class A limits. Representative samples of Geist products are tested by an FCC-registered lab to the Class A limits. All Geist products are compliant with FCC regulations.

Glossary - Conformance Definitions

What is UL®?

UL is an independent agency approved by the NFPA (National Fire Protection Association) to determine the life safety of equipment used in the workplace.

What does "UL® Listed" mean?

The term is used by UL® when it determines that a complete product, such as a power distribution unit (PDU), is safe for use as intended by the manufacturer. Only UL® can authorize the use of the UL® Listing mark.

What does the "cULus®" mark represent?

This mark is placed on products that have been tested and evaluated by UL® to both Canadian and U.S. safety requirements.

What does the CE mark represent?

The CE Mark is a required conformance mark that must be placed on certain types of electrical and electronic equipment sold in the European Union. The CE mark is used to indicate that a manufacturer certifies that a product conforms to all applicable European Union directives.

What is the NEC?

NEC stands for national electric code and is sponsored by the National Fire Protection Association (NFPA). These guidelines, also known as NFPA-70, are used to safeguard life and property from hazards arising from electricity. The NEC is not a U.S. law, however conformance is commonly mandated by state or local law. UL is an independent agency approved by the NFPA to ensure product compliance with the NEC. Additional information is available at www.nfpa.org.

What is RoHS2 compliance, and how does it affect me?

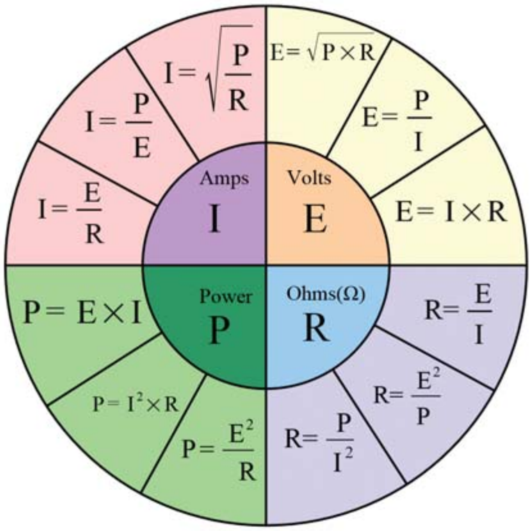
RoHS (pronounced "rows" or "row-hoss") stands for Restriction on the use of Certain Hazardous Substances. The term is most commonly used to refer to the European Union's (EU) RoHS2 Directive. The objective of the EU RoHS2 directive is to restrict the use of hazardous substances in electrical and electronic equipment. This reduction is intended to both reduce the amount of hazardous substances in landfills resulting from the disposal of electrical and electronic equipment and to minimize the health and environmental impact of recycling electrical and electronic equipment.

RoHS Compliance is mandatory for PDU products sold in Europe and is becoming increasingly more important for PDU products sold in the United States. For example, California has already passed Proposition 65, a RoHS-like law requiring certain electrical and electronic equipment to comply with the requirements established by the EU RoHS Directive.

Geist is committed to supporting the objectives of the RoHS Directive by producing RoHS-compliant products. Geist's goal is to produce RoHS-compliant versions of all product offerings by establishing RoHS compliance through diligent management of the supply chain. Please contact a customer service representative at 800.432.3219 to determine the current RoHS status of any Geist product.

Geist's engineering team is dedicated to providing the highest quality products and service in the industry.

Ohm's Law Power Wheel



Cable AWG & Ratings - NEC/UL® Requirements

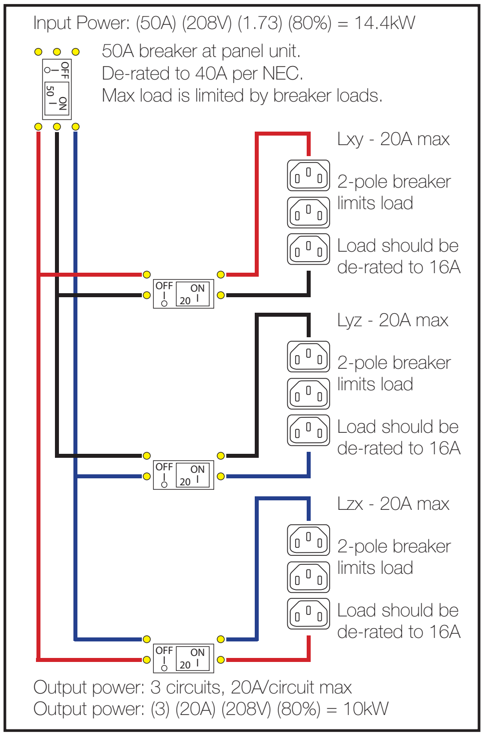
Branch Circuit Rating	PDU Nameplate Rating	Wire AWG	# of Conductors
15 A, 120 V	12 A, 120 V	14	3
15 A, 208 V	12 A, 208 V	14	3
20 A, 120 V	16 A, 120 V	12	3
20 A, 208 V	16 A, 208 V	12	3
20 A, 208 V 3~ DELTA	16 A, 208 V 3~ DELTA	12	4
20 A, 120/208 V 3~ WYE	16 A, 120/208 V 3~ WYE	12	5
30 A, 120 V	24 A, 120 V	10	3
30 A, 208 V	24 A, 208 V	10	3
30 A, 208 V 3~ DELTA	24 A, 208 V 3~ DELTA	10	4
30 A, 120/208 V 3~ WYE	24 A, 120/208 V 3~ WYE	10	5
50 A, 208 V 3~ DELTA	35 A, 208 V 3~ DELTA	8	4
50 A, 208 V	40 A, 208 V	6	3
50 A, 208 V 3~ DELTA	40 A, 208 V 3~	6	4
60 A, 208 V	48 A, 208 V	6	3
60 A, 208 V 3~ DELTA	48 A, 208 V 3~ DELTA	4	4

Power Ratings and Requirements for a Single AC Feed

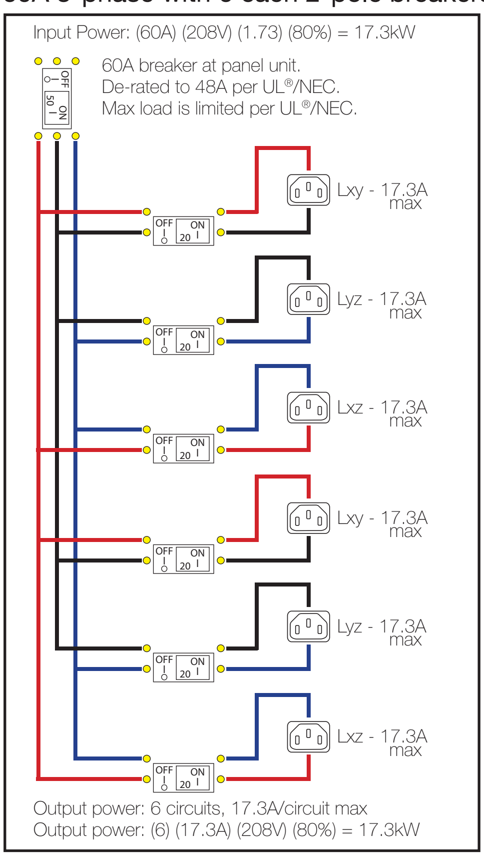
PDU Nameplate Current Rating	Branch Circuit Rating	Volts	Phase	Watts	80% Rule De-rated Watts	kW	BTU / hr (kW x 3414)	AC Tons** (BTU / 12000)	Air Volume*** (120 CFM * kW)
12	15	120	1	1,800	1,440	1.4	4,916	0.41	168
16	20	120	1	2,400	1,920	1.9	6,555	0.55	228
24	30	120	1	3,600	2,880	2.9	9,832	0.82	348
16	20	208	1	4,160	3,328	3.3	11,362	0.95	396
24	30	208	1	6,240	4,992	5.0	17,043	1.42	600
35	50	208	1	10,400	7,280	7.3	24,854	2.07	876
48	60	208	1	12,480	9,984	10.0	34,085	2.84	1,200
16	20	230	1	4,600	3,680	3.7	12,564	1.05	444
24	30	230	1	6,900	5,520	5.5	18,845	1.57	660
48	60	230	1	13,800	11,040	11.0	37,691	3.14	1,320
16	20	208	3	7,197	5,757	5.8	19,656	1.64	696
24	30	208	3	10,795	8,636	8.6	29,484	2.46	1,032
35	50	208	3	17,992	12,594	12.6	42,997	3.58	14,712
48	60	208	3	21,590	17,272	17.3	58,968	4.91	2,076
80	100	208	3	35,984	28,787	28.8	98,279	8.19	3,456
100	125	208	3	44,980	35,984	36.0	122,849	10.24	4,320
120	150	208	3	53,976	43,181	43.2	147,419	12.28	5,184
16	20	230	3	13,800	11,040	11.0	37,691	3.14	1,320
24	30	230	3	20,700	16,560	16.6	56,536	4.71	1,992
48	60	230	3	41,400	33,120	33.1	113,003	94.17	3,972
	*3-phase power is calculated by multiplying single phase by the sq-root of 3 or 1.73.								
	**Tons of air conditioning required to remove heat from associated IT load.								
	***The volume of air that is typically required by the IT equipment for each kW of IT load can typically range from 80 to 140 CFM.								

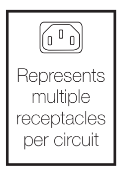
Charts

35A 3-phase with 3 each 2-pole breakers

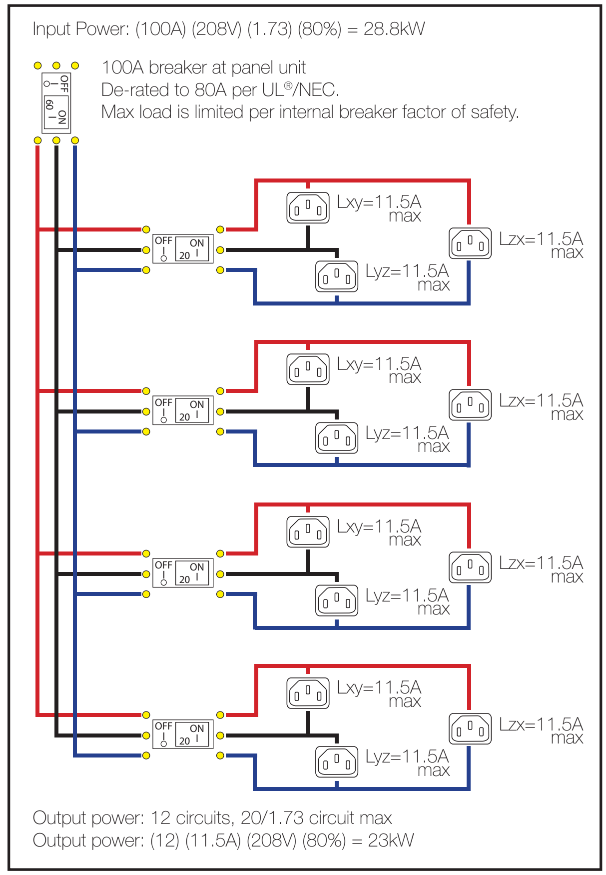


60A 3-phase with 6 each 2-pole breakers

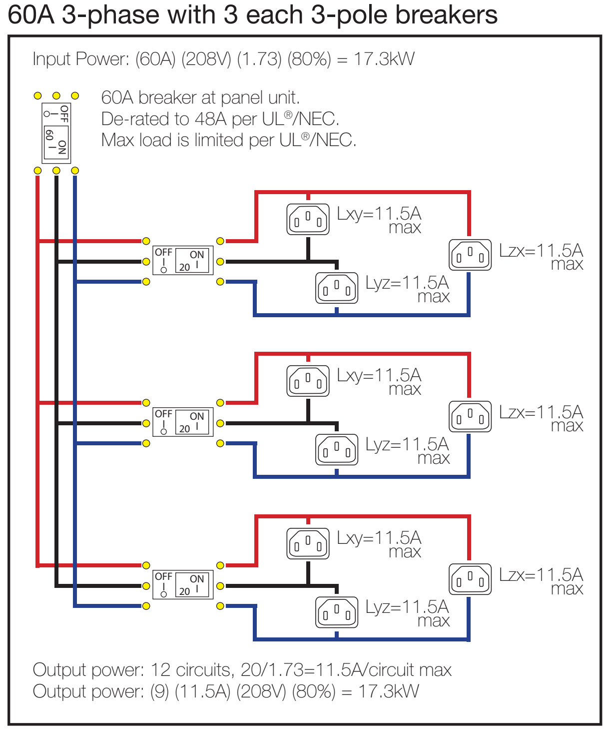




80A 3-phase with 4 each 3-pole breakers



60A 3-phase with 3 each 3-pole breakers

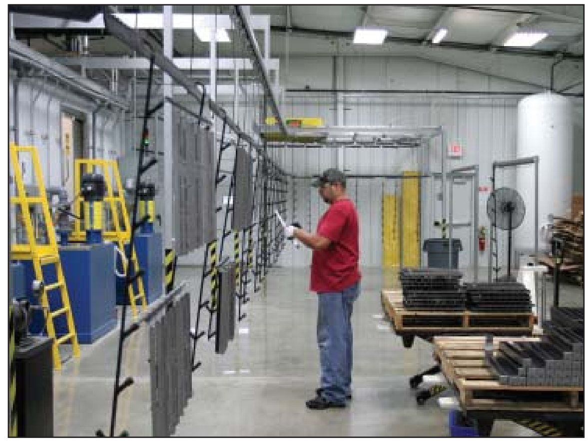


FAQ - Geist Specific

How can Geist deliver customized products in 1 week when others take months?

Geist has the largest in-house engineering department in the industry.

Geist's in-house engineering department includes mechanical, electrical, conformance, board layout and software specialists. The testing lab at Geist is authorized to conduct UL® testing on Geist products to 60950 IT equipment standards as part of the UL® Data Acceptance Program. Our software specialists can create software for new or custom products and deploy directly to production to reduce lead times. Geist also has an in-house team responsible for embedded circuit design, which allows for faster turnaround on custom applications requiring circuit boards. Geist's engineering team is dedicated to providing the highest quality products and service available in the industry.



Geist invests in continuous improvement.

The Geist Metalworks division allows us to punch, bend and paint our own metal products. This allows Geist to reduce already short lead times by eliminating scheduling conflicts with suppliers. The Geist Metalworks team also helps reduce the lead time on custom units, making products available to the customer faster than anyone else in the industry.

FAQ - Geist Specific

Can Geist provide a basic current meter that does not scroll through the additional power information including Voltage, Watts and Power Factor?

Geist single-phase PDUs containing the power meter have the option of being purchased with a real-time meter that displays only the Amp reading for the unit. Please contact your customer service representative at 800.432.3219 for a part number modification with this optional factory configuration. Selection must be made at the time of purchase.

How do I connect multiple units from a single IP address?

Use a router or a switch with routing capabilities. The router connects to your network using one IP address and routes traffic to and from the connected devices in their own separate address space. For example, if you had three devices you could assign IP addresses 10.0.5.2, 10.0.5.3 and 10.0.5.4 to those devices, and 10.0.5.1 to the device side of the router. This is called the gateway, and typically is assigned the first IP address in a given range. The network side of the router would then be assigned a network address on your existing network.

What rating should I use to correctly select a PDU for my installation?

There are several factors to consider when selecting a Geist PDU to ensure that the PDU has sufficient capacity for the intended application. The three main factors to consider are (1) nameplate rating, (2) receptacle ratings and (3) internal breaker configuration.

Nameplate: The nameplate rating marked on a Geist PDU is the intended operating voltage range and maximum operating input current. Nameplate ratings are based on both regulatory requirements and design factors and represent the continuous total current that the PDU will be able to deliver to a load. The PDU should not be installed in an application where the nameplate ratings are exceeded.

Receptacle: The PDU's output power is connected to information technology equipment through either NEMA or IEC receptacles. The PDU should not be installed in a manner that will exceed the maximum current rating of any individual receptacle. For example, a NEMA 5-15R receptacle should not be loaded to over 15A regardless of the nameplate rating of the PDU it is installed in.

Internal Breakers: Geist PDUs can be equipped with internal circuit breakers that are used to protect the circuit in case of overload or earth fault conditions. For PDUs rated 12A or 16A, the circuit breakers are optional components that act as supplementary protectors. For PDUs rated higher than 16A, the circuit breakers are required components that provide primary overcurrent and earth fault protection for the PDU's internal circuits. The PDU should not be connected to a load that will exceed the current rating of an internal breaker. For maximum protection against nuisance tripping, it is recommended that internal breakers are only loaded to 80 percent of the breaker current rating.

Why are Geist cord-connected units listed with a de-rated Amperage?

Geist's cord-connected PDUs carry a nameplate current rating that is 80 percent of the branch circuit rating listed in the catalog specification. The nameplate current rating has been lowered in order to comply with UL®/NEC requirements. Geist PDUs are UL® Listed as Information Technology Equipment to the UL® 60950 Standard. UL® 60950 requires that the attachment plug of Listed Information Technology Equipment shall be rated not less than 125 percent of the Rated Current of the equipment at the nominal system voltage range as defined by the configuration of the plug. This clause in UL® 60950-1 is based on the requirements of the National Electrical Code (NFPA-70), which state that branch circuit conductors and overcurrent protection devices shall be sized to carry 125 percent of the continuous load and 100 percent of the non-continuous load on the circuit breaker.

Due to this UL®/NEC requirement, the nameplate current rating of a Geist PDU is 80 percent of the maximum current rating of the branch circuit used to power the PDU. Most of Geist's customers base their PDU input current specifications on the branch circuit ratings; consequently, the catalog lists the ratings of the branch circuit that the PDU is intended to be connected to. In addition to the branch circuit rating, it is important to consider the nameplate PDU rating which includes the 80 percent de-rating factor required by UL®/NEC when calculating PDU requirements.

Can I purchase a PDU without a circuit breaker?

Yes, some configurations can be purchased without an internal circuit breaker. All Geist PDUs require an appropriately sized branch circuit breaker in the building installation. Branch circuit breakers should be sized according to the PDU's nameplate rating, and electrical code requirements. To comply with the NEC, the circuit breaker in the building installation should have a trip current rating that is 25 percent higher than the PDU's nameplate. For example, a 16A rated PDU requires a 20A circuit breaker.

How do I determine how much power is needed in a cabinet?

Perform the following for a quick estimate of the power needed in a cabinet:

- Add the power ratings in Watts from the nameplate labels of the equipment you want to put in the cabinet. [Sometimes, the labels indicate Amps instead of Watts. In this case, multiply Voltage and Current values to get an approximate value for power.] Example: 30 servers each using 300 Watts = 30 x 300 = 9,000 Watts or 9kW.

Why should I consider designing my data center with 208V instead of 120V?

The electrical power consumption of electrical appliances is measured in Watts. Wattage (Watts value) is a product of the rated Voltage and Current. The higher the Voltage the lower the current required to supply the same Watts. The same size wire can carry nearly 2x as much power (Watts) @ 208V versus 120V. A Voltage of 208V yields 1.73 times more power than 120V.

What are the benefits of utilizing two 20A breakers versus two 15A breakers on a 30A PDU?

20A breakers in a 30A unit allow maximum flexibility of load connection without nuisance tripping. The receptacles in a 30A PDU are divided into two independent groups. A 30A PDU distributing to 15A or 20A receptacles must be broken down into either 15A or 20A circuits internally. By opting for 20A internal circuits, PDU circuit balance is less critical. One circuit may be loaded to greater than15A. This would not be possible if each breaker were rated at 15A.

FAQ - Geist Specific

Is it possible to distribute both 120V and 208V from a PDU with a single input cord?

PDUs with 3-phase wye input allow for the option of distributing 120V and 208V in a single power strip. 3-phase wye consists of three phases, one neutral and one ground conductor. 208V output is achieved across two phase conductors and 120V output is achieved across one phase conductor and the neutral conductor.

How does Wattage relate to heat in a cabinet?

Heat is measured in Watts and power is measured in Watts. Almost all electrical energy used in computing is converted to heat. A computer power supply can be as low as 80 percent efficient. This means that for every 100 Watts it draws, 20 Watts may be converted directly into heat without ever being used by the computer. As the computer processes information, the rest of the power is dissipated throughout the system as heat. Since all power can be counted as heat, adding the Watt ratings of all equipment in a cabinet will give a relatively 1:1 relationship to heat generated. Example: 40 servers x 300 Watts each = 12,000 Watts (12kW) heat.

Why can't I output 120V from a 208V single-phase input?

Geist PDUs are high quality power strips intended to be used to distribute power to information technology equipment within a data center. These PDUs, which are available in single or three phase configurations, are not designed to increase or reduce the input circuit's voltage level. Single-phase 120V rated power distribution units installed in North America will typically be powered by a 120V line-to-neutral circuit. The outlets on these PDUs will all be wired line-to-neutral and will output 120V. Single-phase 208V rated power distribution units installed in North America will typically be powered by a 208V line-to-line circuit. The neutral conductor is not connected to a standard 208V single-phase PDU; consequently, all outlets will be wired line-to-line and will output 208V.

What are the advantages of bringing 3-phase power to my cabinet?

1) Less wire under the floor improves airflow and reduces wiring confusion. A 20A 3-phase installation contains five wires where the equivalent single phase system would require nine wires (3x3).

2) Fewer whips to pull saves you time and money. A 3-phase system has one whip for the electrician to bring to the cabinet where the equivalent single-phase system would have three whips. This saves both material and labor cost.

3) Simplified load balancing reduces technician installation and troubleshooting time. With all 3 phases available in a single cabinet, load balancing can be achieved at the cabinet level where similar type equipment is often found. In a single-phase system, a minimum of three cabinets may need to be examined to balance the same load.

What is the difference between a circuit breaker or surge suppressor?

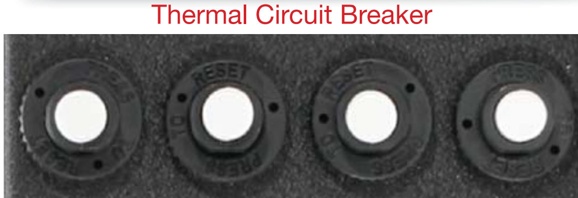
Cicuit Breaker

A circuit breaker is a device that opens and closes an electrical circuit. It senses the current flow and operates automatically when the current exceeds the breaker's trip threshold. Human intervention is required to switch the circuit back on. A circuit breaker is current-limiting and is used to protect the wire within an installation.

Magnetic Breaker / Switch

Push to reset

Thermal Circuit Breaker



Surge Suppressor

A surge suppressor limits the magnitude of the voltage in an electrical circuit without interrupting the current flow. It is used to prevent voltage spikes from damaging electrical equipment.

Surge Suppressor

Can Geist provide a unit with a plenum-rated power cable?

Geist is pleased to offer UL® Listed DP-1 Rated cable, with an FT-4 flame rating, as an option available on most Geist PDUs. Please contact us at 800.432.3219 for assistance with your specific application or additional information.

What gets measured, gets improved. How do you measure "green?"

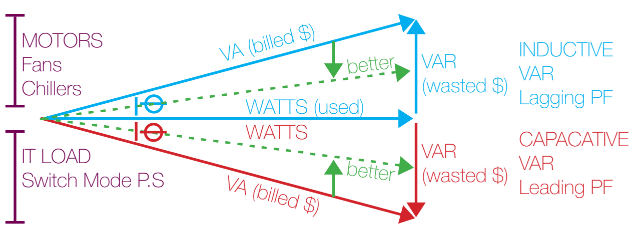
Geist can help you capture return on green initiatives by providing the metrics you need, helping you decrease your carbon footprint. Whether it's monitoring power consumption per server via outlet level monitoring or looking at environmental conditions within your data center, Geist has a solution for your monitoring needs. IP accessible units provide real-time feedback of actual data center conditions.

FAQ - Geist Specific

Power Triangle

The power triangle illustrates the inefficiency of typical equipment connected to AC power. Losses in an AC power load are primarily inductive or capacitive, expressed as reactance. Inductive losses are the result of magnetic opposition to current flow (motors, coils and transformers). Capacitive losses often arise from modern switching power supplies found in most IT equipment. Both types of losses result in wasted energy, as the energy delivered from the utility (VA) is greater than the work performed by that energy (W). The difference (VAR) represents wasted energy dollars.

A perfectly balanced AC load, where the inductive reactance equals the capacitive reactance, would result in a perfect use of delivered energy. In this case, VA equals W, VAR is equal to zero, the power triangle becomes a straight line, and all energy delivered is used to perform work. This is also called unity power factor (PF = W/VA). A PF of less than one indicates inefficiency and wasted energy.



Why is density such a hot topic in data centers?

Physics defines density as mass/unit volume. In the data center, density is used in a different context. Density is referred to when cabinets are filled with power consuming equipment, leading to high power density and heat density. In past years, data center designers designed to accommodate certain power levels per square foot of raised floor space. Now, the trend is to consider power level per cabinet. For instance, five to 10 years ago, the norm was to load cabinets to 3-4 kW. Current servers use faster, more power-hungry processors, leading to more power consumption. Cabinets filled with 1U servers, or blade servers, can draw upwards of 20kW. This high power consumption in a relatively small amount of space is referred to as high power density or simply high density computing. Geist offers several PDUs ideal for high density computing, with PDUs ranging up to 34kW.

What are the best products and practices for true redundancy?

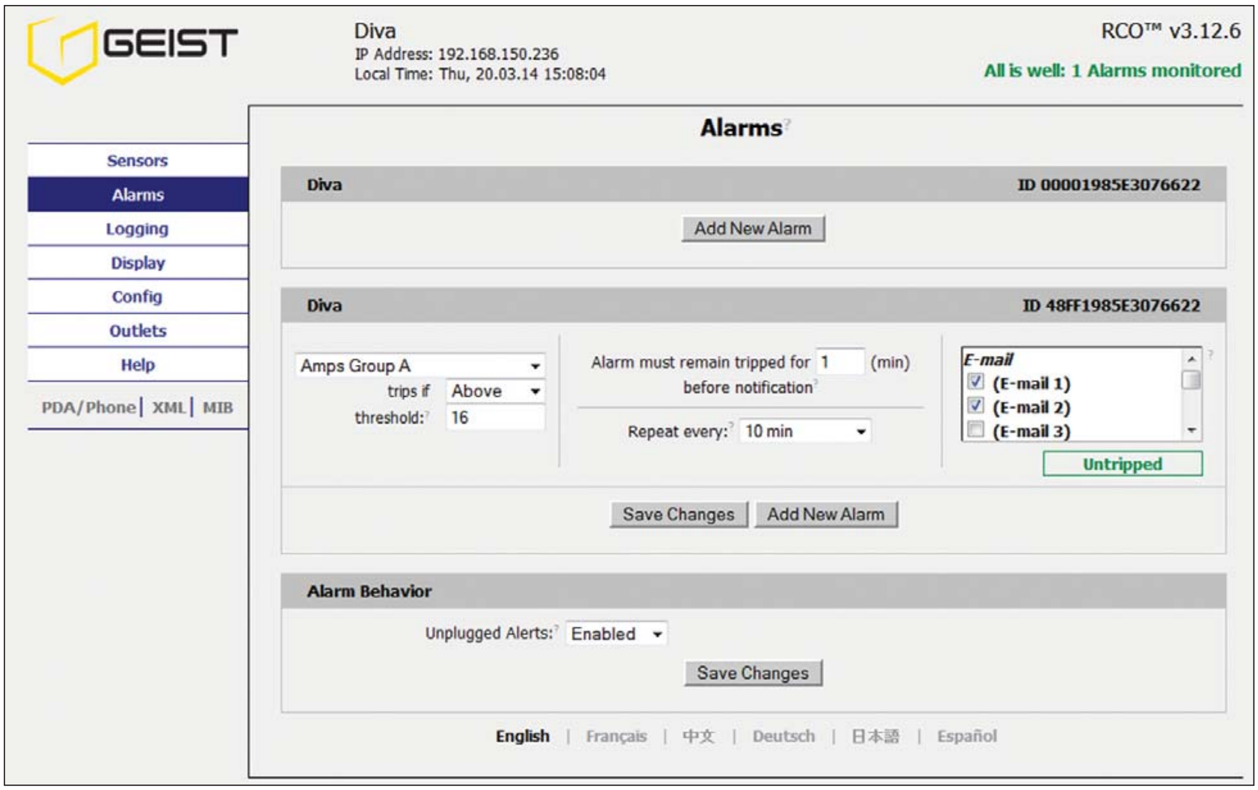
Mission-critical data centers design redundancy into their power systems, often taking dual feeds of power from the building entrance all the way to the cabinet. The basic tenant of redundancy is to reduce or eliminate single points of failure. For this reason, it is generally accepted practice to use two separate PDUs within each cabinet rather than one, dual-corded PDU. This practice maintains redundancy and eliminates the potential of a single point of failure in the power system.

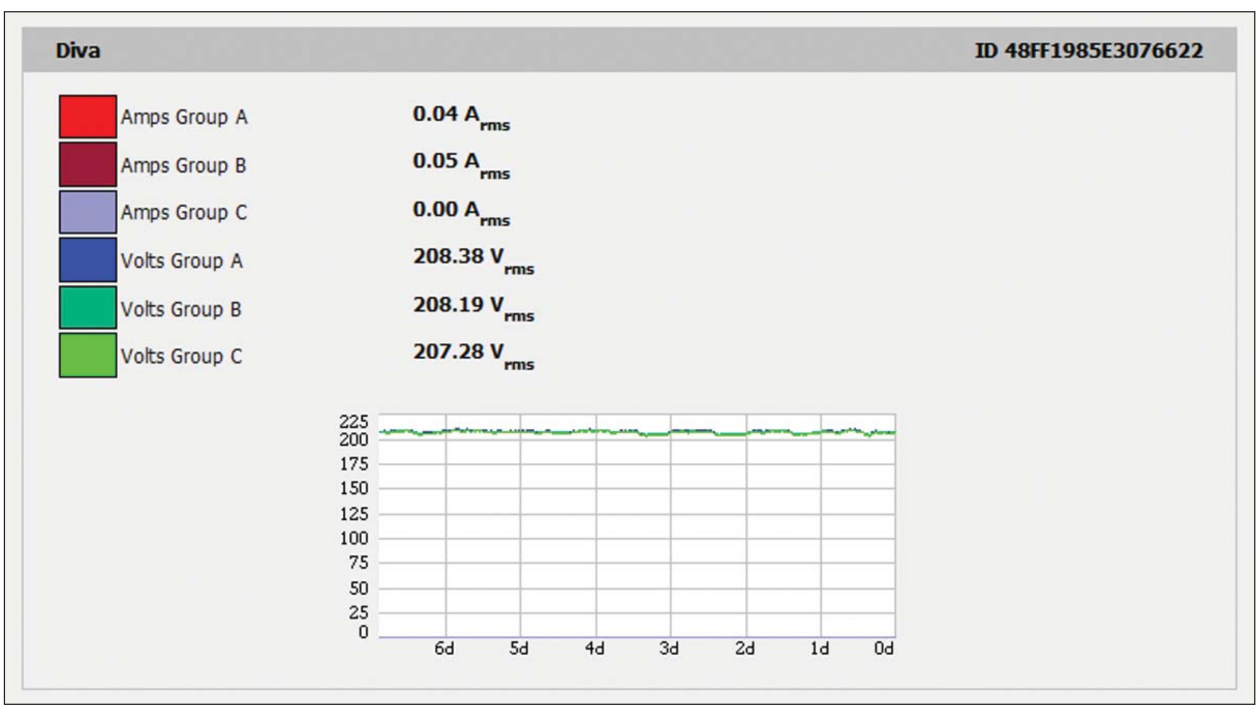
There is, however, some critical thinking that goes along with cabinet-level PDU loading. Since each server is likely to be running on two separate power supplies, each power supply should only be handling half of the total server load. By extending this thinking to the entire cabinet-level PDU, each of a redundant set of PDUs should only be loaded to half of the PDU's rated load. To load the cabinet level PDU to greater than half of its rated load could lead to a cascade failure if one power feed is interrupted. The shift of the entire server load onto the remaining PDU would overload the circuit protection and ultimately trip breakers, leaving the cabinet powerless.

One of the simplest ways to track cabinet-level PDU loading is to invest in, at a minimum, locally monitored PDUs. Technicians can observe the curent load as cabinets are populated, ensuring that each PDU is loaded to no greater than half of the rated output current. Once the load has been achieved the remaining unused outlets should be blocked.

Why is it important to monitor current draw at the outlet level?

Monitoring current at the outlet level allows you to pinpoint potential system-critical failures and take preventative measures. A gradual rise in system current draw might indicate a power supply or cooling failure. A sharp spike might indicate a short circuit. Outlet level monitoring can also help track where power is being used. Outlet monitoring is also an easy way to accomodate departmentalized power billing within large companies whose data centers serve several departments. Contact your customer service representative at 800.432.3219 to review your specific needs.





FAQ - Best Practices

What is the importance of branch circuit monitoring at the PDU level?

Branch circuit monitoring is often promoted by remote power panel (RPP) manufacturers as the best way to collect IT load data and prevent downtime due to circuit overloading. In most of today's data centers, that is not true. Most branch circuit deployments in modern data centers are above 30 Amps, which means the power strips deployed in the cabinets must be broken down into sub-circuits sized for the receptacles within the strips. A 30-Amp strip, for instance, will contain at least two branch circuits internally to satisfy the requirements of the NEC and still allow the user access to all of the available power. Higher power units, such as 60 Amp x 3-phase units can contain up to six internal circuits to satisfy the NEC and still allow access to all available power.

Monitoring at the strip level in these instances allows more granular power readings. In a 30-Amp single-phase power strip, for example, it would be best to monitor the incoming current and both internal branch circuits.

Monitoring the input phase currents can give warnings to the end user if the overall current is about to breach the threshold of the RPP mounted branch circuit protector. Monitoring of each individual circuit within the strip is still necessary. This sub-circuit monitoring can not only ensure that the internal branch circuits are not overloaded but can also help in properly balancing the load between the internal circuits.

Internal load balancing within the power strips becomes more critical in 3-phase loads, where there can be more internal circuits to balance. 30 Amp x 3-phase power strips contain three internal circuits. If 208V deployment is used, the breakers each draw current off of two different phases, further complicating the monitoring. In this instance, it would be ideal to monitor the three input phases (X, Y, Z) as well as the internal sub-circuits which each draw power off of two different phases (XY, YZ, ZX). Monitoring the sub-circuits allows the loads to be evenly balanced over the three phases and prevents overloading of any of the internal sub circuits. Monitoring the phase currents allows visibility of the load placed on the RPP mounted branch circuit.

Monitoring at the power strip level gives the clearest reading of the actual IT load within the data center. When calculating PUE or DCiE, or any other metric that uses the IT load, the IT load should be continually monitored as close to the actual IT load as possible. By monitoring in the power strip, the load is not affected by energy losses inherent within the power chain.

The prominent losses associated with UPS and transformers, as well as losses in switchgear and due to wire run length, are discarded by monitoring at the strip level. This gives the clearest and most accurate view of the IT equipment load. Monitoring continuously gives the best visibility of the loads. This allows the user to see all data and trend it over time, as opposed to momentary monitoring (hourly/daily/weekly), which can miss peak usage times.

Geist's new Upgradeable power strips give data center managers the flexibility to install the intelligence they require today with the option to upgrade technology as needs evolve.

Geist Upgradeable PDUs offer power strips that last for years with an interchangeable monitoring device, so users can install the latest monitoring and technology without replacing a good power strip.

Why should I consider designing my data center with 230/400V 3-phase?

The standard power distribution system for large data centers in North America is a 277/480V three-phase power system. A typical data center uses distributed transformers to convert the voltage to 120V and 208V single-phase branch circuits for powering the IT equipment. Most of the rest of the world uses 230/400V power, which is simpler and more efficient to use.

Converting from 277/480V to 230/400V can be accomplished using an autotransformer, which is cheaper, lighter, smaller and wastes less power than a conventional transformer. This also means lower cooling costs, as the autotransformer can be located outside the data center.

Modern IT equipment can use an input voltage anywhere from 100V to 240V, so a 230V branch circuit can power almost anything found in a modern data center. Since the power used by a given load is the product of Voltage times Current, more power can be delivered to a rack using the same wiring. Power density can be increased without using additional breakers. Conversely, smaller gauge wire can be used to supply the same power to a given load. Either way, there is a cost savings in equipment required to deliver power to the load. Use of the international 230/400V distribution system instead of the standard 120/208V system can save up to 56 percent in the lifetime cost of the distribution system.