STABILINE®

WHR Series Automatic Voltage Regulators

Broadcast
Medical
Marine
Industrial
HDTV
UHF
VHF
AM
FM
X-RAY
MRI
Cat Scan
Shore Power
Telecommunications
DAB
Radar

Superior Electric

Uninterruptible Power Supplies • Power Conditioning • Transient Voltage Surge Supressors

WHR Series STABILINE Voltage Regulators

The WHR Series is the most extensive line of STABILINE® Voltage Regulators Superior Electric has ever offered. This line of regulators includes units for use on all AC power systems, up to 660 volt, currently in use throughout the world. An extensive range of standard sizes, features and options is included.

Superior Electric has been manufacturing and marketing voltage control and conditioning equipment since 1938. The quality of our products, combined with our commitment to customer service, has established Superior Electric as the industry leader. WHR Series STABILINE Voltage Regulators are obtainable worldwide through an extensive Authorized Reseller Network. These Resellers offer literature, technical assistance and a wide range of models off the shelf for fastest possible deliver and service.

In addition, Superior Electric Manufacturer's Representatives are available to provide prompt attention to customer needs. Call or fax for ordering and application information or for the address of the closest Manufacturer's Representative or Authorized Reseller.

If you need application assistance, a special version WHR Series Regulator or to order, contact Superior Electric at:

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Start-up Service • Service Training • On-Site Repairs

. . . Superior Electric offers these services for WHR Series STABILINE Voltage Regulators. Contact our Customer Service Group for a full description of programs.

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WHR Series STABILINE Voltage Regulators

WHR Series STABILINE Voltage Regulators maintain constant voltage to your equipment, even when the input voltage and system load vary widely.

All electronic and electrical equipment is designed to operate at a particular nominal voltage. If the actual voltage becomes too high or too low, equipment malfunction or failure will occur. WHR Series Voltage Regulators are a cost effective way of eliminating these problems.

Modular construction is key to Superior Electric's ability to offer such a wide variety of regulators with excellent quality, fast delivery and competitive pricing. WHR Series STABILINE Voltage Regulators use standardized power modules, control modules, enclosures and optional equipment.

Applications

Broadcasting:
Transmitters
Receiving Stations
Studios
Mobile Production Vehicles

Electronic Equipment:
Computers
Telecommunications
Radar
Uninterruptible Power Supplies

Industrial:
Distribution Equipment
Motors
Resistance Heating
Magnetic Solenoids & Clutches
Plating
Welders
Machine Tools
Battery Chargers
Test Stands

Lighting:
Incandescent
Fluorescent
High-Intensity Discharge
Infrared

Marine:
Shore Power
Private & Commercial Vessels

Medical:
X-Ray Machines
CAT Scanners
MRI Equipment

Features

- Excellent Accuracy
  Holds Output Voltage Within ±1%
- Two Input Voltage Ranges Available
- Input ranges shifted to provide greater low voltage protection
- All Buck or Boost Capability
- Power Ratings: 2 to 1680 kVA
- 19" Rack Mount Versions
- Efficiency: 99 % Typical
- High Overload Capacity
- No Waveform Distortion
- Low Impedance
- Fast Response Time
- No Power Factor Restrictions
- 2 Year Warranty
- Designed for UL & CSA Approvals

Standard Options

- High Energy Transient Suppression
- Single or Three Phase Models
- ZIG-ZAG Neutral Generation
- All Voltages up to 660 Volts
- Choice of Two Input Ranges
- Single or Individual Phase Control
- Full Range of Power Ratings
- 19" Rack Mount Versions
- Tropicalization Treatment
- Input Circuit Breaker Available with Shunt or Undervoltage Trip
- Bypass Switch
- Ammeters
- Frequency Trip Meter
- Input Voltage Range Alarm Contacts
- Phase Loss - Reversal Alarm Contacts
- Manual Raise - Lower Switches
- Delayed Output
- Soft Start

Power Problems

Why are the problems getting worse?

Power problems have increased due to a combination of three growing trends.

1) We have become more dependent on our data processing equipment, electrical machines and electronic communications.

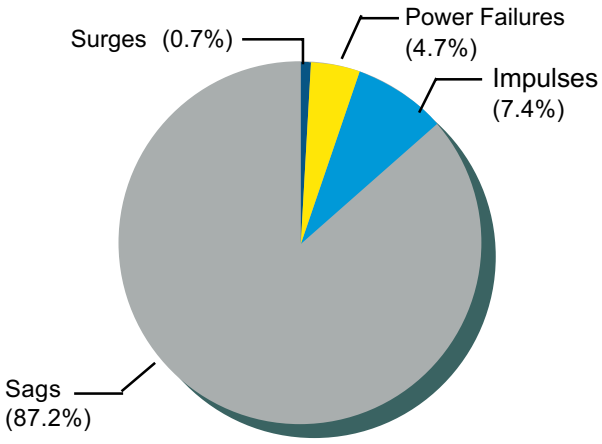
2) Due to increasing competitive pressures, electrical devices have become more voltage sensitive as designs and components are pushed to their limits.

3) The number of power disturbances has increased because power demand grew faster than generating capacity, and many electrical loads now produce power problems due to non-sinusoidal current draw.

Types of Disturbances

According to the findings of an extensive study of U.S. commercial power performed by Bell Telephone Laboratories:

- 56 percent of sites experience steady-state voltage more than 6% above or 12% below the nominal voltage (ANSI utilization band B).
- Steady state line frequency varies 58.7 to 60.7 Hz.
- The distribution of short term disturbances is:



What are the disturbances and where do they come from?

Sags / Surges are short duration changes in voltage level. Sags (low voltage) are much more common than surges (high voltage). Starting electric motors and other equipment, ground faults, undersized power systems, and lightning all produce voltage sags. Surges may be generated when large electrical loads are shut off. Pages 7 & 8 illustrate the problems caused by low or high voltages.

Impulses, Spikes & Transients are all names used to describe very short duration, high amplitude voltage pulses on the power lines. These voltage pulses often reach 6,000 volts. They are caused by lightning that strikes on or near the power lines, utility switching, static electricity, and switching electrical devices on or off.

Impulses damage all types of electronic and electrical equipment. The high voltage levels puncture or weaken insulation. The fast rate of voltage change stresses the turn-to-turn insulation of windings in motors, transformers, solenoids, etc. The damage may not cause immediate failure. Often the equipment is weakened and may fail days or weeks after the event. Besides equipment damage, impulses cause machine resets, data processing errors, and other apparently random malfunctions.

High or Low Voltages Sustained high and low voltages are usually caused by the distribution system. This system of wires and transformers that connects all electrical loads to the utility generators has impedance. This impedance causes the voltage to drop when current flows through the system. The further you are from the power source and the more current drawn, the more the voltage will drop. To maintain the voltage as best they can, the utility will increase the voltage so customers close to the power source will have higher than nominal voltage while the furthest customers will have lower than nominal voltage (maybe much lower). Because the utility will only increase the voltage by a certain amount, and because additional voltage drop is caused in the user's building wiring, voltages are usually low.

See pages 7-8 for a listing of typical problems experienced by different kinds of equipment.

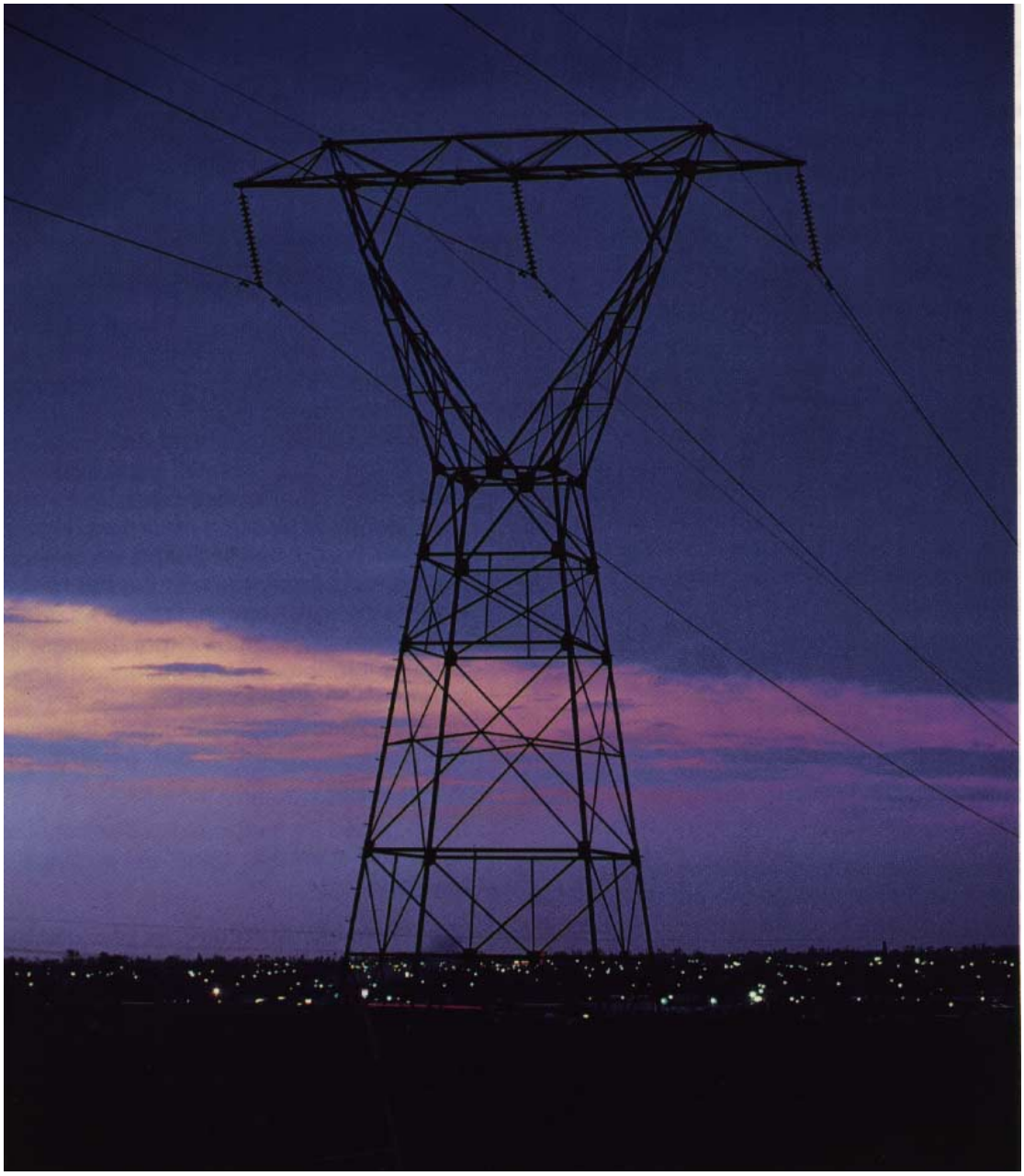
Brownouts are intentional undervoltages instituted by the utility. When power demand exceeds the capacity of the utility generators, the utility lowers the voltage to all or some customers. This reduces the load on the generators so they won't burn out, but causes even more acute equipment malfunctions and damage.

Harmonic Distortion is a distortion in the shape of the normal voltage sine wave. It is generated by devices with non-sinusoidal load currents interacting with the impedance of the distribution system. This combination produces non-sinusoidal voltage drops and thus, non-sinusoidal voltages. Electronic power supplies, solid state motor drives, and transformer magnetizing current all produce harmonic distortion.

The distorted voltage may disrupt the operation of many devices connected to the AC line. Harmonic distortion causes overheating and burnout of three-phase transformers, and adversely affects motor operation.

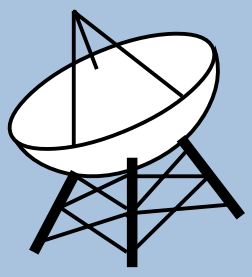
Three Phase Voltage Unbalance simply means the voltages on a three-phase system are not equal. Utilities generate three-phase AC power because it is produced and distributed at lower cost than single-phase AC or DC power, and because three phases are needed to produce steady torque in AC generators and motors. To power single phase loads, any two of the three power wires are connected. Voltage unbalance is usually caused by connecting more single phase loads to one of the three phases. This situation produces unbalanced load currents, uneven voltage drops, and thus, unbalanced voltages.

For three-phase loads, a voltage unbalance of one or two percent is usually not a problem. However, larger voltage unbalances can cause many problems. For example, three-phase motors with 5% voltage unbalance exhibit 25% decrease in torque, 50% increase in losses, 40% increase in temperature, and a whopping 80% decrease in life. In transmitter applications, voltage unbalance causes severe ripple in high voltage power supplies, straining the power supply filtering and increasing AM noise.



Examples of Undervoltage & Overvoltage Problems

Transmitters



Transmitters are often placed in remote locations, at the top of mountains, in rural areas. The long utility lines produce poor voltage regulation, and the transmitter tower attracts lightning strikes.

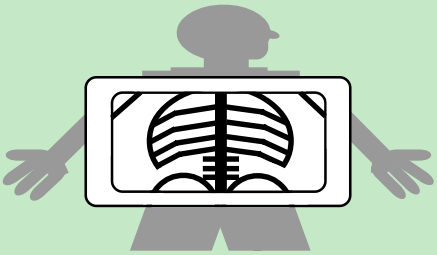
With Voltage 15% Low:

Power tube life decreased by 2/3 because cold operation promotes buildup of contaminates in tube.

With Voltage 10% High:

Power tube life decreased by 2/3 due to increased temperatures accelerating decarburizing process.

X-Ray, CAT Scanners, MRI



Critical medical equipment draws large bursts of power. Stable voltages are needed for acceptable images. To work properly, stepless, low impedance regulators are required.

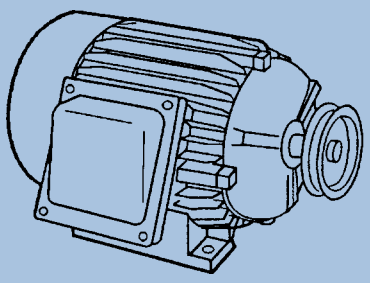
With Voltage 15% Low:

Underexposed X-Ray and CAT images, & poor quality MRI images due to power starvation. Controls may shut down and reset.

With Voltage 10% High:

Life of video monitors & input power supplies greatly reduced. Brakes holding the arms & tables in place overheat and fail.

Motors



The starting and maximum running torque of standard induction motors varies as the square of the voltage. Heating increases with low or high voltage, and voltage unbalance.

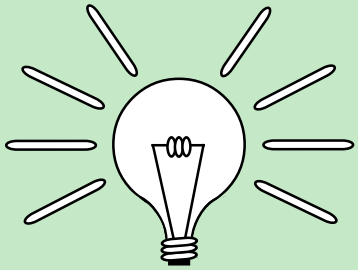
With Voltage 15% Low:

Torque	Decreases 38%
Current	Increases 20%
Losses	Increase 38%
Temp.	Increases 32%
Motor Life	Decreases 72%

With Voltage 10% High:

Torque	Increases 21%
Current	Decreases 6%
Losses	Increase 19%
Temp.	Increases 10%
Motor Life	Decreases 25%

Lighting



As shown below, light output and life of incandescent lamps are dramatically affected by changes in the voltage. Fluorescent lamps are less affected. However, fluorescent ballasts are quite sensitive to voltage.

With Voltage 15% Low:

Life	Increases 880%
Light	Decreases 40%

Need one third more bulbs to give adequate lighting.

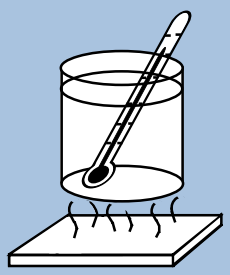
With Voltage 10% High:

Life	Decreases 67%
Light	Increases 33%

Bulbs must be replaced three times as often.

Examples of Undervoltage & Overvoltage Problems

Infrared & Resistance Heating



Includes: strip, radiant and immersion heaters; soldering irons and pots; heat-treating furnaces; ovens; etc. The heat produced varies as the square of the voltage.

With Voltage 15% Low:

Heat Decreases 28%

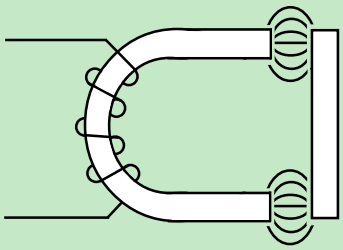
Typical batch heating job will take 4 hours instead of 3 hours.

With Voltage 10% High:

Heat Increases 21%

Heating element life is decreased, and part being heated may be damaged.

Solenoid-Devices



These include solenoids, vibratory feeders, magnetic clutches and brakes, contactors, relays, etc. The pull of AC solenoids varies as the square of the voltage.

With Voltage 15% Low:

Force Decreases 28%

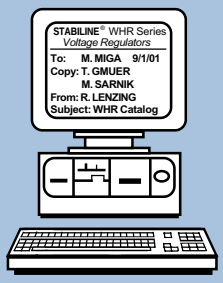
Solenoid takes longer to open valve, close a relay, eject a part, etc. The device may fail to operate.

With Voltage 10% High:

Force Increases 21%

Solenoid temperature and wear go up, and the life of the solenoid is substantially reduced.

Electronic Equipment



Items from military radar, to personal computers, to numerical machine tools. These devices are so greatly affected by voltage variations that some regulation is usually built in.

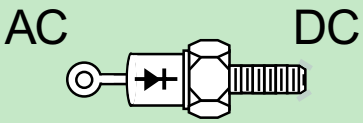
With Voltage 15% Low:

Electron tubes (computer monitors and TV picture tubes) put out much less power, pictures shrink, and circuits may fail to operate.

With Voltage 10% High:

Unregulated electron tubes fail 4 times as fast, circuits malfunction, component and system failures increase.

Rectifier Loads



These include plating, DC welders, precipitators, battery chargers and DC motor supplies. The rectifier output voltage varies with the AC input voltage.

With Voltage 15% Low:

Poor welds are produced. Plating deposition rates drop 15-40%. Battery charging may cease. 38% drop in precipitator power.

With Voltage 10% High:

Plating thickness may be excessive. Welds burn through. Batteries over charge. Reduced surge capacity of metal rectifiers.

The Solution

WHR Series STABILINE Voltage Regulators are the only units to meet all performance requirements, and offer so many superior features and options.

Performance Requirements

Based on the problems and their causes, the five primary characteristics needed for regulators are:

1. **Voltage Regulation:** The output voltage must be selectable to an accuracy of 1% to eliminate voltage unbalance problems on three phase systems, and to minimize voltage deviations caused by abrupt input voltage changes.

2. **Input Voltage Range:** Because line voltages drop much more than they increase, the input range should be large, and shifted to allow for more low voltage correction than high voltage correction. WHR Series STABILINE Voltage Regulators have two input ranges, each sized and shifted to match typical conditions. These units also allow for all decrease or all increase (all buck or all boost) operation to give maximum voltage correction for unusual applications.

3. **Low Impedance:** Since the interaction of load currents and the source impedance causes low voltage, harmonic distortion and voltage unbalance, the impedance of the regulator must be very low so as to not add to the problem.

4. **Load Compatibility:** The regulator must be able to handle loads with high starting currents, all power factors and high crest factors in order to power all types of equipment. To prevent instability, the regulator's speed of response must be designed to work with the electronic power supplies used in much of today's equipment.

5. **Transient Suppression:** Transients are a major problem in many locations. High energy transient suppression is available for WHR Series Voltage Regulators.

Why are WHR Series STABILINE Voltage Regulators superior to other units?

Six types of regulator designs commonly available are:

Induction System	Variable Transformer with Buck-Boost Transformer
Saturable Reactor	Constant Voltage Ferroresonant Transformer
Tap Switching System	Limited Range Variable Transformer (used in WHR Series Regulators).

Induction System:

This design is adapted from a wound rotor induction motor. It has a primary winding connected across the input line and a secondary winding in series with the load. One winding is mounted on the stator, the other on the rotor. The shaft is held in place with a series of gears. Load voltage is adjusted by changing the position of the shaft which in turn changes the relative position of the windings. Because it works through stepless linear transformer action, it has good accuracy and overload capacity. Due to the air gap between the stator and rotor and other construction features similar to a motor, it has high output impedance, modest efficiency, and is large, heavy and slow. Modular construction is not possible with this design.

Variable Transformer Controlled Buck-Boost Transformer:

These regulators use a variable transformer to control the voltage to the primary winding of a buck-boost transformer. The low voltage secondary winding of the buck-boost transformer is connected in series with the load. Depending on the setting of the variable transformer, this secondary winding adds to or subtracts voltage from the input line to maintain constant output voltage. Since both transformers must handle the power needed to correct the voltage, impedance is increased and efficiency reduced. Because the same windings of the buck-boost transformer are used to increase and decrease the input voltage, the high and low input ranges cannot be shifted to compensate for the more common low voltage conditions without over-sizing the transformers. Connections for all buck or all boost operation are not available. Since the buck-boost transformer is sized for each unit, full modular construction is not used.

Some linear variable transformers use diodes in the load circuit to block circulating currents within the variable transformer. Added problems due to the semiconductors in the main power path include: heat, reliability, transient voltage susceptibility, and limited overload capacity.

Saturable Reactor Regulators:

Direct current is used to control a buck-boost type regulator by driving a saturable reactor in and out of magnetic saturation at the required point on the sine wave. The nonlinear reactor in series with the current causes high impedance, harmonic distortion and limits load power factor range. Large time constants associated with the inductor can cause slow speed of response. This design limits the amount of current the unit will supply, thus protecting itself during overload. However, it cannot supply needed high starting currents.

Efficiency

How important is the efficiency of a regulator?
$ VERY $

Efficiency is rated as the percentage of input power that gets delivered to the load. WHR STABILINE regulators have typical operating efficiencies of 99%; while the efficiency of other designs may only be 90% or less.

For a typical 100 KVA unit and an average cost for electricity of $.10 per kilowatt hour, the direct savings with a WHR regulator is $1.00 per hour or up to $8,760 per year. Savings due to reduced air conditioning requirements will add to the total savings.

Input power at 90% efficiency:
= 100 KVA/.9 = 111 KVA

Input power at 99% efficiency:
= 100 KVA/.99 = 101 KVA

Power saved with a WHR regulator:
= 111 - 101 = 10 KW

$ saved per hour: = $.10 x 10 = $1.00 per hour

Constant Voltage Transformers (Ferroresonant):

These transformers are designed to have the core magnetically saturate at a particular voltage and frequency. As the transformer saturates, the output is limited to a relatively constant voltage. Because of the nonlinear nature of a saturating transformer, resonating components are added to prevent the output voltage from becoming too distorted. These units typically regulate the voltage to within 3-5%, have high impedance, and are noisy, inefficient, and sensitive to frequency changes.

Tap Switching System:

This style of regulator uses a series of electronic switches (triacs - SCRs) to connect the output of the regulator to one of several voltage taps on a fixed ratio transformer. To control costs only a few taps are used, resulting in output voltages that are not closely regulated. Typical accuracy is 5 to 8%, making these units unable to correct unbalanced line voltages. Tap switching regulators usually try to compensate for poor output voltage accuracy by having very fast speed of response. Unfortunately, this response speed often creates instability when powering equipment with electronic power supplies. If the line voltage regulator and the power supply regulators have about the same speed of response, the two may behave as a “flip-flop” with the output voltage of one going high while the other goes low. Also, because triacs are switching the load currents, reliability and low power factor loads can be a problem.

Limited Range, Variable Transformer Control:

This is the technology employed by WHR Series STABILINE Voltage Regulators. Special POWERSTAT® Variable Transformers have been designed specifically for regulator use. In theory they operate like standard rugged full range POWERSTAT Variable Transformers. Both are variable autotransformers that provide continuously adjustable output voltage by means of a movable brush-tap riding on a commutator. Both can adjust the output voltage to within a fraction of a volt.

Standard variable transformers typically provide any output voltage between zero, and 17% above the input voltage. Most of this output voltage range (voltages between zero and 85% of the input voltage) is not needed when standard variable transformers are used to provide regulated line voltage. Line voltage regulators do not need an output of zero volts, or 25% or even 50% of the input voltage. At the other end of the range, increasing the input voltage by only 17% is not enough to correct the very low input voltages that wide range regulators are required to correct.

The output voltage ranges of the new limited range POWERSTAT Variable Transformers have been matched to the requirements for line voltage regulators. These devices cannot reduce their output voltage to zero, and wide range versions can boost the input voltage much more than 17%. Limiting the output voltage range of the POWERSTAT Variable Transformer, allows the design to accommodate substantially increased current and power ratings without increasing size or weight. Using these highly efficient limited range POWERSTAT Variable Transformers to directly control the output voltage of a regulator eliminates the need for multiple device combinations such as: standard variable transformers with buck-boost transformers, transformers with tap switching power semiconductors, reactors with power amplifiers and harmonic filters, constant voltage transformers with harmonic filters, etc. With the limited range variable transformer construction, reliability and efficiency increase, while impedance is reduced.

The control units for these regulators consist of highly reliable analog servo systems which can be completely isolated from the line voltage for maximum protection and reliability. The system speed of response has been selected to insure the output voltage will be steady without becoming unstable. The system response has been designed to be highly accurate and stable. The speed of response is faster than the normal utility voltage rate of change to provide closely regulated output voltage, yet slower than that of fast electronic power supplies to prevent the instability that occurs when two connected systems have similar response characteristics.

With limited range variable transformer control, the number of transformer turns between the input power and the load is continually adjusted on a real time basis. Only the turns necessary to correct the voltage are used. If the input voltage does not need to be increased or decreased the load current flows directly from the input to the output and no limited range variable transformer turns carry load current. If the input is slightly high or low, only a few turns carry load current, etc. This minimizes the actual losses and impedance of the regulator. Due to their design these devices handle heavy starting currents, all load power factors, high crest factor loads, and can also be connected to provide all buck or all boost correction.

To provide excellent quality, fast delivery response and competitive pricing, WHR Series Regulators take full advantage of modular construction.

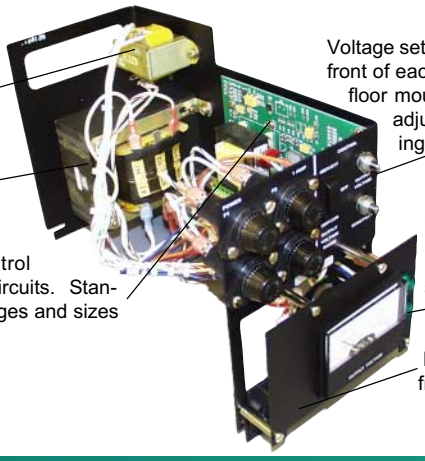
Comparison Shows WHR Series STABILINE Voltage Regulators Are Superior

Technology	1% Accuracy	Shifted Input Range	All Buck All Boost Operation	Very Low Impedance	Low Harmonic Distortion	All Load Power-factors	Full Modularity	99% Typical Efficiency
WHR Series Regulator, Limited Range Variable Transformer	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tap Switching System	No	Some	Some	Yes	Yes	No	No	No
Constant Voltage Transformer (Ferro)	No	Some	No	No	No	No	No	No
Saturable Reactor	Yes	No	No	No	No	No	No	No
Variable Transformer With Buck-Boost	Yes	Some	No	Yes	Yes	Yes	No	No
Induction System	Yes	No	No	No	Load Dependent	Yes	No	No

Construction of WHR Series Voltage Regulators

WHR Series STABILINE Voltage Regulators use standardized control modules, power modules, enclosures, and options. All are designed and built specifically for regulator use.

Control Modules



Sense transformer steps down the voltage being regulated and feeds this signal to the control unit.

Control power transformer provides proper voltages and isolation for drive circuits.

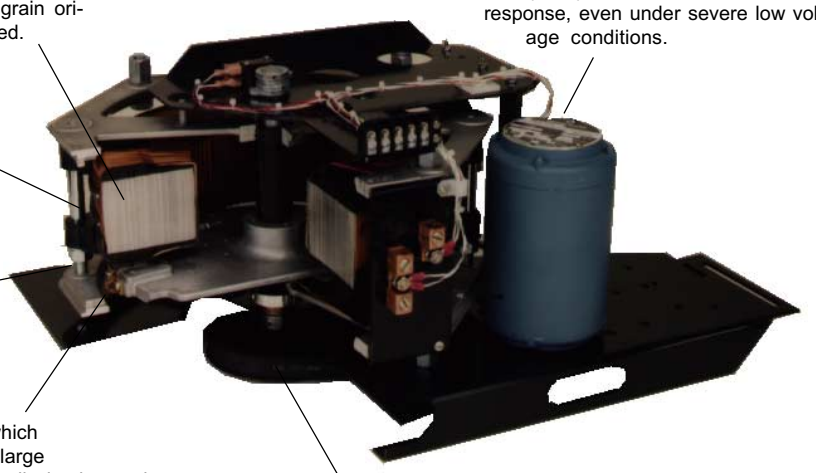
Very reliable plug connected control board contains all of the electronic circuits. Standardized design is used with all voltages and sizes of WHR Series Voltage Regulators.

Voltage settings and control circuit fuses are located at the front of each control module, behind the front panel on all floor mount units. This location allows for easy adjustments by authorized personnel while avoiding accidental mis-adjustment.

All control displays (output voltage, power light, control light, etc.) are visible with the front panel on or off. This makes it easy to monitor the status of the unit and make adjustments.

Remote sense connections are located at the front of the control module for fast easy wiring.

Power Modules



To reduce magnetizing current and increase efficiency, tape wound toroidal cores are fabricated from grain oriented silicone steel and then fully annealed.

All windings are made with copper wire to further increase efficiency, and are wound on custom built winding machines to assure uniform spacing and smooth commutators.

Commutators are held in place by our patented POWERKOTE® process which embeds the commutator in a high temperature material to hold it in place, even under severe overloads.

Commutators are plated with a proprietary precious metal plating system that maintains the proper contact resistance and gives increased corrosion protection.

Brush assemblies utilize brush carbons which are tailored to the unit, and embedded in a large brass holder to provide much better heat dissipation and overload capacity than cheaper solid carbon designs.

Heavy duty drive motors provide rapid response, even under severe low voltage conditions.

Robust drive components ensure long, trouble-free life.

Enclosures, Terminals, Instructions, Pack

The enclosures have been specifically designed to house WHR Series Regulators. All units are available in floor mount enclosures. Smaller units are also offered for 19" rack mounting. Since all service is performed from the front of floor mount enclosures, no rear or side aisles are required, and floor space requirements are kept to a minimum. Enclosures are NEMA type 1 as defined in NEMA standard 250. As such they are designed to protect users against accidental contact with the enclosed equipment, and are intended for use indoors in areas where unusual service conditions do not exist. All are constructed of heavy gauge sheet metal, have a full range of knockouts, and incorporate lift-off doors.

Input and output field wiring terminals are provided. They are sized to industry standards and are suitable for copper wire.

Extensive use of modular construction allows Superior Electric to build the most comprehensive line of regulators, with excellent quality and deliveries.

Control modules contain everything needed to select the desired voltage, monitor and display actual output voltage, and control a power module to maintain the selected output voltage.

The control modules incorporate a standard plug connected control board containing all the electronic circuits. The control board is simple, reliable and very rugged.

Power modules contain everything needed to adjust the output voltage. They consist of limited range POWERSTAT® Variable Transformers and all drive components.

POWERSTAT Variable Transformers provide a simple rugged means of controlling electrical voltage, current and power. They take in utility line voltage, and provide continuously adjustable output voltage. Standard fixed ratio transformers have output terminals connected to a particular turn to provide a given output voltage. Instead of a fixed output connection to a particular turn, POWERSTAT Variable Transformers use a brush riding on a commutator (formed by part of the transformer turns) to select any output turn and thereby control the output voltage. Because they are autotransformers, one winding acts as both primary and secondary.

The drive motors are the links between the POWERSTAT Variable Transformers and the control modules. These regulators utilize SLO-SYN® AC Synchronous Motors.

A manual is provided with each unit. It gives detailed information covering the description, theory of operation, installation, start up, operation, maintenance, and repair of the unit. Included are rating charts, control module details, schematics, and dimensions.

All units are suitably packed for shipment worldwide.

(SLO-SYN® is a registered Trademark of Superior Electric)

Unit shown is a 3 phase, 108 kVA regulator with individual phase control, circuit breaker, and ammeters.

Model: WHR34NTT32-CB100

Selecting A WHR Series Voltage Regulator

There are only five things you need to know to choose the basic unit for your application:

1. Do I need a single or three phase regulator?
2. What is the nominal voltage?
3. Should I select a narrow or wide input range?
4. Do I need single or individual phase control?
5. What size WHR Series Regulator do I need?

Knowing these, select your basic unit from the rating charts on Pages 29 through 43. Then select the options you want, and you have the best unit for your application. Reference the "Work Sheet" on Page 28.

Here are the questions, answers, and guidelines to help you choose the basic unit.

1 Single or three phase regulator?

- ❒ **Single Phase**
- ❒ **Single Phase 240/120 volt**
- ❒ **Three phase**

If you want to control a single phase load, select a single phase regulator. It doesn't matter if the power system is single phase or three phase. If the power system is three phase, only one phase is used to power a single phase load.

Single phase 240/120 volt units (WHR Series 22) are for use with 240/120 volt single phase power systems. This system is common in many small businesses and homes in North America. It has two, 120 volt single phase sources wired in series to also provide 240 volt single phase. A 240/120 volt regulator increases or decreases the voltage in each of the 120 volt lines. The 240 volt single phase regulator (WHR Series 12) increases or decreases the voltage in only one 240 volt line.

If you have a three phase load, or you want to regulate a three phase power system feeding a combination of loads, you need a three phase regulator. If your input power is not wye connected (input neutral not available), review the description of the "Neutral Generating ZIG-ZAG Transformer" option on Page 22 and "Three Phase Configurations" section to see if a ZIG-ZAG transformer is required.

2 What is the nominal voltage?

- ❒ **120-127 (100)**
- ❒ **208 x 220-230-240 (277)**
- ❒ **380-400-415 x 480**
- ❒ **480 x 600**

Since there are only a few nominal voltages in use throughout the world, and because WHR Series Regulators handle multiple voltages, there are only four choices. The voltages listed above are nominal, 50/60 cycle voltages. These are the official voltages by which the power system is identified. The actual output voltage of a WHR Series Regulator can easily be set for higher and lower voltages near these nominals. The utilization voltage marked on your equipment may be slightly different than one of these nominal voltages. For example, if the equipment indicates a requirement for 115 or 117 volts, a regulator with a 120 volt nominal rating is needed.

WHR Series Voltage Regulators do not convert one nominal voltage on the input to another totally different nominal voltage on the output. For example, they will not accept 480 volts in and deliver 120 volts out. Superior Electric offers other products that fulfill this requirement or can provide a special design to meet your specific needs. However, because of the all buck and all boost capabilities of these units, WHR Series Regulators can shift the output to another nominal voltage near the input nominal. For example, the 380-400-415 x 480 volt wide range regulators can deliver regulated 380 volts when connected to a 480 volt input. If you have a voltage shift application, review the "All buck and all boost operation" section of this catalog, Page 19.

Solving problems is what Superior Electric is best at. If you need application assistance, call us. With over 60 years of industry experience, we will be glad to help.

3 Narrow or wide input correction range?

- ❒ Narrow Range
- ❒ Wide Range

The input range of a regulator is the range of input voltages over which the regulator will maintain constant output voltage. For clarification and uniformity it is expressed as a percent of the set output voltage. WHR Series Regulators are available in two standardized input ranges.

WHR Series STABILINE Voltage Regulators with voltage ratings of:

120-127
208 x 220-230-240
380-400-415 x 480

Narrow Input Range	-20% low, +10% high
Wide Input Range	-30% low, +15% high

Units with the 480 x 600 volt rating:

Narrow Input Range	-16% low, + 8% high
Wide Input Range	-25% low, +12% high

Consider a unit with narrow input range where problems are not excessive or installation space is limited. Choose wide range for installations located at the end of long lines, locations with obvious problems, or if you want the most protection. The power that must be corrected is greater for wide range units than narrow range units. Therefore, narrow range units are usually smaller and lighter.

4 Single or individual phase control?

- ❒ Single Control
- ❒ Individual Phase Control

With most single phase systems the choice is easy. Since there is only one voltage, single control is the only possibility.

Single control can be used for most 240/120 volt single phase applications (WHR Series 22) if the actual voltages on the two 120 volt lines match each other within 4 volts, or if the regulator is to be used only for 240 volt loads. Use individual phase control if the two 120 volt input lines do not match within 4 volts. Note: the input neutral must be connected to the regulator if individual phase control is used or if 120 volt loads are to be connected to the regulator.

With three phase systems, many applications can use single control if the three input voltages are balanced within 2%. Single control does not correct for unbalanced line voltage. Select individual phase control if in doubt or if the input voltages are not balanced within 2%. Individual phase control corrects the output voltage of each phase separately.

For basic Wye input models (WHR3 or WHRS3) the input neutral should be connected if available. The input neutral **must** be connected to allow neutral current to flow if individual phase control or transient voltage suppression options are used, or if the load currents are not balanced. If input neutral is not available, see "Neutral Generating ZIG-ZAG Transformer" option and "Three Phase Configurations", page 22. If input neutral is not available and required, order one of the Neutral Generating ZIG-ZAG Transformer options.

5 What size WHR Series STABILINE Voltage Regulator?

- ❒ Maximum Load Current
- ❒ Maximum Load kVA

The last step in selecting a WHR Series Regulator for your application is to determine the size needed. Regulator sizing is based on the maximum load initially planned, plus a small amount for future expansion (about 10% to 25%), and occasionally some derating for special conditions. The load may be stated in current (amperes) or kVA. The rating charts list both. kVA is a measure of apparent power. For any given voltage, current and kVA are directly related.

Finding the maximum load is usually simple. Several methods to determine the size regulator required are outlined below. Pick the method that applies to your situation. High room temperatures, large starting currents, high altitudes, and all boost operation are conditions which may require a regulator with additional capacity. Review “Rating for Special Operating Conditions” Page 18, if any of these apply to your application.

Single Load

If you are powering only one piece of equipment such as a welder, machine tool, X-Ray machine, transmitter, etc., choose a regulator with a rating slightly higher than the equipment’s full load rating. Rated voltage, frequency, number of phases, and current or kVA, should be located on the equipment nameplate or listed in the manufacturer’s literature.

Contact the equipment manufacturer if you are sizing a regulator for a single system which consists of a number of pieces of equipment such as a transmitter installation, CAT scanner, machining center or X-Ray apparatus. Be sure to ask if there are any unusual conditions such as high room temperatures, large starting currents, etc.

Maximum Input Current

The circuit feeding the regulator must be sized for the maximum input current. The "Max Input Amps" shown in the rating charts is the input current to a WHR Series Regulator with minimum input voltage and maximum rated load. For any given load, the input current will increase as the input voltage to the regulator decreases. The input current is approximately proportional to load current.

Regulator sized to match feeder circuit

If there are several loads on the same feeder which need to be regulated, select a WHR Series Regulator with a current rating at least as great as the circuit feeding the loads. The entire circuit will be protected and the full capacity of the circuit can be used.

The maximum current that can be drawn from a feeder circuit is equal to the size of the circuit breaker or fuse protecting the circuit. Therefore, size the WHR Series Regulator to the amp rating of the protector. These protective devices should be sized no larger than the maximum current rating of the distribution wiring.

Multiple loads on a single regulator

The regulator must be sized to handle the total combined load. The procedure for calculating the total load on a WHR Series Regulator is the same as that for determining the total load of a branch-circuit or feeder. Refer to the National Electrical Code (NFPA-70) for a complete explanation of how to compute total loads. As indicated by the NEC, the WHR Series Regulator and branch circuits should be rated at least 25% above the calculated load to allow for future expansion and other unforeseen conditions such as high starting currents.

Volt-amperes (VA), Amperes (A) or kVA (1000 VA) may be used to compute the total load. For WHR Series Regulators, kVA is most often used. If the equipment rating is given in amperes (A), watts (W), Kilowatts (kW) or Volt-amperes (VA), the following definitions and formulas are used to convert each to kVA.

For single phase loads:

$$kVA = \frac{\text{Load Volts} \times \text{Load Amperes}}{1000}$$

For three phase loads:

$$kVA = \frac{1.73 \times \text{Load Volts Line to Line} \times \text{Load Amps}}{1000}$$

For single and three phase loads:

$$kVA = \frac{\text{Volt Amperes}}{1000}$$

$$kVA = \frac{\text{Kilowatts}}{\text{Power Factor}}$$

$$kVA = \frac{\text{Watts}}{1000 \times \text{Power Factor}}$$

VA is shorthand for "volt amperes" which is a measure of apparent power.

V A

V stands for volts
A indicates amperes

kVA stands for thousands of volt- amperes. This is a larger block of apparent power than VA.

k V A

k indicates 1000
V stands for volts
A indicates amps

Watts (W) and Kilowatts (kW) are measures of real power. Real power is always less than or equal to apparent power. The ratio of real power to apparent power is called "power factor" (PF). Resistive loads such as incandescent light bulbs and heating elements have a unity (1.0) power factor. For resistive loads, watts equals volt-amperes, and kW equals kVA. Most non-resistive loads have power factors between 0.7 and 0.9.

Balanced loading of 240/120 Volt single phase units and three phase units:

240/120 volt single phase regulators (WHR Series 22) have two 120 volt outputs. Each one can supply only one-half the unit's, total kVA capacity. If care is not taken, it is possible to apply a combination of loads that will not exceed the total kVA rating of the unit, but will exceed the rating of one 120 volt output. This can be avoided by balancing the 120 volt single-phase loads. When working with 240/120 volt single phase systems, the kVA of the 120 volt single phase loads must be equally divided between the two 120 volt outputs, or the size of the regulator must be increased so that the 120 volt output with the maximum load is not overloaded.

For three phase regulators, each output winding has a maximum capacity of one-third the total rated kVA. It is necessary to divide the single phase loads evenly between the three phase output voltages, or increase the regulator size so that no phase is overloaded.

Rating For Special Operating Conditions:

When your application requires operation under special conditions such as high room temperatures, high altitudes, large starting currents or all boost operation, a regulator with a higher power rating may be required. If your application involves one or more of these conditions, change the needed load capacity by the amounts indicated in each applicable section. Use this corrected capacity to select your WHR Series Voltage Regulator.

High ambient temperature:

WHR Series Voltage Regulators are rated for operation in locations where the ambient temperature is a maximum of 40°C (104°F) and the average temperature over any 24 hour period does not exceed 30°C (86°F). The average temperature for any 24 hour period may be increased to 40°C (104°F) and the maximum temperature may be increased to 50°C (122°F) if the load does not exceed 90% of the unit's rating. When selecting a regulator for these higher ambient temperatures, increase the required load capacity by 10%.

High altitudes:

The standard ratings apply to operation in altitudes up to 6,600 Ft. (2,000 meters).

For higher altitudes up to 10,000 Ft. (3,000 meters) and a maximum ambient of 30°C (86°F), the load should not exceed 95% of rated. When selecting a regulator for these conditions, increase the required capacity by 5%.

For altitudes up to 15,000 Ft. (4,500 meters) and a maximum ambient of 20°C (68°F), the load should not exceed 90% of rated. When selecting a regulator for these conditions, increase the required capacity by 10%.

Overload:

Due to their rugged construction WHR Series Regulators will safely handle many overloads and high starting current applications. The load capacity of all WHR Series Regulators is:

100% rated	continuous
200% rated	60 seconds
400% rated	3 seconds
600% rated	1 second
800% rated	0.5 second
1000% to 2500%	1/2 cycle inrush

Any load which draws large amounts of current for short periods of time should be compared against the load capacity of the regulator. Increase regulator size as required to accommodate these currents without exceeding the short term capacity of the regulator.

Some high torque motors draw many times their normal current for considerable periods of time when starting. If any individual motor is more than one half the total load, the motor's locked rotor current (starting current) and starting time should be compared against the load capacity of the regulator. Increase regulator size as required to accommodate the starting current without exceeding the short term capacity of the regulator. The same applies to multiple motors, all started at once, that are more than one half the total load.

For Custom Designed Units or application assistance, call 860-585-4500 Ext. 4755 - In USA & Canada 1-800-787-3532, Ext. 4755

All-Buck and All-Boost Operation:

WHR Series Voltage Regulators can be connected to provide all-buck (unit will only lower the input voltage) or all-boost (unit will only increase the input voltage) operation. This feature is used to correct input voltages that are always extremely high or extremely low. It allows the regulator to be powered from nominal input voltages that are somewhat higher or lower than the desired nominal output voltage.

When connected for all-buck operation, WHR Series Regulators will bring extra high input voltages down to the selected output voltage. Since all-buck operation reduces the voltage in the regulator, the nominal input voltage may be increased. The current ratings remain the same. Refer to the All-Buck ratings in the following chart.

When connected for all-boost operation, WHR Series Regulators will correct extra low input voltage. Since operation in the all-boost mode will increase the voltage and heating in the regulator, the rated load current and the maximum rated nominal input voltage must be reduced in accordance with the chart below.

All-Buck and All-Boost Rating Chart

Standard Rating			All-Buck Operation (max output voltage = input voltage)				All-Boost Operation (min output voltage = input voltage)				
			Maximum Nominal Input Voltage		§ Minimum Output Voltage (% of Input)	† High Input Voltage Range (% of Output)	Maximum Nominal Input Voltage		§ Maximum Output Voltage (% of Input)	‡ Low Input Voltage Range (% of Output)	Current De-rating (% of rated)
Phase	Voltage	Range	50 Hz	60 Hz			50 Hz	60 Hz			
Single Phase Unit	120	Narrow	140	140	80%	125%	100	120	125%	75%	77%
		Wide	150	150	67%	150%	100	120	150%	65%	72%
	208 X 240	Narrow	277	277	80%	125%	208	240	125%	75%	77%
		Wide	300	300	67%	150%	208	240	150%	65%	72%
	380 X 480	Narrow	480	550	80%	125%	415	480	125%	75%	77%
		Wide	520	600	67%	150%	415	480	150%	65%	72%
	480 X 600	Narrow	550	690	84%	120%	480	600	120%	80%	77%
		Wide	600	750	74%	137%	480	600	137%	70%	72%
Three Phase Units	208 X 240	Narrow	240	270	80%	125%	173	208	125%	75%	77%
		Wide	260	300	67%	150%	173	208	150%	65%	72%
	380 X 480	Narrow	480	550	80%	125%	345	415	125%	75%	77%
		Wide	520	600	67%	150%	345	415	150%	65%	72%
	480 X 600	Narrow	550	690	84%	120%	415	480	120%	80%	77%
		Wide	600	750	74%	137%	415	480	137%	70%	72%

§ Selectable output voltage is a function of the control module and must remain within the limits specified in the unit rating charts.
† In all buck operation, the input voltage range is from the selected output voltage to the 'high input voltage range'.
‡ In all boost operation, the input voltage range is from the 'low input voltage range' to the selected output voltage.
NOTE: WHR11SSCX1R and WHR11SSDX1R cannot be connected for all-buck or all-boost operation.

Control Options

Single Phase Control:

One control unit is used to sense the line-line output voltage on one phase. All phase voltages are increased or decreased by the same amount to bring the output voltage on the sensed phase within the voltage and accuracy settings selected by the user. Single phase control is used on single phase units, and on multi-phase power systems with balanced voltages.

Individual Phase Control:

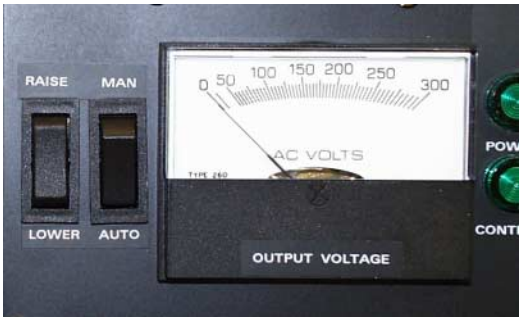
Each phase of a multi-phase regulator has a control unit that independently regulates each line-neutral output voltage. Individual phase control is used to correct unbalanced voltages on multi-phase systems.

Control Modules:

The control modules incorporate standard plug connected control boards to drive the AC synchronous motors in the power modules. An analog voltmeter, input power light, and sense power light are always visible. Control fuses, output voltage adjustment potentiometer, voltage accuracy adjustment potentiometer and control off - voltage select switch are also provided. They are located behind the front cover on floor mount units, and on the front panel of rack mount units. For R1 and R2 enclosures the entire control module is contained on the front panel which is removable without removing unit from rack cabinet. Because synchronous motors are used, recovery rates are 20% longer when operated on 50 Hz versus 60 Hz power systems.

Manual Raise Lower Switches:

Switches are added to each control module to allow the operator to bypass the automatic control board and manually raise or lower the output voltage. When returned to the automatic control position the preset conditions will be restored.



Floor Model

Sense leads of each control module are wired to the regulator's output. Sense leads are connected line-line in all regulators with single control, and line-neutral in all units with individual phase control.

In some cases better control can be obtained by sensing and thus regulating the voltage at another point, such as at the end of long lines between the regulator and the load. This is known as remote sensing. All units are equipped with terminals to make wiring for remote sensing quick and easy.

Rack Model

Power Circuit Options

Narrow or Wide Input Correction Range

Input range is the variation of input voltage over which the regulator will maintain constant output voltage. For clarification and uniformity, it is expressed as a percent of desired output voltage. WHR Series Voltage Regulators are available in one of two standardized input ranges as follows:

WHR Series Regulators with voltage ratings of:

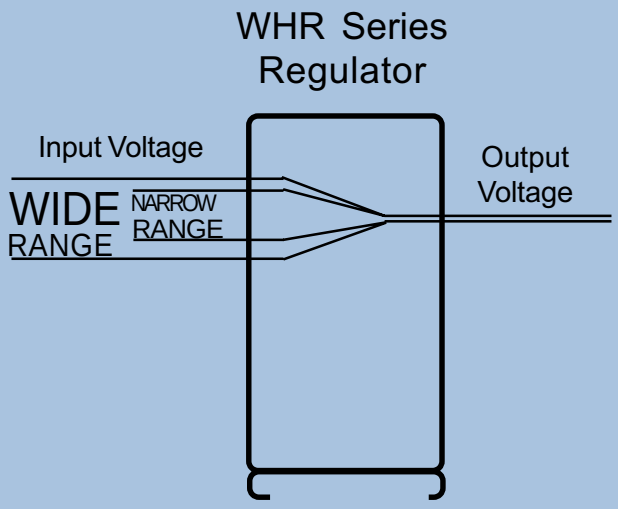
120-127
208 x 220-230-240
380-400-415 x 480

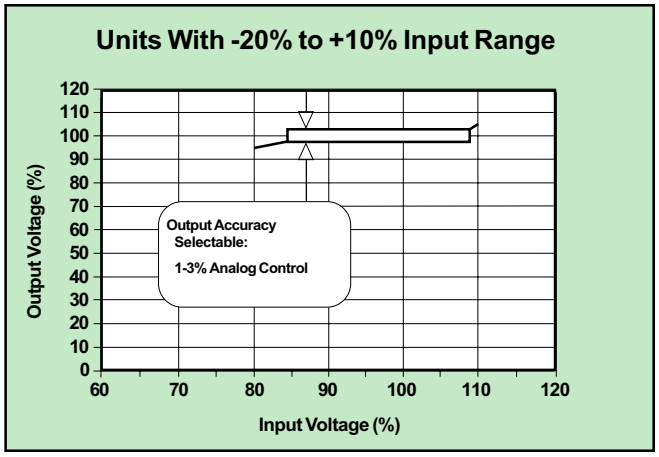
Narrow Input Range -20% low, +10% high
Wide Input Range -30% low, +15% high

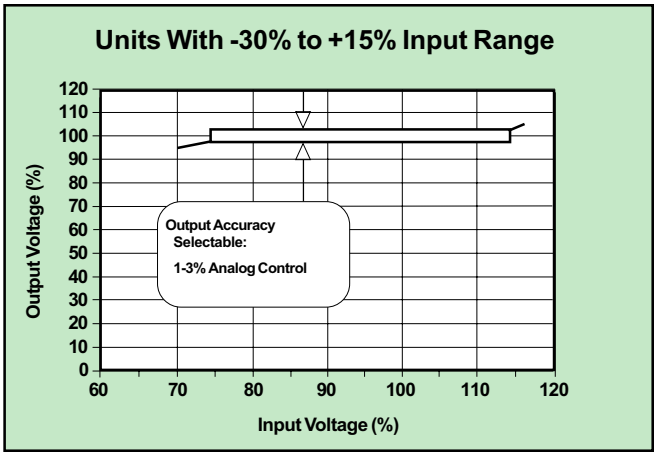
Units with the 480 x 600 volt rating:

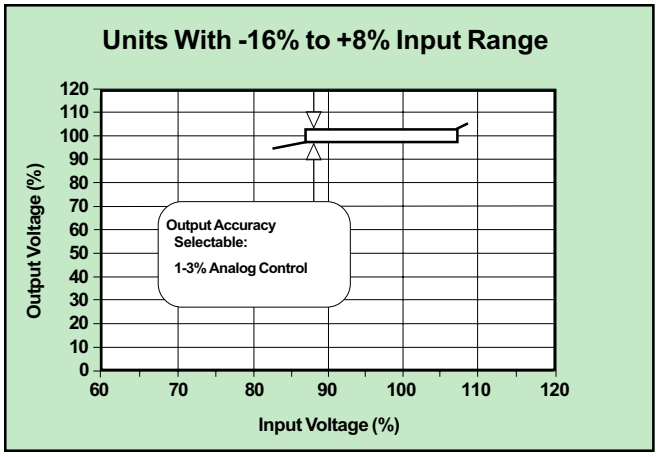
Narrow Input Range -16% low, + 8% high
Wide Input Range -25% low, +12% high

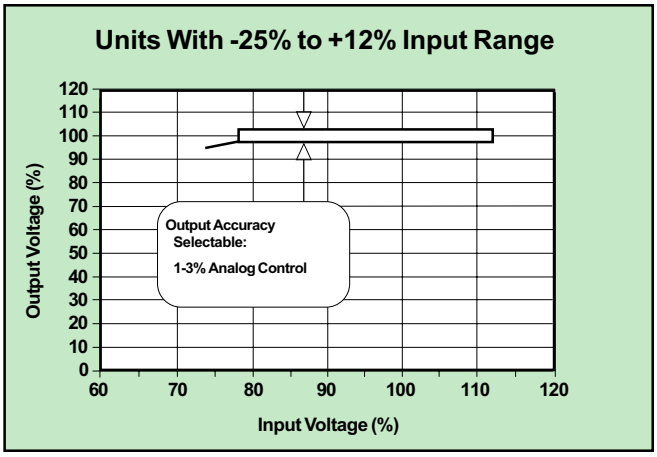
At the very extremes of the input range the output voltage may become slightly higher or lower than would otherwise be the case. The following voltage range charts show the output voltages produced for each standard input range.











Transient Suppression:

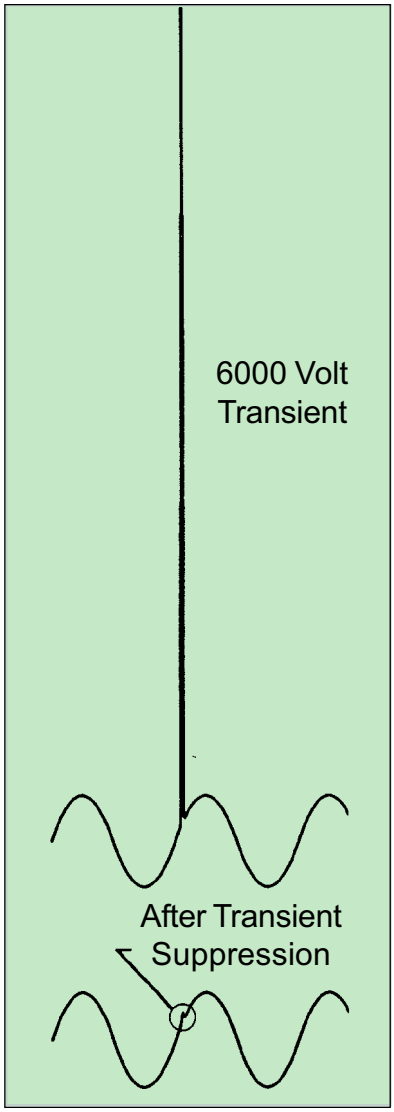
Units with this option (WHRS version) incorporate multistage, high energy transient voltage suppressors. Transient voltage suppressors protect the connected equipment from voltage transients commonly caused by lightning strikes, utility line switching and load switching. Most locations experience hundreds or thousands of transients each year with magnitudes up to 6,000 volts. Transients are a major cause of equipment malfunction and failure. They damage all types of electrical devices by weakening or immediately breaking down the electrical insulation. Transients also cause control circuits to malfunction resulting in machine resets, data processing errors, and other apparently random problems.

The transient suppression circuits used in WHR Series Voltage Regulators attenuate all types and magnitudes of normal mode transients defined in the following industry standards:

IEEE Std. C62.45, IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits
Ring Wave and Unidirectional
Location Categories A and B

UL 1449, Transient Voltage Surge Suppressors

These multistage transient suppressors use a combination of technologies to provide maximum reduction of the transients without distorting the voltage. The first stage uses devices that divert the very high voltage portion of the transients away from the load. Then a filtering circuit, which tracks the sine wave, blocks and smooths the transient. The result is a highly effective low impedance sine-wave tracking system that eliminates transients at all points on the power voltage sine wave. They provide 40 dB typical transverse-mode attenuation. Thus, a 6000 volt transient will be reduced to about 60 volts. Impedance is kept to a minimum, about 1%, so loads that normally draw large pulses of current (high current crest factor loads) are not adversely affected.



Neutral Generating Zig-Zag Transformer:
(three phase units only)

This transformer generates a neutral for three phase power systems. It does not provide electrical power isolation. If an input neutral is not available, a Zig-Zag option must be used when individual phase control or transient voltage suppression options are specified or the loads are not balanced. There are two Zig-Zag transformer options available with the WHR series voltage regulator.

The 9 series (WHR9 and WHRS9) Zig-Zag provides a neutral for the load when there is no input source neutral available or used. This Zig-Zag transformer option is also used to eliminate overheating of the distribution transformer and the neutral feeding the system. This problem is created when loads with high harmonic currents are used, such as some transmitters, computer equipment and solid state motor drives. These loads typically draw a large burst of line current during each half cycle of the voltage. The three phase line currents add together to create a neutral current greater than the line current. The input transformer and neutral will overheat and fail if they are not sized to handle the increased neutral current. The Zig-Zag transformer eliminates the problem because it derives the load's neutral current from input line currents, and cancels harmonic load currents that are multiples of three times the line frequency. Since the input neutral is not connected, it carries no load current and cannot overheat the distribution transformer. The WHR9 and WHRS9 series regulator Zig-Zag transformers are designed to handle high harmonic loads. The neutral is rated 150% of the regulator line current.

The 6 series (WHR6 and WHRS6) Zig-Zag transformers do not provide a neutral for the load. This series of Zig-Zag transformers provides a neutral reference for the regulator's internal circuitry only. No input or output neutral connects are available. This Zig-Zag transformer series is used usually for Delta input and Delta output configurations where individual phase control or transient voltage suppression options are specified, or the loads are not balanced. Because this Zig-Zag transformer does not have to carry the full load current, it is usually smaller and less costly then the 9 series Zig-Zag transformer.

Three Phase Configurations:

Three phase WHR Series Voltage Regulators are provided in three configurations to complement the numerous AC utility and load configurations found around the world. These configurations are shown in the table below.

Configuration Input	Output §	Model # Designations
Wye	Wye	WHR3 or WHRS3
Delta	Delta	WHR6 or WHRS6
Delta	Wye	WHR9 or WHRS9

§ Wye configured outputs also handle Delta loads, and single phase line-to-line or line-to-neutral loads. Delta configured output also handles single phase line-to-line loads.

Wye to Wye Configuration:

This basic configuration (WHR3 or WHRS3) is a three phase WHR regulator that does not have a Zig-Zag transformer. These are designed to operate with a four wire, plus ground, Wye input. The output can be Wye, Delta or a combination of the two, as long as the output rating is not exceeded on any phase. The input neutral connection should be connected for these models. If the three input line voltages and the loads are balanced, this configuration can be used without input neutral connected. However, in most applications these conditions can not be guaranteed, so it is strongly recommended that the input neutral be connected if available.

Delta to Delta Configuration

Delta to Delta configurations (WHR6 or WHRS6) incorporate a Zig-Zag transformer to provide a neutral reference of the three phase power systems for internal use only. This Zig-Zag transformer provides a neutral reference when input and output neutral are not connected, nor required. This option is required if individual phase control or transient suppression is specified, or the loads are not balanced on a Delta power system. UNIT WITH THIS OPTION MUST NOT HAVE AN INPUT OR OUTPUT NEUTRAL CONNECTED.

Delta to Wye Configuration

Delta to Wye configurations (WHR9 or WHRS9) include a Zig-Zag transformer to generate a neutral for three phase power systems. It is typically used where loads require a four wire Wye connection and input is only a three wire power source. It is also used to eliminate overheating of the distribution transformer and the neutral feeding the system as described in "Neutral Generating Zig-Zag Transformer." This option takes a Delta input source and creates a four-wire Wye output but does not provide isolation. This Zig-Zag transformer is designed to handle the full load current. UNIT WITH THIS OPTION MUST NOT HAVE AN INPUT NEUTRAL CONNECTION.

Input Circuit Breaker:

An input circuit breaker can be provided on any unit to provide short circuit and overload protection. WHR Series Regulators use high interrupting capacity, industrial circuit breakers.

All circuit breakers may be equipped with a shunt trip or an undervoltage release. Both are used to open the circuit breaker electrically. A shunt trip causes the breaker to open when voltage is applied to the shunt trip coil. The trip coil is de-energized when the breaker opens. The undervoltage release trips the breaker when the coil is de-energized. The undervoltage release coil must be energized before the circuit breaker can be closed. The shunt trip and undervoltage release are rated 120 volt, AC.

The shunt trip is usually preferred over the undervoltage release for tripping breakers because a small momentary loss of voltage will not cause nuisance breaker tripping, and additional trip controls are more easily added independently in parallel. The undervoltage release is used when it is desired to trip the breaker when voltage is lost. For example, an undervoltage release must be used if the phase failure (phase voltage loss), phase reversal relay option is to be used to trip the breaker when phase voltage is lost. If just the phase reversal feature is needed, a shunt trip may be used.

Delayed Output:

This option is useful in areas where the power is unstable and frequently fails. In these applications the voltage often falls to a low level before failing entirely, and then returns at a high level. When the power goes out, it may quickly return due to the utility circuit breakers automatically reclosing. Or, the power may immediately come back on only to fail again as the generator attempts to start all the connected loads at once.

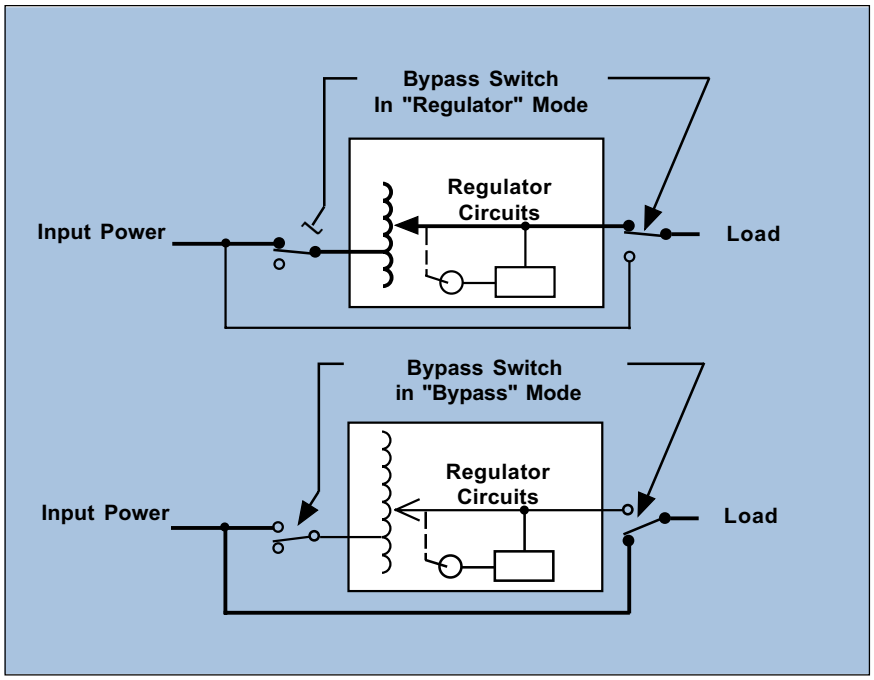
The delayed output option, prevents equipment damage under these conditions, and allows time for the power to stabilize before energizing the load. This is accomplished by adding a contactor and a timer to the regulator. When the regulator is initially energized: the timer starts, the contactor is open and the load is de-energized. After the preset time delay the contactor automatically closes energizing the load. The contactor is rated for the full output current of the regulator. The time delay is field adjustable from approximately 5 to 60 seconds. Factory adjusted to approximately 10 seconds when shipped.

See Block Diagram on Page 27 for System Configuration.

Manual Bypass Switch:

These are two-position, non-load break, manual bypass switches. In the "REGULATOR" position, the regulator circuits are connected to the input power, and the load is connected to the output of the regulator circuits. In the "BYPASS" position the regulator circuits are disconnected from the input power and the load is connected directly to the input power. The neutral is not switched.

Bypass switches are provided in the WHR cabinets to conserve space and eliminate extra wiring during installation. Because the bypass is located in the cabinet, live wires are present even in the “BYPASS” position. To completely disconnect the WHR series regulator, use a BPS series external bypass. See page 26 for details.



The circuit breaker, undervoltage release circuit, and 9 series neutral generating ZIG-ZAG transformer options are energized regardless of the bypass switch position, since they are always needed.

Caution

While in BYPASS there are "Live" wires and circuits within the cabinet.

Tropicalization Treatment:

Tropicalization permits a treated unit to operate in a high humidity environment. The units are treated to resist:

1. Insulation degradation due to moisture absorption.
2. Fungus growth prevalent in high humidity locations. Fungus growth can create a conductive path on an insulator, causing voltage breakdowns.
3. Corrosion of metal due to oxidation.

The following are the special treatments used on tropicalized, WHR Series Regulators:

Control Modules:

- Printed circuits are given a conformal coating according to MIL-I-46058C.
- All plated hardware is given an additional dichromate treatment.
- Plastic parts used in the voltmeter, terminal board and control fuses are selected to resist fungus growth and moisture absorption.

POWERSTAT Variable Transformers:

- The coils are given a fungus proof varnish coating.
- Phenolic parts are coated with a MIL-V-173 type 1 bakelite rosin fungicide varnish.
- Radiators are anodized per MIL-A-8625C.

Drive Components:

- A military version motor is used. It incorporates double varnish, special grease, hard wired terminals, and special finishes.
- Plastic parts used in the terminal board and limit switches are selected to resist fungus growth and moisture absorption.

Other

- Enclosure hardware is given an additional dichromate treatment.
- Buss bars are specially plated.
- Optional equipment either uses fungus inert materials or has special fungus inert finishes.

Meter, Alarm Circuit Options

Ammeters:

With this option, one meter is provided for each phase to display load current. Meters have 2% accuracy.

Frequency Trip Meter:

The frequency is monitored and displayed on the front of the unit. If the frequency becomes greater or less than user selected values, an output relay is energized. The relay is equipped with a form "C" normally open / normally closed contact available for customer use.

Input Voltage Range Alarm Contact:

For each control unit, this option closes a normally open solid state contact when the regulator is providing maximum voltage correction. The contact is available for customer use. This condition indicates the input voltage is approaching the limit of the regulator's correction range, and the output voltage may be out of tolerance.

Phase Loss, Phase Reversal Alarm Contacts: (three phase units only)

This option senses the three phase voltage and operates a relay (form "C" normally open - normally closed contact) when any phase voltage is lost, or if the voltage sequence of the power is reversed.

If an input circuit breaker with an undervoltage release is ordered, the system is configured to automatically trip the breaker when there is a phase loss or phase reversal. If an input breaker with a shunt trip is ordered, the system is configured to automatically trip the breaker when there is a phase reversal. The system might not trip the breaker when there is a phase loss because power to operate the shunt trip may not be available.

Alarm circuit contacts provided with the Frequency Trip Meter, Input Voltage Range Alarm and Phase Loss - Phase Reversal options are rated 5 amps 240 volts AC.

When these options are ordered with one of the circuit breaker trip options, the unit is furnished with 120 volt AC, 1 amp power source and the alarm circuit contacts are wired to trip the input breaker. If you do not want the alarm contacts to trip the input breaker, the unit can easily be re-configured to not trip the breaker and to perform other control functions.

See Block Diagram on Page 27 for System Configuration.

Soft Start:

Some loads should be started on reduced voltage in order to limit inrush currents, mechanical shock, thermal shock, etc. The soft start option controls a WHR Series Voltage Regulator so that when power is applied the regulator's output voltage starts out approximately 10% low. After a preset time delay, the output voltage ramps up to the selected regulated output voltage. The soft start option can be ordered in combination with all other standard WHR Series regulator options.

The soft start option works by driving the regulator to the minimum output voltage position when power is lost (or when a user supplied contact is opened). When input power is lost, the soft start controls automatically connect the drive motors on the POWERSTAT power module(s) to the output of a small uninterruptible power supply (UPS). This drives the power modules to the minimum output voltage position. After a predetermined time the UPS is automatically turned off. It requires up to 15 seconds (depending on the size of the regulator) to drive the POWERSTAT power module(s) to the minimum output voltage position.

When regulator power is restored, the load voltage will be approximately 7% less than the input voltage on narrow range WHR Regulators and 13% less than the input voltage on wide range models. After the soft start timer times out, the regulator control module(s) are engaged and the output voltage ramps up to the selected, regulated output voltage. The time delay is field adjustable from 2 to 20 seconds.

External Bypass Switch:

Three phase external bypass switches are housed in separate NEMA type 1 ventilated enclosures, intended for indoor use under usual service conditions. Terminations are provided for the utility, load, regulator input, and regulator output connections. The switches are rated 600 volts, 50/60 Hz, non-load break. Power must be turned off by other means before switch transfer is activated.

In the "Regulator" position the utility is fed to the regulator input and the regulator output is fed to the load. In the "BYPASS" position all hot power leads are diverted from the regulator enclosure and the utility is connected directly to the load. This provides complete electrical isolation unless auxiliary power is supplied to the enclosure for alarm circuits.

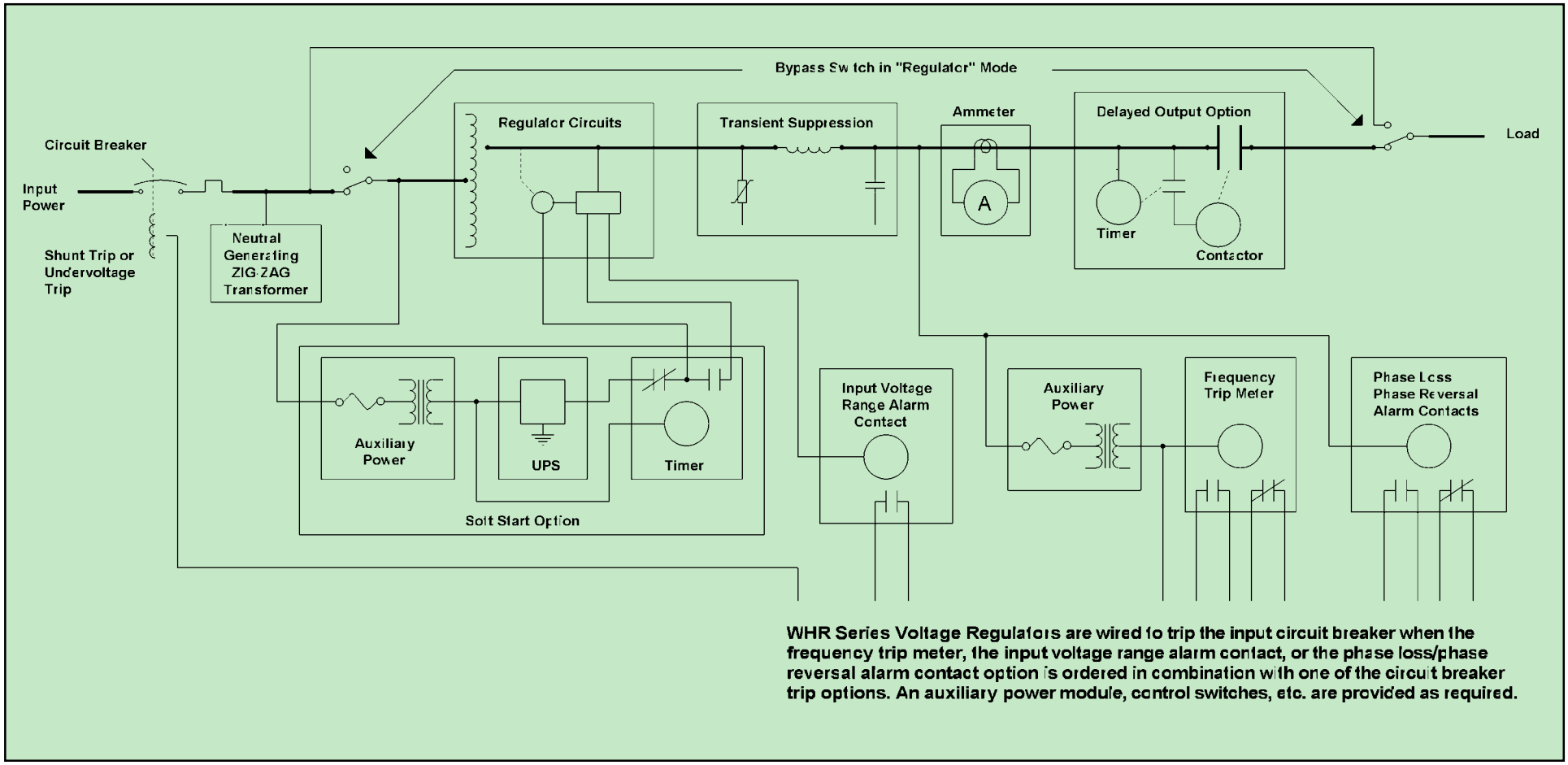
All regulator features are bypassed when an external bypass switch is used. Alarm contacts will default to their de-energized position. An external bypass switch should not be used under the following conditions:

- The installation is relying on the regulator's internal circuit breaker to protect for system overloads.
- The regulator's Zig-Zag transformer (WHR9 or WHRS9) is providing the load neutral.
- De-energized alarm contacts will interfere with system operation.

Select the BPS series external bypass switch based on the worst case current it will handle. This rating will normally be the input current rating of the WHR series regulator.

Model No.	Current (Amps)	Approximate Ship Weight (Pounds)	Approximate Ship Weight (Kilograms)	Enclosure
BPS100	100	230	104	C
BPS200N	200	305	138	E
BPS400N	400	320	145	E
BPS600N	600	555	252	EPLUS
BPS800N	800	675	306	FPLUS
BPS1200N	1200	780	354	GPLUS

Block Diagram with Options



WHR Series Voltage Regulators are wired to trip the input circuit breaker when the frequency trip meter, the input voltage range alarm contact, or the phase loss/phase reversal alarm contact option is ordered in combination with one of the circuit breaker trip options. An auxiliary power module, control switches, etc. are provided as required.

Work Sheet - WHR Series STABILINE® Voltage Regulators

Insert base model number without options for an application by determining the requirements listed on the right and using the charts on the following pages. Add options as listed below.

Superior Electric
383 Middle Street
Bristol, CT 06010

Telephone: (860) 585-4500
FAX: (860) 582-3784
Customer Service: (860) 585-4500 Ext. 4750
Application Support: (860) 585-4500 Ext. 4755

In U.S.A. and Canada

Telephone: 1-800-787-3582
FAX: 1-800-821-1369
Customer Service: 1-800-787=3532 Ext. 4750
Application Support: 1-800-787=3532 Ext. 4755

For reference only. See charts.

[ ] Phases / Connection
- [ ] (1) Single Phase
- [ ] (2) Single Phase 240/120 volt
- [ ] (3) Three phase

[ ] Voltage (_____volts)
- [ ] (1) 120-127 (100)
- [ ] (2) 208 x 220-230-240 (277)
- [ ] (4) 380-400-415 x 480
- [ ] (6) 480 x 600

[ ] Input Correction Range
- [ ] (N) Narrow Range
- [ ] (W) Wide Range

[ ] Control
- [ ] (S) Single Control
- [ ] (D) Double Control
- [ ] (T) Triple Control

[ ] Size Code (____kva/ ____amps)
- [ ] (see charts)

Model number of base unit without options: WHR

Model number of unit with selected options: WHR -

POWER CIRCUIT OPTIONS

Transient Voltage Suppression	S
Three Phase Delta Input … (replace 3 in Model #)	
[ ] Delta Input / Delta Output, Non-Balanced Loads	6
[ ] Delta Input / Wye Output, Non-Isolated	9
Input Circuit Breaker	CB
With Shunt Trip	CS
With Undervoltage Trip Release	CR
Delayed Output	D
Manual Bypass Switch	M
Tropicalization Treatment	T

METER OPTIONS

None	0
Ammeter	1
Frequency Meter With Alarm Contacts	2
Ammeter & Frequency Meter With Alarm Contacts	3

ALARM CIRCUIT OPTIONS (With Contacts)

None	0
Input Voltage Range	4
Phase Loss, Phase Reversal	5
Input Voltage Range & Phase Loss / Reversal	6

MISCELLANEOUS OPTIONS

None	0
Manual Raise - Lower Switches	7
Soft Start	8
Manual Raise – Lower Switches & Soft Start	9

Notes:
1. Spaces are omitted from the model number for lettered options not selected.
2. The three digit option numbers are all used unless all three are zero, then they are omitted.

Special Type WHR11SSCX1R and WHR11SSDX1R - Single Phase - 120 Volt

Input & Output Voltages (Nominal)

Line - Line and Line - Neutral	Frequency (Hz)	Selectable Output Voltage
120-127	50 / 60	100 to 140

Units can also be used on 100 volt 50/60 Hz systems.

Input Correction Ranges

WHR11SSCX1R:	-8% to +8% of selected output voltage	110 to 130 volts with the output set at 120 volts
	-17% to +17% of selected output voltage	100 to 140 volts with the output set at 120 volts
WHR11SSDX1R	-10% to +5% of selected output voltage	108 to 126 volts with the output set at 120 volts

Rated Load		Input Range	Model Number (base unit)	Max. Input Amps	Recovery Rate† (seconds / %)	Approximate Weights				Enclosures
						Pounds		Kilograms		
Amps	kVA at 120 V					Net	Ship	Net	Ship	
Rack Mount Units										
*87	6.8	±17%	WHR11SSCX1R	70	0.086	88	110	40	50	RS
*114	13.7	±8%		126	0.170					
167	20.0	10% to +5%	WHR11SSDX1R	186	0.200	110	132	50	60	RS2

* Input correction range and load ratings are selectable using jumper connections on the output panel. Jumper X2-X3 (both jumpers) for wider rower input range and higher current / kva rating.

These voltage regulators are designed to be used in applications where space is at a premium, such as mobile communications vans and on shipboard. The units are very compact and can be used in standard 19 inch rack or stand-alone applications. The user can select either a narrow input range or a wide input range on the WHR11SSCX1R by moving jumpers. This unit is rated at 114 amps and 13.7 kVA when connected for narrow range correction, or 57 amps and 6.8 kVA when connected for wide range correction.

Special Options for All WHR Regulators:

In addition to the standard options listed on page 4 and described earlier in this catalog, Superior Electric can provide specially designed units to meet your needs. If there is a specific option required, please call our customer service specialist and request a quote. Some of the special options provided in the past are listed below:

- Input Voltmeters (analog or digital)
- Input Ammeters (analog or digital)
- Multi-Phase power meter
- Casters (On Floor Mount Models)
- Door Interlock Switches
- Line Cord and Plugs (Smaller Models Only)
- Special Input / Output Quick Connects (Using Superior Electric SUPERCON® Electrical Connectors)
- NEMA 4X Enclosure With Air Conditioner (Larger Models Only)
- Step Up or Step Down Auto Transformer
- Step Up or Step Down Isolation Transformer
- 1:1 Isolation Transformer
- Adjustable Output Under Voltage Alarm Relay
- Adjustable Output Over Voltage Alarm Relay

Single Phase - 120 Volt - Narrow Range

Input & Output Voltages (Nominal)

Line - Line and Line - Neutral
120-127

Frequency (Hz)
50 / 60

Selectable Output Voltage
100 to 140

Units can also be used on 100 volt 50/60 Hz systems.

Input Correction Range: -20% to +10% of selected output voltage — 96 to 132 volts with the output set at 120 volts

Rated Load		Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Approximate Weights				Enclosure
					Pounds		Kilograms		
Amps	kVA at 120 V				Net	Ship	Net	Ship	
Floor Mount Units									
*30	3.6	WHR11NSD11	37	0.026	178	228	81	103	A
*50	6.0	WHR11NSE11	60	0.026	215	265	98	120	A
80	9.6	WHR11NSF11	100	0.056	218	268	99	122	A
160	19	WHR11NSF12	200	0.056	347	397	157	180	C
240	28	WHR11NSF13	300	0.056	458	508	208	230	D
320	38	WHR11NSF14	400	0.084	563	613	255	278	E
400	48	WHR11NSF15	500	0.084	640	690	290	313	E
480	57	WHR11NSF16	600	0.084	766	816	347	370	F
560	65	WHR11NSF17	700	0.110	841	891	381	404	F
640	75	WHR11NSF24	800	0.110	1,003	1,103	455	500	DPLUS
800	95	WHR11NSF25	1000	0.170	1,195	1,295	542	587	EPLUS
960	115	WHR11NSF26	1200	0.170	1,422	1,522	645	690	FPLUS
1120	130	WHR11NSF27	1400	0.170	1,572	1,672	713	758	FPLUS
1280	150	WHR11NSF28	1600	0.340	1,722	1,822	781	826	FPLUS
1450	175	WHR11NSF36	1800	0.340	2,038	2,138	924	970	FF
1680	200	WHR11NSF37	2100	0.340	2,263	2,363	1,026	1,072	FF
1900	225	WHR11NSF38	2400	0.340	2,488	2,588	1,129	1,174	FF
2150	250	WHR11NSF39	2700	0.340	2,789	2,889	1,265	1,310	GG
19-Inch Rack Mount Units									
#* 30	3.6	WHR11NSD11R-CB	37	0.026	65	95	29	43	R1
#* 30	3.6	WHR11NSD11R5U	37	0.026	60	90	27	41	R5U
#* 50	6.0	WHR11NSE11R-CB	60	0.026	102	132	46	60	R1
# 80	9.6	WHR11NSF11R-CB	100	0.056	105	135	48	61	R1
# 160	19	WHR11NSF12R	200	0.056	190	220	86	100	R2

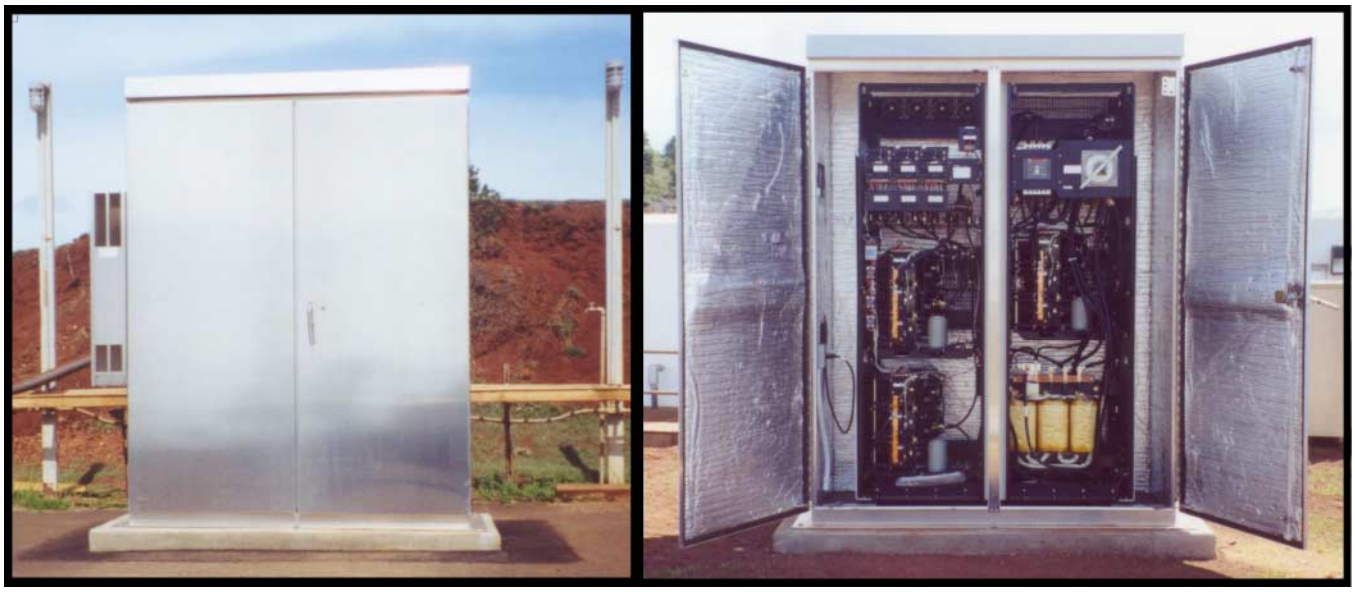
Notes: Listed model numbers, weights and enclosures are for base units. Options may increase weights and enclosure sizes.

* Due to their fast recovery times, the maximum output accuracy for these units is 1.5%.

\# These are 19 inch rack mounted units. Units with -CB at the end of the model number are provided with an input circuit breaker. Other options are only available on a special order basis; contact factory.

† Recovery rates shown are for 60 Hz operation. For 50 Hz, multiply by 1.2.

Special Options *(cont'd)*



WHRS92NTF33-CSMT167 with special NEMA 4X enclosure & air conditioning option

Single Phase - 120 Volt - Wide Range

Input & Output Voltages (Nominal)
Line - Line and Line - Neutral
120-127

Frequency (Hz)
50 / 60

Selectable Output Voltage
100 to 140

Units can also be used on 100 volt 50/60 Hz systems.

Input Correction Range: -30% to +15% of selected output voltage

84 to 138 volts with the output set at 120 volts

Rated Load		Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Approximate Weights				Enclosure
					Pounds		Kilograms		
Amps	kVA at 120 V				Net	Ship	Net	Ship	
Floor Mount Units									
*42	5.0	WHR11WSE11	60	0.025	215	265	98	120	A
72	8.6	WHR11WSF11	100	0.066	209	259	95	117	A
145	17	WHR11WSF12	200	0.066	329	379	149	172	C
215	25	WHR11WSF13	300	0.066	431	481	195	218	D
290	35	WHR11WSF14	400	0.099	529	579	240	263	E
360	43	WHR11WSF15	500	0.099	595	645	270	293	E
430	50	WHR11WSF16	600	0.099	712	762	323	346	F
500	60	WHR11WSF17	700	0.133	778	828	353	376	F
580	70	WHR11WSF24	800	0.133	931	1,031	422	468	DPLUS
720	85	WHR11WSF25	1000	0.200	1,105	1,205	501	547	EPLUS
850	100	WHR11WSF26	1200	0.200	1,314	1,414	596	641	FPLUS
1000	120	WHR11WSF27	1400	0.200	1,446	1,546	656	701	FPLUS
1150	135	WHR11WSF28	1600	0.390	1,578	1,678	716	761	FPLUS
1300	150	WHR11WSF36	1800	0.390	1,876	1,976	851	896	FF
1500	175	WHR11WSF37	2100	0.390	2,074	2,174	941	986	FF
1700	200	WHR11WSF38	2400	0.390	2,272	2,372	1,031	1,076	FF
1900	225	WHR11WSF39	2700	0.390	2,546	2,646	1,155	1,200	GG
19-Inch Rack Mount Units									
#*42	5.0	WHR11WSE11R-CB	60	0.025	102	132	46	60	R1
#72	8.6	WHR11WSF11R-CB	100	0.066	96	126	44	57	R1
#145	17	WHR11WSF12R	200	0.066	172	202	78	92	R2

Notes: Listed model numbers, weights and enclosures are for base units. Options may increase weights and enclosure sizes.
* Due to their fast recovery times, the maximum output accuracy for these units is 1.5%.
\# These are 19 inch rack mounted units. Units with -CB at the end of the model number are provided with an input circuit breaker. Other options are only available on a special order basis; contact factory.
† Recovery rates shown are for 60 Hz operation. For 50 Hz, multiply by 1.2.

Support Services

Superior Electric offers the following services for WHR Series STABILINE® Voltage Regulators. Contact the Customer Service Group for a quotation.

Start-Up Service

Superior Electric personnel will travel to the site where the WHR Series unit is to be installed, inspect the installation and energize the unit. Arrangements for Start-Up Service must be made before the unit is shipped. Start-Up Service includes inspection of the unit and all field electrical connections, and adjustments to the unit. After inspection, the WHR Series unit will be energized and demonstrated to be operating to the satisfaction of the customer. Superior Electric expects the unit to be installed and wired before the Start-Up Service procedure. Additional charges will be invoiced if the Start-Up Service extends beyond one day on site, if delay is because the unit was not prepared for Start-Up Service.

A worldwide fee is set for Start-Up Service. In addition, labor and expenses will be applied for Start-Up Service outside North America.

Service Training

Depending upon the WHR Series unit(s) purchased, a one to two-day Service Training program is offered at Superior Electric's facility in Bristol, Connecticut, USA to provide application, installation, maintenance and repair training. The fee for a Service Training program is set, for one or two persons. Each additional person is discounted 20%. All training materials and meals are included. Travel and lodging are not included. On-site Service Training alone, or in conjunction with Start-Up Service, can be provided.

On-Site Repair Service

WHR Series units are covered by a full two-year warranty. Superior Electric's standard Warranty and Limitation of Liability shall apply.

If a WHR Series unit does not work properly, the Customer Service Group will assist in correcting the problem through telephone consultation, replacement parts or factory Repair/Service. Because of the large physical size of some units, Superior Electric can provide On-Site Repair/Service for warranty and out-of-warranty situations. The fee for On-Stie Repair/Service is the sum of labor, expenses and materials. A purchase order for On-Site Repair/Service must be issued before Superior Electric personnel can be assigned. If the unit is in warranty and the failure is not due to shipping damage, improper installation or misuse, the purchase order will be processed at no charge.

Single Phase - 208 X 240 Volt - Narrow Range

Input & Output Voltages (Nominal)

Line - Line and Line - Neutral	Frequency (Hz)	Selectable Output Voltage
208	50 / 60	175 to 240
220 - 230 - 240	50 / 60	200 to 280

Units can also be used on 277 volt 60 Hz systems.

Input Correction Range: -20% to +10% of selected output voltage — 166 to 229 volts with the output set at 208 volts; 192 to 264 volts with the output set at 240 volts

Rated Load						Approximate Weights				
						Pounds		Kilograms		
Amps	kVA at 208 V	kVA at 240 V	Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Net	Ship	Net	Ship	Enclosure
Floor Mount Units										
* 15	3.1	3.6	WHR12NSR11	20	0.026	193	243	88	110	A
* 28	5.8	6.7	WHR12NSS11	35	0.026	233	283	106	128	A
65	13	15	WHR12NST11	80	0.110	224	274	102	124	A
130	25	30	WHR12NST12	160	0.110	344	394	156	179	C
195	40	45	WHR12NST13	240	0.110	446	496	202	225	D
260	50	60	WHR12NST14	320	0.170	544	594	247	269	E
325	65	75	WHR12NST15	400	0.170	610	660	277	299	E
390	80	90	WHR12NST16	480	0.170	727	777	330	352	F
455	90	100	WHR12NST17	560	0.220	793	843	360	382	F
520	100	125	WHR12NST24	640	0.220	946	1,046	429	474	DPLUS
650	125	150	WHR12NST25	800	0.340	1,120	1,220	508	553	EPLUS
780	150	175	WHR12NST26	960	0.340	1,329	1,429	603	648	FPLUS
910	175	200	WHR12NST27	1120	0.340	1,461	1,561	663	708	FPLUS
1040	200	250	WHR12NST28	1280	0.670	1,593	1,693	723	768	FPLUS
1170	225	275	WHR12NST36	1440	0.670	1,891	1,991	858	903	FF
1350	275	325	WHR12NST37	1680	0.670	2,089	2,189	948	993	FF
1550	300	350	WHR12NST38	1920	0.670	2,287	2,387	1,037	1,083	FF
1750	350	400	WHR12NST39	2160	0.670	2,561	2,661	1,162	1,207	GG
19-Inch Rack Mount Units										
#* 15	3.1	3.6	WHR12NSR11R-CB	20	0.026	80	110	36	50	R1
#* 28	5.8	6.7	WHR12NSS11R-CB	35	0.026	120	150	54	68	R1
# 65	13	15	WHR12NST11R-CB	80	0.110	111	141	50	64	R1
#130	25	30	WHR12NST12R	160	0.110	187	217	85	98	R2

Notes:
Listed model numbers, weights and enclosures are for base units. Options may increase weights and enclosure sizes.

* Due to their fast recovery times, the maximum output accuracy for these units is 1.5%.

\# These are 19 inch rack mounted units. Units with -CB at the end of the model number are provided with an input circuit breaker. Other options are only available on a special order basis; contact factory.

† Recovery rates shown are for 60 Hz operation. For 50 Hz, multiply by 1.2.

Need More Information . . . *Installation and Operation Instruction Manuals shipped with each unit cover Theory of Operation, Start-up, Operation, Maintenance, and Trouble-shooting . . . contact our Customer Service Group.*

860-585-4500 - Ext. 4750 • In USA and Canada: 1-800-787-3532 - Ext. 4750

Single Phase - 208 X 240 Volt - Wide Range

Input & Output Voltages (Nominal)

Line - Line and Line - Neutral	Frequency (Hz)	Selectable Output Voltage
208	50 / 60	175 to 240
220 - 230 - 240	50 / 60	200 to 280

Units can also be used on 277 volt 60 Hz systems.

Input Correction Range: -30% to +15% of selected output voltage — 146 to 239 volts with the output set at 208 volts; 168 to 276 volts with the output set at 240 volts

Rated Load Amps	Rated Load kVA at 208 V	kVA at 240 V	Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Approximate Weights Pounds Net	Pounds Ship	Kilograms Net	Kilograms Ship	Enclosure
Floor Mount Units										
* 21	4.3	5.0	WHR12WSS11	30	0.025	233	283	106	128	A
36	7.5	8.6	WHR12WST11	50	0.066	224	274	102	124	A
72	15	17	WHR12WST12	100	0.066	344	394	156	179	C
108	22	25	WHR12WST13	150	0.066	446	496	202	225	D
145	30	35	WHR12WST14	200	0.099	544	594	247	269	E
180	38	43	WHR12WST15	250	0.099	610	660	277	299	E
215	45	50	WHR12WST16	300	0.099	727	777	330	352	F
250	50	60	WHR12WST17	350	0.130	793	843	360	382	F
290	60	70	WHR12WST24	400	0.130	946	1,046	429	474	DPLUS
360	75	85	WHR12WST25	500	0.200	1,120	1,220	508	553	EPLUS
430	90	100	WHR12WST26	600	0.200	1,329	1,429	603	648	FPLUS
500	100	120	WHR12WST27	700	0.200	1,461	1,561	663	708	FPLUS
575	120	135	WHR12WST28	800	0.390	1,593	1,693	723	768	FPLUS
650	135	150	WHR12WST36	900	0.390	1,891	1,991	858	903	FF
750	150	175	WHR12WST37	1050	0.390	2,089	2,189	948	993	FF
850	175	200	WHR12WST38	1200	0.390	2,287	2,387	1,037	1,083	FF
950	200	225	WHR12WST39	1350	0.390	2,561	2,661	1,162	1,207	GG
19-Inch Rack Mount Units										
#* 21	4.3	5.0	WHR12WSS11R-CB	30	0.025	120	150	54	68	R1
# 36	7.5	8.6	WHR12WST11R-CB	50	0.066	111	141	50	64	R1
# 72	15	17	WHR12WST12R	100	0.066	187	217	85	98	R2

Notes:
Listed model numbers, weights and enclosures are for base units. Options may increase weights and enclosure sizes.

* Due to their fast recovery times, the maximum output accuracy for these units is 1.5%.

\# These are 19 inch rack mounted units. Units with -CB at the end of the model number are provided with an input circuit breaker. Other options are only available on a special order basis; contact factory.

† Recovery rates shown are for 60 Hz operation. For 50 Hz, multiply by 1.2.

Model: WHR12WST11R-CB

Single Phase, 3 Wire - 240/120 Volt - Narrow Range

Input & Output Voltages (Nominal)

Line - Line	Line - Neutral	Frequency (Hz)	Selectable Output Voltage
240	120	50 / 60	200 to 280

Units can also be used on 200/100 and 208 volt, 50/60 Hz systems.

Input Correction Range: -20% to +10% of selected output voltage 192 to 264 volts with the output set at 240 volts

Single Control

Rated Load		Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Approximate Weights				Enclosure
					Pounds		Kilograms		
Amps	kVA at 240 V				Net	Ship	Net	Ship	
Floor Mount Units									
* 30	7.2	WHR22NSD12	37	0.026	282	332	128	151	C
* 50	12	WHR22NSE12	60	0.026	356	406	161	184	C
80	19	WHR22NSF12	100	0.056	362	412	164	187	C
160	38	WHR22NSF14	200	0.084	580	630	263	286	E
240	57	WHR22NSF16	300	0.084	781	831	354	377	F
320	75	WHR22NSF24	400	0.110	1,018	1,118	462	507	DPLUS
400	95	WHR22NSF25	500	0.170	1,210	1,310	549	594	EPLUS
480	115	WHR22NSF26	600	0.170	1,437	1,537	652	697	FPLUS
560	130	WHR22NSF27	700	0.170	1,587	1,687	720	765	FPLUS
640	150	WHR22NSF28	800	0.340	1,737	1,837	788	833	FPLUS
720	175	WHR22NSF29	900	0.340	1,946	2,046	883	928	GPLUS
960	225	WHR22NSF38	1200	0.340	2,503	2,603	1,135	1,181	FF
19-Inch Rack Mount Units									
#* 30	7.2	WHR22NSD12R-CB	37	0.026	125	155	57	70	R2
#* 50	12	WHR22NSE12R-CB	60	0.026	199	229	90	104	R2
# 80	19	WHR22NSF12R-CB	100	0.056	205	235	93	107	R2

Individual Phase Control

Rated Load		Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Approximate Weights				Enclosure
					Pounds		Kilograms		
Amps	kVA at 240 V				Net	Ship	Net	Ship	
Floor Mount Units									
* 30	7.2	WHR22NDD21	37	0.026	307	357	139	162	C
* 50	12	WHR22NDE21	60	0.026	381	431	173	195	C
80	19	WHR22NDF21	100	0.056	387	437	176	198	C
160	38	WHR22NDF22	200	0.056	605	655	274	297	E
240	57	WHR22NDF23	300	0.056	806	856	366	388	F
320	75	WHR22NDF24	400	0.084	1,043	1,143	473	518	DPLUS
400	95	WHR22NDF25	500	0.084	1,235	1,335	560	606	EPLUS
480	115	WHR22NDF26	600	0.084	1,385	1,485	628	674	EPLUS
560	130	WHR22NDF27	700	0.110	1,612	1,712	731	777	FPLUS
640	150	WHR22NDF28	800	0.110	1,762	1,862	799	845	FPLUS
720	175	WHR22NDF29	900	0.110	1,971	2,071	894	939	GPLUS
800	190	WHR22NDF45	1000	0.170	2,390	2,590	1,084	1,175	2-EPLUS
960	225	WHR22NDF46	1200	0.170	2,844	3,044	1,290	1,381	2-FPLUS
1120	250	WHR22NDF47	1400	0.170	3,144	3,344	1,426	1,517	2-FPLUS
1280	300	WHR22NDF48	1600	0.340	3,444	3,644	1,562	1,653	2-FPLUS
1450	350	WHR22NDF66	1800	0.340	4,076	4,276	1,849	1,940	2-FF
1680	400	WHR22NDF67	2100	0.340	4,526	4,726	2,053	2,144	2-FF
1900	450	WHR22NDF68	2400	0.340	4,976	5,176	2,257	2,348	2-FF
2150	500	WHR22NDF69	2700	0.340	5,578	5,778	2,530	2,621	2-GG

Notes:
Listed model numbers, weights and enclosures are for base units. Options may increase weights and enclosure sizes.

* Due to their fast recovery times, the maximum output accuracy for these units is 1.5%.

\# These are 19 inch rack mounted units equipped with an input circuit breaker. Other options are only available on a special order basis; contact factory.

† Recovery rates shown are for 60 Hz operation, for 50 Hz, multiply by 1.2.

Single Phase, 3 Wire - 240/120 Volt - Wide Range

Input & Output Voltages (Nominal)

Line - Line	Line - Neutral	Frequency (Hz)	Selectable Output Voltage
240	120	50 / 60	200 to 280

Units can also be used on 200/100 and 208 volt, 50/60 Hz systems.

Input Correction Range: -30% to +15% of selected output voltage 168 to 276 volts with the output set at 240 volts

Single Control

Rated Load		Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Approximate Weights				Enclosure
					Pounds		Kilograms		
Amps	kVA at 240 V				Net	Ship	Net	Ship	
Floor Mount Units									
* 42	10	WHR22WSE12	60	0.025	356	406	161	184	C
72	17	WHR22WSF12	100	0.066	344	394	156	179	C
145	35	WHR22WSF14	200	0.099	544	594	247	269	E
215	50	WHR22WSF16	300	0.099	727	777	330	352	F
290	70	WHR22WSF24	400	0.130	946	1,046	429	474	DPLUS
360	85	WHR22WSF25	500	0.200	1,120	1,220	508	553	EPLUS
430	100	WHR22WSF26	600	0.200	1,329	1,429	603	648	FPLUS
500	120	WHR22WSF27	700	0.200	1,461	1,561	663	708	FPLUS
575	135	WHR22WSF28	800	0.390	1,593	1,693	723	768	FPLUS
650	150	WHR22WSF29	900	0.390	1,784	1,884	809	855	GPLUS
850	200	WHR22WSF38	1200	0.390	2,287	2,387	1,037	1,083	FF
19-Inch Rack Mount Units									
#*42	10	WHR22WSE12R-CB	60	0.025	199	229	90	104	R2
#72	17	WHR22WSF12R-CB	100	0.066	187	217	85	98	R2

Individual Phase Control

Rated Load		Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Approximate Weights				Enclosure
					Pounds		Kilograms		
Amps	kVA at 240 V				Net	Ship	Net	Ship	
Floor Mount Units									
* 42	10	WHR22WDE21	60	0.025	381	431	173	195	C
72	17	WHR22WDF21	100	0.066	369	419	167	190	C
145	35	WHR22WDF22	200	0.066	569	616	258	279	E
215	50	WHR22WDF23	300	0.066	752	802	341	364	F
290	70	WHR22WDF24	400	0.099	971	1,071	440	486	DPLUS
360	85	WHR22WDF25	500	0.099	1,145	1,245	519	565	EPLUS
430	100	WHR22WDF26	600	0.099	1,454	1,522	614	660	FPLUS
500	120	WHR22WDF27	700	0.130	1,486	1,586	674	719	FPLUS
575	135	WHR22WDF28	800	0.130	1,618	1,718	734	779	FPLUS
650	150	WHR22WDF29	900	0.130	1,809	1,909	821	866	GPLUS
720	175	WHR22WDF45	1000	0.200	2,210	2,410	1,002	1,093	2-EPLUS
850	200	WHR22WDF46	1200	0.200	2,628	2,828	1,192	1,283	2-FPLUS
1000	240	WHR22WDF47	1400	0.200	2,892	3,092	1,312	1,403	2-FPLUS
1150	275	WHR22WDF48	1600	0.390	3,156	3,356	1,432	1,522	2-FPLUS
1300	300	WHR22WDF66	1800	0.390	3,752	3,952	1,702	1,793	2-FF
1500	350	WHR22WDF67	2100	0.390	4,148	4,348	1,882	1,972	2-FF
1700	400	WHR22WDF68	2400	0.390	4,544	4,744	2,061	2,152	2-FF
1900	450	WHR22WDF69	2700	0.390	5,092	5,292	2,310	2,400	2-GG

Notes:
Listed model numbers, weights and enclosures are for base units. Options may increase weights and enclosure sizes.

* Due to their fast recovery times, the maximum output accuracy for these units is 1.5%.

\# These are 19 inch rack mounted units equipped with an input circuit breaker. Other options are only available on a special order basis; contact factory.

† Recovery rates shown are for 60 Hz operation. For 50 Hz, multiply by 1.2.

Single Phase - 380 X 480 Volt

Input & Output Voltages (Nominal)

Line - Line	Frequency (Hz)	Selectable Output Voltage
380-400-415	50 / 60	375 to 455
480	60	430 to 530

Narrow Range

Input Correction Range: -20% to +10% of selected output voltage

304 to 418 volts with the output set at 380 volts
384 to 528 volts with the output set at 480 volts

Rated Load Amps	Rated Load kVA at 380 V	kVA at 480 V	Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Approximate Weights Pounds Net	Pounds Ship	Kilograms Net	Kilograms Ship	Enclosure
Floor Mount Units										
* 15	5.7	7.2	WHR24NSR12	20	0.026	282	332	128	151	C
* 28	10	13	WHR24NSS12	35	0.026	356	406	161	184	C
65	25	30	WHR24NST12	80	0.110	344	394	156	179	C
130	50	60	WHR24NST14	160	0.170	544	594	247	269	E
195	75	90	WHR24NST16	240	0.170	727	777	330	352	F
260	100	125	WHR24NST24	320	0.220	946	1,046	429	474	DPLUS
325	125	150	WHR24NST25	400	0.340	1,120	1,220	508	553	EPLUS
390	150	185	WHR24NST26	480	0.340	1,329	1,429	603	648	FPLUS
455	175	215	WHR24NST27	560	0.340	1,461	1,561	663	708	FPLUS
520	200	250	WHR24NST28	640	0.670	1,593	1,693	723	768	FPLUS
585	225	275	WHR24NST29	720	0.670	1,784	1,884	809	855	GPLUS
780	300	375	WHR24NST38	960	0.670	2,287	2,387	1,037	1,083	FF
19-Inch Rack Mount Units										
#* 15	5.7	7.2	WHR24NSR12R-CB	20	0.026	125	155	57	70	R2
#* 28	10	13	WHR24NSS12R-CB	35	0.026	199	229	90	104	R2
# 65	25	30	WHR24NST12R-CB	80	0.110	187	217	85	98	R2

Wide Range

Input Correction Range: -30% to +15% of selected output voltage

266 to 437 volts with the output set at 380 volts
336 to 552 volts with the output set at 480 volts

Rated Load Amps	Rated Load kVA at 380 V	kVA at 480 V	Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Approximate Weights Pounds Net	Pounds Ship	Kilograms Net	Kilograms Ship	Enclosure
Floor Mount Units										
* 21	8.0	10	WHR24WSS12	30	0.025	356	406	161	184	C
36	13	17	WHR24WST12	50	0.066	344	394	156	179	C
72	27	35	WHR24WST14	100	0.099	544	594	247	269	E
108	40	50	WHR24WST16	150	0.099	727	777	330	352	F
145	55	70	WHR24WST24	200	0.130	946	1,046	429	474	DPLUS
180	65	85	WHR24WST25	250	0.200	1,120	1,220	508	553	EPLUS
215	80	100	WHR24WST26	300	0.200	1,329	1,429	603	648	FPLUS
250	95	120	WHR24WST27	350	0.200	1,461	1,561	663	708	FPLUS
290	105	135	WHR24WST28	400	0.390	1,593	1,693	723	768	FPLUS
325	120	150	WHR24WST29	450	0.390	1,784	1,884	809	855	GPLUS
430	160	200	WHR24WST38	600	0.390	2,287	2,387	1,037	1,083	FF
19-Inch Rack Mount Units										
#* 21	8.0	10	WHR24WSS12R-CB	30	0.025	199	229	90	104	R2
# 36	13	17	WHR24WST12R-CB	50	0.066	187	217	85	98	R2

Notes:
Listed model numbers, weights and enclosures are for base units. Options may increase weights and enclosure sizes.
* Due to their fast recovery times, the maximum output accuracy for these units is 1.5%.
\# These are 19 inch rack mounted units equipped with an input circuit breaker. Other options are only available on a special order basis; contact factory.
† Recovery rates shown are for 60 Hz operation, for 50 Hz, multiply by 1.2.

Single Phase - 480 X 600 Volt

Input & Output Voltages (Nominal)

Line - Line	Frequency (Hz)	Selectable Output Voltage
480	50 / 60	430 to 530
600	60	520 to 660

Narrow Range

Input Correction Range: -16% to +8% of selected output voltage

403 to 518 volts with the output set at 480 volts
504 to 648 volts with the output set at 600 volts

Rated Load						Approximate Weights				
						Pounds		Kilograms		
Amps	kVA at 480 V	kVA at 600 V	Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Net	Ship	Net	Ship	Enclosure
Floor Mount Units										
60	29	36	WHR26NSX12	70	0.140	344	394	156	179	C
120	55	70	WHR26NSX14	140	0.210	544	594	247	269	E
180	85	105	WHR26NSX16	210	0.210	727	777	330	352	F
240	115	145	WHR26NSX24	280	0.270	946	1,046	429	474	DPLUS
300	145	175	WHR26NSX25	350	0.410	1,120	1,220	508	553	EPLUS
360	175	200	WHR26NSX26	420	0.410	1,329	1,429	603	648	FPLUS
420	200	250	WHR26NSX27	490	0.410	1,461	1,561	663	708	FPLUS
480	225	275	WHR26NSX28	560	0.820	1,593	1,693	723	768	FPLUS
540	250	325	WHR26NSX29	630	0.820	1,784	1,884	809	855	GPLUS
720	350	425	WHR26NSX38	840	0.820	2,287	2,387	1,037	1,083	FF
19-Inch Rack Mount Units										
# 60	29	36	WHR26NSX12R-CB	70	0.140	187	217	85	98	R2

Wide Range

Input Correction Range: -25% to +12% of selected output voltage

360 to 538 volts with the output set at 480 volts
450 to 672 volts with the output set at 600 volts

Rated Load						Approximate Weights				
						Pounds		Kilograms		
Amps	kVA at 480 V	kVA at 600 V	Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Net	Ship	Net	Ship	Enclosure
Floor Mount Units										
33	16	20	WHR26WSX12	45	0.082	344	394	156	179	C
67	32	40	WHR26WSX14	90	0.120	544	594	247	269	E
100	48	60	WHR26WSX16	135	0.160	727	777	330	352	F
130	64	80	WHR26WSX24	180	0.160	946	1,046	429	474	DPLUS
165	80	100	WHR26WSX25	225	0.250	1,120	1,220	508	553	EPLUS
200	95	120	WHR26WSX26	270	0.250	1,329	1,429	603	648	FPLUS
230	110	140	WHR26WSX27	315	0.250	1,461	1,561	663	708	FPLUS
265	125	160	WHR26WSX28	360	0.490	1,593	1,693	723	768	FPLUS
300	140	180	WHR26WSX29	405	0.490	1,784	1,884	809	855	GPLUS
400	190	240	WHR26WSX38	540	0.490	2,287	2,387	1,037	1,083	FF
19-Inch Rack Mount Units										
# 33	16	20	WHR26WSX12R-CB	45	0.082	187	217	85	98	R2

Notes:
Listed model numbers, weights and enclosures are for base units. Options may increase weights and enclosure sizes.
These are 19 inch rack mounted units equipped with an input circuit breaker. Other options are only available on a special order basis; contact factory.
† Recovery rates shown are for 60 Hz operation. For 50 Hz, multiply by 1.2.

Three Phase - 208 X 240 Volt - Narrow Range

Base units listed below are designed for 4 wire Wye inputs. If input neutral is not provided see page 23, Three Phase Configurations to determine if a Delta configuration is required.

Input & Output Voltages (Nominal)

Line - Line	Line - Neutral	Frequency (Hz)	Selectable Output Voltage
208-220	120-127	50 / 60	175 to 240
240	138	60	200 to 280‡

Input Correction Range: -20% to +10% of selected output voltage — 166 to 229 volts with the output set at 208 volts; 192 to 264 volts with the output set at 240 volts

Single Control

Rated Load Amps	Rated Load kVA at 208 V	kVA at 240 V	Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Approximate Weights Pounds Net	Pounds Ship	Kilograms Net	Kilograms Ship	Enclosure
Floor Mount Units										
*30	10	13	WHR32NSD13	37	0.026	353	403	160	183	D
*50	18	20	WHR32NSE13	60	0.026	464	514	210	233	D
80	28	33	WHR32NSF13	100	0.056	473	523	215	237	D
160	55	65	WHR32NSF16	200	0.084	781	831	354	377	F
240	85	100	WHR32NSF33	300	0.110	1,226	1,326	556	601	DD
320	110	125	WHR32NSF34	400	0.170	1,505	1,605	683	728	EE
400	140	150	WHR32NSF35	500	0.170	1,730	1,830	785	830	EE
480	170	200	WHR32NSF36	600	0.340	2,053	2,153	931	977	FF
560	200	225	WHR32NSF37	700	0.340	2,278	2,378	1,033	1,079	FF
640	225	250	WHR32NSF38	800	0.340	2,503	2,603	1,135	1,181	FF
720	250	300	WHR32NSF39	900	0.340	2,804	2,904	1,272	1,317	GG

Individual Phase Control

Rated Load Amps	Rated Load kVA at 208 V	kVA at 240 V	Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Approximate Weights Pounds Net	Pounds Ship	Kilograms Net	Kilograms Ship	Enclosure
Floor Mount Units										
* 30	10	13	WHR32NTD31	37	0.026	418	468	190	212	D
* 50	18	20	WHR32NTE31	60	0.026	529	579	240	263	D
80	28	33	WHR32NTF31	100	0.056	538	588	244	267	D
160	55	65	WHR32NTF32	200	0.056	846	896	384	406	F
240	85	100	WHR32NTF33T	300	0.056	1,113	1,163	505	528	G
240	85	100	WHR32NTF33	300	0.084	1,291	1,391	586	631	DD
320	110	125	WHR32NTF34	400	0.084	1,570	1,670	712	757	EE
400	140	150	WHR32NTF35	500	0.084	1,795	1,895	814	860	EE
480	170	200	WHR32NTF36	600	0.084	2,118	2,218	961	1,006	FF
560	200	225	WHR32NTF37	700	0.110	2,343	2,443	1,063	1,108	FF
640	225	250	WHR32NTF38	800	0.110	2,568	2,668	1,165	1,210	FF
720	250	300	WHR32NTF39	900	0.110	2,869	2,969	1,301	1,347	GG
800	285	325	WHR32NTF65	1000	0.170	3,585	3,885	1,626	1,762	3-EPLUS
960	350	400	WHR32NTF66	1200	0.170	4,266	4,566	1,935	2,071	3-FPLUS
1120	400	450	WHR32NTF67	1400	0.170	4,716	5,016	2,139	2,275	3-FPLUS
1280	450	525	WHR32NTF68	1600	0.340	5,166	5,466	2,343	2,479	3-FPLUS
1450	525	600	WHR32NTF96	1800	0.340	6,114	6,414	2,773	2,909	3-FF
1680	600	675	WHR32NTF97	2100	0.340	6,789	7,089	3,079	3,216	3-FF
1900	675	750	WHR32NTF98	2400	0.340	7,464	7,764	3,386	3,522	3-FF
2150	750	850	WHR32NTF99	2700	0.340	8,367	8,667	3,795	3,931	3-GG

Notes:

Listed model numbers, weights and enclosures are for base units. Options may increase weights and enclosure sizes.

* Due to their fast recovery times, the maximum output accuracy for these units is 1.5%.

† Recovery rates shown are for 60 Hz operation. For 50 Hz, multiply by 1.2.

‡ This selectable output range is provided only with single control.

Three Phase - 208 X 240 Volt - Wide Range

Base units listed below are designed for 4 wire Wye inputs. If input neutral is not provided see page 23, Three Phase Configurations to determine if a Delta configuration is required.

Input & Output Voltages (Nominal)

Line - Line	Line - Neutral	Frequency (Hz)	Selectable Output Voltage
208-220	120-127	50 / 60	175 to 240
240	138	60	200 to 280‡

Input Correction Range: -30% to +15% of selected output voltage

146 to 239 volts with the output set at 208 volts
168 to 276 volts with the output set at 240 volts

Single Control

Rated Load Amps	Rated Load kVA at 208 V	kVA at 240 V	Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Approximate Weights Pounds Net	Approximate Weights Pounds Ship	Approximate Weights Kilograms Net	Approximate Weights Kilograms Ship	Enclosure
Floor Mount Units										
* 42	15	#	WHR32WSE13	60	0.025	464	514	210	233	D
72	25	30	WHR32WSF13	100	0.066	446	496	202	225	D
144	50	60	WHR32WSF16	200	0.099	727	777	330	352	F
216	75	90	WHR32WSF33	300	0.130	1,145	1,245	519	565	DD
288	100	120	WHR32WSF34	400	0.200	1,397	1,497	634	679	EE
360	125	150	WHR32WSF35	500	0.200	1,595	1,695	723	769	EE
432	150	175	WHR32WSF36	600	0.390	1,891	1,991	858	903	FF
504	175	200	WHR32WSF37	700	0.390	2,089	2,189	948	993	FF
576	200	225	WHR32WSF38	800	0.390	2,287	2,387	1,037	1,083	FF
648	225	250	WHR32WSF39	900	0.390	2,561	2,661	1,162	1,207	GG

Individual Phase Control

Rated Load Amps	Rated Load kVA at 208 V	kVA at 240 V	Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Approximate Weights Pounds Net	Approximate Weights Pounds Ship	Approximate Weights Kilograms Net	Approximate Weights Kilograms Ship	Enclosure
Floor Mount Units										
* 42	15	#	WHR32WTE31	60	0.025	529	579	240	263	D
72	25	30	WHR32WTF31	100	0.066	511	561	232	254	D
144	50	60	WHR32WTF32	200	0.066	792	842	359	382	F
216	75	90	WHR32WTF33T	300	0.066	1,032	1,082	468	491	G
216	75	90	WHR32WTF33	300	0.099	1,210	1,310	549	594	DD
288	100	120	WHR32WTF34	400	0.099	1,408	1,508	639	684	EE
360	125	150	WHR32WTF35	500	0.099	1,660	1,760	753	798	EE
432	150	175	WHR32WTF36	600	0.099	1,858	1,958	843	888	FF
504	175	200	WHR32WTF37	700	0.130	2,154	2,254	977	1,022	FF
576	200	225	WHR32WTF38	800	0.130	2,352	2,452	1,067	1,112	FF
648	225	250	WHR32WTF39	900	0.130	2,626	2,726	1,191	1,236	GG
720	250	300	WHR32WTF65	1000	0.200	3,315	3,615	1,504	1,640	3-EPLUS
850	300	350	WHR32WTF66	1200	0.200	3,942	4,242	1,788	1,924	3-FPLUS
1000	350	400	WHR32WTF67	1400	0.200	4,338	4,638	1,968	2,104	3-FPLUS
1150	400	450	WHR32WTF68	1600	0.390	4,734	5,034	2,147	2,283	3-FPLUS
1300	450	525	WHR32WTF96	1800	0.390	5,628	5,928	2,553	2,689	3-FF
1500	525	600	WHR32WTF97	2100	0.390	6,222	6,522	2,822	2,958	3-FF
1700	600	675	WHR32WTF98	2400	0.390	6,816	7,116	3,092	3,228	3-FF
1900	675	750	WHR32WTF99	2700	0.390	7,638	7,938	3,465	3,601	3-GG

Notes:

Listed model numbers, weights and enclosures are for base units. Options may increase weights and enclosure sizes.

* Due to their fast recovery times, the maximum output accuracy for these units is 1.5%.

† Recovery rates shown are for 60 Hz operation. For 50 Hz, multiply by 1.2.

‡ This selectable output range is provided only with single control.

Maximum nominal input voltage for these units is 220Y/127, 60 Hz.

Three Phase - 380 X 480 Volt - Narrow Range

Base units listed below are designed for 4 wire Wye inputs. If input neutral is not provided see page 23, Three Phase Configurations to determine if a Delta configuration is required.

Input & Output Voltages (Nominal)

Line - Line	Line - Neutral	Frequency (Hz)	Selectable Output Voltage
380-400-415	220-230-240	50 / 60	375 to455
480	277	60	430 to 530

Input Correction Range: -20% to +10% of selected output voltage

304 to 418 volts with the output set at 380 volts
384 to 528 volts with the output set at 480 volts

Single Control

Rated Load Amps	Rated Load kVA at 380 V	kVA at 480 V	Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Approximate Weights Pounds Net	Pounds Ship	Kilograms Net	Kilograms Ship	Enclosure
Floor Mount Units										
*15	10	13	WHR34NSR13	20	0.026	353	403	160	183	D
*28	18	23	WHR34NSS13	35	0.026	464	514	210	233	D
65	43	54	WHR34NST13	80	0.110	446	496	202	225	D
130	85	105	WHR34NST16	160	0.170	727	777	330	352	F
195	125	160	WHR34NST33	240	0.220	1,145	1,245	519	565	DD
260	170	215	WHR34NST34	320	0.340	1,397	1,497	634	679	EE
325	210	270	WHR34NST35	400	0.340	1,595	1,695	723	769	EE
390	250	325	WHR34NST36	480	0.670	1,891	1,991	858	903	FF
450	300	375	WHR34NST37	560	0.670	2,089	2,189	948	993	FF
520	325	425	WHR34NST38	640	0.670	2,287	2,387	1,037	1,083	FF
580	375	475	WHR34NST39	720	0.670	2,561	2,661	1,162	1,207	GG

Individual Phase Control

Rated Load Amps	Rated Load kVA at 380 V	kVA at 480 V	Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Approximate Weights Pounds Net	Pounds Ship	Kilograms Net	Kilograms Ship	Enclosure
Floor Mount Units										
*15	10	13	WHR34NTR31	20	0.026	418	468	190	212	D
*28	18	23	WHR34NTS31	35	0.026	529	579	240	263	D
65	43	54	WHR34NTT31	80	0.110	511	561	232	254	D
130	85	105	WHR34NTT32	160	0.110	792	842	359	382	F
195	125	160	WHR34NTT33T	240	0.110	1,032	1,082	468	491	G
195	125	160	WHR34NTT33	240	0.170	1,210	1,310	549	594	DD
260	170	215	WHR34NTT34	320	0.170	1,462	1,562	663	709	EE
325	210	270	WHR34NTT35	400	0.170	1,660	1,760	753	798	EE
390	250	325	WHR34NTT36	480	0.170	1,956	2,056	887	933	FF
450	300	375	WHR34NTT37	560	0.220	2,154	2,254	977	1,022	FF
520	325	425	WHR34NTT38	640	0.220	2,352	2,452	1,067	1,112	FF
580	375	475	WHR34NTT39	720	0.220	2,626	2,726	1,191	1,236	GG
650	425	540	WHR34NTT65	800	0.340	3,315	3,615	1,504	1,640	3-EPLUS
780	500	650	WHR34NTT66	960	0.340	3,942	4,242	1,788	1,924	3-FPLUS
910	600	750	WHR34NTT67	1120	0.340	4,338	4,638	1,968	2,104	3-FPLUS
1040	675	850	WHR34NTT68	1280	0.670	4,734	5,034	2,147	2,283	3-FPLUS
1170	750	950	WHR34NTT96	1440	0.670	5,628	5,928	2,553	2,689	3-FF
1350	875	1100	WHR34NTT97	1680	0.670	6,222	6,522	2,822	2,958	3-FF
1550	1000	1250	WHR34NTT98	1920	0.670	6,816	7,116	3,092	3,228	3-FF
1750	1150	1450	WHR34NTT99	2160	0.670	7,638	7,938	3,465	3,601	3-GG

Listed model numbers, weights and enclosures are for base units. Options may increase weights and enclosure sizes.
* Due to their fast recovery times, the maximum output accuracy for these units is 1.5%.
† Recovery rates shown are for 60 Hz operation. For 50 Hz, multiply by 1.2.

Three Phase - 380 X 480 Volt - Wide Range

Base units listed below are designed for 4 wire Wye inputs. If input neutral is not provided see page 23, Three Phase Configurations to determine if a Delta configuration is required.

Input & Output Voltages (Nominal)

Line - Line	Line - Neutral	Frequency (Hz)	Selectable Output Voltage
380-400-415	220-230-240	50 / 60	375 to 455
480	277	60	430 to 530

Input Correction Range: -30% to +15% of selected output voltage

266 to 437 volts with the output set at 380 volts
336 to 552 volts with the output set at 480 volts

Single Control

Rated Load		kVA at 480 V	Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Approximate Weights				Enclosure
						Pounds		Kilograms		
Amps	kVA at 380 V					Net	Ship	Net	Ship	
Floor Mount Units										
36	24	30	WHR34WST13	50	0.066	446	496	202	225	D
72	47	60	WHR34WST16	100	0.099	727	777	330	352	F
108	70	90	WHR34WST33	150	0.130	1,145	1,245	519	565	DD
145	95	120	WHR34WST34	200	0.200	1,397	1,497	634	679	EE
180	110	150	WHR34WST35	250	0.200	1,595	1,695	723	769	EE
215	130	175	WHR34WST36	300	0.390	1,891	1,991	858	903	FF
250	150	200	WHR34WST37	350	0.390	2,089	2,189	948	993	FF
285	175	225	WHR34WST38	400	0.390	2,287	2,387	1,037	1,083	FF
325	200	250	WHR34WST39	450	0.390	2,561	2,661	1,162	1,207	GG

Individual Phase Control

Rated Load		kVA at 480 V	Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Approximate Weights				Enclosure
						Pounds		Kilograms		
Amps	kVA at 380 V					Net	Ship	Net	Ship	
Floor Mount Units										
36	24	30	WHR34WTT31	50	0.066	511	561	232	254	D
72	47	60	WHR34WTT32	100	0.066	792	842	359	382	F
108	70	90	WHR34WTT33T	150	0.066	1,032	1,082	468	491	G
108	70	90	WHR34WTT33	150	0.099	1,210	1,310	549	594	DD
145	95	120	WHR34WTT34	200	0.099	1,462	1,562	663	709	EE
180	110	150	WHR34WTT35	250	0.099	1,660	1,760	753	798	EE
215	130	175	WHR34WTT36	300	0.099	1,956	2,056	887	933	FF
250	150	200	WHR34WTT37	350	0.130	2,154	2,254	977	1,022	FF
285	175	225	WHR34WTT38	400	0.130	2,352	2,452	1,067	1,112	FF
325	200	250	WHR34WTT39	450	0.130	2,626	2,726	1,191	1,236	GG
360	225	300	WHR34WTT65	500	0.200	3,315	3,615	1,504	1,640	3-EPLUS
430	275	350	WHR34WTT66	600	0.200	3,942	4,242	1,788	1,924	3-FPLUS
500	325	400	WHR34WTT67	700	0.200	4,338	4,638	1,968	2,104	3-FPLUS
575	375	475	WHR34WTT68	800	0.390	4,734	5,034	2,147	2,283	3-FPLUS
650	425	550	WHR34WTT96	900	0.390	5,628	5,928	2,553	2,689	3-FF
750	500	600	WHR34WTT97	1050	0.390	6,222	6,522	2,822	2,958	3-FF
850	550	700	WHR34WTT98	1200	0.390	6,816	7,116	3,092	3,228	3-FF
950	625	775	WHR34WTT99	1350	0.390	7,638	7,938	3,465	3,601	3-GG

Listed model numbers, weights and enclosures are for base units. Options may increase weights and enclosure sizes.
† Recovery rates shown are for 60 Hz operation. For 50 Hz, multiply by 1.2.

Three Phase - 480 X 600 Volt - Narrow Range

Base units listed below are designed for 4 wire Wye inputs. If input neutral is not provided see page 23, Three Phase Configurations to determine if a Delta configuration is required.

Input & Output Voltages (Nominal)

Line - Line	Line - Neutral	Frequency (Hz)	Selectable Output Voltage
480	277	50 / 60	430 to 530
600	346	60	520 to 660

Input Correction Range: -16% to +8% of selected output voltage

403 to 518 volts with the output set at 480 volts
504 to 648 volts with the output set at 600 volts

Single Control

Rated Load		kVA at 600 V	Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Approximate Weights				Enclosure
Amps	kVA at 480 V					Pounds		Kilograms		
						Net	Ship	Net	Ship	
Floor Mount Units										
60	50	62	WHR36NSX13	70	0.140	446	496	202	225	D
120	100	125	WHR36NSX16	140	0.210	727	777	330	352	F
180	150	188	WHR36NSX33	210	0.270	1,145	1,245	519	565	DD
240	200	250	WHR36NSX34	280	0.410	1,397	1,497	634	679	EE
300	250	312	WHR36NSX35	350	0.410	1,595	1,695	723	769	EE
360	300	375	WHR36NSX36	420	0.820	1,891	1,991	858	903	FF
420	350	438	WHR36NSX37	490	0.820	2,089	2,189	948	993	FF
480	400	500	WHR36NSX38	560	0.820	2,287	2,387	1,037	1,083	FF
540	450	560	WHR36NSX39	630	0.820	2,561	2,661	1,162	1,207	GG

Individual Phase Control

Rated Load		kVA at 600 V	Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Approximate Weights				Enclosure
Amps	kVA at 480 V					Pounds		Kilograms		
						Net	Ship	Net	Ship	
Floor Mount Units										
60	50	62	WHR36NTX31	70	0.140	511	561	232	254	D
120	100	125	WHR36NTX32	140	0.140	792	842	359	382	F
180	150	188	WHR36NTX33T	210	0.140	1,032	1,082	468	491	G
180	150	188	WHR36NTX33	210	0.210	1,210	1,310	549	594	DD
240	200	250	WHR36NTX34	280	0.210	1,462	1,562	663	709	EE
300	250	312	WHR36NTX35	350	0.210	1,660	1,760	753	798	EE
360	300	375	WHR36NTX36	420	0.210	1,956	2,056	887	933	FF
420	350	438	WHR36NTX37	490	0.270	2,154	2,254	977	1,022	FF
480	400	500	WHR36NTX38	560	0.270	2,352	2,452	1,067	1,112	FF
540	450	560	WHR36NTX39	630	0.270	2,626	2,726	1,191	1,236	GG
600	500	620	WHR36NTX65	700	0.410	3,315	3,615	1,504	1,640	3-EPLUS
720	600	750	WHR36NTX66	840	0.410	3,942	4,242	1,788	1,924	3-FPLUS
840	700	870	WHR36NTX67	980	0.410	4,338	4,638	1,968	2,104	3-FPLUS
960	800	1000	WHR36NTX68	1120	0.820	4,734	5,034	2,147	2,283	3-FPLUS
1080	900	1120	WHR36NTX96	1260	0.820	5,628	5,928	2,553	2,689	3-FF
1260	1050	1300	WHR36NTX97	1470	0.820	6,222	6,522	2,822	2,958	3-FF
1440	1200	1500	WHR36NTX98	1680	0.820	6,816	7,116	3,092	3,228	3-FF
1620	1350	1680	WHR36NTX99	1890	0.820	7,638	7,938	3,465	3,601	3-GG

Listed model numbers, weights and enclosures are for base units. Options may increase weights and enclosure sizes.
† Recovery rates shown are for 60 Hz operation. For 50 Hz, multiply by 1.2.

Three Phase - 480 X 600 Volt - Wide Range

Base units listed below are designed for 4 wire Wye inputs. If input neutral is not provided see page 23, Three Phase Configurations to determine if a Delta configuration is required.

Input & Output Voltages (Nominal)

Line - Line	Line - Neutral	Frequency (Hz)	Selectable Output Voltage
480	277	50 / 60	430 to 530
600	346	60	520 to 660

Input Correction Range: -25% to +12% of selected output voltage

360 to 538 volts with the output set at 480 volts
450 to 672 volts with the output set at 600 volts

Single Control

Rated Load						Approximate Weights				
						Pounds		Kilograms		
Amps	kVA at 480 V	kVA at 600 V	Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Net	Ship	Net	Ship	Enclosure
Floor Mount Units										
33	28	35	WHR36WSX13	45	0.082	446	496	202	225	D
67	55	69	WHR36WSX16	90	0.120	727	777	330	352	F
100	80	100	WHR36WSX33	135	0.160	1,145	1,245	519	565	DD
130	110	135	WHR36WSX34	180	0.250	1,397	1,497	634	679	EE
165	135	170	WHR36WSX35	225	0.250	1,595	1,695	723	769	EE
200	165	200	WHR36WSX36	270	0.490	1,891	1,991	858	903	FF
230	190	240	WHR36WSX37	315	0.490	2,089	2,189	948	993	FF
265	220	275	WHR36WSX38	360	0.490	2,287	2,387	1,037	1,083	FF
300	250	300	WHR36WSX39	405	0.490	2,561	2,661	1,162	1,207	GG

Individual Phase Control

Rated Load						Approximate Weights				
						Pounds		Kilograms		
Amps	kVA at 480 V	kVA at 600 V	Model Number (base unit)	Max. Input Amps	Recovery Rate † (seconds / %)	Net	Ship	Net	Ship	Enclosure
Floor Mount Units										
33	28	35	WHR36WTX31	45	0.082	511	561	232	254	D
67	55	69	WHR36WTX32	90	0.082	792	842	359	382	F
100	80	100	WHR36WTX33T	135	0.082	1,032	1,082	468	491	G
100	80	100	WHR36WTX33	135	0.120	1,210	1,310	549	594	DD
130	110	135	WHR36WTX34	180	0.120	1,462	1,562	663	709	EE
165	135	170	WHR36WTX35	225	0.120	1,660	1,760	753	798	EE
200	165	200	WHR36WTX36	270	0.120	1,956	2,056	887	933	FF
230	190	240	WHR36WTX37	315	0.160	2,154	2,254	977	1,022	FF
265	220	275	WHR36WTX38	360	0.160	2,352	2,452	1,067	1,112	FF
300	250	300	WHR36WTX39	405	0.160	2,626	2,726	1,191	1,236	GG
330	275	350	WHR36WTX65	450	0.250	3,315	3,615	1,504	1,640	3-EPLUS
400	325	400	WHR36WTX66	540	0.250	3,942	4,242	1,788	1,924	3-FPLUS
465	375	475	WHR36WTX67	630	0.250	4,338	4,638	1,968	2,104	3-FPLUS
530	425	550	WHR36WTX68	720	0.490	4,734	5,034	2,147	2,283	3-FPLUS
600	500	625	WHR36WTX96	810	0.490	5,628	5,928	2,553	2,689	3-FF
700	575	725	WHR36WTX97	945	0.490	6,222	6,522	2,822	2,958	3-FF
800	650	800	WHR36WTX98	1080	0.490	6,816	7,116	3,092	3,228	3-FF
900	750	900	WHR36WTX99	1215	0.490	7,638	7,938	3,465	3,601	3-GG

Listed model numbers, weights and enclosures are for base units. Options may increase weights and enclosure sizes.
† Recovery rates shown are for 60 Hz operation. For 50 Hz, multiply by 1.2.

General Specifications

Electrical:

Input - Output Nominal Voltages Phases Frequency	See Rating Charts
Input Voltage Range	See Rating Charts
Output Accuracy	Adjustable from 1% to 3%
Response Time	0.025 seconds at 60 Hz, 0.030 seconds at 50 Hz
Recovery Rate	See Rating Charts
Maximum Input Current	See Rating Charts
Load Current and kVA	See Rating Charts
Load Capacity	100% rated — continuous 200% rated — 60 seconds 400% rated — 3 seconds 600% rated — 1 second 800% rated — 0.5 second 1000% to 2500% — 1/2 cycle inrush
Load Power Factor	0 lagging to 0 leading
Load Crest Factor	6 Max (I peak / I RMS)
Efficiency	99% typical, at full load
Heat Generated	BTU (typical) = 35 x rated kVA
Harmonic Distortion	Less than 1% added
Surge Withstand Capability	6000 volts per IEEE C62.41, location category B
Impedance	1% (typical) without transient suppression option 2% (typical) with transient suppression option
Transverse-Mode Noise Attenuation	40 dB (typical) with transient suppression option

Environmental:

Service Conditions	Units are housed in NEMA I ventilated enclosures, intended for indoor use under usual service conditions.
Temperature Operating	Average ambient temperature for any 24 hour period not to exceed 30°C (86°F), and maximum temperature not to exceed 40°C (104°F). Average ambient temperature for any 24 hour period may be increased to 40°C (104°F), and the maximum temperature may be increased to 50°C (122°F), if the load is decreased to 90% of standard rating. Minimum temperature is 0°C (32°F).
Storage	-40°C to +70°C (-40°F to +158°F)
Humidity (Operating and Storage)	
Units without tropicalization	10 to 75% average relative humidity for any 7 day period, and maximum relative humidity not to exceed 95% non-condensing.
Units with tropicalization	10 to 95% average relative humidity and maximum relative humidity not to exceed 95% non-condensing.
Altitude Operating	maximum altitude — derating 6,600 Ft. (2,000 meters) — no derating 10,000 Ft. (3,000 meters) — load to 95%, ambient 30°C (86°F) 15,000 Ft. (4,500 meters) — load to 90%, ambient 20°C (68°F)
Storage	50,000 Ft. (15,000 meters) max

Recommendation Request Form

If unable to select the WHR Series STABILINE® Automatic Voltage Regulator best suited for your application, or you just want to confirm your selection, complete a photocopy of this questionnaire and send it to Superior Electric. Without obligation, recommendations for a basic WHR Series unit will be furnished from the information supplied in the questionnaire. If options are selected the complete unit model number will also be furnished.

Contact Information:

Name: _____ Phone: _____

Firm: _____ Fax: _____

Address: _____ E-mail: _____

Input Source:

Phases: ☐Single Phase ☐Single Phase 3 wire (240/120) ☐Three Phase, Wye ☐Three Phase, Delta

Voltage Nominal: ☐ 120 ☐208 ☐220-240 ☐240/120 ☐ 380-400 ☐480 ☐ 600 ☐other _____

Voltage Fluctuation: ☐-20% to +10% ☐-30% to +15% ☐other _____

Frequency: ☐50 Hz. ☐60 Hz. ☐other _____

For 3 and 4 wire systems (not counting safety ground)

Do the phase voltages always remain balanced? ☐ Yes ☐No ☐Do Not Know

Load Requirements and Description:

(For multiple loads, complete this section for each load, using additional copies of this form.)

Phases: Single Phase ☐Single Phase 3 wire (240/120) ☐Three Phase, Wye Three Phase, Delta

Nominal Voltage: ☐120 ☐ 208 ☐230 ☐240/120 ☐380 ☐480 ☐600 ☐other

Max. Load current: _____ Max Load kVA: _____

Max Load Watts: _____ Load Power Factor: _____

Type of Load: ☐Industrial Equipment ☐Medical Equipment ☐Broadcasting Equipment
☐Lighting ☐Marine Equipment ☐Telecommunications Equipment ☐Radar
☐Building Facilities ☐Other _____

Manufacturer: _____

Model Number: _____

Manufacturer's address: _____

Environment:

Ambient temperature: ☐0°C (32°F) to 30°C (86°F) ☐other _____

Altitude: ☐less then 2,000 meters (6,600 feet) ☐other _____

Size Restrictions: ☐None ☐Floor Mount ☐Rack Mount ☐other _____

Customer Required Standard Options:

☐ Input Circuit Breaker … ☐with Shunt Trip ☐with Under-Voltage Trip Release

☐ Ammeter ☐Frequency Meter With Alarm Contacts

☐ Input Voltage Range Alarm ☐Phase Loss, Phase Reversal Alarm

☐ Manual Raise - Lower Switches

☐ Transient Voltage Suppression ☐Manual Bypass Switch ☐Delayed Output ☐Soft Start

☐ Tropicalization Treatment

Customer Required Special Options:

Explain: _____

_____

_____

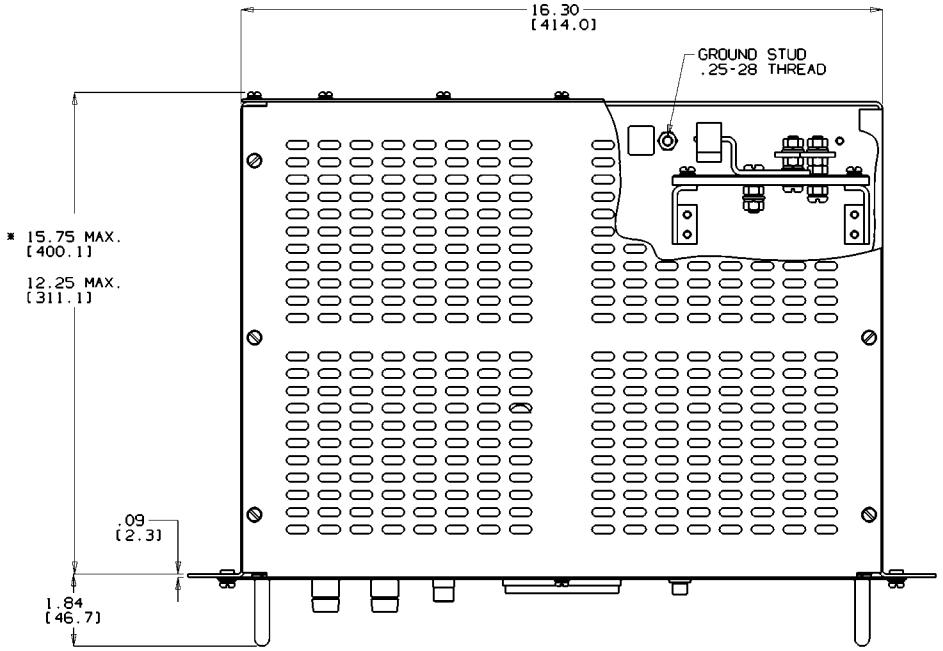
Please fax, e-mail or mail photocopy to:

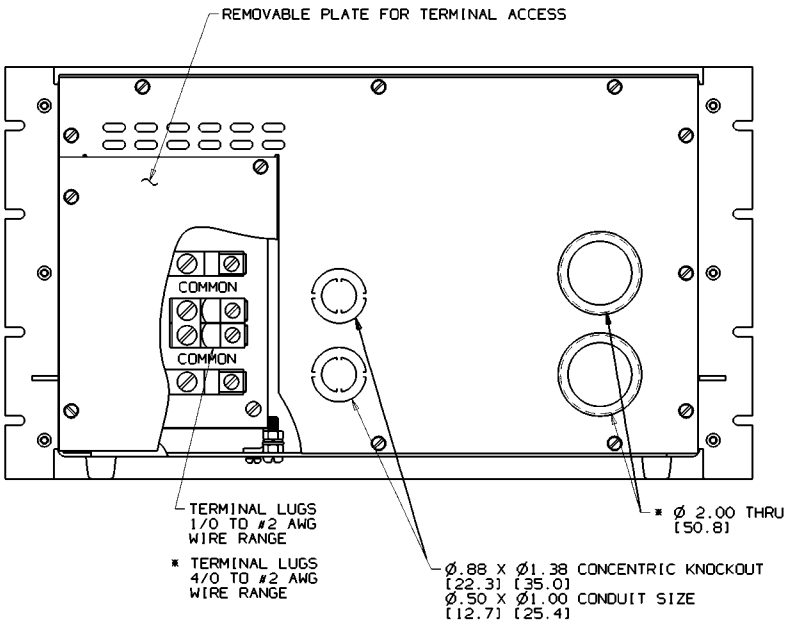
Fax: 860-582-3784 or (U.S.A. and Canada) 1-800-821-1369

E-mail: info@superiorelectric.com

Mail: Superior Electric, 383 Middle Street, Bristol, CT 06010

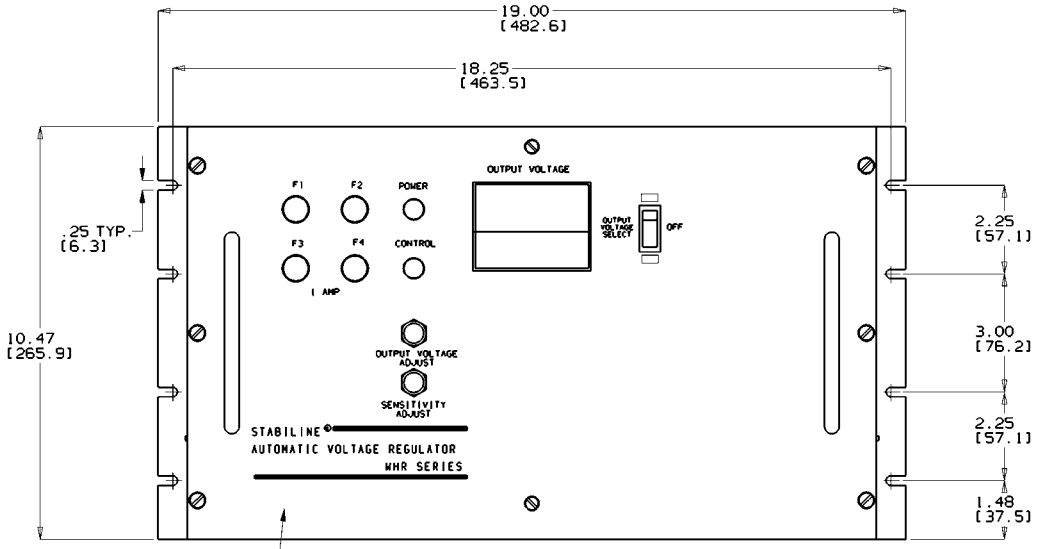
RS & RS2 ENCLOSURES



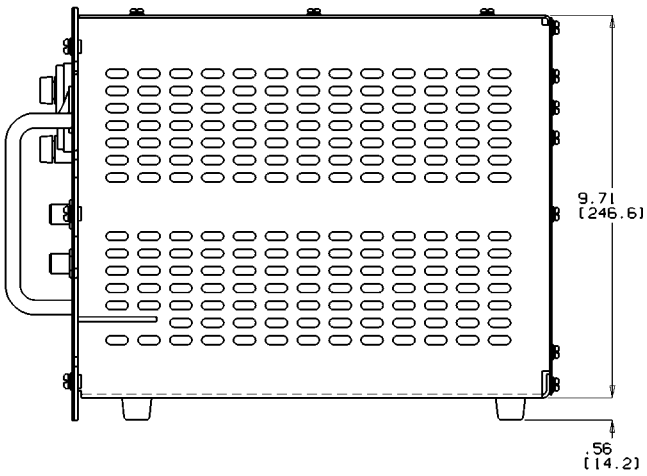


REAR OF ENCLOSURE

* DIMENSIONS NOTED APPLY ONLY TO THE RS2 ENCLOSURE



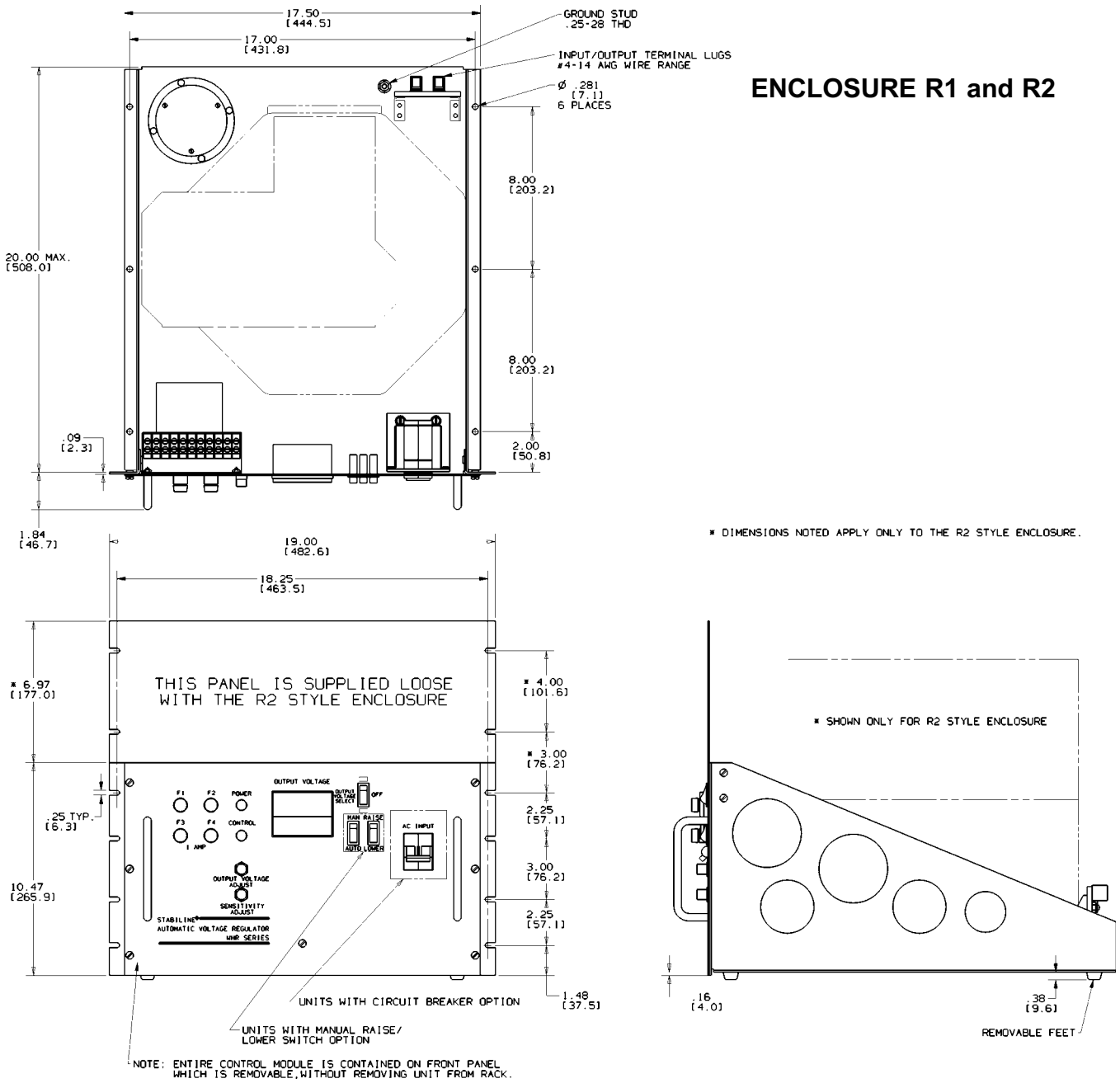
NOTE: ENTIRE CONTROL MODULE IS CONTAINED ON FRONT PANEL WHICH IS REMOVABLE WITHOUT REMOVING UNIT FROM RACK.



NOTE: All dimensions are inches [millimeters]

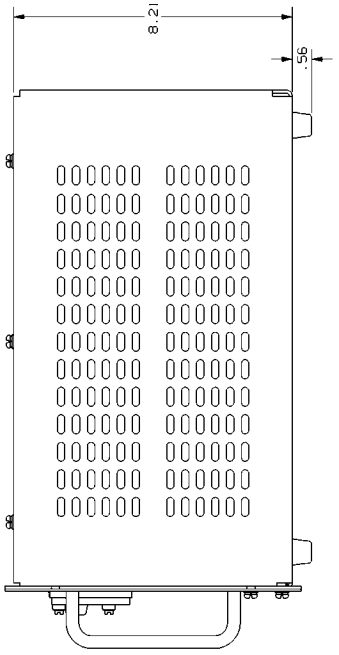
Rack Mount Dimensions

ENCLOSURE R1 and R2

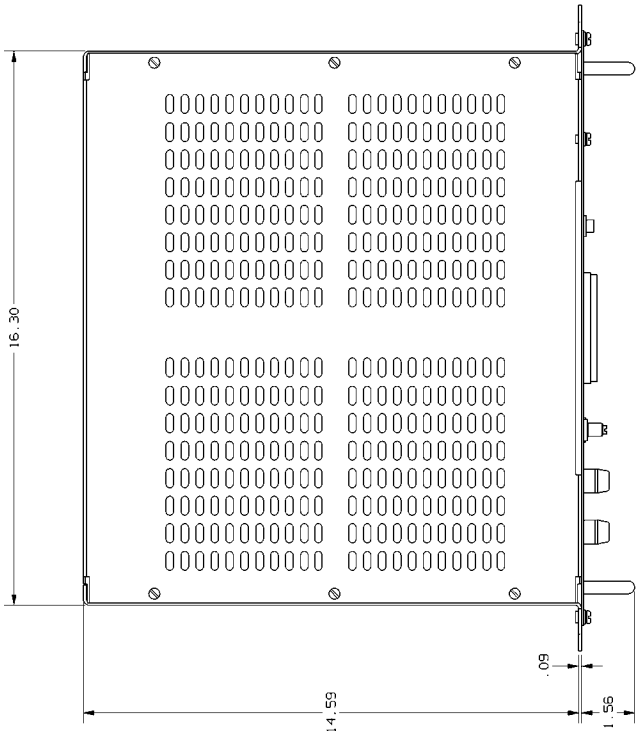


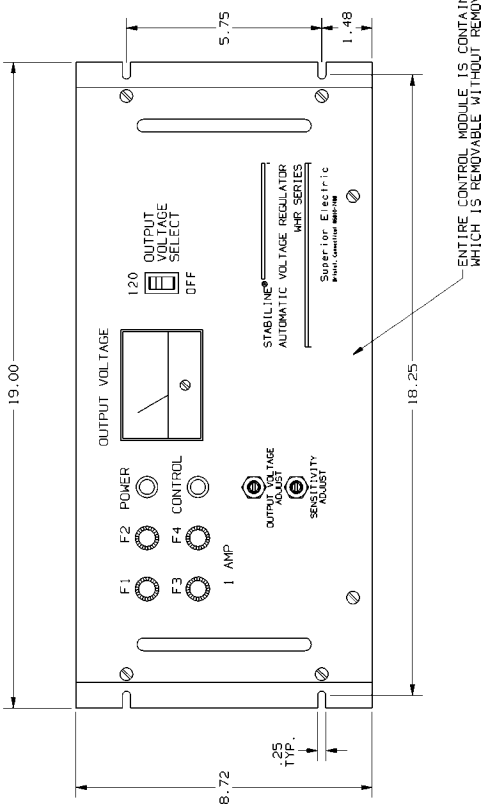
NOTE: All dimensions are inches [millimeters]

Rack Mount Dimensions



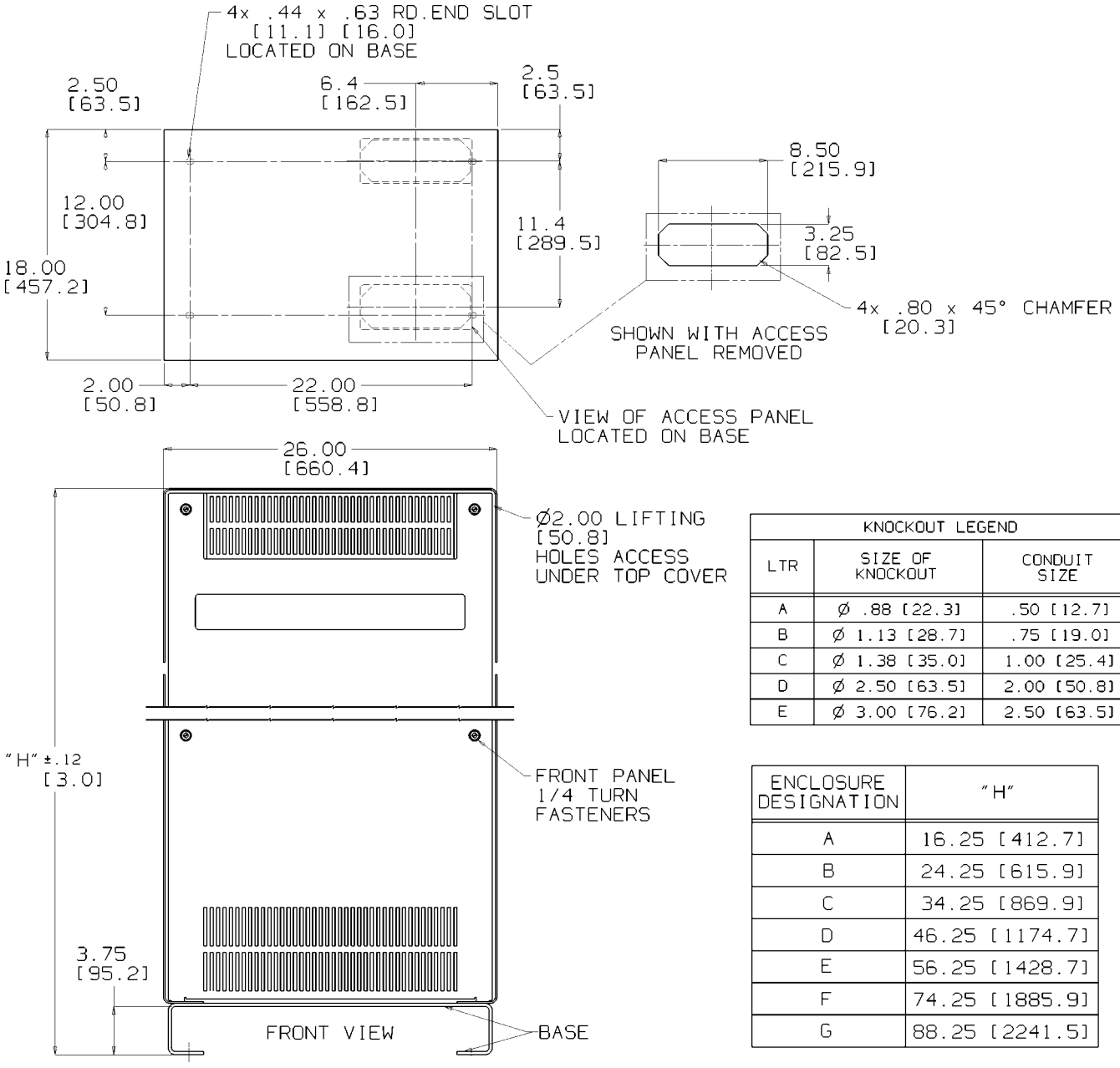
R5U ENCLOSURE





Floor Mount Dimensions

ENCLOSURES A THROUGH G

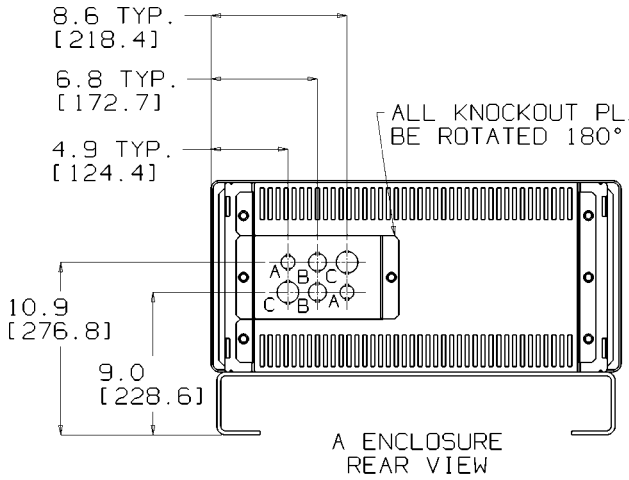


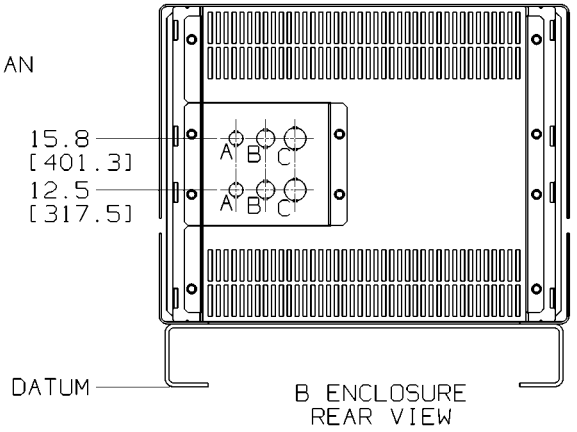
KNOCKOUT LEGEND		
LTR	SIZE OF KNOCKOUT	CONDUIT SIZE
A	Ø .88 [22.3]	.50 [12.7]
B	Ø 1.13 [28.7]	.75 [19.0]
C	Ø 1.38 [35.0]	1.00 [25.4]
D	Ø 2.50 [63.5]	2.00 [50.8]
E	Ø 3.00 [76.2]	2.50 [63.5]

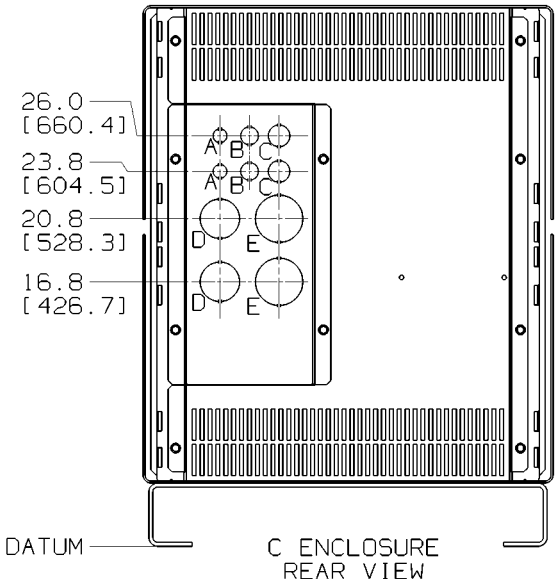
ENCLOSURE DESIGNATION	"H"
A	16.25 [412.7]
B	24.25 [615.9]
C	34.25 [869.9]
D	46.25 [1174.7]
E	56.25 [1428.7]
F	74.25 [1885.9]
G	88.25 [2241.5]

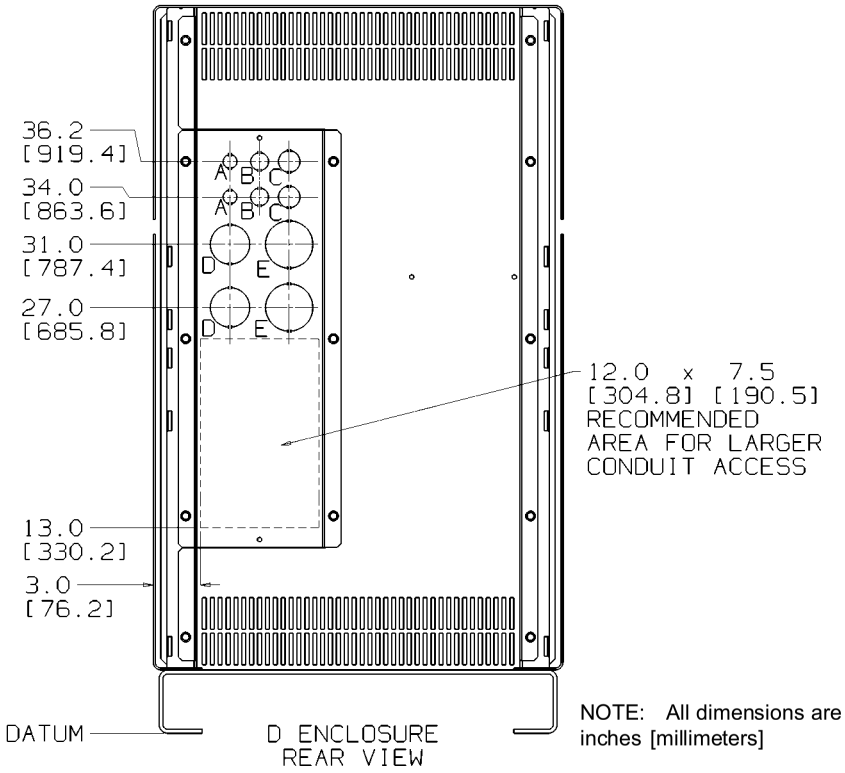
NOTE: All dimensions are inches [millimeters]

ENCLOSURES A THROUGH G





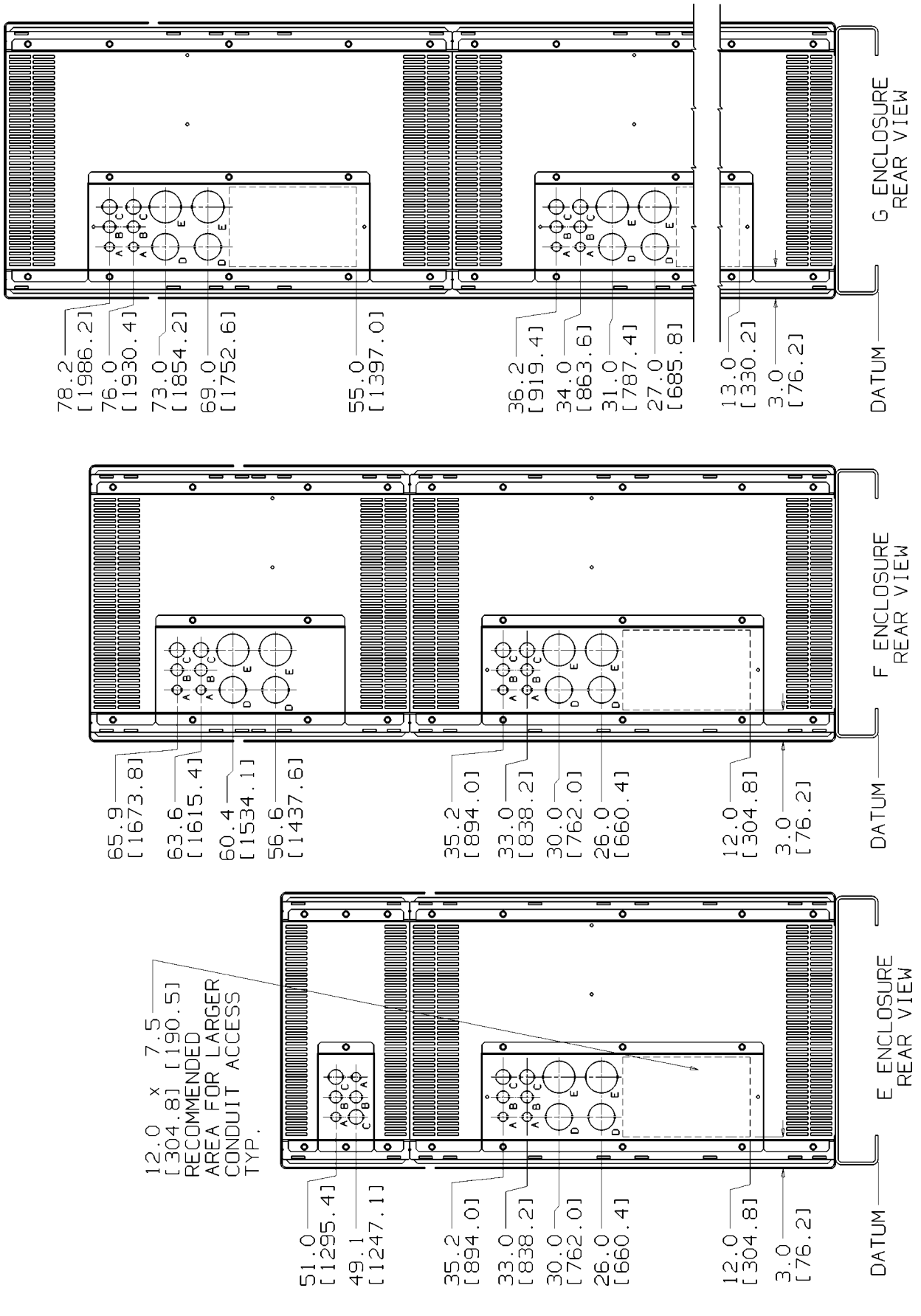




NOTE: All dimensions are inches [millimeters]

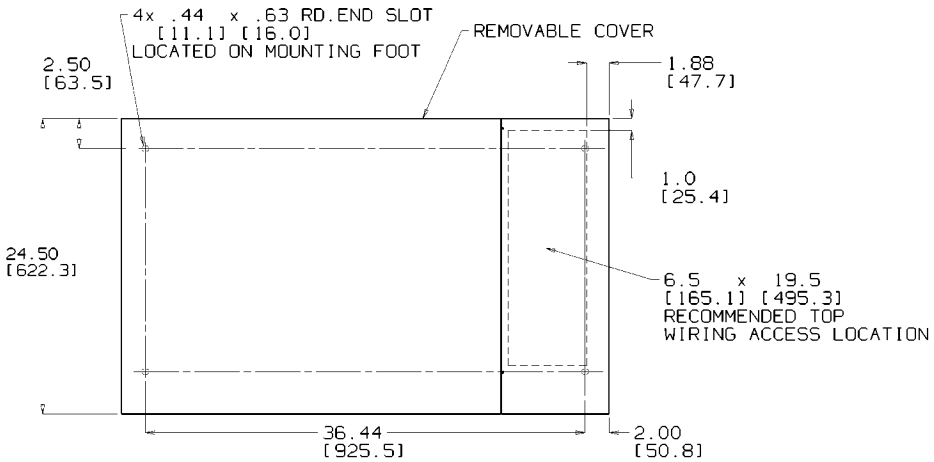
Floor Mount Dimensions

ENCLOSURES A THROUGH G

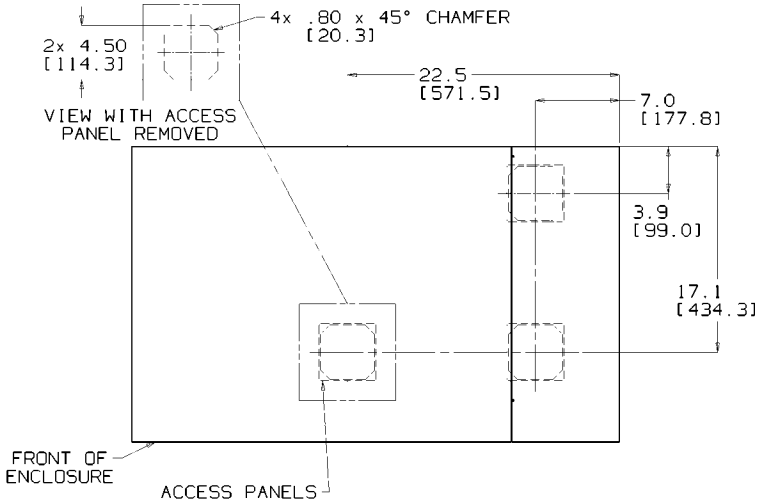


NOTE: All dimensions are inches [millimeters]

ENCLOSURES DPLUS through GPLUS

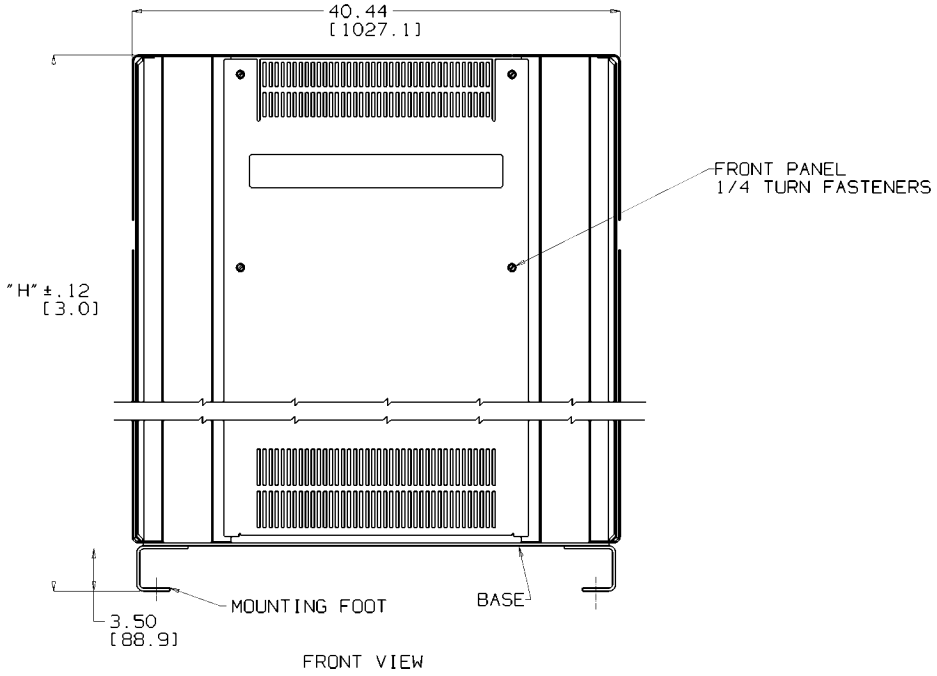


TOP VIEW OF MTG.FEET AND REMOVABLE COVER



TOP VIEW OF ACCESS PANELS LOCATED ON BASE

BOTTOM WIRING



FRONT VIEW

KNOCKOUT LEGEND		
LTR	SIZE OF KNOCKOUT	CONDUIT SIZE
A	Ø .88 [22.3]	.50 [12.7]
B	Ø 1.13 [28.7]	.75 [19.0]
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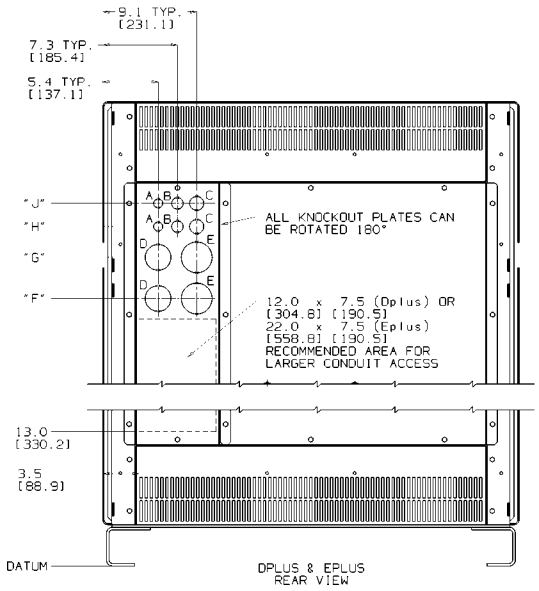
D	Ø 2.50 [63.5]	2.00 [50.8]
E	Ø 3.00 [76.2]	2.50 [63.5]

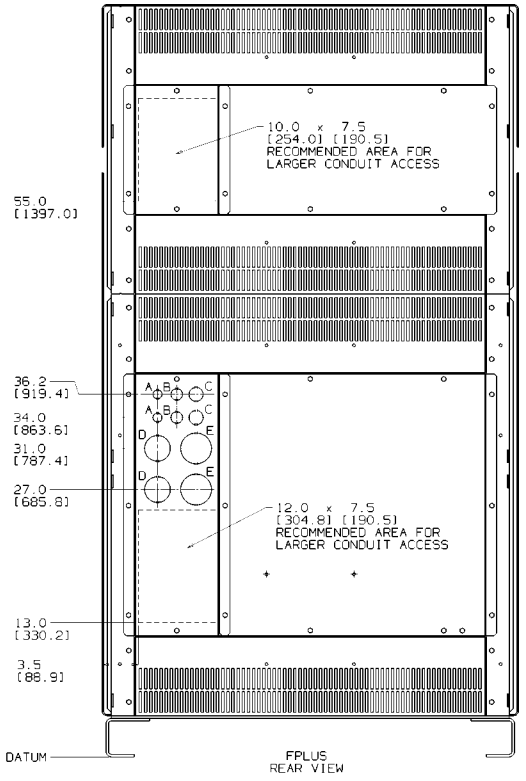
ENCLOSURE DESIGNATION	"H"
DPLUS	46.25 [1174.7]
EPLUS	56.25 [1428.7]
FPLUS	74.25 [1885.9]
GPLUS	88.25 [2241.5]

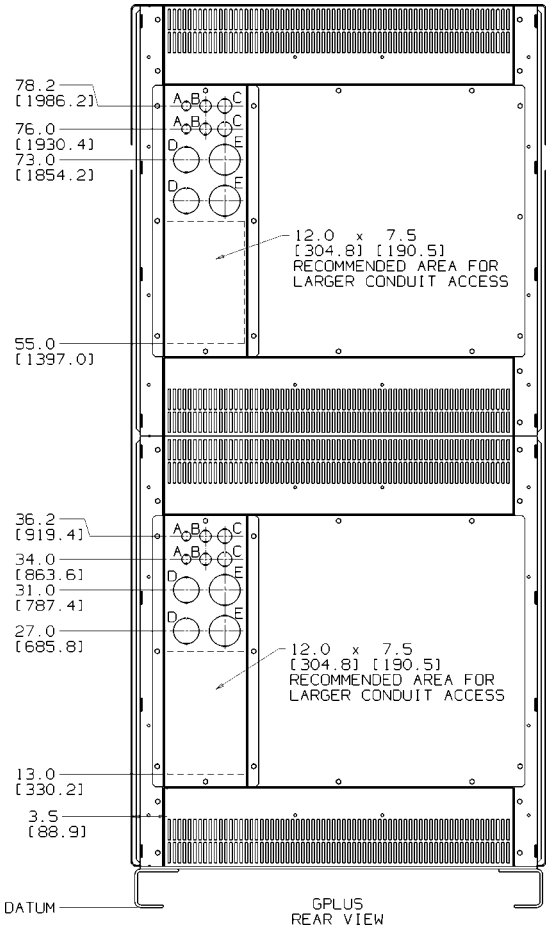
NOTE: All dimensions are inches [millimeters]

ENCLOSURES DPLUS through GPLUS

DIMENSION LEGEND		
LTR	ENCLOSURE	
	DPLUS	EPLUS
"F"	27.0 [685.8]	37.0 [939.8]
"G"	31.0 [787.4]	41.0 [1041.4]
"H"	34.0 [863.6]	44.0 [1117.6]
"J"	36.2 [919.4]	46.2 [1173.4]

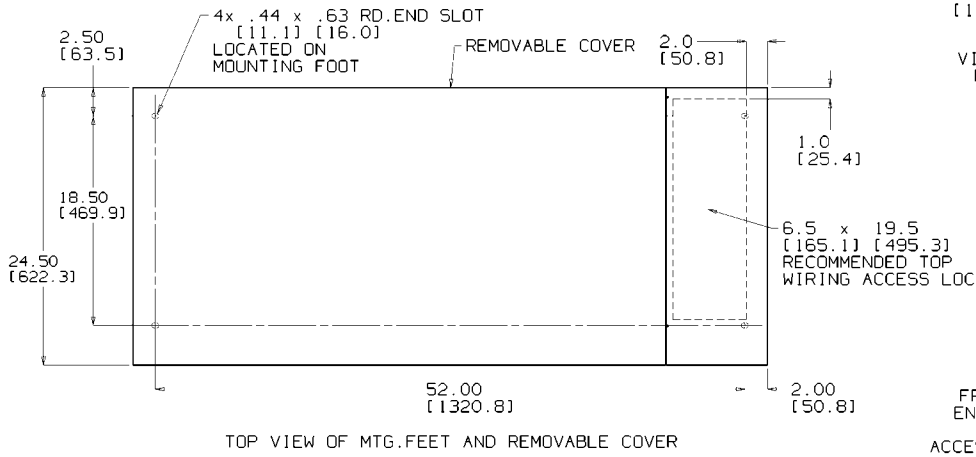




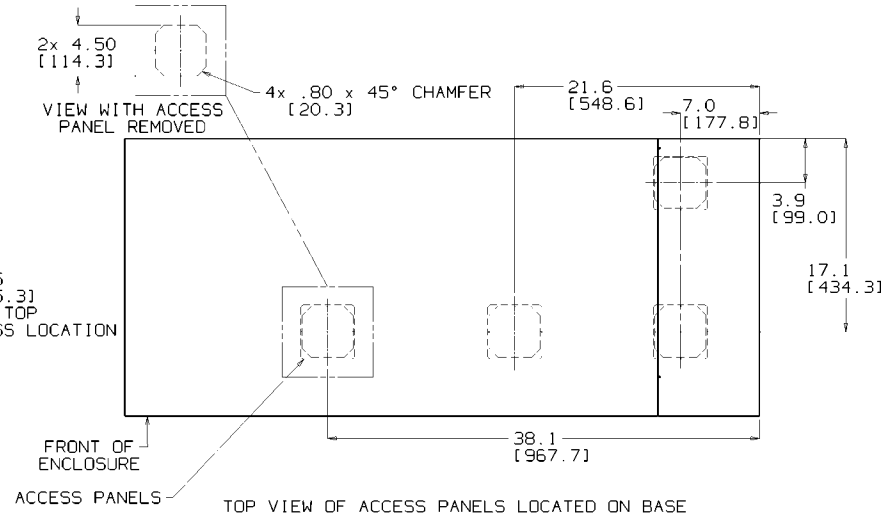


NOTE: All dimensions are inches [millimeters]

ENCLOSURES DD through GG

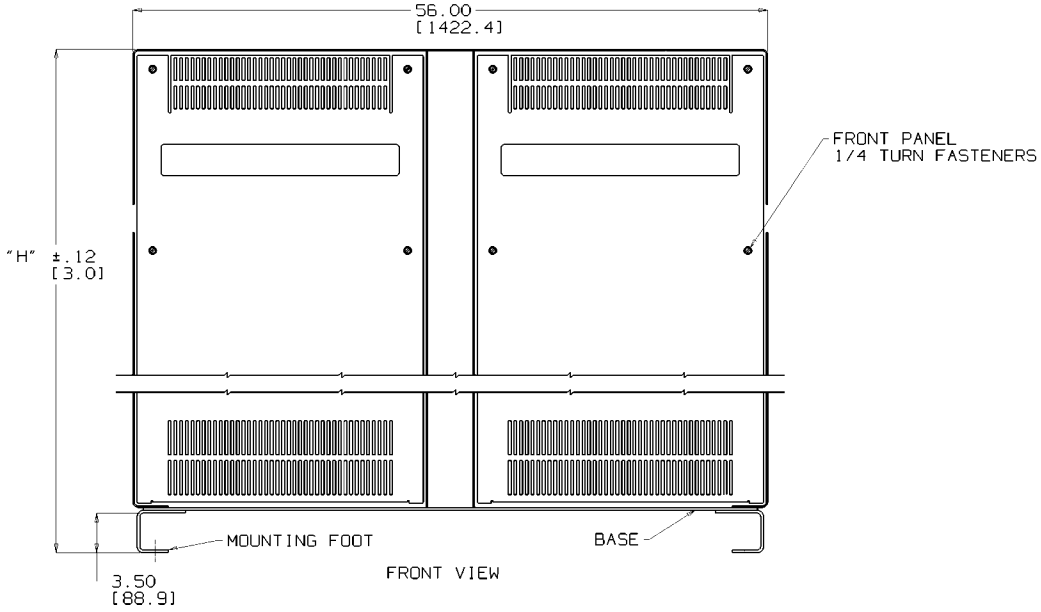


TOP VIEW OF MTG.FEET AND REMOVABLE COVER



TOP VIEW OF ACCESS PANELS LOCATED ON BASE

BOTTOM WIRING



FRONT VIEW

KNOCKOUT LEGEND		
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A	Ø .88 [22.3]	.50 [12.7]
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ENCLOSURES DD through GG

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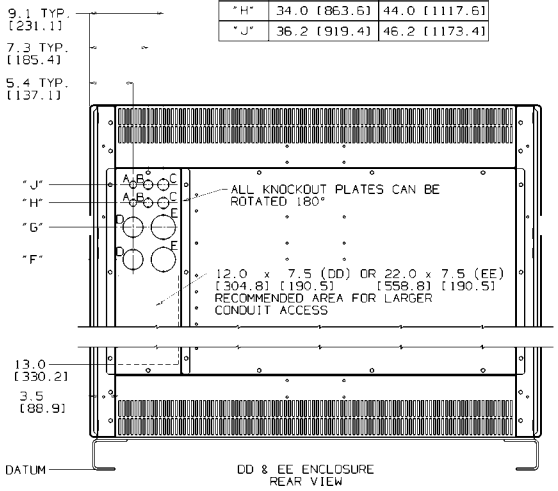
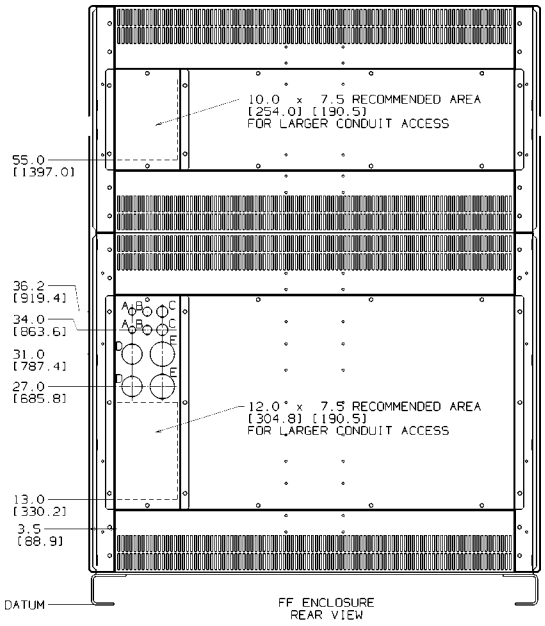
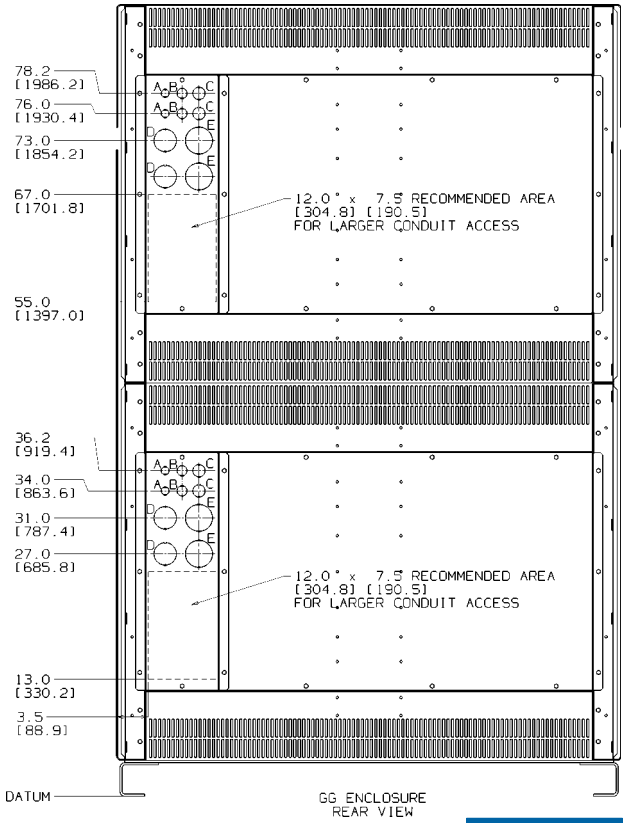


DD & EE ENCLOSURE
REAR VIEW



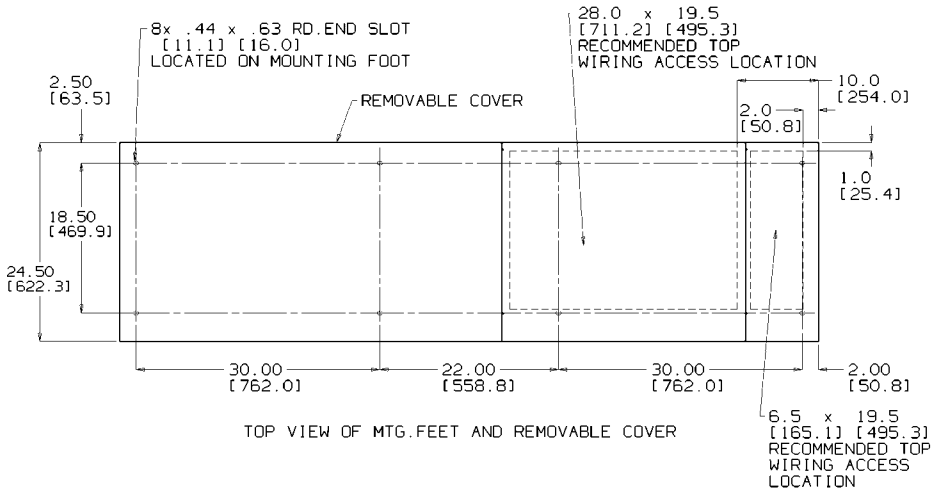
FF ENCLOSURE
REAR VIEW



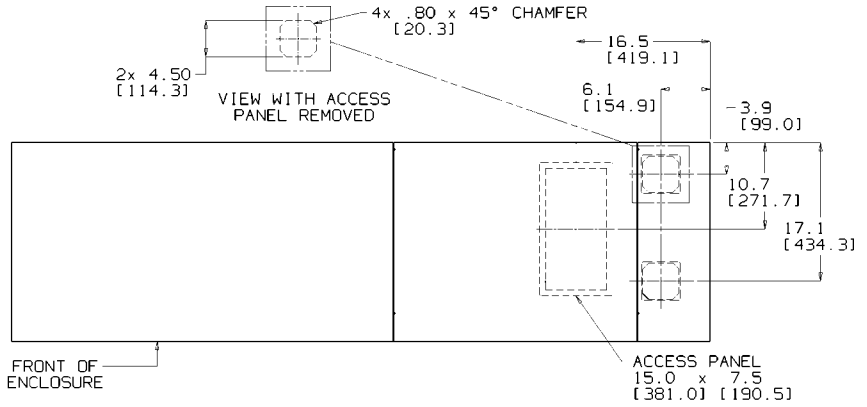
GG ENCLOSURE
REAR VIEW

NOTE: All dimensions are inches [millimeters]

ENCLOSURES EEE through GGG

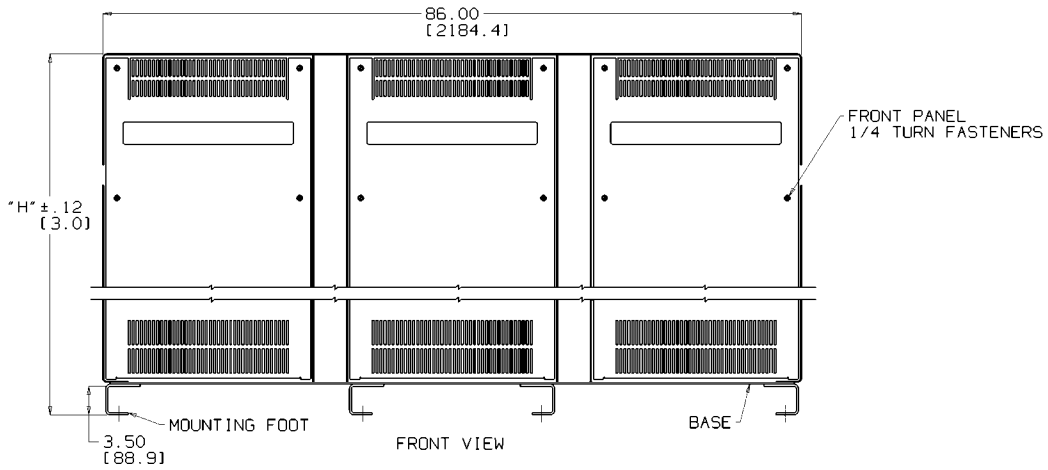


TOP VIEW OF MTG.FEET AND REMOVABLE COVER



TOP VIEW OF ACCESS PANELS LOCATED ON BASE

BOTTOM WIRING



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ENCLOSURE DESIGNATION	"H"
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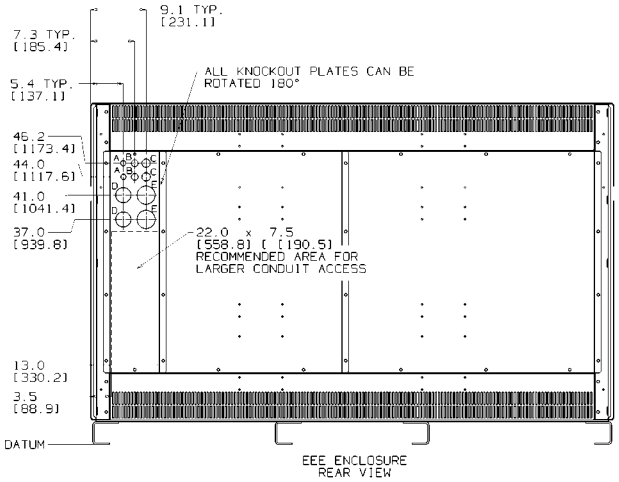
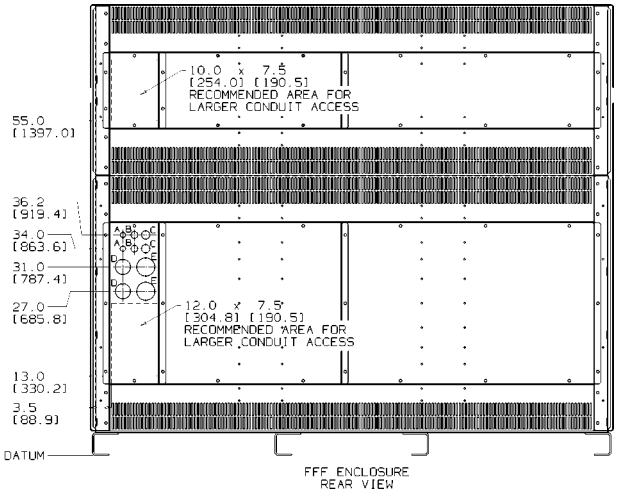
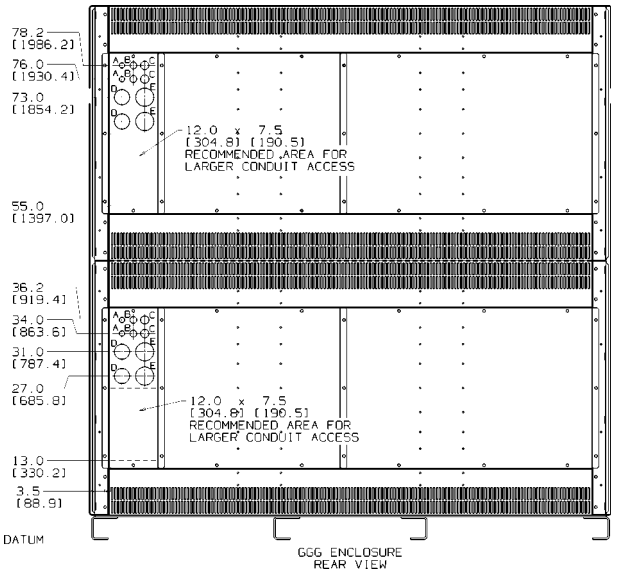
GGG	88.25 [2241.5]

NOTE: All dimensions are inches [millimeters]

ENCLOSURES EEE through GGG







NOTE: All dimensions are inches [millimeters]

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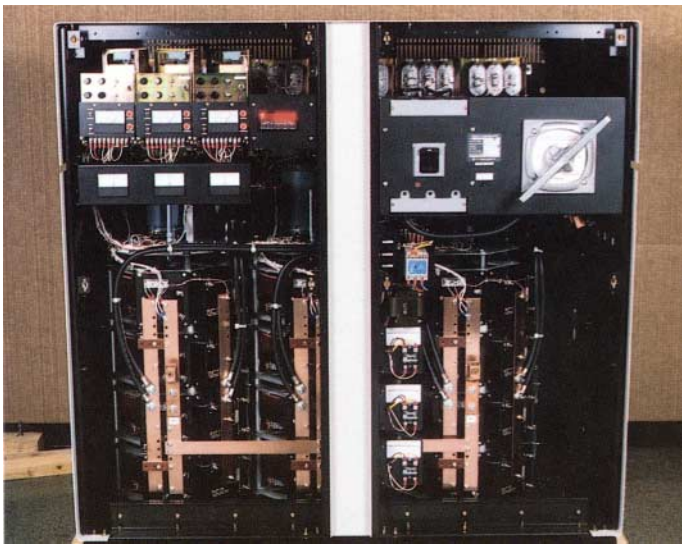
Circuit Board Fabrication



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Printed in USA C7005-3 10/01