

MiniSub[®]



A COMPLETE DRY TYPE SUBSTATION PACKAGE

Your Proven Choice in Distribution Technology



POWERSystems
TECHNOLOGY LTD

Small Size • Large Savings • Increased Safety

A Dry Type Unit Substation Certified for Any Installation

Our motivation is to create a more reliable, safer
and innovative building Distribution System

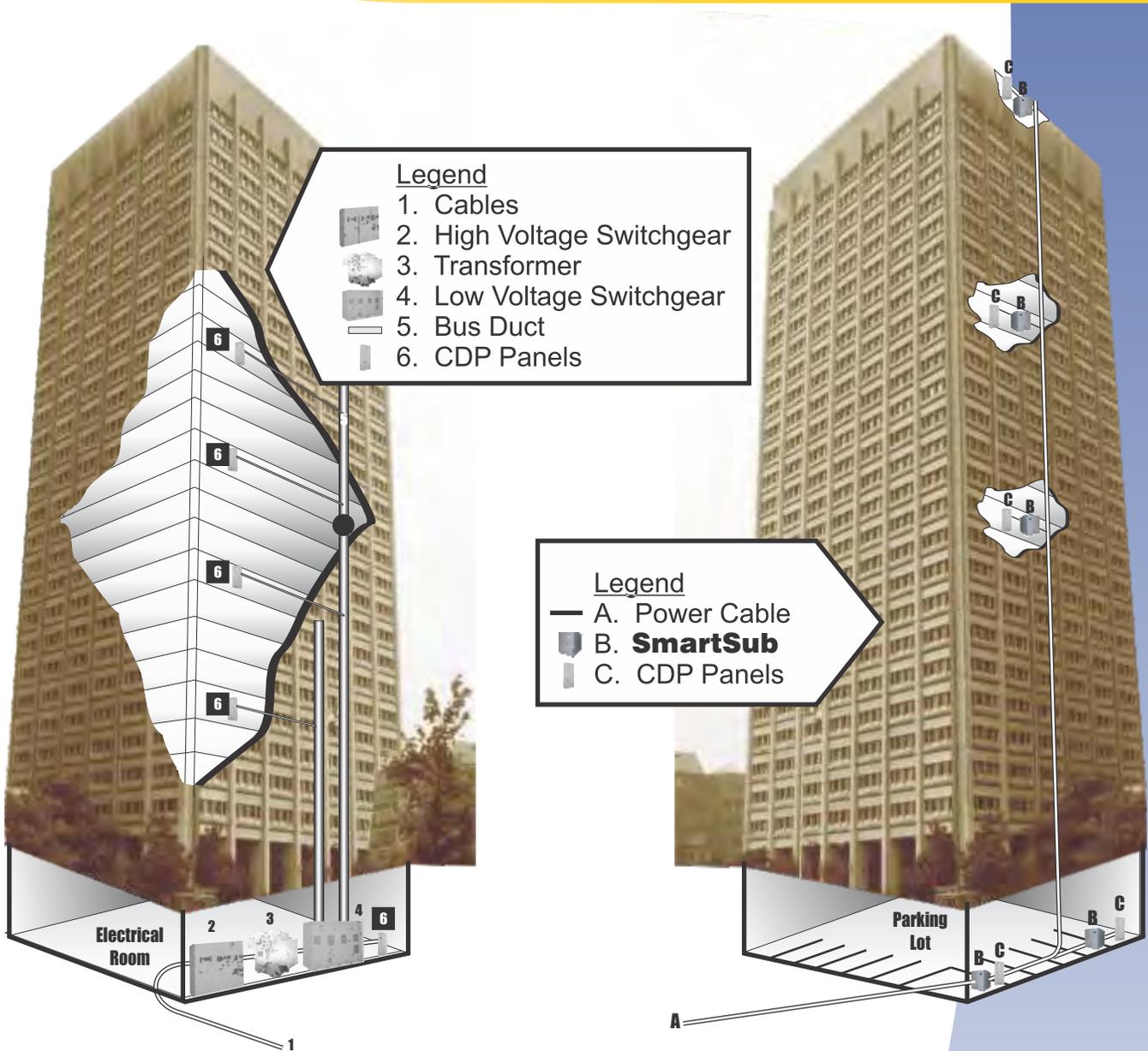


Ultra Compact Unit Substation Dry type Transformer Design

Power Systems Technology now offers a dry type compact unit substation using many of the key features found in our original Minisub. The key features are:

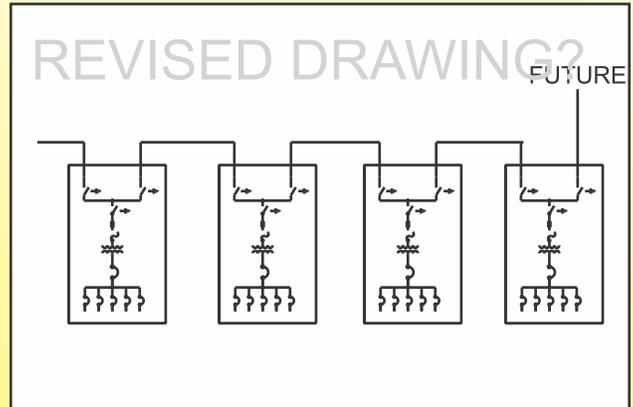
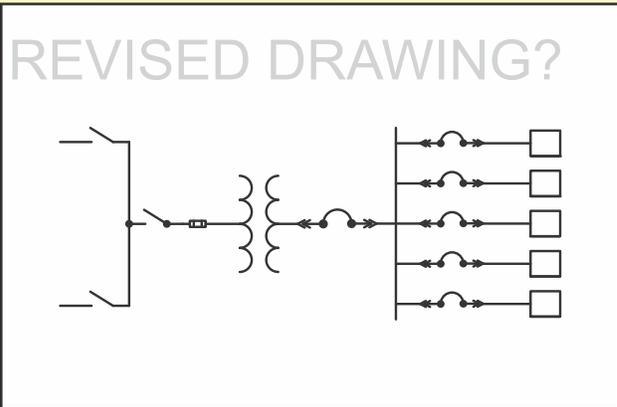
- Compact size only slightly larger than a standard transformer alone
- Includes up to three primary switches and protection
- Maintenance free SF6 switching technology
- Voltage ranges up to 15kV
- Selection of low voltage breaker and metering options
- Increased Safety and Reliability
- All assembled and tested as one unit

Comparison of Building Distribution

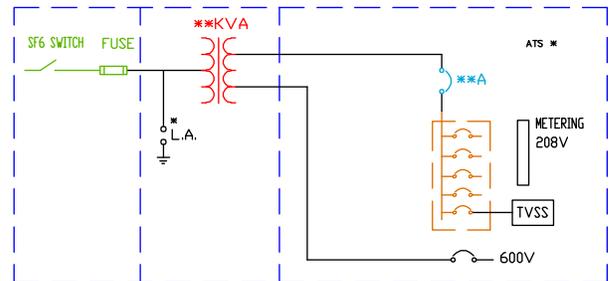
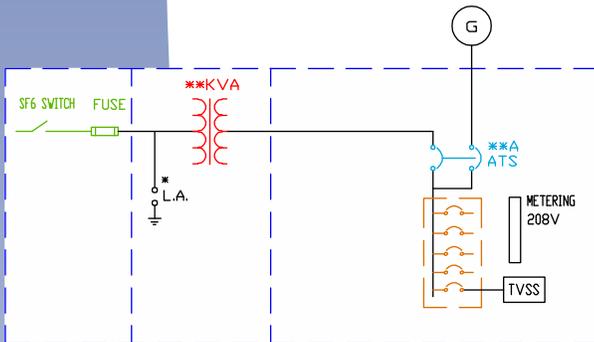
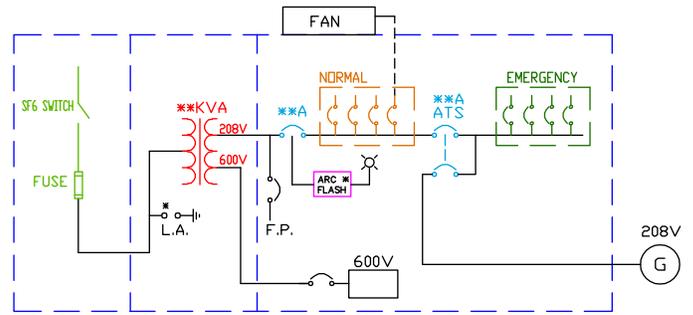
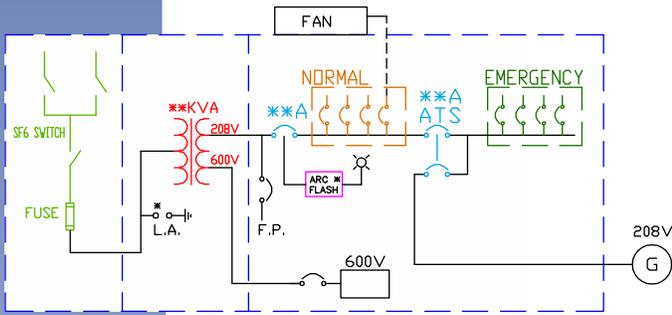


Traditional

MiniSub



MiniSub Examples



**Engineering advances
the world through new ideas**





The SmartSub has the ability to send Data (SCADA functionality) to the Building Management System (BMS/BAS). This provides immediate and long term cost benefits through:

- Maintenance and Operating efficiencies
- Monitoring power Disturbances and Alarms
- Individual metering / recording of breaker loads
- Automatic transfer of dual power sources



ArcWhipper Contact



Qualitrol Gas Pressure Gauge



*Three position load break switch
(Closed-Open-Ground)*

Construction Features

ARCWHIPPER SF6 loadbreak switches are ruggedly constructed, incorporate proven design and are rated/tested in accordance with ANSI standards C37.71-1984, 037.721987 and CSA T.I.L. D25 for long life with minimal maintenance.

Switch contacts are equipped with very high speed auxiliary arcing contacts to quickly interrupt in 1/4 to 1/2 cycle, leaving main contact surfaces undamaged by arcing. The arcing contact allows main contacts to be designed for high continuous, fault close and momentary current performance.

Switches are factory filled with non-toxic, non-flammable, high dielectric SF6 gas insulation. SF6 quality and stability are maintained by use of totally sealed tank construction, an internal purifying absorbent and the extremely fast ARCWHIPPER interrupter. A color coded, field replaceable pressure gauge and self-sealing fill valve allow monitoring and addition of SF6 as necessary.

Switch tanks are 1/4" thick steel with a highly corrosion/abrasion resistant 5 mil epoxy finish. External fittings and fasteners are marine grade stainless steel or bronze. For increased corrosion resistance, stainless steel tanks can be provided.

Current carrying parts are high conductivity electrolytic grade copper with plating, locking fasteners, and torque wrench assembly to assure permanent low resistance connections.

Moving contacts are self-aligning, self cleaning (wiping type) and designed to increase contact pressure with increasing currents. Contact assemblies are supported by high strength, molded glass polyester

insulation with flex connectors at critical locations to prevent stressing and misaligning due to high current or mechanical forces.

Ratings

ARCWHIPPER SF6 loadbreak switches are designed, tested and rated per applicable sections of IEEE, ANSI, NEMA, CSA T.I.L. D25 and other industry standards including:

- CSA T.I.L. D25 standard for Pressurized Gas Insulated Switchgear.
- ANSI C37.71-1984 Standard for Subsurface Load Interrupting Switches.
- ANSI C37.72-1987 Standard for Padmounted Load Interrupting Switches.
- ANSI/IEEE 386 Standard for Separable Connectors and Bushings.
- IEC 265 International Standards for Load Interrupting Switches.
- ASTM D-2472 Specification for Commercial Type Electrical Grade SF6.
- ANSI C57.12.28 Standard for Padmount Enclosures.



*Three position load break switch
with vacuum breaker*

Application Information

ARCWHIPPER SF6 loadbreak switches are completely submersible, fully deadfront, and corrosion resistant for application in the harshest conditions including areas subject to flooding, severe contamination, rodents and snakes, blowing snow/dust, sea coasts, high altitude, and even Division 2 hazardous locations. Non-toxic, non-flammable SF6 insulation permits installation indoors or outdoors in high traffic areas. Compact size and reduced weight provide solutions where overall space is important such as in high-rise buildings, front lot lines and in small vaults.

Switch Operators and Options

ARCWHIPPER SF6 load break switches are equipped with external handles for manual operation as standard. The handle can be padlocked in all switch positions and has an anti-reversing feature for additional safety. Interlocks can be provided as may be required by local practice and for increased safety. In addition, remote/SCADA and fully automatic operators are available for increased levels of control and system automation. These motor operators attach to the switch and may be easily disconnected for manual operation.



MiniSub with Radial switch

Manual Operation

The handles are removable and can be attached to the switch operating shaft through an arc of 360 degrees in 45 degree increments for maximum mechanical advantage during operation or may be removed and stored on the padlockable hanger bracket when not in use. Rotating the handle toward the desired position causes quick make/break, spring operated contact movement independent of the operating handle movement. Latches prevent contact blow off and provide positive position indication. Additional features include: padlock provisions in all positions, bushing oriented line diagram and instructions. Three position switches are equipped with anti-pass through provisions to prevent inadvertent operation to the closed position.

Note: All switches are available with a ground position.

V-MAG Vacuum Circuit Breaker 600 amp

Breaker comes with electronic relay with a variety of fuse settings (maximum interrupting 31 KA). The V-MAG is tested in excess of ANSI C37.60 and is a compact MAINTENANCE FREE Vacuum Circuit Breaker with every detail designed for maximum reliability. A cast resin molding supports the vacuum interrupters and drive mechanism. The vacuum interrupters are driven through a single cast resin beam by the Magnetic Actuator. Breakers supplied in the MiniSub will have isolating switch ahead to provide visible isolation.



Load Break Switches



*Three Separate 3 Position Switch
Closed - Open - Ground*



*V-MAG Vacuum
Circuit Breaker 600 amp*

Primary Switching



Automatic Load Transfer Switch



MiniSub with Primary Transfer Switch



Anti-reverse handle with provision for locks and switch position contacts

Key Interlocks

Are available as required to prevent paralleling feeders or to limit access to energized equipment or to otherwise coordinate proper system operation. Keylocks are mounted on the specified switched ways with locking provided for the required position.

Manual, Remote or Automatic Switching

ARCWHIPPER is equipped for manual operation as standard and includes: external handles for operation by hand; quick make/break spring operators; bushing oriented line diagram; positive position indicators; padlock provisions; and operating instructions.

Remote operation can also be provided by motor operators with pushbutton or SCADA control. Automatic transfer switches use fast acting motor operators with voltage/current sensing and full function control. Units are factory wired/adjusted.

Automatic Load Transfer Switches

The MiniSub is ideal for maintaining power to critical loads such as hospitals, airports, shopping centers, and industrial facilities. Upon loss of preferred primary feeder voltage, the load is automatically transferred to an alternate source. Optional automatic retransfer, overcurrent detection and fault isolation provide additional system flexibility.

Units include fast acting 24 VAC motor operators attached to the

switch operating handles. Voltage sensing is done through a set of elbow mounted detectors and relay combination which supply data to the full function automatic control with self-contained 120 VAC/24VDC control power source. All items are factory assembled, wired, adjusted, and tested for simplified installation and operation.

Anti-reverse Operating Handles

Eliminate the possibility of interrupting currents beyond the capability of the switch by preventing immediate operation after closing on a fault. A latch on the operating handle must be reset prior to subsequent operation allowing upstream circuit protection time to clear the fault.



Visible grounding window

Visible Break, Make and Ground

Each switched way is equipped with a viewing window for clear, visual confirmation and assurance of contact position of ALL PHASES. Conforms to local code and operation practices which require visible break and (where equipped) visible grounding during system operation, maintenance, repair, or testing.

In keeping with the Power Systems philosophy of all high voltage components being dead front, we are using the Elastimold elbow style fusing mounted in a separate compartment. Access to the fuses is key interlocked with the high voltage switch. The importance of Dead Front can not be over stated. This means No live parts, no maintenance or possible contamination from the environment. Connection to the transformer is accomplished using a 15 KV class EPR insulated conductor. Due to the short distance shielding is not necessary. The fuses can operate from -30 to+ 65°C, are a full range current limiting class fuse.

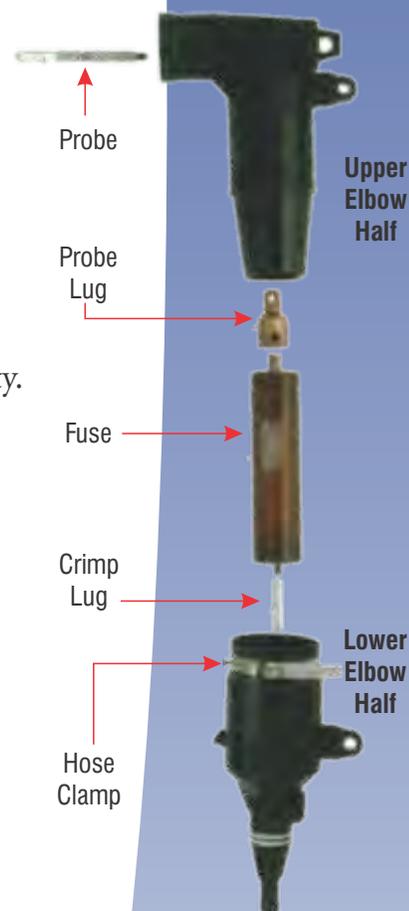
Elastimold® Fused Elbows

The fastest, most cost-effective way to improve a distribution system's reliability.

Elastimold® Fused elbows provide full-range current limiting fusing with 50kA interrupting capacity. they are rated for 5kV ungrounded to 28kV grounded Wye. Plus they provide 15/25kV hotstack operable, loadbreak elbow switching.



Certified Tests
ANSI C37.40
ANSI C37.41
ANSI C37.47
IEEE 386



Recommended Elastimold EFX-E Elbow Fuse at 40°C Ambient Temperature - Fuse Current Ratings (Amperes)

Fuse Voltage	8.3kV														15.5kV (17.2kV)	
	Transformer 3-Phase Voltage Rating (kV), Phase to Phase															
	2.4		4.16		4.8		7.2-7.96		8.32		12.47		13.2-14.4		20.8	
3-Phase Transformer kVA	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
15	-	6	-	3	-	3	-	3*	-	3*	-	6*	-	6*	-	6*
22.5	-	8	-	6*	-	6*	-	3	-	3	-	6*	-	6*	-	6*
30	10	12	-	6	-	6	-	6*	-	3	-	6*	-	6*	-	6*
45	12	20	-	10	-	8	-	6	-	6*	-	6*	-	6*	-	6*
75	20	30	12	20	-	12	-	8	-	8	-	6	-	6	-	6*
100	30	45	18	25	18	20	-	12	-	10	-	8	-	8	-	6*
112.5	40	65	20	25	18	25	-	12	-	12	-	8	-	8	-	6
150	45	80	25	40	20	30	18	20	12	20	10	12	10	12	-	6
200	65	80	40	65	30	45	20	25	18	25	12	18	12	18	8	10
225	80	-	45	65	40	65	20	30	20	25	12	20	12	18	8	10
300	-	-	65	80	45	80	30	45	25	40	18	25	18	25	12	18
500	-	-	-	-	80	-	65	80	45	80	30	45	30	45	18	(25)
750	-	-	-	-	-	-	80	-	80	-	45	65	45	-	(25)	(45)
1000	-	-	-	-	-	-	-	-	-	-	80	-	-	-	(45)	-

NOTES: Column A = 140-200% of Transformer rating and Column B = 200-300% of transformer rating. Ratings in parenthesis are 17.2kV fuses.





LV Grounding Connection



HV Grounding Connection



Voltage Sensor

Primary Cable Terminations

ANSI/IEEE standard 386 defines the specific interface dimensions that 200 and 600 amp, elbows, inserts and equipment bushings must conform to in order to insure interchangeability. The 200 amp load break, and 600 amp non load break connectors provide a convenient and safe way to connect all primary cables

While the cables and terminations are barriered from access, the elbow test point offers an additional security and safety, as well as a voltage reference for automatic or SCADA type operations. This termination provides a dead front waterproof connection.

Note: Inserts and elbows are not supplied as part of the MiniSub unless specified



MiniSub Connection



200A Elbow



600A Elbow

Transformer Design

Power Systems Technology uses the most reliable, technologically superior power transformer design in the market today.

This is as a result of continuing development in all phases of the design and manufacturing processes in meeting the requirements of a broad range of customers and the most onerous applications.

Additionally, these transformers have demonstrated improved withstand ability to short circuits and will provide a life expectancy considerably in excess of current industry standards.

Core Construction

Cores are manufactured from high quality non-ageing, cold rolled, grain oriented silicon steel laminations. Cores are precision cut to close tolerances using modern equipment, to eliminate burrs and minimize losses. They feature step lap, miter cut, stepped core construction for optimum energy efficiency.

Coil Construction

Coils are either layer (barrel) or disc wound to suit the voltage class. Typically, disc wound coils are utilized above 8.7 kV class. Available in aluminum or copper, windings are designed with wire or foil conductors for optimum performance for the application.

Disc wound coils feature comb construction to electrically balance voltage stresses over the full length of the coil. All internal connections are brazed or TIG or MIG welded.

Insulation

Typically dry type power transformers are manufactured with a class H, 220°C insulation system. High temperature resistant materials are used including Nomex Aramid papers, silicone coated fiberglass, Nomex sleeving, supersil duct sticks and pressure sensitive glass tape. All materials meet or exceed UL standards for use on dry type power transformers.

Core & Coil Assembly

As a completed assembly, the coils are held rigidly in place between insulators clamped to the upper and lower core frames under high compression.



Core Construction



Coil Construction



Core and Coil Assembly



Insulation



Vacuum Pressure Impregnation



Vacuum Pressure Encapsulation



Pressurizing the Tank



Virtually Corona Free

Core Impregnation

It is critical that transformers maintain the integrity of the dielectric properties of the insulation materials essential for long-term life expectancy. In order to meet designed life expectancies, transformers must not be compromised during the impregnation process. This is accomplished by following the standard “Dip & Bake” method using Isonel-51.

Vacuum Pressure Impregnation System

The VPI (Vacuum Pressure Impregnation) system consists of a five step process that is performed on each transformer coil.

It begins with a preheat cycle to remove moisture.

The coils are then placed in a tank of solventless polyester varnish resin and subjected to vacuum and pressure cycles.

These cycles are accurately controlled to ensure complete varnish penetration through the coils.

The process is completed when the coils are baked to allow the varnish resin to cure. Since the VPI process involves additional, closely controlled steps it creates an even better seal around the coils and comes with a cost increase of 3.5% on top of the standard core impregnation.

Vacuum Pressure Encapsulation System

The VPE (Vacuum Pressure Encapsulation) system consists of a five step impregnation process and a four step encapsulation process.

The Impregnation process is

performed on each transformer coil and, just as with the VPI system, then begins the preheat cycle to remove any moisture.

Similar to the VPI system, the coils are then placed in a tank of solventless polyester varnish and subjected to three hours of vacuum and pressure cycles.

As with any impregnation process, these cycles are accurately controlled to ensure complete varnish penetration through the coils. The process is completed when the coils are baked to allow the varnish resin to cure.

After the coils are installed on the core, the encapsulation process begins with another preheat cycle.

The complete assembly is then placed in a tank of solvent type polyester varnish resin for one hour to achieve a full encapsulation.

The assembly is removed and suspended above the tank for an additional hour to remove excess varnish.

A final baking process ensures complete curing.

The result are transformer coils which exhibit virtually corona free performance, a superior resistance to environmental conditions and a new standard of reliability even for the most onerous industrial, utility or commercial applications. Since the VPE process involves more additional, closely controlled steps it creates an even better seal around the coils than the VPI system and comes with a cost increase of 5.0% on top of the standard core impregnation.

Magne-Seal Premium-Duty Sealed Insulation System

Magne-Seal begins in the coil winding process using special techniques to install materials that create a seal at the bottom of each winding layer. Coils are then pre-baked to thoroughly dry them for the varnish processing of a two-step VPI described above. After baking the coils to cure the VPI process a final high-build polyester varnish finish is applied.

All materials used in the Magne-Seal insulation system, Nomex insulation, polyester varnish, sealing materials, are fully rated for 2200C. Epoxy materials used in cast coil and other designs are rated for much lower temperatures.

Magne-Seal is able to deliver 15-30% more overload capacity than designs that use epoxy materials.

Since the Magne-Seal processing system doesn't restrict the use of coil cooling products this allows our designers to provide an efficient convection cooling system that requires less floor space making our

units 10-20% smaller than typical cast coil footprints.

Our designers have available a full range of coil geometries and winding configurations to provide electrical parameters and physical dimensions exactly as specified. This is due to the fact that our designs are not restricted by mold sizes because Magne-Seal is not cast in a mold.

Without the need for molds, expensive casting equipment or epoxy insulation, Mage-Seal provides a sealed coil transformer efficiently and effectively.

Magne-Seal has also successfully passed fire testing that verifies the materials used to construct it do not support combustion. No explosion barriers or blast containment are required. Since the Magne-Seal process involves still more additional, closely controlled steps it creates an even better seal around the coils than the VPE system and comes with a cost increase of 15.0% on top of the standard core impregnation.



Magne-Seal Coil Geometries



Magne-Seal Winding Configuration

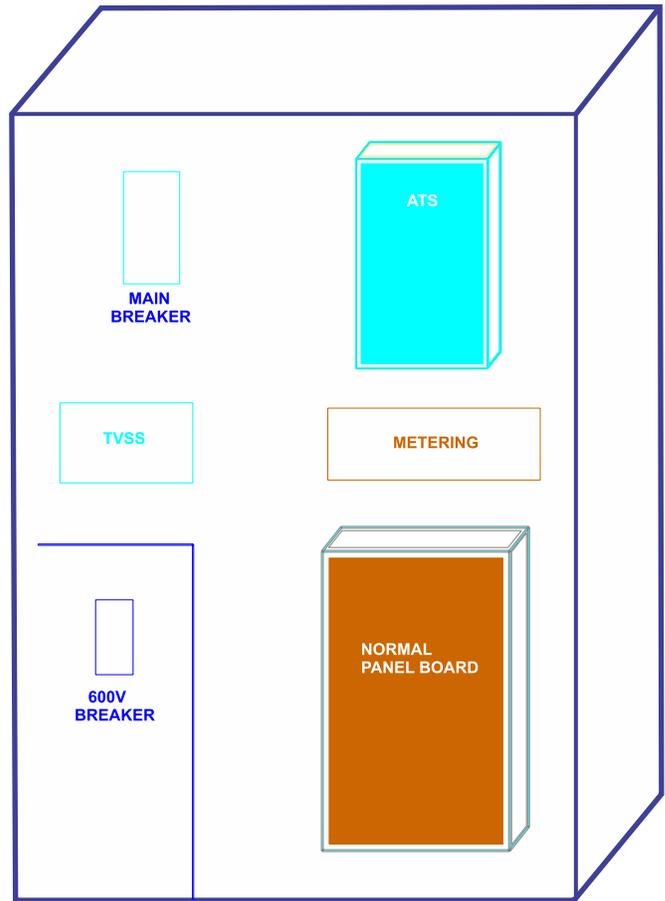
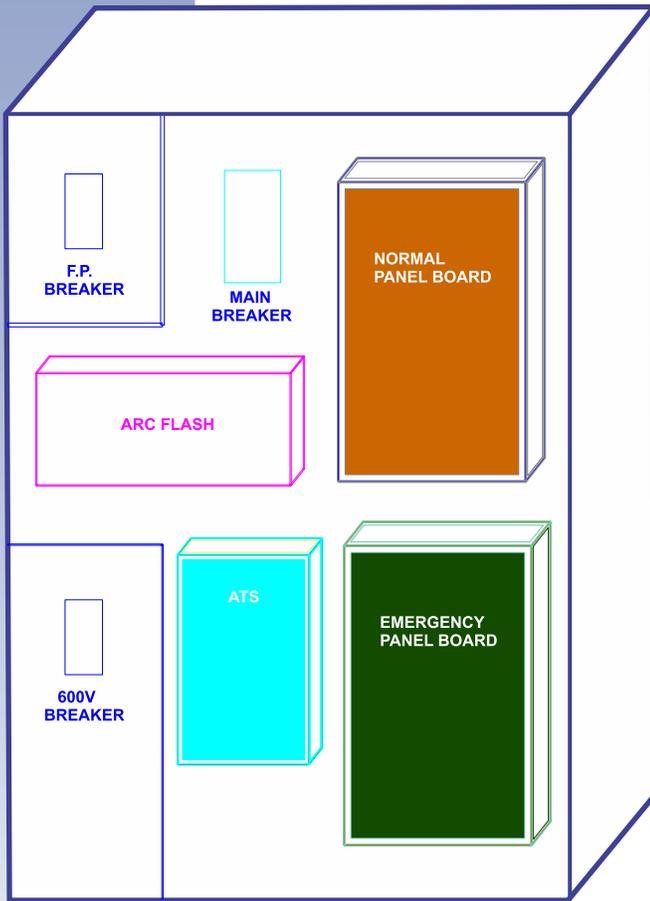
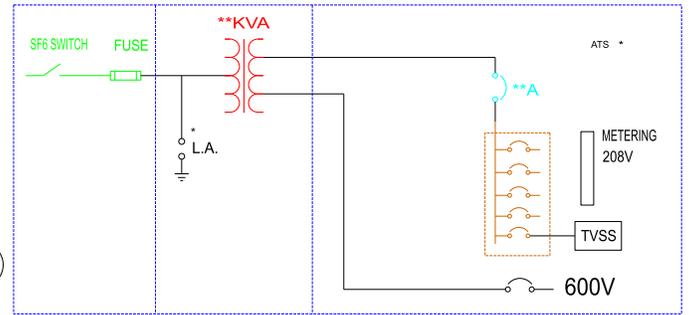
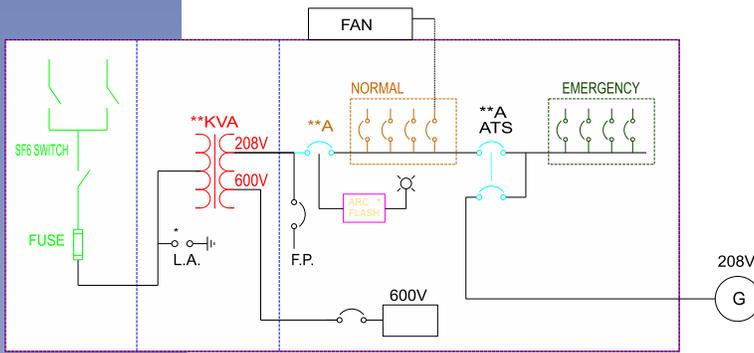


Transformer Controller



Magne-Seal

Secondary Distribution



SIDE MOUNTED DISTRIBUTION

Secondary Distribution

The MiniSub can be ordered with a large selection of secondary distribution to eliminate the need for switchboards or switchgear. The low voltage compartment can house up to three 1200 amp molded or insulated case breakers. A single breaker up to 3000 amps can also be mounted in this section.

When further distribution is required, the MiniSub can be ordered with a side mounted distribution panel rated up to 1200 amps with a main breaker located in this section or up to 2000 amps with the main breaker located in the low voltage section. A public utility compartment can be placed in the bottom part of this section but will limit the interior space.

(see charts A,B and C on pg. ? for available breaker fill sizes)

When ordering a split distribution section with no main breaker the total of the branch breakers should not exceed the primary fuse rating of 150% . By splitting the secondary bus at the bushings of the transformer, significant savings can be accomplished due to the smaller size of cabling required.

Utility Network MiniSubs

By adding a standard breaker with our network relay for the functions of line and load voltage check, reverse power, line and load phase rotation, and overload protection, the MiniSub can be used as a non- submersible tamperproof network transformer and protection unit for installations in Utility Network Systems. The network MiniSub can offer complete SCADA functions on both primary, secondary and transformer functions. The full load break and fault closing capabilities of our closed, open, and ground primary switch offers greater safety and security for the operators.

Auto Transfer Package L.V. Side

If two secondary breakers are installed they can be converted to an automatic transfer switch (note this can not be used for life safety requirements) the breakers are interlocked mechanically and electrically, and provide with a control package to handle the transfer call for the generator to start and could be capable of controlling normal and emergency panels.

Auto Transfer Package H.V. Side

See page 6 for details.



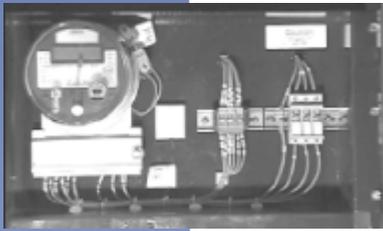
Low Voltage Breakers



Low Voltage Compartment with Distribution Panel



Dual breakers with monitoring



Utility Metering Provision



Customer Metering



Customer Multipoint Metering

Utility Metering Secondary

(Without the side panel) Low voltage CT's and PT's are mounted behind the secondary metering panel and provision for meter as shown . (With a side panel section) The bottom half of the panel is provided with a standard utility compartment for installation of CTs and PTs by the Utility. The meter can be installed in the metering compartment or outside the unit as required.

Customer's Metering

As described in the utility metering, except supplied with one of the available digital packages from several suppliers.

Customer Multi-Point Metering

For customer owned metering systems, The Intellimeter system can meter electricity, gas, water, BTU's for up to 80 points and is accessible via modem connection to a central billing system.

SF6 Refill Kit

This kit is ideal for normal maintenance or emergency refills needed to 'Top Off' or to bring the pressure up to operating levels for all Power Systems load break switches using sulfur hexafluoride (SF6) gas as the insulating and interrupting medium.

Pentahead Socket

Special five sided shrouded bolts are provided on all doors for tamperproofing. A special five sided socket can be purchased.

ARC Guard

The purpose of the Arc Guard System is to quickly detect the arc fault and disconnect an upstream breaker. Please visit our web site for more information.

Surge protection devices (SPD)

Surge Protection devices (SPD) or Transient voltage surge suppressors (TVSS) are designed to protect sensitive electrical and electronic equipment against the harmful effects of lightning strikes, externally and internally generated transients as well as high frequency noise.

Our SPDs use Selenium enhanced or proven Metal Oxide Varistor (MOV) technology and an efficient capacitive filter system to the latest UL1449 3rd Edition specification. IEEE C62.41 states that the best approach for total protection is by using a cascaded approach by installing SPD devices at multiple locations throughout the electrical distribution system, to reduce or eliminate surge problems.

The MiniSub is designed to accommodate both type 1 and/ or type 2 SPDs (Type 1 – permanently connected SPD installed between secondary of service transformer and line side of service disconnect; Type 2 – permanently connected SPD installed on the load side of service disconnect.)

Notes:

SPD surge current ratings are available from 50kA through 300kA/per mode and may include one 100A molded breaker for isolating the SPD, although most SPDs do not require an external disconnect from damage.



Surge protection device

Static Capacitor Bank

Located in the LV section below the bushings This is a MPP type low loss polypropylene foil interlays with metalized kraft paper These units are self healing, can handle ambient temperatures up to 70°C . Capacitors can be sized up to 120 KVAR and are supplied with a disconnecting breaker.

Smart MiniSub Package

Supplies remote monitoring contacts for gas pressure, switch position, as well as oil level and temperature. This combined with the automatic motor operator allows for a complete SCADA package.

Special Key Interlocks

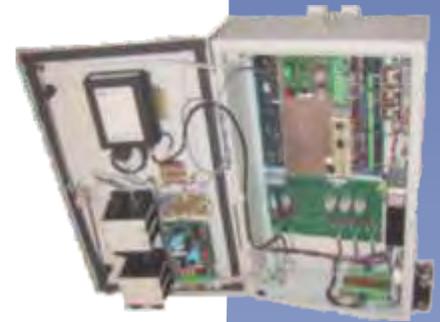
All switches and secondary breakers can be provided with key interlocks as required.

Room Ventilation Option

This option provides forced ventilation with controls mounted at the top of the MiniSub and draws air through the equipment to the ventilation outside the room (ducting not included). Fans are rated at 4cfm per kVA.

This allows the equipment to run cooler than just venting the room area where the MiniSub is situated.

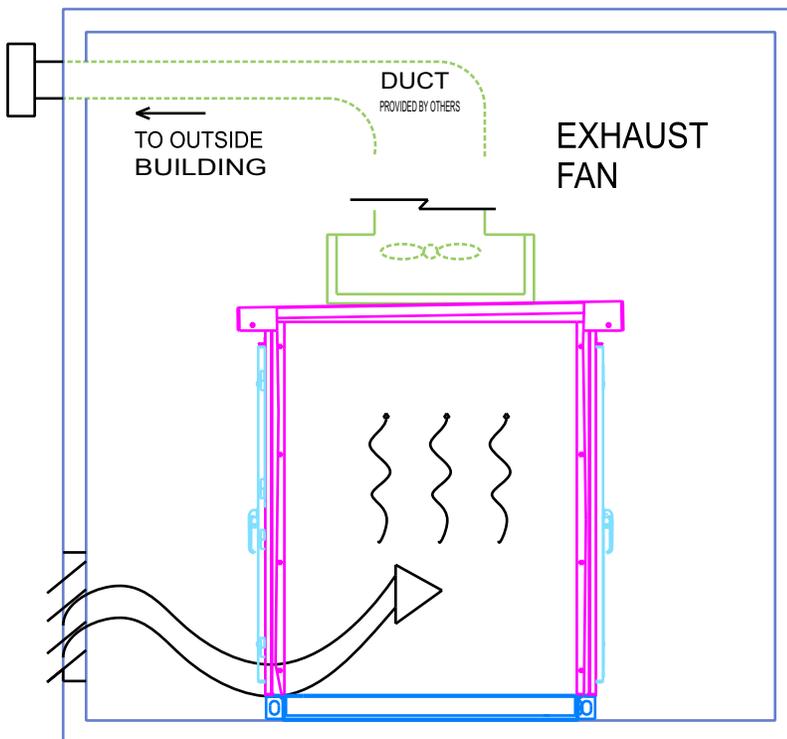
This system will not have the same effect as ANN/ANF ratings allowing smaller kVA and losses to be applied.



SCADA



Kirk Key Interlocks



Ventilation Option



Capacitor Bank

Why build a better quality substation?



Some facilities that benefit from our units!



Our products can be found in many design applications.

Here are just a few examples of the types of industrial, institutional and commercial projects that have benefited from the use of our MiniSubs.



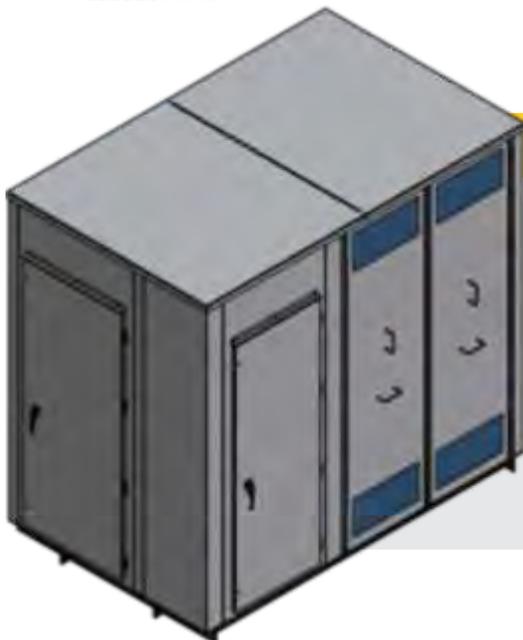
The MiniSubs are available in EEMAC 1, 2, 3 and Tamperproof standards and therefore can be used in parking lots, roof tops and many other accessible locations.



TYPE 1

- Up to 500kVA
- Primary Switch
- Fusing Dead Front
- Secondary Distribution*
- Pre-packaged Room Ventilation*
- B.A.S. Connections*

The Type 1 MiniSub is typically used where space is limited.



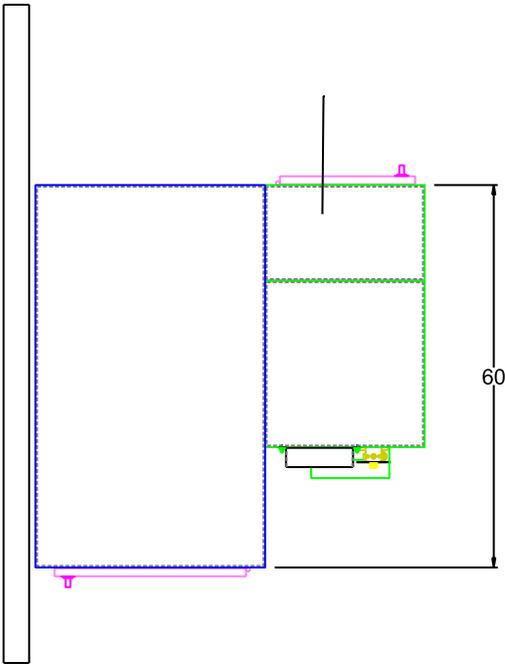
TYPE 2

- Up to 1500kVA
- Primary Switch
- Fusing Dead Front Type
- Secondary Distribution*
- Transfer Switches*
- Pre-packaged Room Ventilation*
- B.A.S. Connections*

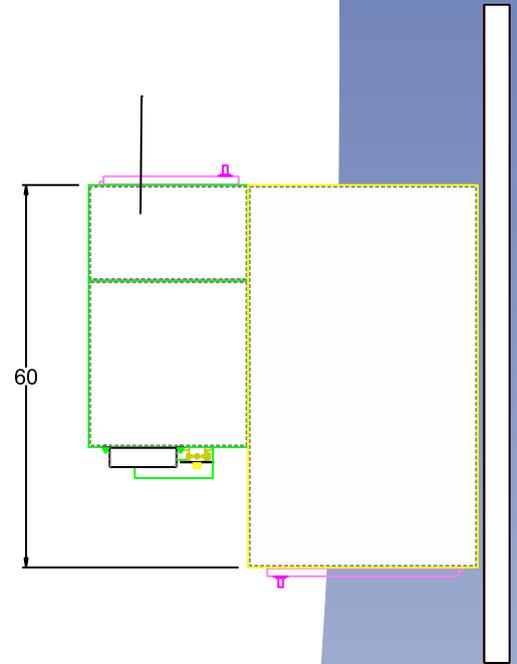
**NOTE: Options may increase dimensions*

Both designs can also combine additional options. Please ask our agent for these details.

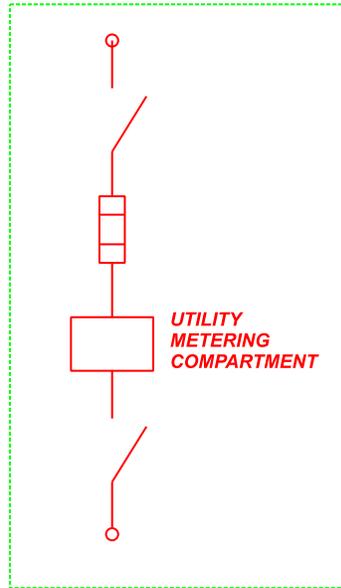
OPTION 2



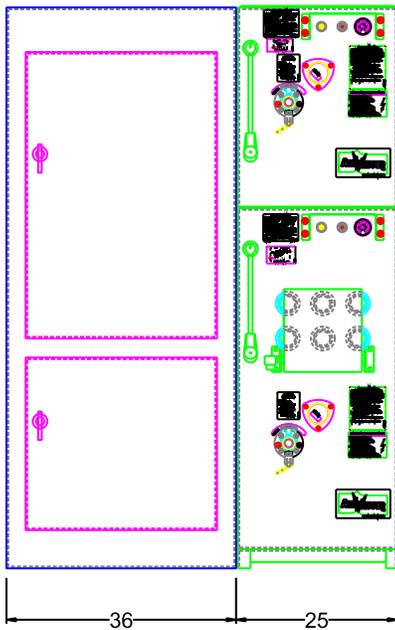
TOP VIEW
RIGHT SIDE METERING



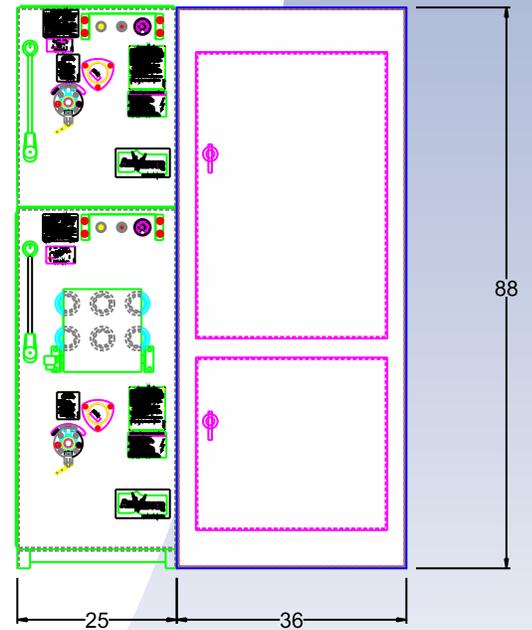
TOP VIEW
LEFT SIDE METERING



SINGLE LINE DIAGRAM



FRONT VIEW



FRONT VIEW

Testing & EMF Emissions



Transformer Test Bay



Final Testing of MiniSubs



Switch Testing Bay

Transformer

All tests are carried out in accordance with requirements described customer's specification and NEMA, CSA and ANSI standards.

1. Resistance measurement of all windings on the rated voltage connection and at the tap extremes;
2. Ratio tests on the rated voltage connection and on all tap connections;
3. Polarity and phase relationship
4. Core insulation
5. Exciting current and no-load losses at rated voltage;
6. Impedance and load losses at rated current on the rated voltage connection & corrected to 85° C;
7. Applied potential;
8. Induce potential;

Switch

Switches are designed and tested to meet requirements and/or applicable NEMA and ANSI (S37.71 C37.72) CSA standards.

1. Low frequency, high potential test verifies the electrical integrity of the insulation system.
Circuit resistance test verifies that all contacts are properly aligned and current transfer points properly assembled.
2. Leak Test verifies that a leak does not exist which could impair the dielectric integrity of the unit during its anticipated service life.
3. Operating assurance test verifies the mechanical performance of the switch; that all contacts and

indicators are correct for all switch positions, that indicators function properly, and that nameplate and circuit diagrams are correct.

4. Partial Discharge (CORONA) test is used only when the insulation system contains material which may be subject to deterioration due to a corona or partial discharge.

Secondary Breakers

1. High Potential (HiPot) Test
2. Torque Test
3. Function Test

MiniSub Assembly

1. HiPot
2. Operational test of all devices associated with the transformer;
3. Insulation on auxiliary devices and wiring;

EMI Protection

Low EMI enclosures are available for specific applications upon request.



SF6 Switch Ratings

Voltage Ratings

Maximum Design Voltage	5/15kV
Frequency	50/60Hz
BIL impulse withstand	95/110kV
One minute AC withstand	35kV
Fifteen minute DC withstand	53kV
Corona extinction	11kV
Open Gap BIL Flashover withstand	200kV

Current Ratings

Load interrupting and loop switching	600A
Transformer magnetizing interrupting	25A
Capacitor or cable charging interrupting	40A
Asymmetrical momentary and 3 operation fault close	40kA
Symmetrical two second rating	25kA
Continuous current	600A
Symmetrical 10 cycle phase to phase simulated internal fault withstand	25kA

Mechanical Ratings

Ambient temperature range	-40 to 120 degrees C
Mechanical life	2,000 operations
V-MAG	10,000 operations
Corrosion resistance per ASTM B-117	2,000 hours
Maximum leak rate	10-7 cc/second
Normal gas pressure @ 68 degrees F	6 psi
Maximum design gas pressure	15 psi

Compliance With Engineering Standards

All Power Systems dry-type power transformers are CSA certified and meet the following additional standards:

CSA-C22.2No.47 :	Air-cooled (Dry-Type) Transformers
CSA-C9 :	Dry Type Transformers

UL approved transformers are available upon request and will meet the following additional standards:

UL 1561:	Dry Type General Purpose and Power Transformers
UL 1562:	Transformers, Distribution, Dry-Type over 600volts.

Power Systems dry-type power transformers are built to comply with the following engineering standards:

IEEE-C57.12.01 :	General Requirements for Dry Type Distribution and Power Transformers
ANSI-C57.12.51 :	Requirements for Ventilated Dry-Type
ANSI-C57.12.70 :	Terminal Markings & Connections for Distribution & Power Transformers
ANSI-C57.12.91 :	Test Code for Dry-Type Distribution and Power Transformers;
ANSI-C57.12.91 :	Guide for Short Circuit Testing of Distribution and Power Transformers
NEMA 250 :	Enclosures for Electrical Equipment
NEMA TR1	
NEMA ST1	
CSA C802 and NEMA TP1 :	Energy Efficiency Standards

Type 1 Weights and Dimensions

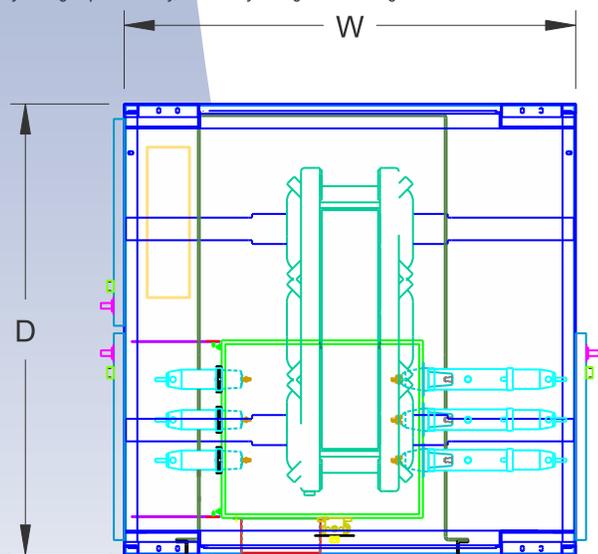
Single Phase

KVA	W		H		D		TOTAL WEIGHT
	(in)	(mm)	(in)	(mm)	(in)	(mm)	
15	60	1524	93	2363	60	1524	3000 Lbs.
25	60	1524	93	2363	60	1524	3200 Lbs.
37.5	60	1524	93	2363	60	1524	3300 Lbs.
50	60	1524	93	2363	60	1524	3500 Lbs.
75	60	1524	93	2363	60	1524	3800 Lbs.
100	60	1524	93	2363	60	1524	4200 Lbs.
167	60	1524	95	2413	60	1524	4500 Lbs.
250	60	1524	95	2413	60	1524	4800 Lbs.
333	60	1524	95	2413	60	1524	5200 Lbs.

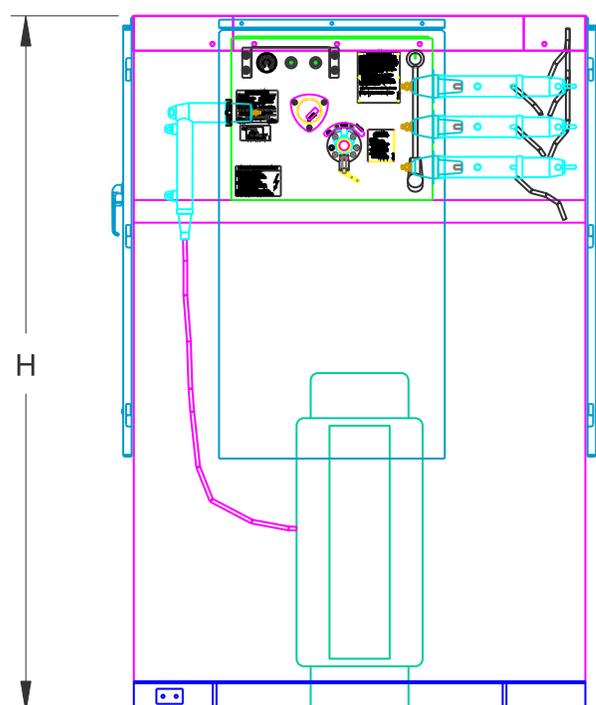
Three Phase

KVA	W		H		D		TOTAL WEIGHT
	(in)	(mm)	(in)	(mm)	(in)	(mm)	
112.5	60	1524	95	2413	60	1524	4000 Lbs.
200	60	1524	95	2413	60	1524	4500 Lbs.
225	60	1524	95	2413	60 <td 1524	4600 Lbs.	
300	60	1524	95	2413	60	1524	5000 Lbs.
500	60	1524	95	2413	60	1524	5400 Lbs.

Notes: 1. All dimensions are inches 2. Total weights don't include panel boards and breakers in L.V. 3. LV breaker panel is optional item 4. All dimensions and weights are approximate, and may change upon Primary/secondary voltages and configuration



TOP VIEW



FRONT VIEW

Type 2 Weights and Dimensions

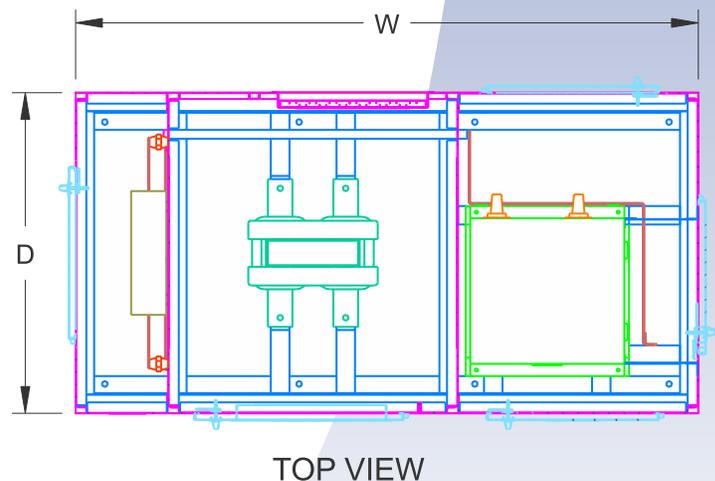
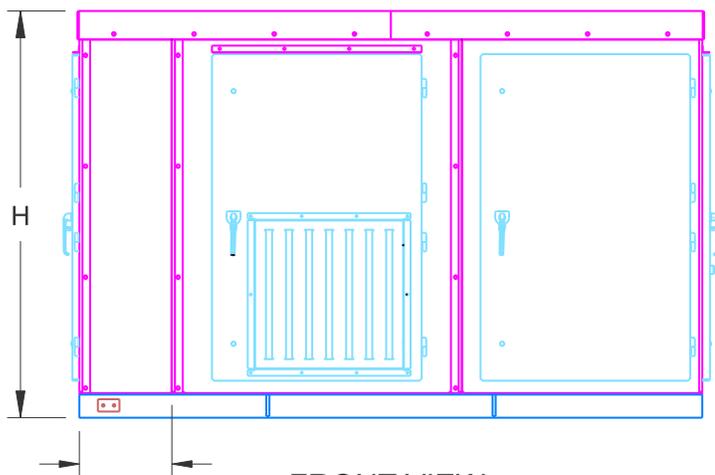
Single Phase

KVA	W		H		D		W1		TOTAL WEIGHT
	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)	
15	100	2540	66	1677	52	1321	15	381	3000 Lbs.
25	100	2540	66	1677	52	1321	15	381	3200 Lbs.
37.5	105	2667	66	1677	52	1321	15	381	3300 Lbs.
50	105	2667	66	1677	52	1321	15	381	3500 Lbs.
75	105	2667	66	1677	52	1321	15	381	3800 Lbs.
100	110	2794	66	1677	52	1321	15	381	4200 Lbs.
167	115	2921	72	1829	52	1321	15	381	4500 Lbs.
250	125	3175	72	1829	52	1321	15	381	4800 Lbs.
333	125	3175	72	1829	52	1321	15	381	5200 Lbs.

Three Phase

KVA	W		H		D		W1		TOTAL WEIGHT
	(in)	(mm)	(in)	(mm)	(in)	(mm)	(in)	(mm)	
112.5	105	2667	66	1677	52	1321	15	381	4000 Lbs.
200	115	2921	72	1829	52	1321	15	381	4500 Lbs.
225	115	2921	72	1829	52	1321	15	381	4600 Lbs.
300	125	3175	72	1829	52	1321	15	381	5000 Lbs.
500	130	3302	72	1829	52	1321	15	381	5400 Lbs.
750	140	3556	72	1829	52	1321	15	381	5800 Lbs.
1000	140	3556	72	1829	52	1321	15	381	6200 Lbs.

Notes: 1. All dimensions are inches 2. Total weights don't include panel boards and breakers in L.V. 3. LV breaker panel is optional item 4. All dimensions and weights are approximate, and may change upon Primary/secondary voltages and configuration



Calculating Breaker Panels

CHART A Main Breaker* and Branch Breaker in CDP	Main Breaker	Interior Height	Max. Branch Breaker ***
	SK-1200A**	28X	14
	SK-1200A**	23X	10
	SK-800A**	28X	14
	SK-800A**	23X	10
	SG-600A	28X	16
	SG-600A	23X	12
	SG-400A	28X	16
	SG-400A	23X	12
	SG-400A	18X	8
	SF-250A	28X	16
	SF-250A	23X	12
	SF-250A	18X	8

- 1 – Choose main breaker and location
- 2 – Choose bus size in amps max 2000
- 3 – Choose interior height (_x) chart A
- 4 – Fill interior based on chart B
- 5 – When P.U.C is mounted in CDP, the highest interior height available is 23X (1200A)

* Main breaker over 1200 Amp is mounted in front LV compartment of MiniSub

** SK-1200A/800A breakers can only be single branch mounted in CDP panel interior

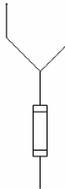
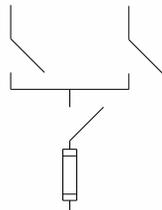
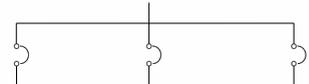
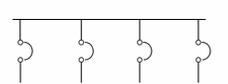
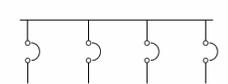
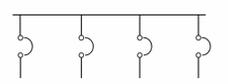
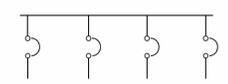
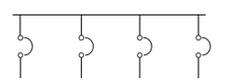
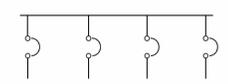
*** The breaker quantity depends on current rating. For details consult Power Systems Technology

* The "X" value is 1.375 inches

CHART B GE Spectra RMS Circuit Breaker Size and Current Rating	Frame	Maximum Amperes	Available Rating Plug Amperes	"X" Value*
	SE-FRAME	30	15 20 25 30	3
		60	40 50 60	3
		100	70 80 90 100	3
		150	110 125 150	3
	SF-FRAME	250	70 90 100 110 125 150 175 200 225 250	3
	SG-FRAME	400	125 150 175 200 225 250 300 350 400	4
		600	250 300 350 400 500 600	4
	SK-FRAME	800	300 400 500 600 700 800	6
		1200	600 700 800 1000 1200	6

CHART C Spectra RMS Circuit Breaker I.c., Ratings, UI, 489, and CSA C22.2 RMS Symmetrical Amp(kA) 50/60Hz	FRAME	TYPE	BREAKER SIZES	AVAILABLE PLUG RATINGS AMPERES	3 PH 208Y/120	BREAKER KAIC	
						3 PH 480Y/277	3 PH 347Y/600
	SE	SEDA	150	15-150	18	14	14
		SEHA	150	15-150	65	25	18
		SELA	150	15-150	100	65	25
		SEPA	150	15-150	200	100	25
	SF	SFHA	250	70-250	65	25	18
		SFLA	250	70-250	10	65	25
		SFPA	250	70-250	200	100	25
	SG	SGDA	400	125-600	65		
SGFA		400/600	125-600	65	35	25	
SGLA		400/600	125-600	100	65	65	
SGPA		400/600	125-600	200	100	65	
SK	SKHA	800/1200	300-1200	65	50	25	
	SKLA	800/1200/	300-1200	100	65	42	
	SKPA	800/1200	300-1200	200	100	65	

MiniSub-D Order Form

CONTACT:		PHONE NUMBER / EMAIL:		DATE:	
PROJECT:		CUSTOMER:			
1	VOLTAGE CLASS	KVA:	BIL:	ENCLOSURE EEMAC	KAIC:
	MAX. 15KV				TYPE:
2		<input type="checkbox"/> SINGLE SWITCH 		<input type="checkbox"/> DUAL SOURCE 	
		<input type="checkbox"/> LOOP SYSTEM 		OPTIONS <input type="checkbox"/>  <input type="checkbox"/> 	
DEAD FRONT ANSI 386 FUSING, FOR SOME CONFIGURATION		CABLE CONNECTIONS: <input type="checkbox"/> 200 AMP <input type="checkbox"/> 600 AMP			ADD GROUND POSITION OR MOTOR OPERATOR AS REQUIRED *
3	Select Transformer Design Size and Voltages	<input type="checkbox"/> SINGLE VOLTAGE  PRI.: _____ SEC.: _____		<input type="checkbox"/> DUAL VOLTAGE  PRI.: _____ SEC.: _____	
		<input type="checkbox"/> TRANSFORMER STUBS ONLY 		<input type="checkbox"/> MAIN BREAKER  AMP: _____ TRIP: _____	
4		<input type="checkbox"/> DUAL BREAKERS  AMP: _____ TRIP: _____		<input type="checkbox"/> 3 BREAKERS  AMP: _____ TRIP: _____	
		PANEL 1 SIZE: _____ 		EMERGENCY PANEL SIZE: _____ 	
5		PANEL 2 SIZE: _____ 		EMERGENCY PANEL SIZE: _____ 	
		SECONDARY OPTIONS VOLTAGE: _____			
6		PANEL 2 SIZE: _____ 		EMERGENCY PANEL SIZE: _____ 	
		SECONDARY OPTIONS VOLTAGE: _____			
7	Select Required Options	<input type="checkbox"/> SCADA MONITORING PACKAGE <input type="checkbox"/> LIGHTNING ARRESTERS <input type="checkbox"/> FAN COOLING FOR 133 <input type="checkbox"/> SF6 REFILL KIT <input type="checkbox"/> CUSTOMER METERING <input type="checkbox"/> TERMINATION ELBOWS <input type="checkbox"/> ENCLOSURE FAN ASSIST <input type="checkbox"/> ARC GUARD <input type="checkbox"/> AUTO TRANSFER PACKAGE H.V. SIDE <input type="checkbox"/> SPECIAL KEY INTERLOCK <input type="checkbox"/> SPARE FUSES <input type="checkbox"/> NGR <input type="checkbox"/> AUTO TRANSFER PACKAGE L.V. SIDE <input type="checkbox"/> SECONDARY UTILITY METERING PROVISION			
		8 Notes			

MiniSub[®]



A COMPLETE SUBSTATION PACKAGE



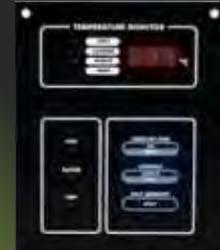
SF 6 Switch



Elbow



Primary Connections



Transformer Controller



Customer Metering



Low Voltage Compartment
with Distribution Panel

SAFETY - RELIABILITY - SECURITY

POWERSystems

TECHNOLOGY LTD

LOCAL REPRESENTATIVE

www.powersystems.ca

Email: admin@powersystems.ca

Tel: (613) 228-7228 1-866-300-1527 Fax: (613) 224-6012

300-30 Colonnade Road North, Ottawa, Ontario, Canada K2E 7J6